The Smallholder Irrigation Market Initiative
Volume II: Regional Studies and Plans

Sub-Saharan Africa, Southwest China, Deccan Plateau, Gangetic Plains, Poor Hills of Asia

By International Development Enterprises and Winrock International

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VOLUME II
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INTRODUCTION TO VOLUME II

Volume II presents the findings of three mission teams sent by International Development Enterprises (IDE) and Winrock International (WI-IDE) to five regions: Sub-Saharan Africa, the natural greenhouse area of Southwest China, Deccan Plateau in India, Gangetic Plains in Bangladesh and the poor hills region of Asia. Because of their natural resource endowments, smallholder entrepreneurial culture, infrastructure and market access, these regions were identified as presenting significant opportunities for smallholders to increase their income through improved on-farm and post-harvest productivity. Each mission started with a broad assessment of the target population, agro-climatic conditions, and key smallholder constraints and opportunities, and then formulated a 15-year vision and plan for the Smallholder Irrigation Market Initiative (SIMI) based on this evaluation.

The next step was the definition of specific investment opportunities and a three-year action plan, divided into two components. The first component, the Core Action Research and Development Plan (CARDEP) is a platform-building action program focusing on targeted marketsheds in the region. CARDEP is designed to reach an initial group of smallholder families and expand the platform of knowledge and experience on which second stage ramping-up activities will be based. The second component describes specific actions for geographic expansion in each region, which will also be implemented during the first three-year implementation plan. The numbers of smallholder families to be reached and the cost of implementation are included in these plans.

The assessment and planning for each region is presented in the following format:

1. A one-page table that summarizes the report for the region
2. An Executive Summary of the regional report, with a summary budget
3. An Assessment of the Target Area
4. A Regional 15-Year Plan
5. A Description of Immediate Investment Opportunities Over a Three-Year Period, Consisting of:
    a. A CARDEP Implementation Plan, with a budget
    b. A Geographic Expansion Plan in the region, with a budget

While specifics of application varied from region to region, the WI-IDE field teams found the key constraints to smallholder productivity showed surprising consistency:

Water Constraints

- *Bucket Irrigation*- in China and peri-urban Africa, the labor involved in bucket irrigation can be cut by 80 percent if smallholders switch to Treadle Pumps,
- *Water Scarce Areas*- adoption of low-cost drip systems linked to watershed development programs and hand-dug wells can improve crop per drop,
- *Treadle Pumps to Low Cost Diesel Pumps to Water Markets*-this productive progression observed in Bangladesh can be applied to the Gangetic plains regions in the Tarai of Nepal and Eastern India, as well as other major river delta areas,
- *Small Piped Gravity Supply Systems* from streams and springs can be used to supply micro-irrigated plots built the same way as current hill village drinking water supply systems.

A Shift from Subsistence to High-Value Cash Crops

- *Smallholders are Finding it Increasingly Difficult* to feed their families and earn a livelihood from subsistence crops,
- *A Gradual Progression from Subsistence to High-Value* cash crops was reported by five-year treadle pump owners and hill farmers trained in agronomics,
- *From Mono-Cropping to Diversified Cash Crops***,** experienced farmers diversified to at least four to six high-value crops,
- *To Avoid Market Gluts,* SIMI will need to establish links to export markets and improved transport in sparsely populated regions. Currently, 1.3 million Treadle Pump owners in Bangladesh are still finding a ready market for vegetables,
- *Off-Season Crops* provide opportunities for market expansion, either by producing cash crops before the glut, or by exploiting of agro climatic advantages or agronomic advances like the production of monsoon tomatoes.

Deficiencies in Supply Chain Access to Inputs

- *Deficiencies in Access to Affordable Irrigation, Seeds, Fertilizer, and Pest Management Technology through Private Sector Supply Chains* were found in all five regions

Constraints in Smallholder Agronomic Practice

- *Low crop yields and poor agronomic practice* were the norm for smallholders interviewed in the five regions, and this observation has been confirmed repeatedly by other studies.
  Notable exceptions to poor agronomic practice were smallholders with many years of experience with irrigated horticulture, as well as those who have used treadle pumps for long periods of time in Bangladesh and India. Farmers who had undergone intensive agronomist-conducted group training at their farms in Nepal were also found to have good agronomic knowledge,
- *Development and Dissemination of Improved Agronomic Production Packages* will be a key feature of SIMI Initiatives. These packages will incorporate irrigation technology such as low-cost drip, seeds and seedlings, inputs, and training and information picture booklets for each crop,
- *Agronomic Training Programs for Lead Farmers, NGOs, and Government Agencies* will be integrated by SIMI with the dissemination of production packages.

Constraints in Smallholder Market Access

- *Smallholder Access to Markets Varied Widely, for example,* in densely populated areas in India and Bangladesh, demand was high and advanced trader systems facilitated market access. The reverse was true in remote regions in Africa and China
- *Transport Constraints* are a major obstacle in Zambia, where farmers paid more than a quarter of their revenues from crops to transport them short distances. The same was found in the Guizhou province in China
- *SIMI Initiatives to Open Access to Market Information, Cost-Effective Trader Networks, and Contract Farming Opportunities* are needed.
- *Improved Access to Affordable Transport* is an important part of SIMI implementation in regions with specific transport constraints.

Smallholder and Supply Chain Access to Credit

- *Constrained Access to Credit* for smallholders was routinely observed as a major problem in all five regions. This important constraint will be addressed by a major separate SIMI initiative.

DESCRIPTION OF REGIONAL FIELD VISITS AND METHODOLOGY

CHINA

The field teams in China visited a variety of sites within the Southwestern region. Interviews included:

- Farmers already cultivating cash crops who live near relatively good water sources, and farmers that are mainly subsistence cultivators living in more remote villages with greater water resource challenges.
- Farmers that are currently using IDE-introduced manual irrigation pumps and those that were field-testing drip irrigation systems.
- Private-sector agricultural input dealers and market traders
- Government officials at the township, county and provincial level.
- Li Guilan of the Guizhou Academy of Agricultural Sciences, who introduced winter vegetable cultivation over the past 20 years, provided a wealth of knowledge and verified the anticipated impact of the SIMI approach.

The WI-IDE field team visited China's most sophisticated farming province of Shangdong, which provided invaluable insight into the intensive greenhouse cultivation that competes with produce from Southwestern China. Additional visits to Beijing educated the field teams on China's national marketplace for fruits and vegetables as well as the high-end consumer market trends toward low-chemical produce.

SUB-SAHARAN AFRICA

The WI-IDE assessment teams undertook detailed interviews with farmers in Zambia, South Africa, Mali, Mozambique, Zimbabwe, Kenya, and Tanzania. Interviews included:

- NGOs, bi- and multi-lateral donors, and government officials in these locations. The WI-IDE team found a high level of interest among the NGOs in creating partnerships with organizations that have experience with smallholder farm intensification, including treadle pump and drip irrigation technologies, as well as those that have output market linkages to both national and export markets. Such organizations include ApproTECH and Development Alternatives International.

The field teams studied all aspects of smallholder cash and staple crop farm economics as well as existing private-sector input and output supply businesses. The team interviewed farmers that had been using low-cost irrigation technologies for a number of years and learned how their businesses have developed through water control, and increasing experience.

POOR HILLS OF ASIA

A team comprised of the IDE Nepal Country Director and two agricultural economists from Winrock International visited several field sites and talked with NGO's, government officials and small farmers in the Tansen district in Western Nepal. Interviews included:

- A group from Helvetas, which has been implementing a rural development project for more than 10 years,

- IDE Nepal field staff, who are implementing a program to promote vegetable production and the use of low-cost micro irrigation systems,
- A group of leader farmers from six villages participating in the IDE program,
- Two agriculture inputs merchants,
- Female and male farmers in two villages, regarding their experience with off-season vegetable production,
- In Kathmandu, donors such as USAID and DFID were interviewed regarding their country programs. Officials of the Department of Agriculture, Department of Irrigation, and the National Planning Commission were also visited. Several national NGO's such as CEAPRED and SAPPROS were interviewed.

GANGETIC PLAINS

A four-person team from IDE and Winrock visited Bangladesh, India and Nepal. In Bangladesh, the team visited and interviewed:

- A bank manager of a rural branch of the government agriculture bank and a field site of BRAC, one of the largest national level NGO's,
- The management team of BRAC, including the executive director and a program manager regarding their micro-credit and agriculture programs,
- The Tengamara Rural Development Society, another national-level NGO with programs focusing on women and credit,
- The head of the Agricultural Engineering Department in the Mymensingh Agricultural University about the department's work in small-scale irrigation,
- Several members of the government agricultural research institutions, such as Bangladesh Agricultural Research Council and the Horticulture Research Centre,
- IDE field programs in Bogra and Mymensingh districts,
- More than 70 farmers, including several focus groups,
- Several types of villages were visited, including some that grew mainly rice, and others that grew mainly vegetables,
- A local NGO in Bogra, which had researched a new technology to grow tomatoes during the monsoon season,
- Approximately seven dealers of agricultural inputs and irrigation equipment,
- Staff of the Bangladesh Agricultural Development Corporation.
- In Bihar, the Sitamarhi district was visited with a team of IDE field staff. Two villages were visited and groups of about 10 farmers were interviewed in each.
- Four villages in the Tarai of Nepal, where several NGO's were implementing development programs. These NGO's include IDE, Plan International, Nirdhan (a micro-credit bank), and MADE (an agricultural NGO). Discussions were held with field staff of the NGO's and with more than 60 farmers. Farmers included those with and without irrigation, subsistence and cash cropping. A government agricultural research station was visited. Officials in Kathmandu were visited as mentioned above in the Hills section.

DECCAN PLATEAU

An IDE agricultural engineer an agricultural economist of Winrock International visited three states in the Deccan region: Karnataka, Andhra Pradesh, and Maharasthra. About eight villages were visited and group and individual interviews were carried out with more than 100 farmers, both men and women. Other interviews included:

- Scientists and researchers, including geologists, agronomists, and horticulturalists,

- Several NGO's, including the Social Centre and Myrada. These NGO's act as umbrella organizations for larger groups of small NGO's. Their involvement in agriculture, watershed management, irrigation, and micro-credit was explored.
- Three watershed development programs were visited in the field, two in Maharasthra and one in Karnataka.
- Government officials in the Ministry of Agriculture,
- Several private sector dealers of agricultural equipment,
- Several government projects such as the Karnataka Watershed Development project and the AP Well project were visited.
- A private-sector company that is offering agricultural services to farmers called Tata Rallis India was visited and the site manager was interviewed.

CHAPTER 1

Africa: Dambos, Rivers and Shallow Groundwater Areas in Sub-Saharan Africa

PART I

REGIONAL EVALUATION AND PLANNING

SUMMARY TABLE
EXECUTIVE SUMMARY

1. ASSESSMENT OF THE TARGET REGION
2. 15-YEAR PLAN

SUMMARY TABLE: SUB-SAHARAN AFRICA	
Geographical Area:	Sub-Saharan Africa, segmented into three zones: East, West, and Southern.
Target Population:	At least four million smallholder families in the region that have the basic pre-condition to engage in high-value crop production.
Water-Related: *Water Source:* *Water Storage:* *Irrigation:*	 A combination of surface water sources such as Dambos and perennial rivers and streams along with drilled-well shallow-groundwater sources. Water is stored in source. Pressurized treadle pumps, low-cost drip, low-cost sprinkler
High-value Crops:	A diversified range of short, medium, and long term crop mixes –vegetables, fruits, paprika, coffee.
Favorable Conditions:	Proven high productivity potential with fertile soils, favorable climate, and good perennial water resources. Demonstrated smallholder growth in high-value crop production for local, regional, and export markets.
Constraints:	Labor constraints to expansion due to the workload of bucket irrigation; Limited availability of affordable micro irrigation technologies; Lack of capital for high input – high output agriculture; Limited access to regional, national, and export markets; Large distances and scattered population, and underdeveloped roads and rural infrastructure; Limited technical knowledge to cultivate irrigated cash crops.
Strategies for Implementation:	1. The rapid development of broad supply-side interventions to make pressurized treadle pumps available throughout rural market towns and cities alongside the other inputs that bucket farmers are purchasing. 2. An intense effort around peri-urban bucket farmers in specific locations that provides capacity in the form of training, drip and sprinkler irrigation technologies for increased intensity and produce quality, and the building of linkages to high-value foreign exchange earning export markets through out-grower schemes. 3. Transport initiatives to reduce the excessive and prohibitive cost of getting produce to market for the farmers that cultivate farther from urban markets.
Immediate Steps:	A. Implementation of a CARDEP program in Zambia for the development and testing of an adaptable yet generic intervention strategy for the African Subcontinent. *Cost of the Program: $1,550,000: first 3 years.* *B.* The development of satellite programs to survey smallholders and the high-value crop sub-sector, the development of specific water and small farmer productivity packages, consortium building for implementation, and the field testing of specific interventions. *Cost of program for three regional satellite programs - $1,650,000 per year.* C. Selected sub-project investment opportunities including micro irrigation promotion, research of peri-urban bucket farmers, intensification, diversification, and output marketing for smallholder produce, transport initiatives and credit interventions.

EXECUTIVE SUMMARY

Despite the agricultural potential of the continent, millions of poor African agriculturalists have been unable to break the grip of poverty. More than half of the population of Sub-Saharan Africa lives on less than $1 per day, and it starts the 21st century as the most technologically backward, the most debt distressed, and the most marginalized region in the world.

Yet Africa has some of the most fertile soils in the world, soils that have enabled large scale commercial farmers who have access to technology, capital, land water to prosper. In addition, the climatic conditions can support high-value cultivation. Yet smallholders have not yet been able to grasp the potential opportunities that the sub-continent has to offer. The green revolution, which benefited millions of Asian farmers, did not have an effect on African agriculturalists who did not have access to the inputs necessary to make the technology succeed. Past programs that have intended to benefit African smallholders have emphasized food security, focusing on staple crops that have tied smallholders down as non income-earning subsistence agriculturalists. With increasing population and consequent pressure on arable land, many of these smallholders now cannot even reliably produce enough food to meet their family needs. These farmers will never be able to escape from this situation with the crop mix that has been promoted by both government and international efforts over the past decades. The problem of poverty is endemic, yet few programs focus on enabling this target population to realize even a fraction of their own capacity by elevating their prosperity through more intensive agricultural production.

While dry land subsistence farmers are trapped in poverty, those smallholders who have spontaneously adopted irrigation technologies for the most part have been overlooked. Irrigation planners focus on formal irrigation schemes, without acknowledging the existence of the millions of resource-poor farmers who laboriously carry buckets of water to their fields. These bucket farmers, however, have demonstrated what is possible: to cultivate high-value crops on small plots, in many cases year-round and sell them in urban marketplaces. While this is a good start, without technological assistance, they will never be able to scale-up their efforts and grow beyond the 500-800 square meters to which their labor resource limits them. However, under the right circumstances, and with irrigation devices that are both affordable and appropriate to their scale of investment, hundreds of thousands of these farmers have demonstrated that they can vastly improve on their current circumstances, and work their way up be reinvesting their profits to climb out of poverty. To date, while only a small percentage of smallholders have been exposed to these technologies, there is a potential to expand the scale and reach millions more throughout the region.

The Smallholder Irrigation Market Initiative (SIMI) will unleash the potential of these bucket farmers and other smallholders with access to water through an intervention mix of technology, capacity building, information and market access. The key entry point will be micro-irrigation. The introduction of this technology will help to remove the labor constraint of lifting and delivering water. While a variety of micro-irrigation technologies have found their way through non-profit programs into many Sub-Saharan African countries, the market penetration and growth remains extremely low. This is due to a dissemination approach that has relied on subsidies and operational focuses within the small areas of coverage of typical non-profit programs. The potential has become apparent through strategies that that operate on a commercial basis, i.e. by establishing strong commercially oriented supply chains, with manufacturers and extensive dealerships and coupled with a strong marketing campaign. Key examples are found in the programs of IDE, Enterprise Work, and ApproTEC, which have introduced micro-irrigation

technologies through similar strategies as those used to reach millions of farmers in Asia--though tailored to the African context.

SIMI in Sub-Saharan Africa will focus on the millions of peri-urban and rural bucket farmers and smallholders with access to water. The CARDEP program detailed within this plan will pilot the intervention strategy in the first three years of implementation. In parallel, SIMI will develop three geographic expansion programs that will: 1. survey smallholders and the high-value crop sub-sector, 2. develop specific water and small farmer productivity packages, 3. form consortium for implementation, and finally 4. field-test specific interventions.

In short, the results of these interventions in Sub-Saharan Africa will enable the smallholders of today to realize the kind of profitability and subsequent prosperity that does justice to the level of effort that they have demonstrated they are willing to invest.

The SIMI team anticipates the budgets and the farmers targeted for the CARDEP program and the geographic expansion to be as follows:

Activity	**3 –Year Budget** (in $ millions)	**Smallholders Reached** **In 3 Years**
CARDEP	1.55	4,500
Geographic Expansion	5.70	60,500
Total	**7.25**	**65,000**

1. ASSESSMENT OF THE TARGET REGION

1.1 Target Population

In Sub-Saharan Africa, 52 percent of the population lives on less than $1 a day. In 1998 the average monthly expenditure was only $14 a person by the rural poor and $27 by the urban poor. The results are that 59 percent of rural people in Sub-Saharan Africa are below the poverty line while 43 percent of the urban population is below it. Africa accounts for 12.5 percent of the world's population but produces only 3.7 percent of global GDP. Even though it exports no less than a fifth of its GDP annually, it accounts for only 1.5 percent of the global trade in goods and services. The 46 countries of Sub-Saharan Africa have a population of 625 million and a per capita GDP of $525 ($364 excluding South Africa)[1]

Table 1. Target Population

Sub-Saharan Region	No. of Countries	Population in 1999 (million)	Annual Per Capita Income in 1999 ($)
West	15	232	411
Central	7	30	953
Eastern	13	246	179
Southern	11	117	1379
Sub-Saharan Africa	46	625	525

According to the FAO[2], 65 percent or 406 million of Sub-Saharan Africa's population is rural and of these 95 percent are agriculturalists. Thus approximately 240 million individuals or roughly 50 million poor farm families comprise our population of target farm families in Sub-Saharan Africa. Clearly the scope of the problem is immense and the numbers of poor rural Africans, despite the best efforts of governments and aid agencies to date, is still increasing while their situation is being compounded by the effects of AIDs, malaria and a host of other factors.

The water resources of Sub-Saharan Africa comprise a major unutilized resource for the region. Only limited developments have occurred along the major rivers. Additionally, shallow groundwater resources and seasonal and permanently flooded inland areas, referred to as dambos, vleis or inland valleys, represent sizeable potential for smallholder irrigation development. While irrigation is the major user of water, only an estimated seven percent of the potential irrigable area of the continent has been developed to date and the increase in irrigated acreage has been only an estimated 1 per cent per year. In Kenya, however, where ApproTEC is now selling more than 6,000 pumps per year this in itself results in an increase in the irrigated area of more than five percent per year.

Annex 4 contains examples of three countries: Mali, Mozambique and South Africa, which are all potential targets for SIMI interventions. Mali has already been the target of an excellent initiative by Enterprise Works to introduce the treadle pump and promote it through mass marketing means, but there has not been an integrated agricultural production and marketing program to further increase the benefits of the treadle pump. Mozambique is another country with significant scope for the treadle pump in dambos and other shallow water applications, but treadle pumps

[1] Economic report for Africa, Chapter 3, 2000, World Bank.
[2] FAOSTAT http://www.fao.org/docrep/X2785e/X2785e05.htm

have only been introduced through NGO projects not through mass marketing. South Africa is a unique case with a rapidly urbanizing population that may have more demand for products such as drip kits, which will allow intensification of kitchen garden plots.

The authors of this plan estimate that approximately four million smallholders, whether currently supplying markets or subsistence farmers, are potential beneficiaries of SIMI. This market is spread throughout Sub-Saharan Africa, and is made up of smallholders who live on or within access to adequate water resources for irrigation - either surface water such as wetlands, including dambos and perennial rivers and streams, or groundwater from shallow wells.

Typology of Peri-Urban Bucket Farmers

Peri-urban bucket farmers are a natural first focus for poverty alleviation and smallholder wealth creation strategies**.** They are already producing irrigated crops for the market, and their starting point is therefore more mature, and their constraints are different. Peri-urban bucket-irrigating farmers, for example, can be found around many of the cities and towns throughout Africa, capitalizing on their proximity to market. It is the urban market that shapes their farming practices, and there is wide variation from place to place in constraints in access to water and land. Bucket farmers outside Lusaka, Zambia, for example, operate with few constraints to land or water, but only irrigate 800 square meters because of the labor demands of bucket irrigation. In the green belt 3 km from Maputo, on the other hand, there are hundreds of farmers growing lettuce and vegetables on considerably less than half an acre, carrying two sprinkling cans at a time from small cement tanks filled from a nearby stream. But these farmers have a constraint in land availability, and as such they are likely customers for technologies like low-cost drip the enable agricultural intensification.

The peri-urban bucket farmers in Africa are a raison d'ětre for SIMI. They already have access to sizeable commercial markets. They are already familiar with irrigated cultivation, and are putting these principles into practice. But there is huge room for improvement in labor and irrigation efficiency. They are already using seeds, fertilizer, and pest management strategies, but here too there is huge room for improvement. They are already growing cash crops, but they can improve crop quality and increase diversity. The wholesale markets in cities that buy their crops are only a few steps away from export markets, providing unexploited opportunities to reach new export markets. For all of these reasons, peri-urban bucket farmers are logically first targets for the Smallholder Irrigation Market Initiative.

In addition to the water constraint that the water lifting and distribution technologies promoted under SIMI will solve, there are additional and varied constraints dependent on each of the farmer's circumstances. For example in rural Zambia, transport is a major constraint. On the other hand, on the outskirts of cities such as Harare, Zimbabwe, there are thousands of bucket farmers, and there the secondary constraint is the availability of land.

1.2 Biophysical Resources

A. Water Resources

Sub-Saharan Africa has two abundant, underutilized water resources that provide significant opportunities for smallholders: dambos and surface waters (streams, rivers, reservoirs and dug-outs).

Dambos are perennial or seasonal wetlands with a wide variety of plants, soils and hydrologic characteristics. Dambos are characterized generally as geologic basin-like depressions or concavities with underlying layers of clayey organic soils of low permeability that retain water at shallow levels.

There are several different types of dambos, but they share two common characteristics. In their natural state, they tend to grow grass rather than trees, and at least for part of the year, they are a source of relatively easy access to a critical resource that is often in short supply in Sub-Saharan Africa- water.[3]

Dambos absorb water during the rainy season and release water gradually during the dry season. Water filtration rates vary depending on sediments and soil types of the dambo. The water level within each dambo drops at a slow, gradual rate according to the transmission characteristics of the soils. Organic soils found in dambos act as the main sponges by which water is retained.[1] Dambos also serve as rainfall catchment basins supplying streams at lower elevations of the catchment network. Dambos can also be independent or outside the main drainage system. Monitoring of water levels becomes more critical as usage increases.

1. Size of the Area Covered by Dambos in South Africa. Scoones[4] suggests that dambos comprise five -10 percen tof the total land area of Africa's savannas. Balek[5] estimates a total of 8.5 million hectares of dambos in Africa. There are an estimated 1.28 million hectares of dambos in Zimbabwe representing 3.6 percent of the country's land area, 259,000 hectares in Malawi, and 3.5 to 4 million hectares of dambos in Zambia.

2. Potential Acreage of Dambos for Smallholder Irrigation. Dambos are potentially some of the most productive natural ecosystems in the Southern Africa region. Dambos are traditionally used as sources of water for domestic purposes, agricultural production, livestock grazing, hunting, gathering and fishing. Dambos support a wide variety of wildlife and birds. Despite the importance of dambos they remain low on the policy and research agendas of southern African countries.[6]

While the total acreage of dambos in Sub-Saharan Africa is extensive, not all dambos are necessarily suited for cultivation and may require fertilizers to replenish nutrient deficiencies. Some dambos are situated in remote locations, out of reach of population centers making them less accessible for cultivation. Therefore estimating the total potential acreage for smallholder irrigation requires more in-depth analysis. However it is safe to say that the productive potential of dambos in Sub-Saharan Africa is very substantial: perhaps as great as 900,000 hectares.

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[3] Shalwindi, Utilization of Dambos in Zambia, 1986.
[4] Scoones, I. Wetlands in Drylands: Key Resources for Agricultural and Pastoral Production in Africa. IIE Dryland Networks Programme Issues Paper #38, 1992.
[5] Balek (1977), quoted in Adam et al., 1977.
[6] Kokwe, Sustainable Use of Dambos in Southern Africa, 1993.

3. Classification. Dambos are located within a variety of agro-ecological zones with different characteristics relating to the elevation, climate, rainfall pattern, soil structure and chemical composition. Verboom's research from 1969–1972 classified plateau dambos into three categories on the basis of soil pH levels and the species composition of dambo vegetation and flora.

> ***Sweet dambos*** contain soils from lime-rich rock with pH above 6.5 with the associated plant species common to the soil type. Acacia trees are commonly found growing on the fringes of sweet dambos.
>
> ***Intermediate dambos*** containing soils developed from mixed sediments with pH levels between 5.5 and 6.5. Species of vegetation are a combination of sweet and sour dambo plant species.
>
> ***Sour dambos*** are common to areas in the northern parts of Zambia where rainfall is higher and soil pH levels are below 5.5, and also southern Zambia where granites and basement complex rocks are common. Vegetation of sour dambos consists of many types of sedge.

In 1999 the Environmental Council of Zambia classified dambos in Zambia in a slightly altered version from Verboom as follows:

> ***Barotse sand dambo system*** occurs in Western Province in Zambia and is distributed on sand substrate. These cover larger areas and can be either seasonal or perennial.
>
> ***High rainfall dambo system*** includes perennial dambos that are part of the drainage system and are found in the higher rainfall zones of northern Zambia. Because of prolonged saturation these dambos have swamp-like characteristics.
>
> ***Medium rainfall dambo system*** occurs on the Southern, Central and Eastern Plateaus of Zambia where rainfall averages less than 1000 mm per annum. These are generally seasonal dambos that feed the drainage systems; their water table remains relatively high throughout the year.
>
> ***Valley dambo system*** occurs in the Luangwa and Zambezi valleys. These dambos can be found outside the main drainage system and are situated primarily on karoo soils and are similar to the Mopane pans. They are mainly seasonal dambos as dry seasons are more prolonged.[7]

1.3 Household Resource Typologies

African farm households require four primary resources to enable them to enter commercial production: land, labor, capital and water. While each of these resources is limited, SIMI's objective is to make the best use of each of the resources available to farmers. While arable land is becoming scarcer in Sub-Saharan Africa, the average smallholder still has access to one hectare[8], enough to produce substantial incomes from irrigated crops. Labor is available within the family, though because of the many demands placed on family members, this labor needs to

[7] Ferreira, Dambos: Their Agricultural Potential, Farming in Zambia, 1977.
[8] Ibid.

be used efficiently. The capital resources of smallholders are extremely limited and SIMI needs to pay special attention to the affordability of products and search for means to improve access to credit. While water is available to all smallholders to meet domestic needs, the vast majority of African smallholders do not have access to irrigation facilities. The smallest bucket drip irrigation kits, however, require only three 20-liter buckets of water per day. While the production from this kit will not lift smallholders from poverty, it provides the first step in a chain to increase production and income.

SIMI will minimize the entry level cost of the technologies and farm inputs. Households with minimal existing resources will be able to transform a few inputs into marketable outputs, setting these farmers on the road to expansion, which enables them to gain confidence, technical knowledge, and increased income for reinvestment in expansion.

While the resource typologies of Africa's farmers are varied, in all cases, the first investors in micro irrigation technology tend to be wealthier farmers for whom the cost of the technology and other inputs is less prohibitive. They typically already cultivate some crops for the market, and, in rural areas, additionally grow rain-fed subsistence crops on unirrigated land. The second tiers of farmers to adopt are poorer farmers that have learned through watching and learning from their neighbors. By focusing on non-irrigation inputs and market access constraints as well as training and the provision of credit, SIMI will be able to reach beyond households that are already producing for markets to those poor farmers who can utilize the technology to lift themselves out of the poverty trap.

1.4 Capacity of Existing Regional Partners

Throughout Africa program exists that are working to improve smallholder livelihoods through interventions such as credit, small scale output processing and market linkages, and agronomic training. SIMI will need to be as inclusive as possible in working with these various partners to address all the needs of smallholders. SIMI will possibly be the most holistic effort to reduce poverty through interventions at all levels: input, throughput, and output. SIMI interventions in any particular area will capitalize on on-going efforts in a mutually beneficial way, and fill in where interventions are required yet missing from on-going projects.

Micro irrigation technologies have been introduced throughout Sub-Saharan Africa. These are predominantly treadle pumps, but also drip and sprinkler technologies, such as the Chapin bucket kit, which has been distributed primarily through religious organizations. In the case of treadle pumps, there are a plethora of organizations involved, but only three organizations are using a market-driven and commercially oriented approach. This approach is required to penetrate the market and realize the extensive poverty reduction potential that exists from these technologies in combination with other market driven initiatives. The organizations employing this approach are: IDE, ApproTEC, and Enterprise Works (EWW). IDE's programs have focused on Zambia. ApproTEC's approach was developed in Kenya and has now expanded to Tanzania. EWW's programs have focused in West Africa and spread to other central African countries. IDE and ApproTEC have a similar philosophy of dissemination, that is, more centralized manufacturing, with dealerships reaching out to the rural areas, while EWW has tended to focus on smaller multiple manufacturers closer to the farmers. In all cases, the technologies that have been promoted have been a version of the treadle pump, adapted from the models popularized in Asia, with the most common modifications being steel construction and the provision of a pressurized outlet.

Many other organizations, including NGOs such as CARE and World Vision have introduced treadle pumps to their own target populations, but these organizations have generally acted as customers to the manufacturing capacity established by the three organizations mentioned above, or other smaller efforts on a country-by-country basis, and supplied pumps to farmers within their working areas. They are therefore customers to the technology, rather than developers of commercial capacity, but do represent a significant purchasing power, and have additional projects non-irrigation projects that focus on smallholder development.

1.5 Supply Chain Capacity

A commercial supply chain providing inputs exists in all the areas where farmers are cultivating commercial crops. Small retailers sell local and imported seeds, fertilizers, and pesticides. These are natural outlets for promoting micro irrigation technologies for smallholder farmers. In areas where the activity of small-scale commercial farming develops, the structure of the supply chain, with or without encouragement, will adjust and further decentralize. This will enable farmers to have closer access to retail outlets for the micro-irrigation products. In addition to dealership networks, SIMI will employ an extensive marketing strategy that reaches out to villages through mass media, including radio, newspapers, TV and public announcements. While the seed dealers are the key point of sale, farmers need to be made aware of the technologies in market places, on farms, through meetings and demonstrations, and during other gatherings that are either capitalized on, or indeed created for the purpose of SIMI promotion.

Manufacturing capacity adequate for the production of treadle pumps is available in all African capital cities. That said, it is important to take into account import duties for steel versus duties for agricultural products. In some countries duties on imported steel are high whereas duties on agricultural products such as pumps are quite low. It is very likely in some countries that pumps will be imported from neighboring countries or even Asia where they can be manufactured and imported at a lower cost than they can be manufactured in-country. A similar situation exists for drip irrigation technologies and pipe used on both inlet and pressure side of treadle pumps. Drip tape or pressure-side pipe for treadle pumps can be manufactured as lay-flat, and therefore tightly rolled to significantly reduce shipping cost thereby making regional or off-shore manufacturing more competitive. For non-lay flat drip irrigation pipes, and for suction hose for treadle pumps, plastic extrusion in Africa will be required due to the product's inherent bulk. Since the plastics industry in many African countries is not well developed, it will probably be necessary, for smaller and more remote countries such as Zambia, Malawi, Rwanda etc., to import from regional manufacturing centers, such as RSA, and Kenya or Tanzania until such time as the demand is adequate to justify the investment in developing local manufacturing capacity. Again, each country's duty structure on certain products will play a decision on importation versus local production.

1.6 Input-Throughput-Output Markets

Inputs such as seeds and fertilizer are often problematic in many parts of Sub-Saharan Africa, and especially in areas that are populated mainly by rain-fed subsistence farmers. Here, problems are encountered in terms of both availability and cost. These products have historically been controlled by the central governments and their importation has not always been timely or in the right product mix so that farmers do not find the products that they need. With the gradual opening of markets and the growth of economies, we are likely to see greater availability of these products. Price is also an important factor in that many farmers in Sub-Saharan Africa have not adopted high yielding varieties and chemical fertilizers due to high cost and other factors. Even if

farmers are interested in adopting higher intensive packages the cost may be prohibitive given their current income levels.

Credit is an important component of any smallholder business. Smallholders in Sub-Saharan Africa are often not eligible for credit or if credit is available the cost of credit may be prohibitive. In many countries in the region commercial credit is only available at interest rates above 30 percent per annum. Government sponsored credit programs for smallholders have not always been successful with political interference often being a factor in failure. SIMI has analyzed the need for smallholder credit for customers of SIMI and concludes that credit is required in many circumstances. A dual approach to solving the credit constraint will be used. This will focus on both reducing the cost of inputs to reduce the credit requirement in the first place as well as tying into local, regional, government and NGO credit facilities that will recognize SIMI interventions as income generating and therefore worthwhile central foci of their credit programs.

The production of agricultural products by smallholder irrigators is another area of concern. Most African governments and international agricultural research has focused on the production of grain crops primarily for food security and subsistence. Although this may have been a successful strategy for averting famine in some cases, it has not been a successful in leading farmers out of poverty. This strategy seriously needs to be reviewed as donors develop programs for poverty alleviation. Agricultural research and extension programs need to be developed which emphasize vegetable and other cash crops suitable for smallholders that have the potential for income generation. Recently more emphasis has been placed on developing suitable crops for smallholders. For example, ICRISAT in Niger and elsewhere has now realized the potential role that irrigation can play in poverty alleviation and they have started to develop packages that can generate substantial incomes for smallholder irrigation farmers.

Farmer training is an important area of concern for SIMI. Packages will be developed to train farmers on all aspects of cultivation with micro-irrigation as the central theme tying together the packages. Farmers need information not only about the operation and maintenance of irrigation equipment; they need to be trained in the production of high value crops and the key role that marketing plays in those crops. Markets vary over the season for typical crops such as shallots, tomatoes, and cabbage. Many irrigated crops in Sub-Saharan Africa can be produced most of the year if not all year round. Since farmers have limited storage capacity they need to time their production to meet peak market prices. Farmers need to know how to determine their competitive advantage and to then adopt successful strategies to produce for those markets.

In many parts of Sub-Saharan Africa the traditional extension agent system is non-functional or at least not effective. Many farmers have never met their extension agent and if so it is quite unlikely that this agent will have the knowledge of horticultural crops needed to assist smallholder farmers. In some areas of Africa, NGOs have field extension agents who have essentially replaced their government counterparts. SIMI intends to work with NGOs and government extension services, to the extent possible, to train agents and farmer leaders in the practices necessary to succeed in irrigated high-value crop production.

Markets for produce are very variable across the subcontinent. There are three key factors to this variability:

1. The distances and infrastructure to the markets, including export markets – i.e. airports and size of planes servicing them assuming there are pre-processing / storage / packaging operations in existence

2. The population densities of the market centers, or in the case of export markets, the competitiveness of the country in producing both cost and quality product as compared to its neighbors
3. The per capita consumption of vegetables and fruits etc. within the domestic markets

In each country in which SIMI works, SIMI will conduct market studies that analyze the potential and risks for smallholders to access local, domestic, regional and international markets. SIMI will determine the scope for smallholders to increase production of various high -value crops. Perishable and non-perishable crops will be analyzed, with special emphasis on crops that for which there may be a natural competitive advantage for African smallholders and crops that can be processed on the farm for added value. Niche crops and crops that have a high value at certain times of the year will be examined.

A wide range of marketing opportunities exists for high valued crops. African countries often have an advantage of producing high valued crops during the European winter months when prices of horticultural crops are high. On the other hand, non-traditional crops, such as off-season irrigated green maize, have successfully been introduced in many African markets, thus expanding the opportunities for irrigation smallholders. The risk to smallholders in producing high valued crops will be analyzed. Typically, producing a diversified mix of crops is helpful in reducing risk. One key to successful marketing is to build trust between smallholders and buyers. This involves better information as well as better performance from both parties. SIMI will work to build this trust through training and information exchange.

1.7 Policy Analysis

The SIMI effort will require partnerships from Private, NGO, and Government sectors. It will be imperative for the effort to be as inclusive as possible, seeking opportunities between each of these for forging operational partnerships and coordinating efforts. Having a vibrant and responsive private sector at input, throughput, and output dimensions will be the ultimate goal to achieve sustainability. NGO partnerships will for the most part facilitate the process of private sector development, and additionally bring credit and training support to the effort. Government will need to be motivated to support the effort at local and national levels. Their policies can affect the availability of inputs, both equipment and other agricultural inputs and farmer's access to water. Policies also affect the markets for smallholder products. If a coordinated attack on poverty is to be made, donors and other parties need to play a role in working with governments to assure that policies enable smallholders to compete in a fair manner with other producers.

In the case of Kenya, Tanzania, and Zambia for example, agricultural imports are duty free. In the case of Kenya, 'smallholder technologies' of which the treadle pump is classified are VAT (value added tax) exempt. Whereas in Zambia, the duty on steel is so high that the cost of locally made pumps are prohibitive to farmers and SIMI is thus considering importing finished pumps. Some countries have programs to actively assist smallholder supply chains, such as the World Bank financed program in Mali, Niger and Burkina Faso, while others assist smallholders in gaining access to export markets, such as the case of FPEAK in Kenya. SIMI will work with these organizations and support policy change that benefits smallholders.

1.8 Principal Constraints

The principle constraints to smallholder growth from subsistence or semi-subsistence agriculture are various. Peri-urban bucket farmers, for example, who are already cultivating for markets have either labor or land availability as their primary constraints. In both cases, micro-irrigation

technologies can play a role in enabling them to improve their situation. Water lifting devices such as treadle pumps and particularly in combination with low- cost sprinklers can drastically reduce the labor required for irrigation, whereas drip irrigation enables greater intensity of agriculture, which eases the land constraint. Poorer rural populations have alternative constraints such as access to markets, input availability, agronomic knowledge and capital. SIMI will encounter a range of circumstances and respond to each with an appropriate set of interventions. Some interventions such as market-informed crop diversification strategies will be beneficial to all farmers, whereas other will focus in the particular constrains of regionally targeted efforts. The following summarizes the predominant constraints that SIMI will address:

1. Limited availability of micro-irrigation technologies

2. Entry level cost of smallholder irrigation technologies

3. Lack of capital for high input – high output agriculture

4. Limited access to regional, national, and export markets

5. Large distances and scattered population, and underdeveloped roads and rural infrastructure

6. Limited technical knowledge to cultivate irrigated cash crops

In each country where SIMI works, SIMI will analyze these constraints and develop strategies aimed at maximizing the number of poor smallholders who can benefit from this approach and work their way out of poverty. If we only benefit the higher income farmers we will have failed.

2. 15-YEAR RECOMMENDED PLAN

2.1 Target Population and Expected Market Penetration

The target population is made up of farmers with varying sources of water as well as varying rates of poverty. In all cases, they are either currently subsistence farmers or cultivating some irrigated crops but limited by technolgy, such as smallholders using buckets as their primary method of water application. The SIMI initiative will enable these farmers, no matter what their starting circumstances, to increase their productivity and start on a path out of poverty.

SIMI will predominantly target farmers who are already cultivating some crops that they sell for cash. These farmers fall into two predominant categories, rural and peri-urban. As these farmers have been largely overlooked by irrigation planners, information on how many there are is not available. SIMI speculates that across Sub-Saharan Africa, there may be some 4 million peri-urban bucket farmers throughout the sub-continent. For example it is estimated that there are some 12,700 households, cultivating an approximate 11,500 hectares on the outskirts of Kumasi in Ghana, and similar numbers in Accra and Takoradi[9], whereas the total irrigated acreage reported by FAO for the whole country is only 6,400 hectares.

SIMI will initially focus its efforts in countries where the numbers of farmers, both peri-urban and rural is known to be large. Such countries are: Zambia, Kenya, Tanzania, Mali, Niger where there are already micro-irrigation programs through the efforts of IDE, ApproTEC, and EWW, as well as other countries that present a great opportunity such as South Africa, Mozambique, Zimbabwe, Ethiopia, and Ghana. Other countries are constrained by politics and insecurity such as Nigeria, Angola, and Somalia, and SIMI will sidestep from neighboring project countries should the political or security climate improve to enable interventions.

South Africa is a special case with a rapidly urbanizing population and where the government has made extraordinary efforts to improve access to domestic water supplies. Millions of South African households now have access to domestic water but do not have the means to pay for this water. Household gardens can be more intensively cultivated through the use of efficient drip irrigation systems. The benefits of improved nutrition and improved (primarily) women's income make this an attractive target for SIMI involvement. SIMI would work to develop and market a low cost drip irrigation kit as well as work with local NGOs in the promotion of improved agronomic practices.

2.2 Basic Water/Micro-Irrigation Development Strategies

The predominant market for micro-irrigation technology in Sub-Saharan Africa today is for water lifting devices. The pumps that have been introduced to date have been adaptations of the versions popularized in Asia to enable a pressurized water outlet. This eases the labor constraint to expansion from bucket irrigation where a command area of approximately 500 square meters is feasible with a single person to enable an expansion to an acre or more. This is the difference between cultivating an income-supplementing amount of cash crops, and running an expandable cash-crop producing smallholder business. Experience to date shows that farmers who purchase pressurized treadle pumps expand their area of irrigated agriculture, and where land is not a

[9] Informal irrigation in the Peri-urban zone of Kumasi, Ghana. G. A. Cornish and J. B. Aidoo, Report OD/TN 97, March 2000, HR Wallingford.

constraint, shift their rain irrigated staple crops further away from the water sources. Additionally, they diversify their cropping and improve their yields as they become more familiar with the benefits and application of water control.

SIMI will introduce a family of pressurized pumping technologies through the target countries with a varying cost structure to enable a range of entry-level investment. This is a strategy adopted by ApproTEC, which has introduced a two cylinder pressurized pump, a lower cost single cylinder pump, and to push the required entry level investment down yet further, is planning to introduce a low- cost pressurized hand pump.

While the overriding current market is for technologies that lift water from source to the cultivated plots, SIMI will also promote distribution technologies such as drip and sprinkler irrigation. In many cases these technologies will be purchased downstream once farmers have used pressurized treadle pumps and expanded their irrigated coverage to the point where labor is yet again a constraint to their further business growth. SIMI will promote both hand-held and stake-mounted low-cost sprinkler systems that can further reduce the labor requirement for irrigation as well as providing greater irrigation uniformity.

Drip irrigation will play a role where agricultural intensification is required. This is mainly under the following circumstances:

1. Where water is so scarce that water efficiency is important
2. Where land constraints require intensification of cultivation
3. Where quality of produce is an absolute imperative to sales market performance as is the case for any export produce
4. Where drip irrigation is used to tie together a package of horticultural inputs with low-level entry cost, targeting subsistence / or people with no previous cultivation knowledge

SIMI will thus lead with a strategy to quickly make available and promote pressurized treadle pumps, and in parallel promote sprinkler and drip technologies that will provide additonal income to smallholder businesses.

The micro-irrigation technology markets will not be static. Farmers will graduate from bucket irrigation to treadle pumps, and then treadle pumps in combination with sprinklers or to drip irrigation, and so on. As the farmers grow their businesses, SIMI will keep abreast of the changes to ensure that technological inputs are available that allow them to expand their businesses.

2.3 Existing and Potential Output Markets for the Smallholder

Peri-urban bucket farmers have the least limitation in market access. These farmers are feeding the local city markets throughout Africa and by virtue of their proximity to these markets have information that guides their farm planning and seasonal production cycles. Where these farmers live on the outskirts of capital cities, they additionally either have or could be assisted to gain access to international markets through out-grower schemes operated by packaging and export companies. Many African countries export horticultural produce including flowers to Europe and the Middle East. The export markets for these perishable crops are serviced by airfreight. Generally, grading, sorting, washing, and packaging companies have their own farming operations as well as increasingly working with out-growers – smallholder farmers that are contracted to provide crops and are provided with inputs and technical knowledge. In Kenya for example, bar-coded and price labeled product leaves as airfreight every day, half of which are flowers and half of which are vegetables. Agricultural exports are Kenya's second largest income

earner. The principal buyers are large supermarket chains, but some of this producefinds its way to smaller scale high-street vendors. Within Kenya there are four to five major processing operations that act for the supermarket chains, and these account for approximately 80 percent of the total export. In addition some 70 to 80 smaller operations supply the remaining 20 percent.

SIMI needs to focus on increasing the Sub-Saharan African market share of export markets for crops in which the exporting countries have a comparative advantage due to soils and climate. Market facilitation will be achieved through the development of a full time marketing function, based within key export markets to proactively introduce Sub-Saharan African product to retailers in Europe, the Middle East, and America. It is likely that the major growth opportunities for smallholder-produced product are among the smaller retailer outlets within these countries. These businesses are struggling against the economies of scale of supermarket chains, but there will always be a consumer market that prefers the convenience and proximity of these retail outlets over supermarkets. One of the economies of scale against which these retailers are competing is that of sourcing product within the international marketplace. This economy of scale can be overcome with effective market systems that organize smallholder produced export and direct it through a trade network that can efficiently supply smaller retail outlets.

For rural farmers, access to market is predominantly limited by transport and poor infrastructure. In many areas of Zambia for example, farmers pay up to $1/4^{th}$ their crop sales price to transport the crop to market. While this is reflective of the distances involved, it is also reflective of the current transport technologies available. Introducing innovation and organizing transport systems can reduce this cost to make the on-farm transition to market-oriented cultivation more profitable and therefore more attractive to subsistence, or current small-scale commercially oriented farmers. Improvement of transport technology and system efficiency through intermediary businesses will aid the movement of market information to the smallholders as well as provide additional promotional channels for micro irrigation and other high-value farm inputs.

It is likely that a country like Zambia will evolve from a system of parallel individual farm movement of goods to more developed intermediary transport businesses that increase efficiency and push the trade centers for horticultural products back towards the farm.

It should be noted that in the more developed small-scale horticulture regions, these intermediary businesses override individual farm transportation and farmers end up selling product at the farm gate rather than each taking product to market. Against conventional wisdom, an additional trader / transport intermediary often actually increases the farmers net revenue by reducing transport cost to market. Transportation can be provided cheaper by a specialist transport business than by individuals acting alone and transporting smaller volumes. A very good example of this is the peri-urban market for vegetables around Harare, where the transport cost is very low and farmers can chose to sell at the farm gate.

These systems cannot, however, be simply put into place. They need to evolve from the current (varied) situation to more efficient systems as the number of smallholders producing for market increases and the volume and density of product warrants change in the transport system and locally utilized technology. At its most basic, this begins with a single farmer taking product to market him or herself. This gradually evolves as the number and density of farmers increases through shared transport systems, hired transport systems, and eventually market to farmer systems. This is similar to the progression made by farmers from bucket irrigation through treadle pumps, to more mechanized water pumps and eventually the development of water markets.

The appropriate transport technology in any particular place or any particular stage in the development of a horticulture system varies according to a number of factors; the distances to be covered, the frequency of transportation, the cost of fuels, the condition of roads and tracks etc. The current transport systems and technologies used in Africa vary from hand carried, bicycle, tricycle trailer, motorized tricycles, through to trucks. A variety of technologies have been developed or adopted in different areas, and as much as introduce new transport technologies, proven systems will be shared between the various areas and countries. Tanzania for example uses three wheeled bicycles that are not seen in Kenya or in Zambia. Kenya and Tanzania both have Chinese power tillers with trailer attachments available at retailers, but in neither case have these as yet broken into the mainstream transport mechanisms.

Efficient transport systems are critical to the rapid adoption of increased market oriented horticulture and the rate of adoption of higher value input – output farming systems. As previously mentioned, in addition to providing an incentive to farmers by bringing the range of market closer to the farm gate, improved transport additionally helps to bring products and information from urban centers out to the farm.

Thus, the strategy to be pursued by SIMI to increase smallholder access to market will focus at all levels: local, regional, national, and export. The principle interventions in rural areas will include improved transport, and at a national and international level SIMI will build ties with output market programs which improve smallholder access to national and international markets.

2.4 Strategies For Implementation

A.On-farm Technologies (inputs and management techniques)

On farm inputs, both hardware and software will be a critical component of the SIMI effort. Perhaps the most challenging of these will be the software, i.e. communicating effective agronomics to transitional farmers that are emerging from subsistence practices. Classical extension models have not for the large part been effective in reaching smallholders.

SIMI will work with a number of grass roots NGOs to train farmers, as well as tying into existing extension services where they can be effectively utilized. SIMI will lean to some degree on the positive results within IDE's Nepal program on models for farmer training, where it has been found that within approximately two seasons, farmers can gain adequate experience to feel confident in their cultivation practices. In support of these efforts, SIMI will research and produce pictorial communication materials for each of the crop types that that can be grown in a particular area. These will provide farmers with take home materials to improve the retention of the training, as well as enable these farmers to train neighbors or others who become interested.

B.Post Harvest Technologies and Output Markets

Post harvest technologies that offer smallholder access to marketplaces both locally, regionally, and internationally will be introduced through local enterprises and farmer groups. These will be developed on the basis of market opportunity and through a commercially oriented dissemination strategy. In addition to improving market access through improved transport networks, SIMI will focus on improving the transportability of goods produced. A plethora of opportunities exist for small scale, and large-scale post harvest processing that will reduce bulk and increase storability, basically reducing the transportation constraint. Aside from this, the careful choice of cash crops can affect access to markets. Less perishable, lower bulk crops can be produced in rural areas with less of a transport disadvantage. Examples include coffee, cashews, tea, euglena (used as a coloring in animal feed), paprika, and dried produce such as tomatoes.

These are principally international market products, and the international marketing effort undertaken by SIMI will support market creation for these crops as well as for the fresh produce as described above.

C. Supply Chain Development

1. Micro-Irrigation Technologies

As farmers enter and access the global marketplace, so too will the farmers benefit from the global supply of farm inputs. This has already happened with seeds across much of Africa where commercial cultivation is practiced. In Zambia for example, more than 60 percent of seeds, fertilizers, and pesticides available on the market are imported. The supply chains for micro-irrigation technologies will be designed to provide the best products at the lowest cost to the farmers. In many countries this will require importation, from their neighboring countries, or indeed from Asia where pumps can potentially be produced and shipped at lower cost than being manufactured anywhere in Africa.

This is known to be true for higher-value and low-bulk irrigation inputs such as pumps fabricated from steel and lay flat pipes that can be tightly rolled. Both steel and plastic products are comparatively more expensive when manufactured in Africa as compared to Asia. For example, a pressurized treadle pump manufactured in Asia is less than half the cost of the same product manufactured in Africa (approximately a $30 difference depending on the model). This price differential is both a factor of labor and materials cost. The approximate cost to ship the same pump is in the region of $6, and most African countries have duty free import of agricultural supplies.

SIMI needs to design the optimal manufacturer / distribution strategy to provide the best products at the cheapest price for the farmers. This will work in parallel with R&D efforts to reduce cost through design, thus pushing lower the entry-level cost of micro irrigation and therefore high value cultivation.

The structure of the distribution networks will be based on market opportunity. To a degree this can be predicted, however, in many African countries, the demand exists within scattered pockets. Thus a reasonable approach is to establish dealerships and retailers across much of the potential area, increasing or reducing outlets and level of program effort as the marketplace and distribution of demand becomes apparent.

In order for SIMI to get rapidly up to speed, the supply chains will need to be capitalized with inventory, and dealerships will need to repay in advance of receiving replacement stock. A commercial inventory and repayment tracking system needs to be used to manage the distribution networks and track capital outlays and repayment rates. Good dealers can graduate to better terms, whereas bad debt might have to be written off while weeding out the dealerships that do not perform. This should be seen as the risk cost of start up business.

2. Inputs (Fertilizer/soil amendments, seeds, pest control (IPM), implements)

There is already a developed marketing and distribution network for high quality imported seeds, at least in areas where farmers are growing commercial crops. In areas where farmers are reliant on subsistence farming, these supply structures often do not exist. SIMI will facilitate the expansion of distribution and retail networks into these areas as they adopt micro irrigation technologies that enable them to take advantage of improved seed quality and other higher input horticulture technologies.

PART II

IMMEDIATE INVESTMENT OPPORTUNITIES

3. CORE ACTION RESEARCH AND DEVELOPMENT PLAN (CARDEP): DEVELOPMENT OF AN INTERVENTION STRATEGY

4. GEOGRAPHIC EXPANSION

3. CARDEP: DEVELOPMENT OF AN INTERVETION STRATEGY

3.1 Marketshed Description

A. Context

Zambia is a landlocked country covering 752,000 km² and has a population of just over 10 million.[10] The population is widely dispersed with an average population density of just 13 people per square kilometer.

The marketsheds to be covered by the CARDEP program are centered around the main cities and towns in the five provinces targeted for market development. These population centers were selected on the basis of proximity small-scale producers, water resource availability, and importance as centers of agricultural trade.

Table 1: CARDEP Marketsheds

Province	Market Centers	Farm Households in Market Center Area
Copperbelt	Mufulira	22,336
Central	Kabwe	54,026
Lusaka	Lusaka	21,739
Southern	Mazabuka,Choma, Livingstone	26,080
Eastern	Chipata	33,556
Total		**157,737**

Source: Republic of Zambia 2000 Census of Population and Housing

Within the marketsheds surrounding these centers, the CARDEP program will focus on areas with access to surface water resources from rivers or groundwater resources in *dambo* areas. "Dambo" is the local name for a basin-like depression with underlying layers of clayey, impermeable soil that keep groundwater at shallow levels throughout the year.

B. Climate

The climate in Zambia consists of two seasons: the rainy, hot season (November - April) and the dry, cold season (May - October). Annual precipitation ranges from 600mm in Southern Province to 1,200mm in northern parts of the Copperbelt.

C. Infrastructure

Zambia's infrastructure development is at a very basic level. The government, with donor support, struggles to maintain the five main paved road arteries that run through the country. Feeder roads are poorly maintained and often impassable during the rainy season. The national railway system runs through four of the five target provinces, the exception being Eastern Province. Rail is the cheapest form of freight and can be used for distributing farm inputs and collecting less delicate produce.

[10] Republic of Zambia 2000 Census of Population and Housing

D. Economic

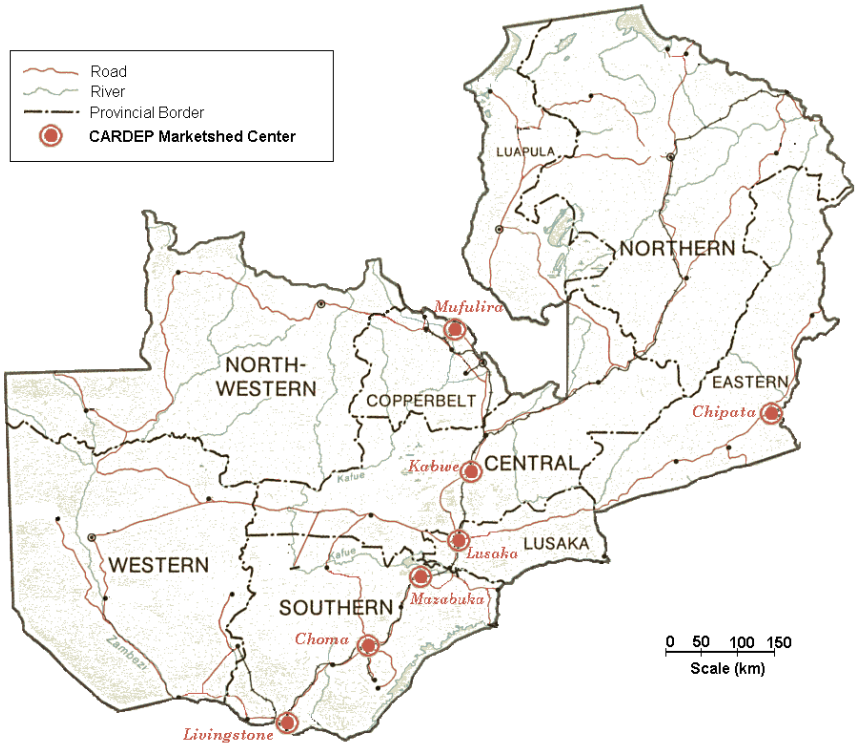
There are 331,000 small-scale farming households in the five CARDEP provinces. The majority of these are subsistence farmers. Ministry of Agriculture Food and Fisheries (MAFF) data indicate that small-scale farm households earn less than $500 per year (or about $83 per person assuming an average of six people per family), which is about one tenth of the national per capita GDP at $880 per year.

Since 1997, IDE has been working to move small-scale farmers toward commercial production through the use of micro-irrigation technologies. More than 2,000 farmers are using treadle pumps to irrigate approximately 0.25 ha per season for two seasons per year. This has brought an estimated 1,000 hectares of additional land under irrigation. Based on IDE monitoring data, treadle pump users make an average extra net income of about $200 per year.

Figure 1: Marketshed Centers in Zambia

About 80 percent of farms use immediate and extended family members as laborers. Hiring of outside labor occurs occasionally during periods of tilling or harvesting. The vast majority of landholdings are acquired under customary law (administered by local chiefs), while only a small minority of smallholders own title deeds.

Financial markets are underdeveloped and access to long-term capital for smallholders is extremely limited. Some micro-finance institutions provide low-interest loans to farmer



associations, cooperatives and private companies.[11]

The cost of inputs in Zambia is high; more than 60 percent of seeds, fertilizers, herbicides and pesticides are imported. The distribution of inputs is inefficient in most cases. Limited farmer access to financing also affects the agricultural input markets. The poor state of the road network infrastructure is an impediment to efficient delivery and distribution of farm inputs.

E. Agriculture

Statistics from MAFF indicate that 12 percent (90,240 km²) of the total land area of Zambia is arable, of which only 16 percent (14,440 km²) is currently under cultivation.

[11] The micro-finance organizations, including Zambia Agricultural Technical Assistance Center, Credit Management Systems, and Micro-Bankers Trust, are supported by USAID and SIDA

Zambia has three main agro-ecological zones based on soils, climatic factors, and common agricultural activities as shown in Table 2 below. Each of these three zones is represented in the CARDEP marketshed areas. Zone II has the largest amount of existing commercial agriculture and has the highest potential for growth in the agricultural sector.

Table 2: Main Features of Zambia's Agro-ecological Zones

Zone	% of land area	Location in CARDEP Marketsheds	Elevation (m)	Annual Rainfall (mm)	Growing season (days)	Mean Temp (°C)	Current Agriculture
I	12%	Luangwa and Zambezi river valleys in Southern	300-900	<800	80-120	20-25	Drought resistant crops
II	48%	Plateau in Lusaka, Central, and Eastern	900-1200	800-1000	100-140	23-25	Maize, tobacco, ground nuts, sunflower, soybeans, wheat, vegetables, sweet potatoes, cotton, cattle, goat, poultry.
III	40%	Plateau in Copperbelt	900-1200	<1000	120-180	16-25	Cassava, rice, sweet potatoes, sunflower, Soya beans, millet, sorghum, pineapples and maize.

Source: Poverty Reduction Strategy Paper, September 2000

The country has 12 agricultural research stations. These stations are government funded with supplementary external funding. MAFF field offices and a broad range of NGOs are currently providing extension services to smallholders, but coverage is poor due to the sparse population distribution and poor infrastructure.

More than 50 NGOs are currently operating in Zambia. Partner NGOs pursuing poverty reduction programs in the agricultural sector include the Cooperative League of the USA (CLUSA), Africare, OXFAM, Hodi, Care International, Women for Change, Lutheran World Federation, Program Against Malnutrition (PAM), Micro Bankers Trust (MBT), Zambia Agricultural Technical Assistance Center (ZATAC), Credit Management Scheme (CMS), World Vision, Association for Sustainable Natural African Products (ASNAP), Organic Products Producers Association of Zambia (OPAZ), and Rotary International and local Rotary Club of Lusaka.

3.2 Target Population

The target population includes small-scale farmers in the defined marketsheds, who cultivate less than three hectares, and have access to adequate water for agricultural activities. The total farm population around the targeted marketshed centers is 157,700 (Table 1). Within six years, we anticipate reaching about 7.5 percent of this total or 12,000 farm households.

3.3 Water Strategy

Zambia's abundant underground and surface water resources encompass numerous rivers, lakes, reservoirs, and dambos. It is estimated that about 45 percent of water resources in Southern Africa are located in Zambia. The total land area available for irrigation is estimated at 423,000 hectares, but less than 40,000 hectares (9 percent) is actually irrigated (Table 3). Irrigated land is concentrated on commercial farms for the production of sugar, wheat, and plantation crops. SIMI's strategy is to increase the irrigated area of smallholders through the introduction of low-cost irrigation technologies.

Table 3: Summary of Irrigation Potential In Zambia

Catchment	Total Irrigation Potential (ha)	Existing Irrigation Schemes (ha)	Percent Utilization
Upper Zambezi	112,000	2000	2%
Kafue basin (Lusaka)	165,000	13,000	8%
Luangwa Basin (Chipata)	14,000	N/A	N/A
Luapula and Tanganyika	64,000	2000	3%
Groundwater Irrigation	60,000	N/A	N/A
Total	423,000	<40,000*	<9%*

Source: World Bank Agricultural Sector Strategy: Issues & Options, 1992
* Estimated national totals based on incomplete regional data

The CARDEP program will take advantage of two abundant water sources that smallholders can use to irrigate dry season crops.

Dambos: perennial or seasonal wetlands that have a variety of plants, soils and hydrological characteristics. Water table depths typically vary from 0 to 6 m, which makes them suitable for low lift water pumps. Individual dambo areas are scattered throughout the country. Nationwide, the total area covered by dambos is approximately 3.6 million hectares. SIMI will focus on dambo areas that are within reach of market population centers.

River valleys: several major rivers run through the CARDEP provinces including the Kafue River in Copperbelt, Central, and Southern Provinces; the Zambezi River in Southern Province; and the Luangwa River in Eastern Province. Smallholders can access water directly from these rivers and their tributaries or from groundwater wells that tap into the relatively shallow water tables in the river valleys.

A. Treadle pumps

IDE's foot-powered treadle pump is the primary micro-irrigation technology to be promoted in the CARDEP program. The pump has been adapted to the Zambian context by IDE engineers and can be used to draw water from shallow dambo ponds, open wells, hand drilled tube wells, rivers, reservoirs and other surface water sources. Two basic designs are used: 1) the river pump, which uses suction to lift water from the source to the pump level a maximum of about 7.5 m, and 2) the pressure pump, which uses both suction and pressure to lift water up to about 15 m. To date, more than 2,000 treadle pumps have been installed, primarily in the five CARDEP provinces. The pressure pump has proved to be more popular among smallholders due to its versatility, despite its higher cost. In the CARDEP Program, the Winrock International and International Development Enterprise partnership (WI-IDE) will strengthen and expand the private-sector supply chain to provide these pumps at an affordable yet sustainable price, and actively promote the pump in rural areas to increase awareness and demand among smallholders.

B. Drip Irrigation

Drip irrigation uses a system of pipes and tubes to deliver irrigation water directly to the base of each plant. Water use is reduced by as much as half and yields can be increased by 30 to 50 percent. IDE has developed low-cost drip kits specifically suited to the needs of smallholders. The drip technology has been developed and tested over a period of five years by IDE in Nepal and India, although it is a new technology for Zambia. Several trial systems have been installed by IDE in Lusaka and Copperbelt Provinces. WI-IDE's strategy will be to increase the capacity to produce the drip system components locally, to establish a private-sector supply chain to provide the kits at an affordable yet sustainable price, and to actively promote the kits in rural areas to increase awareness and demand among smallholders.

C. Micro-Sprinklers

Micro-sprinklers, like drip irrigation systems, improve the efficiency of water use by reducing wastage. They can be attached to a pipe network to irrigate crops that cannot be irrigated by conventional drip systems (soya, sugar beans, and ground nuts for instance). The sprinklers require that the water be at a higher pressure than conventional drip, either by connection to a pump or an elevated storage tank. Each sprinkler head costs approximately US$3.00.[12] The combination of micro-sprinklers with IDE's low-cost drip systems will increase the crop options available to smallholders.

[12] Two private sector companies, Amiran and Aquagro, are currently distributing micro-sprinklers in Zambia.

3.4 High –Value Agricultural Products

IDE's close relationship with small-scale farmers throughout the past five years has led to an important observation regarding the income earning potential of small-scale irrigation. Smallholders with similar land holdings, soil quality, water access, and labor force attain vastly different economic performance. Two of the primary variables determining economic return are 1) the level of diversification practiced by the farmer and 2) the existence of linkages to stable markets.

WI-IDE's poverty alleviation strategy in the CARDEP program, therefore, will include the promotion of a diversified crop with high market potential. The crops described in the following sections have been identified as having the potential to have a significant impact on smallholder incomes. Crops were selected based on an analysis of local and export market demand, crop manageability, profitability, and farmers' previous experience with the crops.

1. Paprika (Capsicum annum.)

Paprika can be grown successfully under rain-fed conditions, particularly in agro-ecological zones II and III (Table 4). Currently 1,500 smallholders are producing paprika under rain-fed conditions. The largest constraint to quality and quantity in *rain-fed* paprika cultivation is insect and disease control.

Under *irrigation*, however, paprika is easier to manage since insect and disease control are less of a problem and yields are substantially higher (Table 4). Two main commercial producers grow irrigated paprika in Zambia.[13] Commercial farmers, however, can usually earn higher profits by growing a wheat-soybean rotation thereby making paprika less attractive and giving smallholders a comparative advantage.

There is an opportunity, therefore, to increase the number of new smallholders producing irrigated paprika. For those smallholders who are already growing rain-fed paprika, small-scale irrigation technology can help them to more than double their average yield from 700 kg/ha to 1,500 kg/ha resulting in a gross revenue increase of US$800/ha. The farm gate price for paprika has been stable over the past three years at about US$1/kg.

Table 4: Average Yields and Gross Revenue from Paprika Cultivation in Zambia

Farm Operation Type	Average yield	Gross Revenue at US$1/kg
Large commercial irrigation	4,000 kg/ha	$4**,000**/ha
Medium commercial **irrigation**	2,500 kg/ha	$2,500/ha
Small-scale rain-fed	700 kg/ha	$700/ha
Small-scale irrigation	1500 kg/ha	$1,500/ha

Source: Zambia Association of High Value Crops, Extension Officer Reports, December 2001

Paprika markets

On the international market, Paprika is in demand as a spice, a food color, and an ingredient used in the pharmaceutical, paint, and cosmetic industries. The countries of the South African Development Cooperation Community (SADCC) produce almost 20 percent of the world's total paprika harvest. Export Development Program (EDP) consultants estimate that the SADCC

[13] Masstock Africa Ltd. and Chakanaka Investments

market share could increase to as much as 33 percent in the next two to three years. The paprika produced in the sub-region meets the standards of the American Spices Trade Association.

As indicated in Table 5, Zimbabwe has produced an average of 10,000 MT of paprika each year for the past five years. The Support to Farmers Associations Project (SFAP) expects production in Zimbabwe to drop by about 20 percent due to political unrest revolving around land ownership. Zambia may be in the best position to fill this production gap because of its advantages in terms of climate and soil quality.

Table 5: Forecast Paprika Production in the South African Sub-Region, 2001/2002 Season

Country	Annual Production (MT
Malawi	3,500
Mozambique	1,500
Namibia	1,000
South Africa	8,000
Zambia	5,000
Zimbabwe	10,000
Total	29,000

Source: Support to Farmer Associations Project: Trip Report to USA, Market Assessment, 2001

Paprika is a fairly new crop in Zambia (less than 10 years) and has been grown primarily by commercial farms as a cash crop for export in its raw form as whole pods. Recently, a private processing plant has been built to extract oleoresin (used as a natural colorant in food coloring, pharmaceuticals, cosmetics, and paints) from paprika with a capacity of 3,000 tonnes per year.[14] Smallholders have been among the major suppliers to the processing plant.

Seven private agribusinesses run out-grower schemes for paprika production.[15] These companies purchase raw paprika from smallholders for grading, packaging, and export to South Africa and Spain. Recently, ground paprika powder has gained popularity as an inexpensive substitute for tomatoes in local restaurants and homes especially during periods of tomato shortages. Farmers are also increasingly using paprika for home consumption.

Major paprika producing areas
Forty-six percent of Zambia's paprika crop is produced by commercial farms[16] in the lower Zambezi basin, an area that is endowed with excellent water resources and rich soils. There is tremendous potential for small-scale producers in this area to start or increase their paprika cultivation using the treadle pump for irrigation.

The remaining 54 percent of the paprika harvest is produced by smallholders in the plateau areas around Lusaka, Mumbwa, Kabwe, Monze, Choma, Kalomo, and Kaoma. Recently, limited amounts of paprika have been grown in Eastern and Copperbelt Provinces.

[14] The plant is operated by Enviro Oils & Colorants
[15] Out-grower schemes are run by the Zambia Association for High Value Crops (ZAHVAC), an association of five member companies promoting paprika production, plus Cheetah Zambia Ltd., and recently Agriflora.
[16] Masstock Africa Ltd. and Chakanaka Investments.

Table 6: Paprika Production in Zambia 2000-2001

Company	Commercial Production (ha)	Smallholder out-growers (ha)	Total Production (tonnes)
Masstock Africa Ltd.	600	-	1,800
Chakanaka Investments	120	-	420
Cheetah Zambia Ltd.	-	400	1,000
ZAHVAC (5 companies)	-	1,500	1,500
Agriflora	-	100	100
Total	720	2,000	4,820

Source: ZAHVAC Extension Officers Report, December 2001

2. Coffee (Coffee Arabica L)

In Zambia, coffee is cultivated by large and mid-sized commercial operations and also by smallholders (Table 7. Collectively, smallholders cultivated approximately 360 ha of coffee in 1999, which amounts to about seven percent of the total coffee area in Zambia. The output from smallholders, however, was only seven tonnes, less than 1 percent of total production in the same year, according to the Zambian Coffee Growers Association (ZCGA). This imbalance in productivity is partly due to the fact that much of the coffee grown by smallholders has not yet reached maturity. Smallholder coffee growers have also been limited in their ability to improve productivity and expand production due a lack of collateral for obtaining loans.

Table 7: Number of Coffee Growers, Cultivated Area, and Total Production (1999)

Farm Type	Number of Growers	1999 Cultivated Area (ha)	1999 Total Production (tonnes)
Large Commercial Growers*	3	1,500	n/a
Mid-Size Commercial Growers	68	3,156	3551
Smallholder Growers	100 (est.)	360	7
Grand Total	**174 (est.)**	**5016**	**n/a**

* Nanga Farms PLC, Mpongwe Development Company, and African Plantations
Source: Zambia Coffee Growers Association, 1999

The water requirement for mature coffee is 250 mm per month. Various types of irrigation systems are used including flood, drip, micro-sprinklers, overhead, and center pivots. Commercial growers keep coffee plants in production for six to eight years before replanting and obtain yields averaging 2.5 to 3.0 tons per hectare. Small-scale producers tend to extend the production period to 10 years; data on smallholder yields is not yet available.

Coffee markets
A few commercial farmers roast and grind portions of their crop for local markets. About 10 percent of the coffee produced in Zambia is sold locally, mainly through supermarket chains, according to ZCGA.

More than 90 percent of the coffee produced in Zambia is sold for the export market through the Coffee Board of Zambia, a growers association regulating the coffee production and marketing for the country. The Coffee Board of Zambia is given an annual quota of 10,000 tonnes by the

Zambia Coffee Growers Association, far in excess of what is currently being produced. Export markets include Europe and Japan. The Zambia Coffee Growers Association markets coffee on behalf of growers creating a single link in the marketing chain. No intermediate marketing system exists therefore smallholders need to deal through a miller or a commercial farmer, often resulting in delayed payments.

According to the Zambia Coffee Growers Association, the export price of coffee has averaged US$2.45/kg since 1985 and has varied from $1.50/kg to almost $4.00/kg. The value in 2000 was $2.00/kg.

3. Fruits and Vegetables

Zambia is highly urbanized with approximately 45 percent of the population living in towns and cities. Demand for locally produced vegetables is high. Most farmers are already experienced in vegetable production at some level, the most popular traditional crops being cabbage, onions, and tomatoes.

Fruit production is less labor intensive than vegetables and can be incorporated into smallholder production, particularly where intercropping methods are employed. Bananas are profitably produced around the Chirundu and lower Zambezi areas, which have excellent water and soil resources. Bananas intercropped with coffee is a possible combination for smallholders. Local markets exist for both fruit and vegetables at local markets, supermarket chains, hotels, and tourist resorts in Livingstone. Table 8 shows the monthly volume and revenue from selected vegetables and fruits at Soweto market, Zambia's largest fruit and vegetable market.

Table 8: Monthly Trade in Selected Fruits and Vegetables at One Lusaka Market

Crop	2001 Average Monthly Volume (tonnes)	Revenue (US$)	Price US$/tonne
Cabbage	836	28,145	33.67
Onion	503	176,785	351.46
Potato	231	88,000	380.95
Tomato	1540	361,428	234.69
Bananas	850	279,286	328.57

Source: ZAMTIT/ZATAC Study of Soweto Market in Lusaka, 2001

Improving post-harvest techniques such as storage, packaging, and processing can enhance the potential market for smallholder fruit and vegetable crops. By reducing wastage, preventing transport damage, increasing shelf life, and adding value to their crops, smallholders can significantly increase their incomes from fruits and vegetables. IDE will identify personnel and partner organizations with expertise in post-harvest techniques and technologies to address these important areas.

Recently, the Organic Products Producers Association of Zambia (OPAZ) has been promoting production of organic spices and oils among small-scale farmers. These products have regional and international markets. IDE is currently assessing the potential of these crops to provide an attractive income for smallholders.

3.5 Constraints Analysis

The following sections describe the constraints that limit Zambian smallholders' ability to participate fully in commercial markets for the crops identified in Section D above. These include constraints that hinder productivity at the farm level and also constraints that hinder the ability of private-sector members of the supply chain and output marketing chain to effectively serve smallholders.

Some of the identified constraints can be addressed using existing IDE technologies and expertise. Other constraints lie outside the areas of IDE experience and it will be necessary to either 1) develop their capacity in new areas, or 2) develop partnerships with organizations that have the appropriate skills and expertise.

1. Farm Level Constraints

a. Technological Constraints

The smallholder's access to agricultural technology in Zambia is hindered by high prices of imported goods. Most irrigation technologies on the market are well beyond the financial means of smallholders, forcing the majority to resort to the inefficient traditional method of bucket irrigation. In order to improve irrigation practices, there is a need for low-cost technologies that will enable smallholders to 1) convey water from the source to the field, 2) increase water efficiency by reducing water losses, and 3) reduce plant stress and improve crop quality by carefully controlling the amount of water applied to the crops.

The first irrigation need, conveying water from source to field, can be met by the treadle pump technologies that have been promoted by IDE since 1997. At present, more than 2,000 smallholders have purchased treadle pumps of various designs and are using them to irrigate dry season crops for consumption and sale.

The second and third irrigation needs, water efficiency and crop water control, can be met with drip irrigation technology that IDE is currently introducing in Zambia.

Most fertilizers and agrochemicals used in Zambia are imported. High transportation costs to this landlocked country make the landed costs of these inputs prohibitively expensive to smallholders.

There is a lack of good quality, affordable paprika seeds. The high cost of paprika seed leads most out-grower managers to recycle certified seeds thus reducing seed quality and reducing yield potential for smallholder producers.

The best method for sowing paprika seed is direct drilling. A lack of affordable sowing machines has meant that most smallholder crops are cultivated using transplanted seedlings.

There is a lack of affordable post-harvest techniques and technologies available to smallholders, which would enable them to improve the marketing of fruit and vegetable crops

b. Capacity-Related Constraints

Smallholders are rich in traditional knowledge, but many lack technical knowledge in agronomy, irrigation, pest and disease management, record keeping, and financial and business management that could help them improve their farm operations. Public sector extension services are poor in quality.

Farmers lack market information on crop prices, which makes it difficult to know which cash crops to grow and when to sell their produce. The privatization of state functions that the government has pursued in the last decade has resulted in the loss of official agricultural marketing and processing agents. This role has been filled by unregulated private middlemen, who often exploit smallholders' lack of access to market information by underpaying them for their produce.

Zambian farmers are typically conservative in outlook and averse to the risks that changes and new ideas bring. Those who have little experience outside of subsistence agriculture have difficulty viewing their small farm as a business enterprise.

Out-grower relationships between smallholders and agribusinesses often put smallholders at a disadvantage or in a position where they can potentially be exploited.

Managing out-grower schemes with smallholders is a relatively new practice for agribusinesses in Zambia. Some companies are not fully convinced of its economic viability and are therefore reluctant to invest significant resources and commitment in relationships with smallholders.

Smallholder coffee farmers lack an independent means of marketing their output to the Zambia Coffee Growers Association. Smallholders must deal through a miller or a commercial farmer, often resulting in delayed payments.

Ensuring continuity of supply is an important requirement for commercial markets. This poses a challenge for small-scale producers who may not be able to provide a continual supply of produce from their small land holdings.

There is a lack of cooperation among small-scale producers of fruits and vegetables. Cooperative group action would enable smallholders to better protect their interests and to access markets that would otherwise be inaccessible.

c. Capital/ Credit Constraints

Smallholders lack access to affordable credit for the purchase of agricultural technologies and crop inputs. This imposes a serious limitation on farmers' ability to improve their productivity. IDE field surveys and regular interaction with farmers indicate that the demand for small-scale irrigation systems is very high, but that smallholders generally lack the financial means to purchase them.

The vast majority of smallholders do not possess title deeds to the land they cultivate. This lack of collateral precludes farmers from obtaining loans from banks and credit institutions.

High interest rates (35-40 percent) on local currency (kwacha) loans are unaffordable to most smallholders.

Most lending institutions make loans in U.S. dollars (at about 12 percent interest) while smallholders are only able to raise local currency to make repayments. The devaluation of the kwacha results in an additional cost to the borrower.

Most banks have a minimum loan requirement that far exceeds the needs of small-scale producers.

Application procedures to obtain a loan are tedious and inconvenient, especially for smallholders who may travel hundreds of kilometers to the nearest town.

d. Other Constraints

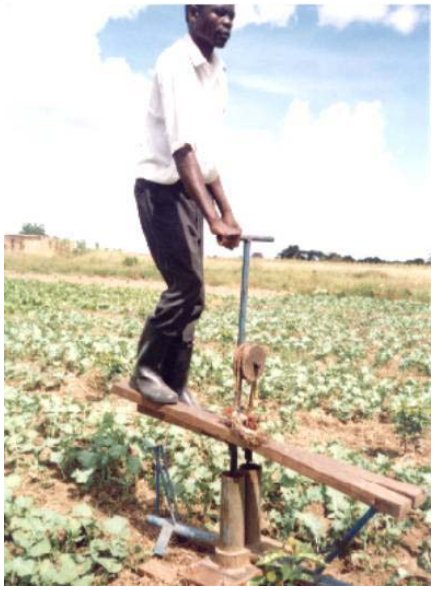
The steady devaluation of the Zambian currency (kwacha) discourages smallholders from saving, which further reduces their ability to invest in productivity-enhancing technologies and crop inputs.

The availability of animal traction has decreased in the past few years due to epidemics of corridor disease and east coast fever. This has lead to a reduction in cultivated areas as more and more farmers depend on manual labor for all farm operations.

The improvement of rural road infrastructure and electrification is critical to the long-term prospects of a successful economic and agricultural development in rural areas.

2. Input Markets

a.Technological Constraints



The retail cost of treadle pumps in Zambia is much higher than in other countries due to the high cost of imported steel, overhead, and local taxes—costs that local manufacturers must pass on to the consumer.

There is limited local capacity for the production of plastic pipe (HDPE and LDPE) used in drip irrigation systems and for the pipes connected to treadle pumps to deliver water from the source to the fields.[17] The monopoly on production results in an inadequate supply of pipe and inordinately high prices (e.g., US$1.45 per meter for 40-mm diameter HDPE pipe).

For both paprika and coffee, expertise in efficient and effective operation of seedling nurseries is lacking. Purchasing seedlings from specialized nurseries is

[17] A single manufacturer in Lusaka, Bonar Plastics, is currently producing HDPE and LDPE pipe.

expensive.

There is a need to identify a design for a low-cost direct-drill sower for paprika. If no existing design can be identified, research and development activities will be necessary to develop an appropriate technology in Zambia.

b. Capacity Related Constraints

The input supply chain for treadle pumps is not yet able to meet the demands for pumps without assistance from IDE and other organizations. Manufacturers and retailers perceive a high risk in micro-irrigation equipment and are therefore unwilling to invest up-front in adequate stock to meet peak annual demand in the dry season. Manufacturers often have more profitable alternatives than treadle pumps and treadle pumps are therefore a lower priority product for them. The link between manufacturers and retailers is weak requiring IDE to temporarily fill the role of wholesaler and liaison.

The capacity to deliver high-quality extension service is lacking in both the public and private sector. Low staff motivation, inadequate technical training, and lack of resources to cover large areas on poor roads contribute to this shortcoming.

Business development services, including technical and business training, are required for the companies that supply input products and services to smallholders: treadle pump manufacturers, plastic pipe manufacturers, drip system assemblers, seed/seedling producers, and retailers.

c. Capital/Credit Constraints

Manufacturers and retailers lack capital to produce and stock micro-irrigation equipment. Manufacturers require up-front payment and retailers sell only on consignment.

Capital loans will be necessary for the establishment or expansion of companies that provide input products and services to smallholders. These companies may include treadle pump manufacturers, plastic pipe manufacturers, drip system assemblers, seed/seedling producers, and retailers.

d. Other Constraints

Poor rural road infrastructure and great distances between farmers and markets contributes to the high cost and poor quality of input products and services to smallholders.

3. Output Markets

a. Technological Constraints

There is a need to identify appropriate and affordable post-harvest technologies that will enhance income from fruit and vegetable production (e.g., solar drying, cold storage). If no existing technologies can be identified, research and development activities will be necessary to develop appropriate designs in Zambia.

Meeting required levels of sanitation is an obstacle for small-scale rural food processing. Certified inspectors have difficulty accessing the small agro-processors.

b. Capacity Related Constraints

Business development services, including technical and business training, will be required for the companies that supply output services to smallholders, such as post-harvest technology producers.

There is a need to establish links between smallholders and existing market opportunities. Linkages between small-scale producers and buyers who have access to international markets, for example.

There will also be a need to develop entirely new markets to serve small-scale farmers. Local markets for dried vegetables, for instance, are not yet established.

c. Capital/Credit Constraints

Capital loans will be necessary for the establishment or expansion of companies that provide output products and services to smallholders such as post-harvest technology producers.

d. Other Constraints

Zambia has opened its borders to agricultural imports from neighboring countries. Zimbabwe, for instance, has a more developed vegetable growing industry and is able to under-price local produce in many cases.

3.6 Intervention Strategy

The CARDEP program calls for a multi-dimensional strategy to help overcome the numerous constraints at the input, farm, and output levels that prevent smallholders from participating fully in commercial markets. Effective implementation will rely on the coordinated efforts of government, NGOs, community-based organizations, and private-sector companies.

- WI-IDE will implement those aspects of the strategy that relate to developing supply chain networks for agricultural inputs, on-farm training and capacity-building activities, and facilitating linkages to output markets and other aspects of market development.
- WI-IDE will partner with other organizations to provide services relating to post-harvest technology, organic and conservation farming methods, farmer organization, and micro-finance.
- Private-sector companies in the supply chain and output chain will be trained and equipped to provide affordable supplies and services to smallholders.

1. Farm Level

a. Technology Strategy

In the past five years, IDE has introduced several affordable, small-scale irrigation technologies. The treadle pump, the pressure treadle pump, drip irrigation systems, and now micro-sprinklers all help to expand smallholders' options beyond the traditional reliance on rain-fed agriculture. WI-IDE will continue the promotion of these technologies in the marketshed areas by increasing smallholders' awareness and understanding of the benefits of irrigated agriculture. In the process,

WI-IDE hopes to shift smallholder attitudes away from a subsistence agriculture mindset to considering their farms as small businesses. Promotional activities include demonstration plots, farmer field days, presentations and displays in local markets and at agricultural shows, publicity events, radio programming, printed advertising, and other means.

WI-IDE will continue to develop appropriate irrigation technologies that will increase the number of smallholders that can grow irrigated crops. The rope-and-washer pump, for instance, allows water to be pumped from deeper aquifers than the treadle pump can reach and so expands the potential areas where smallholders can use irrigation to enhance their productivity.

Post-harvest techniques and technologies suitable for on-farm use will be researched, developed, and introduced through market channels. Most smallholders transport their produce to local markets immediately after harvest, often missing out on opportunities to increase the value of their crop. WI-IDE will seek input from specialists in post-harvest crop treatment to help smallholders to increase their incomes through improved storage and processing. Proper storage facilities can reduce crop wastage and allow smallholders to delay sale of their produce until prices are more favourable. There is also great potential for farmers to deliver value-added products to local markets. Processing technologies such as solar drying, preserving, and the production of tomato paste, fruit juice, and peanut butter are examples of how smallholders can add value to their crops before selling them in the market.

b. Capacity-Building Strategy

During the past five years, IDE Zambia has been providing extension and technological assistance to thousands of smallholders. IDE agronomists and engineers discuss agronomic, technical, and financial matters with farmers during their frequent contacts. Formal training in specific topics is also conducted for groups of smallholders. WI-IDE will work in partnership with other organizations to continue providing capacity-building services to smallholders including:

- Farm management skills including crop selection, irrigation techniques, record keeping (crop data and financial records), and marketing.
- Agronomic training emphasizing the importance of diversification, crop rotation, conservation farming techniques, organic farming techniques such as composting, and Integrated Pest Management (IPM) to reduce reliance on expensive and often hazardous chemicals. It will be especially important to provide technical back up to farmers growing new crops for the first time (e.g., those growing paprika and coffee for the first time). The Conservation Farming Unit of the National Farmers Union has experience in promoting conservation methods. The Organic Products Producers Association of Zambia is promoting organic farming techniques including the use of manure and compost. The University of Zambia (UNZA), Crops Science Department of the School of Agriculture has expertise in Integrated Pest Management. SIMI will work closely with these organizations.
- Post-harvest processing and improved storage methods to extend the life of, and add value to, harvested crops. Partner organizations with expertise in post-harvest crop treatment will be identified and activities coordinated with small-scale farm production activities.
- Group formation and institution building activities will be undertaken to create and strengthen farmer associations. Capacity-building activities will focus on administration skills, problem solving, planning and organization, and group cohesion. Strong

associations with capable leadership can help farmers to protect their collective interests, access credit, access training opportunities, enter into out-grower contracts, negotiate bulk purchases of inputs, and provide mutual support.

c. Capital/ Credit Strategy

WI-IDE will work with micro-credit organizations such as ZATAC, Micro Banker's Trust and Credit Management Systems to increase smallholders' access to credit. Linking these credit institutions to farmer associations will alleviate the constraints posed by lack of collateral. A farmer association can access credit for its members without having the collateral that would normally be required for loans to individual farmers.

WI-IDE will join with lending institutions and farmer lobby groups such as the Zambian National Farmers Union in advocating expedited acquisition of title deeds for smallholders. Obtaining a title deed to their land is a necessary prerequisite for individual smallholders to obtain credit from a lending institution.

2. Input Markets

a. Technology Strategy

Seed produced locally is generally of poor quality and imported seeds are expensive. In collaboration with specialists in seed research and production, IDE will help develop local capacity to produce good-quality seeds in sufficient quantity to meet the needs of smallholders growing irrigated crops. Methods for producing and distributing fruit, vegetable, and paprika seeds will be required. Local production of coffee seedlings at the commercial level is well established. Commercial entities have expressed their willingness to work with out growers and thus IDE does not anticipate seedling production to be a constraint for smallholder coffee growers. IDE will work with private-sector companies to set up a seed supply chain including producers and distributors. The Zambia Seed Control and Certification Institute (SCCI) is currently promoting local seed production with funding from the UNDP. The institute recently has commissioned a seed-clearing house in Copperbelt Province.

The cost of locally manufactured treadle pumps has been an obstacle to many smallholders who would like to grow dry season crops.[18] In Bangladesh, by contrast, IDE is able to produce similar pumps for one third of the Zambia price or less. The high cost in Zambia is attributed to the high cost of imported steel used in the manufacture of the pumps and the high cost of living relative to Bangladesh. Consequently, it may be more cost effective to import pumps than to manufacture them locally. Complete treadle pumps could be imported or components could be imported and assembled by small-scale fabrication shops in Zambia. Importing lower-cost treadle pumps may also stimulate competition and cause local manufacturers to increase efficiency and lower their prices. With lower prices, more farmers will be able to invest in irrigation, which will increase sales volumes and provide additional downward pressure on pump prices.

b.Capacity Building Strategy

IDE has helped to establish a supply chain for affordable irrigation technologies. Treadle pumps are produced by 10 manufacturers in three provinces and distributed through a network of more

[18] Locally manufactured treadle pumps in Zambia cost between US$60 and US$105, not including the plastic suction and delivery pipes. Similar pumps are manufactured in Bangladesh for about $20.

than 20 retailers in five provinces. Drip and micro-sprinkler systems, which are not currently manufactured in Zambia, are imported from the Republic of South Africa and made available to smallholders directly through IDE since the distribution network has not yet been established.

WI-IDE will continue to develop the capacity of the treadle pump manufacturing base with the aim of creating better competition in production, quality, and pricing. IDE will train new manufacturers to increase competition, decentralize production, and improve access to the technology in remote areas.

WI-IDE will develop the local capacity to produce and distribute drip and micro-sprinkler irrigation systems. Currently there is only one local manufacturer of extruded plastic pipe used for drip systems. WI-IDE will help establish a second private-sector producer by helping to secure a capital loan to expand operations.[19] The distribution network for drip and micro-sprinkler technology will build on the existing treadle pump distribution network.

WI-IDE will help to train and equip private-sector input suppliers that can produce and distribute affordable, good-quality seeds for fruits, vegetables, and paprika.

Business development services will be provided to new and existing manufacturers, distributors, and retailers of irrigation equipment and seeds. Training will include basic financial management, record keeping, stock control, promotion, and marketing skills. At the same time, relationships between the supply chain members will be strengthened.

WI-IDE will facilitate collaborative ties between private seed and fertilizer companies and technology distributors. Combining IDE's promotional activities along with those of private institutions will enable more efficient and effective dissemination processes.

c. Capital/Credit Strategy

SIMI will help manufacturers and retailers to access credit through financial institutions, NGOs, or other sources (e.g., the loan to establish plastic extrusion capacity described above and in the footnote). Access to capital will enable companies to purchase stock prior to peak demand periods and expand their operations to better serve smallholders.

3. Output Markets

a. Technology Strategy

Some food processing can occur at the farm level, especially for products destined for local markets. There is also great potential for medium-scale processing operations to collect and process the output of many smallholders. A mid-sized solar drying operation, for instance, would be able to tap into the market for dried tomatoes in European markets. One mid-sized tomato drying operation is currently operating at about 50 percent capacity and is looking for a reliable source of tomatoes.[20] WI- IDE will investigate the feasibility linking smallholders to this plant or of starting a similar processing operation.

[19] IDE is in the final approval process for a World Bank grant that will allow IDE to provide a capital loan to Duram Ltd., a local manufacturing company that wants to expand its operation to include plastic extrusion.
[20] The tomato drying operation is operated by Chikwanka Ltd.

b.Capacity Building Strategy

WI-IDE will facilitate linkages between smallholders and the established markets that exist for high-quality paprika, coffee, vegetables, and fruits. Over the past two years, IDE has helped to establish four clusters of out-growers (a total of 186 farmers) that produce crops under contract to local agribusinesses.[21] WI- IDE will take the lessons learned from this experience and scale up the number of linkages established between smallholders and agribusiness. WI-IDE will identify and work with interested food processing companies, export marketers, supermarkets, restaurants, hotels, and resorts to develop relationships with farmer associations. WI-IDE will also assess potential markets for organic produce as promoted by Association for Sustainable Natural African Products (ASNAP) and Organic Producers Association of Zambia (OPAZ)

WI-IDE will help to train and equip private-sector suppliers that can produce and distribute affordable post-harvest products and services. This may include, for instance, suppliers of on-farm processing equipment or entrepreneurs wanting to establish a medium-scale processing facilities. Business development services will be provided to these companies including basic financial management, record keeping, stock control, promotion, and marketing skills. At the same time, relationships between the supply chain members will be strengthened.

c. Capital/ Credit Strategy

WI-IDE will help suppliers of output products and services to access credit through financial institutions, NGOs, or other sources. This may include, for instance, suppliers of on-farm processing equipment, entrepreneurs wanting to establish a medium-scale processing facilities, or companies that purchase produce from smallholders. Access to capital will enable these companies to expand their existing operations or move into new areas to better serve the output marketing needs of smallholders.

Loans to farmer associations for construction of storage facilities or other post-harvest equipment may also be arranged.

[21] Eighty farmers in Katuba (26 km north of Lusaka) grow paprika for export markets. Sixty farmers in Magoye and Pemba, 26 female farmers in Panuka (Southern Province), and 20 farmers in the Copperbelt grow vegetables for local markets.

Table 9: CARDEP Zambia Budget

	Year 1	Year 2	Year 3	TOTAL
Personnel	205,000	206,500	197,000	608,500
International/National Consulting	29,000	29,500	25,500	84,000
Contracts with R&D Organizations	-	25,000	30,000	55,000
Work with Private Sector	-	25,000	18,000	43,000
Travel	60,000	60,000	75,000	195,000
Training, Promotion & Technical Assistance	63,000	81,500	79,000	223,500
Equipment	84,000	22,300	-	106,300
Administrative	19,177	19,226	17,978	56,381
TOTAL DIRECT COSTS	**460,177**	**469,026**	**442,478**	**1,371,681**
Indirect Costs (13%)	59,823	60,974	57,522	178,319
GRAND TOTAL	**520,000**	**530,000**	**500,000**	**1,550,000**

4. GEOGRAPHIC EXPANSION

INTRODUCTION
In the previous section, a specific three-year CARDEP program has been outlined for Zambia. This three-year program is meant to be the crucible of a set of strategies and technologies to be applied throughout the region. Simultaneously, however, a series of satellite projects will be implemented with the objective of adapting the regional strategy to the specific conditions of the sub-regions. This will be done through intensive interaction with farmers and development agencies in the sub-region.

The intention is to gradually expand the approach being applied in the three year program throughout the region.

The satellite projects will involve the following activities:

1. Conduct a basic survey of water, agriculture, and socio-economic conditions in each area. This would involve an analysis of the high-value crop sub-sector, including identification of opportunities and constraints specific to that sub-region.
2. Based on the outcome of this survey, develop a specific water and small farmer productivity/income generation strategy.
3. Form a consortium of agencies (both government and non-government), interested and capable of participating in the proposed set of interventions. Begin the process of orienting and training these agencies in the approaches and technologies of SIMI.
4. Conduct field testing of the selected set of interventions and technologies. Based on these field tests, the interventions and technologies will be adapted to local conditons in preparation for later scaling up operations.

These satellite projects will be conducted within a two-year time frame, with the intention of following up with a scaled up SIMI intervention in the sub-region.

GEOGRAPHIC EXPANSION PLAN
1. Southern Africa with a focus in South Africa – 600,000/Yr.
2. Eastern Sub-Saharan Africa with a focus in Kenya – 550,000/Yr.
3. Western Sub-Saharan Africa with a focus in Ghana – 500,000/Yr.

In Sub-Saharan Africa, SIMI will develop initially three satellite projects that represent the varied and broad geography of the Sub-continent as well as varying circumstances, challenges, opportunities, and constraints to smallholder business growth. These will contribute to the overall knowledge base of SIMI and the Zambia CARDEP as well as extending SIMI's coverage in preparation for scale-up beyond the first two years. The regional satellite projects each center in a specific country, yet the basic research will be undertaken with more regional foci; Southern, Western, and Eastern Sub-Saharan Africa. Additionally, opportunities for organizational partnerships and consortium building can be drawn from throughout each of the respective regions rather than being limited to each of the specific country locations. SIMI proposes the following satellite projects that will run in parallel to the in-depth CARDEP intervention described for Zambia in Section 3.

1. Southern Africa with a focus in South Africa

South Africa is an important satellite location for SIMI activities. It is the largest single market both in terms of total potential beneficiaries as well as purchasing market for smallholder produce. It is also a regional manufacturing center for southern Sub-Saharan Africa, and as such an important location in terms of irrigation and other input technology manufacturing and regional supply. This is especially important as the surrounding countries do not necessarily have the current capacity or scale of demand that would justify local manufacturing of equipment in the first years of SIMI intervention.

Thus the South African satellite program should not be perceived as solely an extension or expansion of the CARDEP intervention. It will equally contribute to that effort especially in terms of technological input as well as the wealth of research and knowledge resources available within that country that SIMI will capture through organizational partnerships.

2. Eastern Sub-Saharan Africa with a focus in Kenya

Kenya is for alternative regions an important sub-regional center for SIMI activities. As with South Africa, Kenya will be able to contribute to the overall SIMI knowledge and resource base for Sub-Saharan Africa. There is already a wealth of experience in Kenya with both treadle pump and other micro irrigation technologies, and Kenya is indeed the best example in the sub-continent of diversified smallholder based agriculture. In addition, Kenya has the best current experience and track record linking smallholders to export markets through intermediary exporting agencies and as such Kenya has emerged as the leader in African horticulture and floriculture exports to Europe and the Middle East.

Aside from the opportunity to be gained for SIMI in these respects, SIMI will also form a strategic partnership with ApproTECH, which has experience in technology development and adaptation, as well as a systematized dissemination strategy for a range of pressurized pumps. This pump range offers a varied entry-level investment for smallholders, from dual cylinder treadle pumps, cheaper single cylinder treadle pumps, and simple hand pumps at one quarter the price of their treadle pump model.

Kenya also has some experience with low-cost and locally fabricated sprinkler systems, and drip irrigation technologies, and with large numbers of peri-urban bucket farmers and export market potential is a natural location to pilot and lead intensification strategies through these technologies that can result in greater productivity and especially important for export markets; product quality.

3. Western Sub-Saharan Africa with a focus in Ghana

Ghana provides SIMI a foothold in a Western African country that has documented opportunity for the ‘forgotten’ bucket farmers. Cornish and Lawrence found 12,700 smallholders hand irrigating 11,900 hectares of land within 40 km of Kumasi, a town with 700,000 residents in Ghana[22]. This is almost twice the total officially reported irrigated acreage for Ghana, located around a single town.

These peri-urban bucket farmers are widely overlooked by governments and NGO’s, there are large numbers of them, they are poor, carrying water to their plants presents a major labor constraint, and their agronomic intensification is low. Given their proximity to local markets, the

[22] Cornish, G A and Lawrence, P. Informal Irrigation in Peri-urban Areas.H.R Wallingford, Howbrey Park, Oxon UK. Downloaded from H.R Wallingford website.

fact that they are already cultivating for these markets, the opportunity for extension into export markets, and that they face a labor constraint in carrying water, these farmers are a natural starting point for SIMI interventions to have a high impact and begin in Western Africa.

NUMBER OF FARMERS

Geographic Region	**Smallholder's Affected (3 Years)**
Southern Africa with a focus in South Africa	9,000
Eastern Sub-Saharan Africa with a focus in Kenya	47,000
Western Sub-Saharan Africa with a focus in Ghana	4,500
Total	**60,500**

SUB-PROJECTS

Based on experience in current field programs, and intensive interaction with farmers, a number of sub-projects (for application of specific interventions or technologies) have been identified. This list is meant to act as a menu to be drawn from for application in the main CARDEP project and for field-testing in the satellite projects. The interventions in the projects will neither include all of these interventions in each sub-region, nor be limited to these as other opportunities arise:

1. Mass market water lifting irrigation pumps for bucket farmers through a private sector supply chain. This will involve the establishment of a private sector manufacturer, distributor, and retailer network for affordable irrigation pumps. In any particular area, this would initially entail a collation of experiences to date, and a comparison of existing designs on the market.

2. Collect basic information on peri-urban bucket farmers. The few existing studies of peri-urban smallholders in Sub-Saharan Africa confirm that they are widely overlooked by governments and NGOs, that there are large numbers of them, that they are poor, that carrying water in buckets to plants creates a major labor constraint, and that agronomic intensification is low[23]. This was confirmed by the SIMI Africa mission, which interviewed bucket farmers 3 km from Maputo and within an hours drive from Harare. Cornish and Lawrence found 12,700 smallholders hand irrigating 11,900 acres of land within 40 km of Kumasi, a town 700,000 residents in Ghana. This was almost twice the officially reported irrigation acreage for the whole of Ghana, around a single town. In SIMI's research, locals estimated 30-50,000 bucket farmers around Harare, but there is no research to verify these figures. As bucket farmers, and especially peri-urban bucket farmers will be a key focus of SIMI it is essential that this information gap as to the whereabouts, numbers, and constraints of these farmers is understood in order for SIMI to replicate and scale up its assistance to peri-urban bucket farmers.

[23] Cornish, G A and Lawrence, P. Informal Irrigation in Peri-Urban Areas. H.R.Wallingford, Howbrey Park, Oxon, UK. Downloaded from the H.R Wallingford website.

3. Intensification and diversification of peri-urban bucket-farmer production. Focus a more intense effort around peri-urban bucket farmers in specific locations to provide training, and drip and sprinkler irrigation technologies for increased intensity and produce quality.

4. Develop smallholder access to high-value export markets. SIMI will link smallholder farmers to existing export-oriented processing businesses through out-grower schemes. In addition, export markets for smallholder produce will be sourced and developed through a marketing person based in Europe. This position will additionally provide systematic feedback to provide for the design of crop planning for intensified and diversified agriculture

5. Increase access to, and value of markets for smallholder produce through transport interventions. Pilot transport initiatives need to be undertaken through action research with a goal to reduce the excessive and prohibitive cost of getting produce to market for the farmers that cultivate farther from urban markets. This will effectively expand the `radius of viable peri-urban cultivation and even-out the profitability across the relative distances from each of the urban center markets.

6. Credit interventions. SIMI will pilot credit interventions at input, throughput, and output market dimensions. These credit interventions will enable supply chain capitalization, farmer investment in higher input – higher output horticulture, as well as enabling smallholder access to export markets through credit mechanisms interwoven with out-grower schemes.

ANNEXES

1. CARDEP CONSTRAINTS ANALYSIS MATRIX
2. CARDEP LOGICAL FRAMEWORK
3. CARDEP TIMELINE
4. ADDITIONAL INVESTMENT OPPORTUNITIES IN SUB-SAHARAN AFRICA

ANNEX 1: CARDEP CONSTRAINT ANALYSIS MATRIX

Country and geographic scope	Zambia - dambo and river valley areas
Cash Crops to be developed	Paprika, coffee, fruits & vegetables

	Technological Constraints	**Capacity-Related Constraints**	**Capital/ Credit Constraints**	**Other Constraints**
Farm Level	• Water conveyance • Water efficiency and control • Affordable inputs • Quality seeds • Paprika sowing machines • Post-harvest techniques and technology	• Technical/agronomy knowledge • Market information • Conservative outlook, risk averse • Agribusiness exploits out-grower • Agribusiness reluctance to deal with smallholders • Ensuring a continuous supply of produce to meet buyer requirements • Cooperative group action	• Smallholders lack access to affordable credit • Lack of land title deed (collateral) • Devaluation of the kwacha • Minimum loan requirement • Complicated application procedures	• Shrinking savings • Animal traction • Road infrastructure and electrification
Input Markets	• Cost of treadle pumps • Plastic pipe production • Seedling nurseries • Sowing machine design	• The input supply chain for treadle pumps • Private sector perceives high risk • Private sector has more profitable alternatives • Weak manufacturer-retailer link • Extension service • Capacity of input suppliers	• Capital to produce and stock micro-irrigation equipment. • Capital loans for the establishment/ expansion of input companies	• Poor rural road infrastructure hampers input distribution
Output Markets	• Post-harvest • Sanitation standards for food processing.	• Capacity of output companies • Market information • Links to existing markets • New market development	• Capital loans for the establishment/ expansion of output companies	• Competition from agricultural imports

ANNEX 2: CARDEP LOGICAL FRAMEWORK FOR PHASE 1 (YEARS 1 – 3)

Country and geographic scope	**Zambia – dambo and river valley areas**
3-Year Goal	**Increase the net income of** 4,500 **smallholders by an average of** $US 300 **per year after the third year**

OBJECTIVE	3-YEAR TARGET	ACTIVITIES OF IDE	INDICATORS
Farm Level			
Technology Strategy			
Promote irrigation technologies	3000 treadle pumps installed 60,000 square meters under drip irrigation 200 rope-and washer pumps installed	Demonstration plots, farmer field days, presentations/displays in markets and at ag. shows, publicity events, radio programming, printed advertising	Number of irrigation technologies sold and in use (G) Number of promotional activities and attendance (G)
Develop rope-and-washer pump	Pump lift 1.5 L/s from 60 m at 80% efficiency. Ready for market by middle of Year 2	R&D on rope-and-washer pump Field and laboratory testing	Pump performance characteristics Market readiness
Develop post-harvest technologies	Three post harvest technologies with the potential to increase farm income by 20% each	Smallholder needs assessment R&D on crop storage and processing Field and laboratory testing	Number of technologies developed Extra income generated
Capacity-Building Strategy			
Improve technical and managerial skills of smallholders	10,000 smallholders receive skill training	Facilitate training in farm management, agronomy, and post-harvest techniques Coordinate efforts of IDE and partner organizations in providing training	Number of smallholders trained (G) Improvement in skill level (G)
Assist in group formation	70% of smallholders involved in out-grower schemes have access to a functioning Farmer Association	Coordinate efforts of partner organizations that assist with group formation Provide training and support to farmer association leaders	Number of associations formed , number of members (G), number of leaders trained (G) Capability and effectiveness of association

OBJECTIVE	3-YEAR TARGET	ACTIVITIES OF IDE	INDICATORS
Capital/ Credit Strategy			
Improve smallholder access to credit	Affordable credit is available to 1500 smallholders	Coordinate with partner organizations to provide credit	Number of smallholders accessing credit (G) Loan recovery rate
Expedite acquisition of smallholders title deeds	Increase the number of smallholders that obtain title deeds for their land	Coordinate with partner organizations to lobby govt and donors to increase available resources for providing titles to smallholders	Number of smallholders with title deeds (G)
Input Markets			
Technology Strategy			
Seed production	Seed production capability for 300 farmers	Introduce techniques and train smallholders in seed production	Number of smallholders trained in seed production
Import treadle pumps to stimulate competition and reduce retail prices.	Import and sell 1000 treadle pumps from Asia.	Promote T.P. irrigation technology and distribute imported pumps through supply chain	Number of pumps imported and sold
Capacity-Building Strategy			
Develop the capacity of the treadle pump manufacturing base	20 manufacturers provide good-quality pumps affordable to smallholders (at least one producer in each province)	Recruit and train new manufacturers Provide business development services	Number of manufacturers Quality of pump production Pump price
Develop the local capacity for plastic extrusion production	One new factory produces pipe for use with pumps and drip systems at prices 20% lower than the current market price	Extend capital loan to manufacture to expand operations Provide business development services	Plastic extrusion factory is operational and sustainable Price of extruded pipe
Develop local capacity for drip system assembly	Five decentralized drip assembly groups provide good-quality, affordable systems to smallholders	Recruit and train men and women in the assembly process	Number of new assembly groups in business.
Develop local capacity to distribute pumps, drip systems and farm inputs	Retail network expanded in 5 Province target areas advertisement	Recruit and train retailers in to sell irrigation technology and agricultural	Number of new retailers making up the supply chain.

OBJECTIVE	3-YEAR TARGET	ACTIVITIES OF IDE	INDICATORS
to smallholders	and promotional techniques enhanced.	inputs in operational areas.	Increased availability of technology and inputs.
Develop local capacity of seed suppliers to produce and distribute quality seeds.	Five seed producers associations formed in the provincial areas of operation	Mobilize farmers into seed producer associations and provide training in seed multiplication.	5 viable seed producer associations producing and selling.
Establish link between seed/fertilizer companies and irrigation distributors.	Link 70% of technology retailers to seed and fertilizer companies	Negotiate supply terms with seed and fertilizer companies and facilitate linkage.	Number of retailers selling irrigation equipment, seeds and fertilizers.
Capital/ Credit Strategy			
Assist input suppliers to access credit	20 suppliers linked to credit facilities.	Link input suppliers to IDE's revolving credit facility and other credit institutions	Financial status of input suppliers' stocks and inventory.
Output Markets			
Technology Strategy			
Investigate feasibility of medium-scale processing operations	Three agro-processing entrepreneurs identified and trained in agro-processing methods and operation.	Identify appropriate agro-processing equipment. Facilitate acquisition of post harvest agro-processing equipment	Number of new trained agro-processors in operation
Capacity-Building Strategy			
Out-grower linkages			
Develop linkages between out-growers and post-harvest processors and markets.	10 Out-grower schemes linked to viable markets and post harvest processors.	BDS services for post-harvest suppliers. Facilitate linkages between market and out-growers.	Number of successful out-grower schemes producing crops for local and export markets.
Capital/ Credit Strategy			
Assist Output suppliers access credit Assist farmer associations access credit for post-harvest equipment	Post harvest processors and farmer associations linked to credit institutions	Mobilize farmer associations and facilitate linkages between output suppliers and credit institutions.	Number of farmer groups and associations accessing to credit sources.

(G): Indicator data to be gender disaggregated

ANNEX 3: CARDEP TIMELINE

County and geographic area	**Zambia – dambo and river valley areas**					
Program Objective/Activity	**Phase 1**			**Phase 2**		
	1	**2**	**3**	**4**	**5**	**6**
Farm Level						
Technology Strategy						
Promote irrigation technologies	X	X	X	X	X	X
Develop rope-and-washer pump	X	X	X			
Develop post-harvest technologies	X	X	X		X	X
Capacity-Building Strategy						
Improve technical and managerial skills of smallholders	X	X	X	X	X	X
Assist in group formation	X	X	X	X	X	X
Capital/ Credit Strategy						
Improve smallholder access to credit	X	X	X	X	X	X
Expedite acquisition of smallholders title deeds	X	X	X	X	X	X
Input Markets						
Technology Strategy						
Seed production	X	X	X	X	X	X
Import treadle pumps	X	X		X		
Capacity-Building Strategy						
Develop the capacity of the treadle pump manufacturing base	X	X	X	X	X	X
Develop the local capacity for plastic extrusion	X	X				
Develop local capacity for drip system assembly	X	X	X		X	X
Develop local capacity to distribute pumps and drip systems to smallholders	X	X	X	X	X	X
Establish link between seed/fertilizer companies and irrigation distributors.	X	X	X	X	X	X
Capital/ Credit Strategy						
Assist input suppliers to access credit	X	X	X	X	X	X
Output Markets						
Technology Strategy						
Investigate feasibility of medium-scale processing operations	X	X		X	X	X
Capacity-Building Strategy						
Out-grower linkages	X	X	X	X	X	X
Develop linkages between out-growers and post-harvest processors and markets	X	X	X	X	X	X
Capital/ Credit Strategy						
Assist output suppliers access credit	X	X	X	X	X	X

ANNEX 4: ADDITIONAL INVESTMENT OPPORTUNITIES IN SUB-SAHARAN AFRICA

The following three examples provide additional information on SIMI investment opportunities in Sub-Saharan Africa:

MALI

The Niger River, the major water resource of Mali, Niger and parts of Nigeria, originates in the eastern Fouta Djallon highlands in Guinea. Downstream of Bamako in the Niger's mid-section, the river branches out into a maze of distributaries to form a 600 km long, flood-prone labyrinth of lakes, creeks and backwaters. It is often called the internal delta of the Niger -- a huge wetland area similar to the As-Sudd region in the upper middle reaches of the Nile. From Mali, the river passes through the Republic of Niger, entering its lower course where it is joined by the Kaduna River and the Benue before exiting through the Niger Delta into the Gulf of Guinea.

The Niger basin shows great climatological variability. Mean annual rainfall decreases northward from more than 4,100 mm in the South to less than 200 mm in Timbuktu, where the Niger flows for almost 350 km through the southern fringe of the Sahara. Evaporation losses are very high along the middle course, especially in the period when the river spreads out to inundate the internal delta. The fraction of the annual volume of discharge flowing past Mopti lost to evaporation may exceed 50 percent in some years.

At measuring stations on the middle course of the Niger 70 km upstream from Timbuktu, the river width in June is approximately 250 m. The highest peak flow occurred in 1955 with approximately 2,900 m^3/s, whereas the mean annual low water discharge is 61 m^3/s, while the lowest measured discharge occurred in 1980 and was 5 m^3/s.

The presence of these large quantities of water in the heart of the Sahelian region offers opportunities for development of arable farming, animal husbandry and fisheries, far exceeding those in the surrounding area under rainfed conditions.

The Mopti region covers about 89 000 km^2 and is dominated by the central inland delta of the river Niger, an area of 16 000 km^2 which is, under normal rainfall conditions, flooded annually. Over the centuries, the region has been the center of agricultural activities, in which very efficient production systems have developed. In the last few decades, the region has come under increasing pressure, through the combined effect of increasing population density and intermittent periods of drought, which have seriously disrupted the existing production systems.

Along the entire length of the river are opportunities for smallholders to utilize treadle pumps and other water lifting devices to better utilize this resource. Enterprise Works has been operating in Mali since 1997. Under a grant from USAID they have instituted a mass marketing campaign for the treadle pump and they are selling approximately 2000 pumps per year. Their mass marketing includes TV advertising, demonstrations and the development of over twenty manufacturer/dealers throughout the country. SIMI has the potential to bring the added dimension of improved production and marketing to these smallholders.

MOZAMBIQUE

Despite the fact that Mozambique is quite often referred as abundant in water resources, the reality shows an increasing and apprehensive aggravation of the scarcity of water in certain regions of the country. Mozambique is in fact extremely dependent on fresh water flows coming from upstream countries. This can be illustrated by the fact that from a total mean annual runoff of about 214 km^3, only 88 km^3 is generated within the country. In terms of geographic distribution, the south of the country is the most critical, with an annual runoff approximately 21 km^3 from which only 4 km^3 are generated within the country. Despite the increasing scarcity of water in certain areas of the country, water is usually available at no cost or at heavily subsidized price, and very little effort has been made towards conservation.

Since Mozambique is a coastal country, crossed by many rivers running into the Indian Ocean, it is endowed with a very diversified wetland system. The importance of wetlands is related to their ability to retain large volumes of water. Wherever there are wetlands there are also people, mainly small farmers and fishermen. This close association between people and wetlands draw the attention for the strategic importance of these ecosystems in the rural economy, and the need for an effective planning, management and conservation strategy.

The riverine system, the largest inland wetland in Mozambique, includes floodplains, which are important environments for livestock production, fisheries, wildlife and irrigated agriculture. The palustrine system includes coastal lakes, lagoons, swamps, springs, dambos and peatlands. Dambos and peatlands are of enormous importance for small-scale agriculture. Dambos are mainly concentrated in the central and north high rainfall areas, a common feature of headwaters of most streams. Peat soils and sandy soils are common in the South, where semi-arid conditions predominate, and their importance is associated with the availability of water all year round. They occur in lowland areas, as swampy coastal plains and lagoons separated from the sea by beach ridges and between the 600-1,000 mm rainfall isohyetes. Locally called machongos, these soils are generally very fertile and continuously wet due to seepage from the surrounding dune areas with high infiltration and high recharge rates. They also present a very good soil structure for plant growth with high water holding capacity, high soil aeration, and easy workability, making them particularly attractive for small scale agriculture.

A study utilizing a digitized soil found the total area covered by wetlands in Mozambique is about 8 million ha which represents about 10 percent of the country's area. Wetlands without or with only slight physical limitations for agriculture development (mainly the riverine and palustrine systems) cover approximately 6 million ha. Since the total cultivable land in the country is generally considered as 36 million ha, wetlands for agriculture development correspond to about 16 percent of the country's cultivable land. Of course not all of these wetland areas are physically accessible to farmers or accessible to markets, but overall the scale of potential wetland development in Mozambique is enormous.

An agricultural census for Mozambique found the total number of farms in the country of 3.1 million of which 99.7 percent are considered small farms of under 10 ha. In fact the total cultivated area is 3.9 m hectares and the average farm size is 1.28 ha. The average smallholder agricultural income in Mozambique is between $140 and $200 per household while the gross national product per capita is reported as $80 in 1998. Currently only 3.9 percent of the farmers use irrigation, while only 4.5 percent use chemical fertilizers.

While only about 121,000 Mozambican farmers currently use irrigation, the potential is virtually limited only by the number of farmers (3.1 million) and the area of potentially irrigable land from shallow wells and wetland sources (probably greater than 3 million ha).

Although the potential is huge, experience with large communal irrigation projects in Mozambique has been mixed. The African Development Bank estimated that 120,000 ha has been equipped with irrigation facilities but only 65,000 ha was operating as of 1998. To date the emphasis on smallholder irrigation has been quite limited. Four international NGOs have distributed on the order of 100 treadle pumps which are locally fabricated based an ApproTEC model. The SIMI approach to Mozambique will be built on more detailed surveys focusing on those peri-urban farmers who already produce for urban markets. The program will support NGOs on the ground with improved products and the private sector mass marketing approach combined with improved production and marketing.

SOUTH AFRICA

Smallholder irrigation in South Africa has been difficult to characterize because of the unique history of the country and the impact of commercial agriculture on the overall agriculture picture in South Africa. Although the end of apartheid was marked by the first democratic elections held in 1994, agriculture remains dominated by relatively large enterprises, generally owned and managed by white South Africans. The efficiency with which South African agricultural products are produced is a major factor limiting smallholder production and exports of South African agricultural products have started to have impacts on smallholders throughout the region. With this dominance by capital intensive large enterprises and for many other historical and social reasons, the smallholder agriculture sector has often been viewed as non-productive, with little potential for development. Under the previous regime, various efforts were made to bring irrigation to the homeland areas in order to increase productivity. Many of these efforts were not successful due in part to the "top down" approach adopted but also due to the lack of any competitive advantage in the smallholder agriculture subsector. As a result cases of successful smallholder irrigation have been difficult to pinpoint.

South Africa has recently completed a rural survey of former homeland areas in rural South Africa. A sample of 6000 households was conducted in the former homeland areas showing about 12.7 million people or 31.4 percent of South Africa's population lives in rural areas of these former homelands. According to the survey about 71 percent of the 2.4 million households or 1.7 million households had access to land for agricultural purposes. Of these, 1.24 million households were active farm households that produced products for home consumption or for sale although only 3 percent of the 2.4 million households reported that they relied on farming for their main source of income. Of the 1.24 million farms, 1.17 million used inputs including fertilizer, seeds, manure, seedlings and sprays.

Of the farm households 151,000 had access to some source of water on the land and utilized this water for agricultural production. Another 121,000 households did not have access to water on their land but fetched water for agricultural production from outside of their land. Thus approximately 22 percent of the active smallholder farms in South Africa make use of water for irrigation. Sources of water include rivers, dams or ponds, boreholes, rainwater collection tanks, wells or springs, irrigation canals or piped water on the farms. About 53 percent of the

respondents who had a source of water on their land had access to piped water whereas only 7 percent reported access to an irrigation canal.

The survey asked farmers to rank their desires for assistance to improved access to water, land, credit or training. Access to water was the highest ranked (31 percent) desire among smallholders. Further characterization of smallholders found that 1.2 million used implements, 50 percent of those used tractors, though 96 percent hired them and 91 percent paid less than R50 ($5) for these services. Only 0.5 percent used pumps while 16 percent used an animal drawn cart and only 3 percent hired regular employees. About 50 percent of the 1.7 million households with access to land had access to less than one hectare of farm land.

Although this characterization provides some insight into South African smallholders, it leaves many questions unanswered. For example how many smallholders would be interested in purchasing irrigation equipment that would save them time and effort? Although there are 272,000 irrigators, there appears to be only 72,000 farmers nationwide who depend on farming as their main source of income. Thus, our picture of South African smallholder farmers is affected by other variables which may need additional study.

Because women are the main tenders of household gardens they stand to benefit from such a program and are an attractive target for SIMI involvement. SIMI would work to develop and market a low cost drip irrigation kit as well as work with local NGOs in the promotion of improved agronomic practices.

On the other hand, South Africa has a rapidly urbanizing population for whom the government has made extraordinary efforts to improve access to domestic water supplies. Millions of South African households now have access to domestic water but do not have the means to pay for this water. Household gardens, intensively cultivated through the use of efficient drip irrigation systems, can be a source of additional household income and improved nutrition.

CHAPTER 2

Southwestern China with Emphasis on Natural Greenhouse Area

Part I

REGIONAL EVALUATION AND PLANNING

SUMMARY TABLE
EXECUTIVE SUMMARY

1. ASSESSMENT OF THE TARGET REGION

2. 15-YEAR PLAN

SUMMARY TABLE: SOUTHWESTERN CHINA WITH EMPHASIS ON NATURAL GREENHOUSE AREA	
Geographical Area:	The target area falls mainly in Guizhou province and across the intersection of Guizhou, Guanxi, Yunnan, and Sichuan provinces. Deep river valleys, high hill peaks, and plateaus characterize much of this landscape, typical of its karste geology.
Target Population:	750,000 smallholder families in the region that have the basic pre-conditions to engage in high value crop production.
Water-Related: *Water Source:* *Water Storage:* *Irrigation:*	 Perennial mountain rivers and streams. Plastic storage bags, on-farm ponds Pressurized treadle pump, Low-cost drip; low-cost sprinkler
High-value Crops:	Off-season vegetables; Fruits such as oranges, persimmon, papaya; spices such as cardamom; Longer-term tree crops such as teak; and oil crops such as castor.
Favorable Conditions:	Ideal climatic conditions for winter crop production without the need for greenhouse investments. Perennial upland streams and springs. Proven dissemination success with winter vegetable cultivation even without water control that limits expansion. Improving rural and infrastructure thus increasing access to markets.
Constraints:	Access to markets for expansion of current cultivated acreage, lack of availability of water lifting and distribution irrigation technologies, resulting in a labor constraint to expansion due to the workload of bucket irrigation. Lack of diversification of cropping resulting in greater market fluctuation vulnerability, access to capital for investment in intensified production, high transportation costs to market.
Strategies for Implementation:	1. Testing and refining the CARDEP intervention strategy for the development of one marketshed; 2. Output market development through the adaptation of the green foods label for smallholder produce; 3. Output market development through the branding of the regions' produce for high-end retail markets; 4. Systematic research on the Chinese marketplace with an emphasis on informing crop diversification strategies.
Immediate Steps:	D. Implementation of a CARDEP program in the Duanqiao Marketshed for the development and testing of an intervention strategy for Southwestern China. *Cost of Program:* $1,300,000- first 3 years. E. The development of satellite programs to survey smallholders and the high-value crop sub-sector, the development of specific water and small farmer productivity packages, consortium building for implementation, and the field testing of specific interventions. Cost of program for four regional satellite programs - $750,000 per year. F. Selected sub-project investment opportunities including micro-irrigation promotion, diversification of cash crops and the development of marketable agronomic packages, fruit tree and timber nursery development, adaptation of the Chinese Green Foods label for smallholder produce, output market development through branding of the regions produce, and credit interventions.

EXECUTIVE SUMMARY

The southwestern Chinese provinces where SIMI will focus are some of the poorest regions of China. Remote rural populations living in the valleys of the so-called 'Natural Greenhouse' and highland plateaus include a diverse range of ethnic minorities. Most of them are subsistence or semi-subsistence farmers, currently cultivating the staple crops that were encouraged through past government programs for the development of regional food self-sufficiency.

At a national level, the past decade has seen a vast growth in cash crop production, developed principally on China's eastern coastline. Here a sophisticated and intensive production of vegetables and fruits has developed in tune with a vastly increased consumer demand for these products. The target region for SIMI, while still a consumption-poor region, has demonstrated that it can be a part of the growing producer marketplace for cash crops. In an increasingly competitive marketplace, the region has a number of comparative advantages. It has average winter temperatures in the valley floors suited to the production of winter vegetables, without the need for expensive climate control technologies, such as the greenhouses used in other parts of China. Its plateaus have summer temperatures that are low enough for the production of summer vegetables, a time when the market price is higher. These natural climatic advantages have been recognized in the past, and the introduction of winter vegetable production in the 'natural greenhouse' has already spread to some 70,000 acres. Additionally, pilot programs are underway to develop production for the spring market on the cooler hill and plateau areas. This will also extend the period of supply of raw materials for local processing. Where appropriate, fruit trees will also be included.

While past efforts have significantly helped a number of poor farmers to elevate from subsistence agriculture to relatively more profitable cash crops, their focus on a narrow range of crops and their bias towards production rather than marketing have vastly limited the potential impact. Today, the markets for the four key crops are reaching saturation, and the production techniques are limited to basic bucket irrigation that limits the intensity and optimal use of their water resources.

The people of this isolated region do not have the market information or production technology, nor have they built the market ingenuity required for the region to develop into a significant producer for the national marketplace. Yet there are great opportunities. The region is very poor and profit expectations are minimal in comparison to the wealthier regions along the eastern coastline. The natural climate means that smallholders can produce with relatively lower capital investments. The heavily polluted soils and water of the eastern coastline, where the emphasis has been squarely on production quantity rather than quality, is facing difficulties adapting to a rapidly rising trend of consumer demand for 'low chemical' produce. The target area of SIMI, on the other hand, has relatively cleaner soils and unpolluted mountain streams as its water source.

These advantages can be cultivated through a broad range of interventions under SIMI that will enable some 750,000 smallholder households to capitalize on the economic growth occurring in China, and lift themselves from poverty to a sustainable livelihood built from cash generating smallholder enterprises.

SIMI will focus at all levels- input, throughput, and output- to enable these remote populations to realize this potential. It will develop output market strategies in tune with improved rural infrastructure to elevate the access to key markets, as well as create a consumer demand specifically for this regions' produce. It will feed market information back to guide crop diversification strategies, and it will train farmers to produce a more diverse range of crops with

water supply, storage and delivery technologies, and seed and fertilizer technologies, specifically tailored to their circumstances. It will develop the input supply chains to enable this to happen on a sustainable commercial basis. It will remain adaptable, adjusting its programming to fit the changing circumstances of the smallholders as they evolve and gain in experience, confidence, and sophistication, growing from a predominantly subsistence existence to true market-oriented production.

The CARDEP program detailed within this plan will pilot the intervention strategy in the first three years of implementation. To complement the outline CARDEP in this plan, SIMI will also develop four geographic expansion programs to survey smallholders and the high-value crop sub-sector, to develop specific water and small farmer productivity packages, to build consortiums for implementation, and finally for the field-testing of specific interventions.

Southwest China Summary Budget Table

Activity	3 –Year Budget (in $ millions)	Smallholders Reached
CARDEP	1.45	5,500
Geographic Expansion	2.25	34,300
Total	**3.7**	**39,800**

1. ASSESSMENT OF THE TARGET REGION

1.1 Geophysical Description of Target Area

The target area falls mainly in Guizhou province and across the intersection of Guizhou, Guanxi, Yunnan, and Sichuan provinces. Deep river valleys, high hill peaks, and plateaus characterize much of this landscape, typical of its karste geology.

The topography is deeply incised and rugged, with relatively large differences of altitude. The higher regions are more than 1300m above sea level, while the lower regions are less than 500m. The climate is that of the moist subtropical monsoon zone. The coldest month is January with average temperature around 8 degrees Celsius. The hottest is July, which has an average temperature of 18 degrees. However, due to the great variations of terrain, the climate is also subject to tremendous variation. Temperatures in the mountainous areas above 1300 km above sea level annually average less than 14 degrees; those in basins in the lower hills at 800-1250 km above sea level annually average some 16 degrees; and those in river valleys below 800 km above sea level may average over 18 degrees Celsius.

Water resources are certainly not lacking in the region, but are extremely unevenly distributed both in time and in space. Annual precipitation is around 1300 mm, over 70 percent of which is concentrated in the period between May and September. A spring dry period occurs each year between February and April. This dry may extend up to up to 6 months in the river valley zones.

1.2 Target Population and Poverty

A. Demographics

The total rural population living in the Yunnan-Guizhou plateau of south western China is estimated at more than 50 million. At least one third of the rural population in this area is from more than 20 minority ethnic groups, such as Miao, Buyi, and Yi. More than 70 percent of the rural population earn less than 150 USD net annual income. SIMI will predominantly focus on the populations living in the deep river valleys that are characterized as the 'Natural Greenhouse,' but also the subsistence poor living on the mid hills and plateaus. A conservative estimate of the rural population who live in these areas is more than 20 million, about half of who live in Guizhou province.

The areas of the three provinces neighbouring Guizhou, in which the climate also classifies them as a 'Natural Greenhouse' share similar geographical and social-economic conditions as Guizhou.

In Yunnan province, there are six regions at prefecture level; LiJiang prefecture in the Northwest (composed of 4 counties), ChuXiong Yi National Autonomous Region (10 counties), Kunming area, ShaoTong prefecture (12 counties), QuJing (6 counties), and Wenshan (8 counties).

In Guangxi, there are four prefectures, consisting of more than 30 counties in the northwest and northern part of the province with climate similar to the Natural Greenhouse (although the average temperature is higher and range is greater).

In the very south of Sichuan province is LiangShan Yi Nationality Autonomous District. This area is close to the Natural Greenhouse areas in Yunnan and Guizhou and shares all the major characteristics of the 'Natural Greenhouse' in Southwest China. There are 15 rural counties with a rural population close to 4 million.

The total rural population of these areas is around 20 million, comprised of some 3 million households. The majority are living in extreme consumption poverty, earning less than 150 USD per year.

There are approximately 70,000 acres currently under winter vegetable cultivation in the natural greenhouse. There is ample land for expansion, and it is estimated that an additional 200,000 acres could be brought into cultivation. In addition, there are some 80,000 acres of hill and high plateau land currently under staple crop production that are ideally suited to spring and summer vegetable production, that could feed into the spring and autumn markets when the price of vegetables is comparatively higher than at other times of year. Thus, SIMI will target a total of some 350,000 acres of land within the provinces of Guizhou, Guanxi, and Yunnan, and south Sichuan cultivated by around 700,000 of the three million rural households living in these regions.

Table 1: Basic Information on the four target Provinces in Southwest China[24]

	Land area(1000 sq.km)	Total population (1000 persons) at the end of 2000	Rural population	% of Rural population	GDP per capita (USD)	Net income per capita (Rural), 2000	Order of per capita rural income	% of rural population with net income under 150 USD/per capita	% of population with net income under $100 per capita
National		1265830.0	900000.0	71%	850.9	271.4		NA	
Guizhou	176.1	37557.2	32126.3	85.5%	318.6	165.5	30th of 31	62%	28%
Yunnan	394	42408.0	35843.0	84.5%	555.5	178.2	27th	NA	
Guangxi	236.7	47512.0	39256.7	82.6%	516.2	224.7	23rd	NA	
Sichuan	485	84075.0	68425.0	81.4%	575.6	229.4	21st	NA	
Total/ave.		**211552.2**	**175651.0**	**83.0%**					

B. Current Smallholder Practices and Environment

The target region is characterized by a variety of landscapes, ranging from the deep valleys of the 'natural greenhouse' to cooler higher altitude plateaus. The predominant agriculture in the region is historically rain-fed or rainy season gravity-irrigated staple crops, such as rice, wheat, maize, and potatoes. During the late eighties and increasingly in the nineties however, this situation changed as winter vegetable cultivation was introduced to the higher-temperature valley floors of the natural greenhouse.

[24] Source: Statistic Yearbooks of Guizhou, Yunnan, Guangxi and Sichuan, 2000

C. Winter Vegetable Cultivation in the Natural Greenhouse

In the past, the "natural greenhouse" areas were predominantly cultivated with gravity-irrigated rice during the rainy season. The successful introduction of winter vegetables on the rice terraces grew in tune with local infrastructure development. The practice spread southward from where it was initially introduced and today covers an estimated 70,000 acres.

The current practice of winter cultivation is dominated by a narrow selection of crops, such as tomato, chili, winter melon, and eggplant. These crops are mainly irrigated by carrying buckets on shoulder bars up from the perennial rivers and streams that snake through the valley floors. Occasionally rented diesel pumps supplement this manual irrigation, filling in where the labor resource and workload cannot keep up with the irrigation needs. Diesel pumps typically rent for around 10 Yuan[25], or $1.20 per hour, which is prohibitively high, especially in recent years as the profitability of winter vegetable cultivation has declined.

Families in these valleys typically have land-usage rights granted from the village leaders to cultivate or maintain two or three fragmented plots of land. These range from the highest value patches close to the rivers where winter vegetable cultivation has developed, to higher patches up the hillsides which cannot be cultivated except for rain-fed crops. On this land they cultivate crops such as maize, wheat, or soybean. These predominantly staple crops were formerly pushed through central government policy so that each region could reach its own food self-sufficiency. Much of this land was formerly forested, and there are now policies in place to convert some of this land back to forest cover, now that the government has dropped its policy of mandatory food self-sufficiency.

Carrying water for tomato irrigation; these fields could be more easily irrigated with a treadle pump.

Reforestation programs are being attempted through government-sponsored programs that provide farmers with 150Kg of grain per mu[26], in order to reforest with seedlings provided by the government and maintain the land. There is some confusion, however, in the areas visited. Farmers were initially happy with the arrangement, but then they were told it has been cut back to just 75 Kg grain per mu. The government told them they can still have the 150 Kg, but they would have to plant trees on an additional mu of even higher, uncultivated land. They are also not satisfied with the seedlings and varieties provided by the government because they have the lowest timber value. Given a choice and adequate capital, the farmers would cultivate trees with better economic prospects from timber sales.

D. Cultivation on the Higher, Cooler Plateaus

The higher plateaus within the target region of SW China are cooler due to their elevation and are suitable for vegetable and other cash crop cultivation during the summer months. In effect, these regions are a natural cool-house, with the opportunity to supply vegetables at an opposing time of

[25] One USD is equal to about 8 Chinese Yuan.
[26] One *mu* is equal to approximately one-six of an acre 90.17 acres or about one-fifteenth (0.067) of a hectare.

year to the 'greenhouse' valley floors. The Guizhou Academy of Agricultural Sciences that introduced winter vegetables to the natural greenhouse currently has trials that extend to some 500 acres to cultivate summer vegetables on these cooler plateaus.

1. 3 Input Markets

Input supply chains for cash crops that sell seeds, fertilizers, pesticides, and plastic mulch have developed in tune with the growth of cash crop cultivation. These are supplied from small shops at township and village level trading posts. A typical township marketplace would have three to four input dealers, and while they are relatively small, they do offer a decent range of product. The available seeds and insecticides come from provincial, national, and international companies, some of which are supported by promotional posters. Provincially-based seed companies appear to be characterized by transitional government institutions that are under pressure to commercialize their activities, such as the Guizhou Academy of Agricultural Sciences.

Imported seeds are coming from both the purely commercial sector (mainly Holland, Switzerland, and Israel) and the semi-commercial sector such as the AVRDC in Taiwan. The sealed tins or packages of seeds are appropriately sized for the scale of farming of a typical smallholder in the region. Seed wholesalers provide credit for their dealerships and do not impose pricing or otherwise control downstream sales. The system is also adequately developed that it could be responsive to farmer demands, but farmer interest in new varieties or indeed new crops would have to come through demonstration or advertising.

In the more developed vegetable producing regions of China, such as Hai Nan, or Shandong the seed companies have established multiple and extensive demonstration farms to seek out new markets for their inputs. This process is assisted by regional and international vegetable trade shows that bring together producers, buyers, and input companies. In the Natural Greenhouse, no such extensive input marketing is developed, yet through the dealerships described above, a decent range of product is available. There are reportedly no commercial nurseries in the field assessment area, and this limits the introduction of higher yielding, pest resistant fruit tree varieties.

There is currently no market structure for the provision of smallholder irrigation technologies for anything other than diesel or electric pumps. These are sold at the county level as the demand and retail network capitalization is inadequate to support outlets at the township level where most farmers purchase their inputs and sell their produce. However, the township level input dealers are ideally placed to broaden their product range to include micro-irrigation equipment, and have indicated a desire to do this. The simplicity of broadening their product portfolio to include micro irrigation technologies is assisted by the fact that this region has surface water resources and as such, there is no requirement for installation or well drilling services to be an integral or even outsourced component of their businesses.

1.4 Throughput Markets

A. Extension Services

Government extension services exist in a structure that spreads downwards from Province through County to Township level. These networks are under-funded and lack training. However, even equipped with the right resources, their coverage would need to be supplemented in order to achieve the extent of training services that will be required under the SIMI initiative. Farmers have limited awareness of their existence, and their services are limited to a privileged few, who then pass knowledge informally to neighbors and other farmers.

While the capacity of the current system is limited, the nature of a command economy and political structure is that they can be "switched on," and village leaders can organize farmers to take advantage of such services, if indeed the services were fuelled with useful information. The work of Li Guilan in the eighties and nineties used these systems to sow the seeds that transferred the seasonally barren hillsides of the natural greenhouse into an expanding and viable vegetable growing region.

B. Credit

China is now examining policies governing credit programs. The policies have resulted in heavily subsidized interest rates, low loan recovery rates, credit rationing that widened rural income gaps, and a heavy drain on the national treasury. The examination of current policies also includes measures to better utilize resources currently within the system, and lessons learned from successful rural microcredit programs in other countries. Microcredit is theoretically available for smallholders through government channels, a turnaround in policy since around 1998 when the thinking moved away from major credit investments, such as mining or processing factories, to smaller packages for individual farmers. However, access is limited to wealthier and better "connected" farmers, and in China, 'micro-credit' loans vary from 250 – 1000 USD, with 600 USD being a rough average. Guizhou province has the lowest repayment rates in the country, which some reports suggest may be as low as 10%. Interest is charged at 4%, and the official government repayment targets are 70%. At such low repayment rates, government officials are concerned about further lending against a program that has clearly failed and for which they are accountable.

There are however significant funds still in the pipeline. Guizhou province, for example, still has some 100 million USD as yet not dispersed from a total of 226 million dollars allocated for the period 1998–2000. Aside from a recipient mentality of non-repayment, weak income-generating investments and dictatorial government officials (intent on determining how borrowers should spend their loans) have amplified the failure of the government credit programs.

This puts SIMI in an interesting position. There is credit available within the system, the government is searching for ways to utilize and manage it effectively, and SIMI has a number of proven high-value income-generating investments on offer. The risk however is that government will push credit into a rigid menu of SIMI technologies against an unchanged mentality of non-repayment. This is opposed to the SIMI approach of flexibility in choice of technologies and a sustainable system without subsidies.

1.5 Output Markets

The market for vegetables and fruits in China has developed rapidly over the past ten years to a current national acreage of 220 million mu, not including potatoes. The total vegetable output is 400 million metric tons annually, which equates to a per capita consumption of some 350kg per

year, but the actual figure is closer to 140kg per year, due to storage transportation and trimming losses between producers and the predominantly urban markets.

China has such diverse climates that growth in cash crop cultivation has occurred across extensive geography, predominantly in the eastern side of the country. Here, a variety of climatic zones have enabled different areas to supply vegetables into the national market at the specific times of year when the climate is optimal within each of their respective locations. The major vegetable producing areas are Shandong, and in the South, Hai Nan island, Guanxi autonomous region, Guangdong, Hunan, and Fujian.

The time of year in which each of these regions produces and sells vegetables has been extended with the use of cold storage, diversified seed varieties, greenhouses, and accordingly the seasonal volumes and price variations have evened out as competition for each of the seasonal windows of opportunity have been sought out by the various regional producers.

The production, transportation, and processing of vegetables and fruits from these regions is sophisticated. Intensive production, refrigerated transport, cooled storage, and sophisticated processing facilities have all developed along with the increased supply. Provincial governments have encouraged these developments in order to secure their respective places as production regions.

In Shandong for example, the government sponsors a major annual international vegetable show, that last year attracted over 380,000 visitors, and showcased over 800 varieties of plants. As the production grew in this area so too did the labor demand, and hired labor came from all over the country. This hired labor acted as knowledge transfer agents back to their respective provinces. In addition, provincial governments from around Chine hired expertise from Shandong to transfer technology to their provinces. At its peak, up to 30,000 farmers were away training, and earning some 20–30,000 yuan per year.

The export market has developed to 1.97 million metric tons (1999) with a total value of 0.4 billion dollars. Of this total, 1.1 million metric tons were exported as fresh refrigerated produce, whilst 0.87 million metric tons were exported frozen, dried, or canned.

A. Markets for Vegetables and Fruits from the Natural Greenhouse

In comparison to these highly developed and sophisticated regions, the target area of the SIMI effort is still struggling. A poor and relatively isolated region, it is currently providing what it can to a relatively saturated and predominantly regional marketplace. As there was growth for seasonal market shares from around China, there was also growth for produce from the natural greenhouse. Its predominant advantage was to supply during the winter months, but this market opportunity has narrowed, due to competitive regions extending their seasons of cultivation with improved cultivation and storage technology, as well as the spread of production within the natural greenhouse area itself.

Vegetables from the natural greenhouse region are carried on farmers' backs, on carts, and on trucks to township wholesale trading points. From here, they are purchased by truck owners and traders, sorted and graded, and then transported to county retail and wholesale markets from where a percentage is further traded to provincial cities. There are no facilities for storage, or any

refrigerated trucks, and transportation links from the region into the broader national market are weak in comparison to the more developed East Coast. The output market structure from the natural greenhouse is limited to small independent truck and trade operators that feed from rural areas to cities. A typical township market such as the 'Broken Bridge,' where the practice of winter vegetable cultivation was initiated, has an annual trade of some 3 million U.S. Dollars.

As the volume of winter vegetables cultivated in this region has swelled to around 70,000 acres today, the average prices of the produce have fallen by about half. According to Li Guilan[27], with today's very basic output market structure, the volume of crops cultivated is about right. If vegetable cultivation further spreads, then the farmers that are in the least advantaged position with respect to rural markets will stop cultivating due to low prices.

B. Processing

The biggest processing operation in the target provinces is a chili processor that makes chili sauce and has developed over the last ten years into a national brand. This processor purchases chilies from around 40,000 farmers. Another company produces a canned kiwi fruit drink. In addition, there are over 200 Pharmaceutical companies in Guizhou province, purchasing medicinal herbs from across the province, and turning them into herbal remedies in tablet form.

Although these are examples of successful output processing companies in the target region, on a national scale, the level of post harvest processing here, as compared to the developed East Coast, remains rather limited. In these regions that have high volume supplies and better infrastructure including shipping ports, many large-scale food processors, such as freezing plants, produce for both the national and international markets. A concerted effort to develop and expand vegetable production in the hill and upland areas in the dry season would help meet a lucrative market niche as well as extending the period for supply of fruit and vegetables for processing well beyond the winter season.

C. Consumer Market Trends

There is a rapidly growing demand throughout China and South East Asia for low chemical or chemical free produce. These are sold at a premium and the demand is such that they account for significant shelf space in Chinese supermarkets. These are not organic, but low in residual chemicals as compared with the bulk of Chinese farm produce, the production of which developed very rapidly, and the focus of which was on volume.

The Chinese Green Food Development Center has developed a standards system for consumer foodstuffs that includes meats, dairy products, vegetables, and fruits. There are 50 testing centers across China affiliated with the Green Food Development Center, and reaching acceptable standards through these centers along with an annual fee, enables the use of the Chinese Green Foods Label. In some product categories, such as baby foods, every producer maintains the standards and subscribes to the Green logo.

1.6 Policy Analysis

[27] Professor and Vice President of the Guizhou Academy of Agricultural Sciences.

Some major recent developments have placed market-driven poverty alleviation strategies in a decidedly advantageous position. The first of these was when the government abandoned the fundamental policy of mandatory local self-sufficiency in grain. This has opened opportunity for smallholders to decide what to cultivate, and adapt from subsistence agriculture to grow into farm enterprises supplying higher value crops to market. It also reduced pressure to cultivate basic grain crops in hilly and mountainous areas.

An additional and more localized development was that WI-IDE's cooperation partner, Yang Zuwen, founder of Guizhou Hengde Green Engineering Pty Ltd, after years of exploration, developed a feasible development model based on planting exploitable forests. An experimental project for poverty alleviation, the central government has already adopted and started work on the model for a pilot region in Huajiang region, close to the Duanqiao marketshed in the Natural Greenhouse. At the same time, the model has been receiving serious attention from the Shi Xiushi, the Governor of Guizhou Province who personally directed a group of experts to evaluate it, and has subsequently decided to take the model as a major component of the development strategy for the whole province. This strategy includes the irrigation technologies that have been demonstrated by IDE in the region such as the pressurized treadle pump and low cost water storage bag.

1.7 Key Constraints to the Development of Smallholder Market Participation

The target region for SIMI interventions in China is populated by some of the nation's poorest people. While some of them in the comparatively advantaged areas have demonstrated that cultivation of marketable crops, even against current constraints, can lead to increased prosperity, for the most part this region is suffering from extreme levels of poverty. This section analyses the constraints, identified through the various field visits and studies, that the smallholders face before shifting from mostly subsistence agriculture to managing productive microenterprises. Some potential solutions to these constraints are now listed.

A. Market Access

The geographical area has proven itself to be a viable vegetable cultivation center, so further expansion of vegetable cultivation and increased profitability is principally constrained by the current output market. This is linked to the limited, yet improving, infrastructure in the region, as well as a relatively primitive transport network between this region and national markets. Additionally, the lack of regional marketing expertise inhibits the potential to creatively position this regions' produce to compete in the increasingly sophisticated national consumer market.

B. Water Control

Water control is a limitation to both increased productivity in areas where cash crops are currently cultivated, as well as the spread of commercial cultivation to new areas. The water control constraints are varied throughout the region, ranging from water lifting devices in the natural greenhouse, which result in an additional labor constraint, to water storage and drip irrigation technologies in the higher lands where water is correspondingly scarcer. Aside from the labor and water scarcity problems that these technologies will vastly improve, they have also demonstrated their potential to increase yields through better water control and the more precise application of fertilizers

In the hill areas, an increased supply of irrigation water would build upon the experience of a similar program in the mid-hills of Nepal. There, the increased availability of low-cost PVC pipe and cash inflows from seasonal and expatriate workers allowed families, groups of families and villages to tap springs and streams for water sources, with eventual delivery to individual households. Sharing of water between groups of households usually restricted delivery to specific times of the day so that low-cost water storage structures were needed. This allowed the use of water for household use, livestock, and drip irrigation of small vegetable plots located near the household. The China model needs to allow for scaling-up to larger plots and larger water storage structures.

C. Diversity of Cropping

Part of the reason for the limited market is the region's reliance on a very narrow range of crops. The reliance on such a limited variety of crops leaves farmers more vulnerable to the risk of falling market prices. Although the crop variation is slight, it has broadened to some degree through necessity as the market for the first commercial crops introduced in the natural greenhouse have become saturated. A lack of crop diversity increases the risks, accelerates market saturation, and reduces the profitability of smallholder farming in the natural greenhouse. In comparison, the developed vegetable growing regions have better information access from both input and output dimensions in order to guide their crop planning. For example, in Shandong, seed companies demonstrate over 800 varieties of crops, and the extensive trade networks that are close to farmers can provide market feedback from the consumer, either to processors or retailers.

D. Access to Capital

The shift from mainly subsistence cultivation over to higher input, commercially focused crop production requires capital. In order to target the poorer communities, and to ensure a relative equality among the participants, SIMI will need to implement a credit component at the household level. Currently poorer households lease land to wealthier neighbors, who have developed adequate resources from their early adoption of winter cultivation to fuel an expansion of their cultivated acreage. The entry level costs for the poorer populations are currently prohibitive, preventing entry into commercial cultivation.

E. Transportation

Whilst transportation has been identified as a constraint to increased output market access, lack of farm-to-market roads is also a critical constraint. This is especially true for produce cultivated higher up the hillsides, as the road networks tend to follow the major rivers along the valley floors. However, the smaller perennial rivers and streams that are tributaries to these larger rivers are populated due to the access of water, and SIMI needs to focus efforts on these poorer populations. They have specific transportation difficulties to get their produce from the high hillsides to the roads running along the larger rivers in the valley floor. This constraint will likely be reduced with a focus on lower bulk, higher value, and storable crops such as dried herbs, cultivated medicines, or dried vegetables as much as through technological innovation.

Despite the fact that winter produce from the natural greenhouse can be transported with relatively minimal losses without refrigeration, the emerging production of spring and summer

vegetables on the plateaus will not enjoy this advantage. To transport these summer crops without significant loss will require refrigerated transportation due to the higher summer temperatures.

2. 15-YEAR RECOMMENDED PLAN

2.1 Target Population

The vision of SIMI over the course of the next fifteen years is that this particularly poor region of South Western China will increase in prosperity through SIMI's facilitation of a substantive growth of its market share of the national market for cash crops. This market-lead initiative will create a demand for these crops that will support a large expansion of microenterprise productivity throughout the region. In most cases, the millions of smallholders that will be able to capitalize on this market opportunity are currently producing little more than subsistence crops. In addition to the market creation, SIMI will intervene at the input and throughput levels to enable rural farmers to participate in this opportunity, ultimately elevating the farmers from consumption poverty to prosperous and active market participants.

The SIMI business plan will focus efforts at all three dimensions; input, throughput, and output. In each dimension, interventions are identified that include technology, capacity building, credit, and information access, the principle operational foci will be as follows:

- A regional increase in the national market share of both current proven crop varieties and additional crops that can be advantageously cultivated in this region.
- A corresponding increase and diversification of cash crop production throughout the region, focusing on areas classified as the natural greenhouse as well as the cooler higher plateaus. Extension of production season will be part of this process.

2.2 Strategies for Implementation

A. Post Harvest Technologies and Output Markets
SIMI in China will place a great emphasis on output market development. The current supply of a relatively narrow variety-range of winter vegetables from this area approximately meets the current demand that is accessible to these farmers. This has been reflected in a price reduction over the last five years as the area of cultivation has swelled to meet the demand. Thus SIMI will focus on output market development in tune with a parallel crop diversification program. The strategies will focus on capitalizing on the regions three key comparative advantages:

- The region's diverse natural climates, due to its varied altitude ,enable it to become a low-cost, year-round supplier of fruits and vegetables without the input costs associated with creating artificial climates such as greenhouses.
- The relatively limited historical use of fertilizers and pesticides, and the quality of its water, positions it optimally to break into the increasing market for low-chemical produce.
- The income expectation in the area due to its extreme poverty positions it to compete on price with the sophisticated growing regions of the east and southern coast.

SIMI will have a long-term strategy to develop this area as a competitive player in the national marketplace. This will involve developing both links to high value consumer markets, as well as tying into programs and opportunities for the development of output processing businesses and shelf-ready packaging operations.

This development will be in tune with the on-going improvement in farm-to-market and city-to-city infrastructure in the region. This infrastructure will enable farmers to tie into the national transportation networks that are moving agricultural produce around the country between seasonal production regions for the national markets. This requires coordination with the provincial and county governments who will need to fund such infrastructure.

By focusing efforts in both the valley floors and in the cooler hills and plateaus, it will be possible to develop year-round production of vegetables from the area. This will greatly enhance the attractiveness of the area to output processors, and in order to further encourage their assessment of establishing facilities in the region, program ties will be made to government development credit, and provincial level preferential tax arrangements.

The market-lead SIMI initiative will result in an increased demand for a diverse range of cash crops from the region. In tune with the demand development, SIMI will focus on developing high-value input packages for smallholders in the region. These will be tailored to the varying land, water, and seasonal climatic circumstances found within the target region.

Thus SIMI will need to employ a coordinated spread of program initiatives that will include technology, capacity building, credit, and information access. These initiatives will change over the course of the intervention as smallholders improve their businesses, increasing in sophistication and experience.

B. On-Farm Technologies (inputs and management techniques)

A broad array of technological inputs will be required such as seeds, fertilizers, insecticides, and water lifting, water storage, and water distribution technologies. In the case of seeds, fertilizers, and insecticides, an array of high quality inputs are already available in China, and the focus will be to channel them through supply chains to the target areas. SIMI can draw experiences from the businesses supplying these inputs to the more developed east coast agricultural sector.

Water control technologies will be the central focus around which input packages and training efforts are built. Where smallholders are already cultivating for market, there is a proven demand for water lifting devices. Carrying water to the crops is an arduous task accounting for approximately 1/4th the total labor input for commercial crops.

The water markets are varied, and are dynamic in nature. SIMI needs to respond to this environment with a range of technologies that fit the specific requirements of the farmers, and remain adaptable as the water markets change. SIMI assumes that the water markets in the natural greenhouse and the cooler hills and plateaus will evolve in a similar fashion to they way they have in Bangladesh. In this country, treadle pumps enabled farmers to either step up from bucket

irrigation, or enter the irrigation market altogether. As the number and intensity of irrigators developed, and profits were realized from irrigated agriculture, farmers were able to step up to using diesel pumps, and as the intensity of these increased a competitive water market evolved, whereby newcomers to cash crop cultivation were able to purchase water at a cost effective rate as competition on the supply side increased.

The predominant initial demand will be for pressurized treadle pumps, and a variety of models will be tested in the field alongside the models currently introduced by IDE to determine the optimal product mix for the region. In addition, water distribution technologies such as drip and sprinkler irrigation will be introduced. The market for these technologies is diverse, ranging for water saving in the higher altitudes where cultivation is limited by water availability in the dry season, to farmers that have adequate water availability but focus on realizing higher quality product output.

Thus SIMI will introduce a range of technologies, leading with sales of pressurized treadle pumps, in parallel with an extensive demonstration and field testing of drip, sprinkler, and water storage technologies. Water storage technologies will have a strong influence on the development of water markets, as they provide a measurable volume of water to be pumped, and they enable the water purchaser to control the irrigation regime even though they may have no control over the timing of water pumping.

Management and smallholder business planning are going to be critical to this effort. SIMI needs to encourage smallholders to diversify their current cropping, and take advantage of the segmentation of their land. A smallholder business can be thought of as an investment portfolio, that should stretch from quick returns and riskier investments such as vegetable crops for which the markets are more volatile, medium term investments such as cardamom and fruit trees, and 'retirement plans' with high value tree crops like teak.

Many of the crops that will be introduced by SIMI based on market information will be new to the smallholders and thus training in cultivation techniques, disease control, and on-farm post-harvest pre-market preparation will be a central theme of SIMI that will be designed around water control dissemination and training strategies. SIMI will establish key demonstration and resource centers throughout the programs area of coverage that will provide farmer training through farmer visits and outreach services.

C. Credit

Credit is available within existing government programs. Government partnerships on the SIMI initiative will attempt to direct these resources towards the income generating activities proposed under this initiative.

D. Information

SIMI will develop a central information centre to feed market information to influence the varieties chosen and to encourage diversity. Farm demonstrations in conjunction with seed companies will be will be established in key locations to both test and demonstrate varieties of vegetables and fruit trees. These centers will additionally act as nurseries until this transitions into private hands, as well as acting as central coordination points for extension training of farmers.

The information center will additionally act to provide feedback from the marketplace to enable smallholders and traders to plan production through identification of market trends in the Chinese consumer marketplace.

E. Supply Chain Development

In order to feed the technologies required for smallholder business development, SIMI will facilitate a network of parallel supply chains to provide the necessary technological inputs. In almost all cases, these businesses will be grown from existing enterprises through a diversification of product line. Adequate competition will be built into the system such that smallholders receive goods at a fair market price and so that customer service, both pre- and post-sales product warranties and pre-sale advice can be channeled through this network.

China is in a fortunate position of having an extensive manufacturing base that can produce anything locally at a competitive rate. Input supply chains for irrigation equipment will need to be capitalized initially by SIMI until such a time as manufacturers realize the scale of market and there is adequate manufacturer competition to encourage them to invest directly and 'purchase' market share through their capital outlays. This situation is already realized among seed and fertilizer companies who supply their registered dealers with credit in the form of inventory as well as providing promotional and informational posters and leaflets. SIMI will continually tweak the supply chain structure and technology availability to keep abreast of the dynamic input marketplaces and ensure product is available at competitive rates at the most suitable points of sale.

PART II

IMMEDIATE INVESTMENT OPPORTUNITIES

3. CORE ACTION RESEARCH AND DEVELOPMENT PLAN (CARDEP): DEVELOPMENT OF AN INTERVENTION STRATEGY

4. GEOGRAPHIC EXPANSION

3. CARDEP: DEVELOPMENT OF AN INTERVENTION STRATEGY

3.1 Marketshed Description

A. Context

The Duanqiao marketshed is located 130 km southwest of Guiyang, the capital of Guizhou province. The marketshed covers an area of about 350 km², defined by the four townships surrounding Duanqiao town (see Figure 1 and Table 1). The marketshed population approaches 57,000 people (about 10,000 households based on an average five people per household), 90 percent of which are rural. Minority groups including Buyi, Miao, Li, Gelo, and Yi make up 80 percent of the population, with Buyi being in the majority according to the township leaders.

Figure 1: Location of Guizhou Province and Duanqiao Marketshed

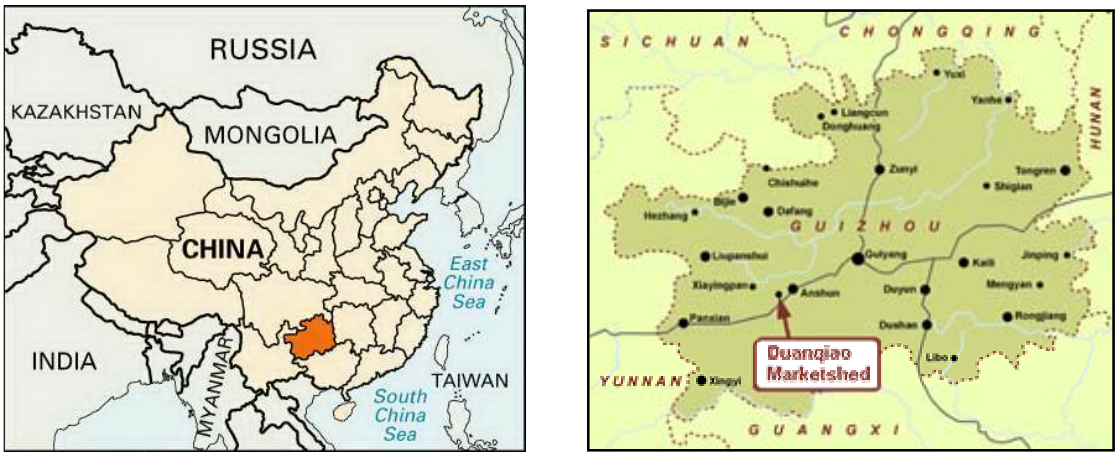


Table 1: Duanqiao Marketshed Townships

County	Township	Population
Guanling	Duanqiao	14213
Guanling	Bade	13927
Guanling	Shangguan	20525
Zhenning	Dabang	8100
Total		56765

Source: Statistic Bureau of Guanling County and Zhenning County

B. Infrastructure

In recent years, increasing levels of resources have been invested in impoverished regions of Guizhou by the central government as part of the national strategy to develop the Western

provinces and promote tourism. As a result, the region's infrastructure has seen relatively rapid improvements. The majority of rural households are connected to electricity (albeit unreliable), and there are prospects for hydropower development in the region. Recently, mobile phone communication and Internet connections have become available. Road access off the main road is limited but passable for most of the year. In three years, a high-standard highway will pass through Shangguan and close to Dabang, which will greatly improve access to regional and international markets.

Smallholders from the marketshed transport their crops however they can to the market at Duanqiao town. Typically, farmers have no information on market prices for their produce when they start off on the trip to market. At Duanqiao market, the farmers sell their produce to traders who sort and pack the vegetables and transport them as partial loads on passing trucks going to the wholesale market at Guiyang, 2.5 hours away. From Guiyang, the produce typically ends up at retail markets in local and regional population centers.

The Duanqiao marketshed holds an important place in Guizhou's agricultural marketing network. The Ministry of Agriculture lists it as one of the province's four major transport hubs for agricultural products. Duanqiao lies at the crossroads of arterial highways from Kunming and Xingyi.

G. Agriculture

The dramatic variations in terrain produce diverse conditions for agriculture in the region. At elevations below 800 m, climatic conditions are ideally suited for vegetable cultivation in the winter months (September – May) when demand and market prices are highest.

Villages that have good access to markets but poor water resources (like most of those in Shangguan Township), or that have good water resources but poor market access (like those downstream of Dabang), practice primarily subsistence agriculture. Cash income depends mainly on migratory labor or selling small amounts of agricultural or forestry products. Semi-subsistence farmers account for an estimated 50 percent of the total rural population in the marketshed.

The poorest people in the marketshed are farmers in the mountain villages, who are mainly of the Black Miao ethnic group. They are both isolated from markets and have poor water resources, depending mainly on non-irrigated crops like corn for survival.

H. Trends

Historically, Zhenning and Guanling counties had abundant vegetation and high-value forest products. Locally produced tung oil was in high demand on international markets until the early '90s. Population increases and national agricultural policies (collectivisation, the "Great Leap Forward" in 1958-59, and the emphasis on grain self-sufficiency) lead to excessive cultivation of mountain land and environmental degradation.

The de-collectivization of agriculture in the early 1980s mitigated this trend. In the late '80s and early '90s, the incomes of rural people in the region reached a historical peak resulting mainly from off-season vegetables and tung oil seed. Tomatoes fetched twice or more their current price and were cultivated on more than 10,000 mu, more than double the current area. According to local officials, production of tung oil seed was 10 or more times the present amount. Many rural households had cash incomes in excess of US$1,250 per year.

Since the mid-1990s, smallholder incomes in the Duanqiao marketshed have decreased significantly. Prices for off-season vegetables slipped due to increased competition with imports from the south, especially Guangxi and Yunnan provinces. Production of tung oil seed began to drop due to the appearance of bacterial diseases carried by imported fruits and a drastic drop in prices after a synthetic substitute was developed in Japan. The majority of smallholders in the region fell back into poverty.

3.2 Target Population

The target population for the first three years of the CARDEP program in Duanqiao marketshed will include smallholders with basic access to land and water resources for agriculture. The program will specifically target the 80 percent of the marketshed population that has a net annual income of less than US$150 and a net cash income of less than $60 per annum.

3.3. Water Strategy

About 30 percent of households live in villages located along the riverbanks with a relatively plentiful and stable year-round water source. The remaining 70 percent of households hold varying amounts of mid-range and hillside land with varying degrees of water shortage. Regardless of the location, however, three water-related needs are common among all smallholders: the need to lift water from source to field, the need to store water for later use, and the need to use water resources efficiently. The water strategy for the Duanqiao marketshed has three components corresponding to these three needs.

A. Water-Lifting Technology

Water Storage Bag

Currently, water lifting is accomplished almost exclusively by manual labor, typically using two buckets carried on a shoulder bar. The efficiency of this method is very low and it consumes a great deal of the available labor, which in turn limits the utilization of the available land. A simple foot-powered treadle pump, similar to those promoted by IDE in other Asian and African countries, can increase water lifting efficiency five to ten times over manual methods. IDE engineers in China have adapted the treadle pump technology to local conditions, and initial trials have generated great interest and enthusiasm among local farmers for the technology. The pump uses both suction and pressure to lift water up to 20 m from the source to the field.

In the second phase of the program (years 4-6), the partnership of Winrock International and International Development Enterprise (WI-IDE) plans to introduce small-scale engine-powered pumps to the market on the assumption that as smallholder's incomes increase, the demand for higher-capacity water-lifting technology will increase.

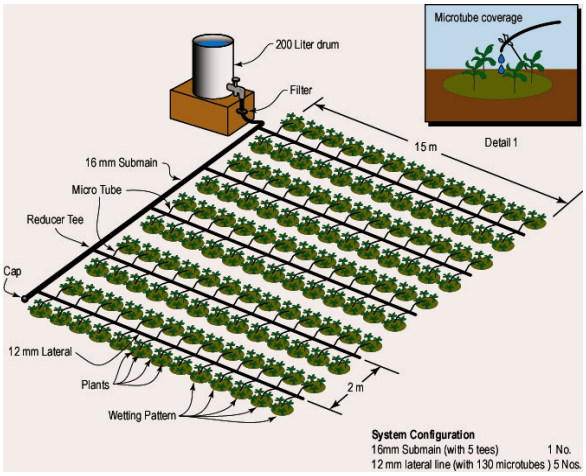
B. Water Storage Technology

During WI-IDE's field surveys and interviews, farmers in the marketshed have expressed a need for low-cost water storage options. The availability of water storage will help alleviate water shortages in dry months, improve efficiency of pumping (water can be pumped and stored for later use), and can be used to feed the drip irrigation systems described below. IDE has developed a low-cost, lightweight water storage bag that can be used by smallholders to store water in their fields. Testing of the water bag will be completed and private-sector manufacturers and distributors will be established to provide the storage bags at an affordable and sustainable price. The water bags are limited in the amount of water they can hold; therefore further research and development of other water storage options will be undertaken.

C. Drip Irrigation

The labor cost required to lift water to the fields makes it important that the water is used efficiently to ensure that crops get sufficient water and to maximize irrigated area. Drip irrigation is the most water-efficient form of irrigation available. IDE has developed low-cost drip irrigation kits assembled from locally manufactured parts and designed specifically for the needs of small-scale farmers. Two basic types of drip systems are applicable in the Duanqiao marketshed: 1) kits configured for irrigation of vegetable plots and 2) kits configured for irrigation tree crops. The tree drip kits will be promoted primarily in the upland areas where reforestation efforts are being promoted by the government and other agencies.

The immediate needs expressed by local smallholders are for water-lifting and water-storage technologies. Thus, the active introduction of drip irrigation to the marketplace will not occur until year four of the CARDEP program. IDE expects that with effective demonstrations and awareness raising, there will be significant demand for the drip systems by that time. Adaptation and testing of the drip irrigation technology for the China context will be completed. Demonstration plots will be established to raise awareness about drip irrigation and convince farmers of its benefits. Private-sector assemblers and distributors will be established to provide the drip systems at affordable and sustainable prices.



Drum kit for drip irrigation

3.4. High-Value Agricultural Products

A. Off-season vegetables

The climatic conditions in the valley floors of the Duanqiao marketshed are ideal for growing vegetables in the winter off-season (September – May). In the Duanqiao marketshed, among the five or six key vegetables that are cultivated, tomatoes are the largest cash crop. Links to local, regional, and national markets are well established through centers such as Chongqing. In addition to fresh tomatoes, the potential market for processed tomatoes is also excellent. Tomato paste has become very popular as Western foods such as pizza have become more fashionable in

urban centers. Tomato paste is also increasingly used as a flavor and nutritional supplement to traditional Chinese foods.

B. Persimmon

The persimmon varieties that are currently grown in the Duanqiao marketshed begin to generate income after five years and continue yielding for 90 to 100 years. The market for persimmons is expanding and already there are supply shortages. Fresh and dried persimmons are major part of the traditional Chinese fruit diet. The persimmon fruit can be dried and pulverized to make meal that is coming into wide use as protein supplement in bread, and bread itself is becoming more prevalent as Western foods gain in popularity. Persimmon wine also has a large market in China, and uses the same basic technology (fermentation, aging, bottling) as grape wine. On international markets, persimmon-leaf tea is now popular in Japan as non-caffeine, anti-aging herbal medicine. Production of persimmon tea requires a special variety, which has yet to be introduced in the Duanqiao marketshed.

C. Castor-oil Plant

Castor is used as a stable industrial lubricant as well as a medicine. The meal prepared from the plant is a good fertilizer and high protein animal feed. These products are non-perishable or at the very least have a good shelf life. The crop returns an income in short cycle. By some estimates, the global production is 1.7 million tons, but demand is estimated at 3 million tons, so there is much room for growth.

D. Papaya

Papaya seems an ideal vehicle for boosting local cultivators' incomes, as it offers same-year harvest and a high cash return. Market prospects for the crop are excellent due to the high income elasticity of demand for fresh fruit in Chinese cities, and the potential for processing for the dried fruit and a wide range of non-food applications including medicines and cosmetics. Hong Kong is a major importer of papaya. Papaya has been successfully introduced in parts of the Duanqiao marketshed by the Hengde Green Engineering project using IDE drip systems to irrigate the trees.

E. Teak

Teak is a high-demand tropical hardwood with large established markets in China, Japan, and Korea. Teak trees usually can be harvested after about 30 years. However, with high density planting, three years old young trees can also be harvest for commercial use.

F. Poultry

Free range chickens raised in the woodlands created by above tree crops. These free-range chickens are more tasteful than those raised through intensive chicken farming, so it is more popular in China. It cost less to raise this kind of chicken though it is not as productive as those raised in the modern chicken farm.

3.5 Constraints Analysis

Constraints at the input, farm, and output level must be addressed before small farmers can realize the tremendous potential for increasing their productivity and income through micro-irrigated crops in the Duanqiao marketshed.

3.5.1 Constraints Analysis: Farm Level

A. Technological Constraints

Smallholders in the natural greenhouse area get their seeds, pesticides, and fertilizers from government representatives, small retailers, and traders. Although prices are market determined, smallholders apparently could not get good prices because of small volume and informational asymmetry. It seems there were no shortage of chemical fertilizers, however, most farmers could not afford the optimal level of fertilizer inputs. Vegetable seed varieties are out of date; some of the tomato seeds grown were varieties introduced more than 10 years ago. Poor quality seed is also a common problem. There is no established and reliable source of seeds for the new crops proposed under the CARDEP program including papaya, teak, and also chicks for poultry raising.

B. Capacity-Related Constraints

Improved input practices developed at the Guizhou Academy of Agricultural Science are able to double the yields of winter vegetables. A careful study of existing smallholder practices and identification of opportunities for improvement is an important next step. Interventions may include training in fertilizer use and composting and introducing small farmers to integrated pest management strategies to meet the Chinese 'Green Foods' standards for pesticide content in crops.

Agronomic training will be necessary for smallholders to grow papaya or teak since these are new crops in the marketshed.

Those who grow off-season vegetables have no access to timely market information, which adds to their risks. Increased knowledge of market prices and demand for various crops would help smallholders to determine the best crop mix and the best timing for crop sales.

Due to the limited scale of each household's operation and limited cooperative organization, smallholders are unable to grade and pack their produce at the point of harvest. Building this capacity would allow smallholders to sell directly to wholesale markets and increase their leverage over price.

C. Capital/Credit Constraints

Most smallholders have little or no access to affordable credit to buy inputs. Interest rates from some private sources are as high as 30 percent per year for such advances. Smallholders that cannot afford to buy seeds, plastic sheets (used as a moisture barrier over vegetables), and fertilizer end up leasing out their land instead of cultivating it themselves. Opening access to rural micro-credit is needed to increase the income and productivity of poor farmers.

D. Other Constraints

The lack of clear legal rights over land removes a potential collateral source for smallholders to obtain credit. Also, land holdings are unnecessarily and uneconomically scattered because of non-alienability of land.

3.5.2. Constraints Analysis: Input Markets

A. Technological Constraints

There is no access to low-cost soil testing to guide fertilizer use. Technology for producing papaya seeds and seedlings in high volumes is also unavailable. The teak seedling process is similarly constrained by lack of technological improvements to speed up the current long production cycle.

B. Capacity-Related Constraints

Business development services and technical training required to build and operate nurseries limit the ability to deliver seedlings and seeds to smallholders.

C. Capital/Credit Constraints

Capital injection is needed to create and run nurseries.

3.5.3 Constraints Analysis: Output Markets

A. Technological Constraints

There is a need to identify and source small scale processing technology for tomato products (e.g. paste) suitable for installation at the village or township level. This will allow local people to add value to their produce and increase marketing options. Large operators have little incentive to establish capacity at this level because of the lack of scale.

B. Capacity-Related Constraints

Business development services and technical training to establish and operate food-processing facilities in the area are lacking.

Transport facilities for perishable goods from Guizhou province in the south to the populous north in areas like Beijing are chaotic and poor. Currently, there are no means for refrigerated transport of vegetables from the south to the north by air, rail, or truck. The owner of a vegetable processing plant two hours west of Shanghai told IDE that it costs him US$1,500 to send a 40-foot container of frozen vegetables to Japan, US$3600 to Los Angeles, and US$2500 to Beijing. Addressing the institutional and private-sector constraints to efficient and economical transport for perishable products between South and North China is a priority.

C. Capital/Credit Constraints

Credit is required to help establish local processing facilities.

3.6 Intervention Strategy

3.6.1 Intervention Strategy: Farm Level

A. Technology Strategy

Final development and testing of the pressure treadle pump, water bag, and drip systems will be completed to ensure that the technologies are ready for market. This will include farmer trials and laboratory testing for performance, durability, and user-friendliness. Initially, laboratory testing will be conducted at IDE's testing facility in Bangladesh until a suitable location can be found in China or until WI-IDE develops its own capacity.

WI-IDE will promote the irrigation technologies in the marketshed areas by increasing smallholders' awareness and understanding of the benefits of irrigated agriculture. Promotional activities may include demonstration plots, farmer field days, presentations and displays in local markets and at agricultural shows, publicity events, radio programming, printed advertising, and other means. Developing an effective mix of promotional activities will be a trial and error process, drawing on locally appropriate methods of mass communication and WI-IDE's considerable experience in technology promotion in other countries.

WI-IDE will collaborate with a poverty alleviation pilot project starting this year in the Duanqiao marketshed that is funded by the central government. An expert working group of development specialists, academics, and high-level government officials has been formed to oversee the project. IDE has close ties with Hengde Green Engineering, the company that developed and is implementing the project. A major component of the project is the promotion of tree crops in the karst mountain regions. IDE's tree drip irrigation system has been tested and accepted as a complementary and necessary technology to solve the smallholders' irrigation needs.

B. Capacity-Building Strategy

WI-IDE will provide training to smallholders in agronomy, integrated pest management, irrigation techniques, and farm management. The exact training topics will be determined through a training needs assessment. Training will be especially important for newly introduced crops and for farmers who are not accustomed to market-oriented production. Training activities may include group workshops or informal one-on-one guidance in the fields. WI-IDE staff, cooperating NGO partners, and "barefoot trainers" will conduct the trainings. A training centre in Dabang will be established to co-ordinate these initiatives.

"Barefoot trainers" will be recruited from among model farmers in the marketshed. They will be trained and organized to promote irrigation technologies and provide agronomic support. The cost of supporting the barefoot trainers will be built into the price of the irrigation technologies.

A reward scheme will be designed to provide incentives for the trainers to promote the irrigation technologies among other farmers and provide technical support.

The government extension system suffers from under-funding and low morale and therefore is not able to provide effective service to smallholders. WI-IDE will work with the local government extension staff to build up a capacity that can provide required services at the farm level. Based on the discussion with local agronomists and experts in related fields, WI-IDE can start support the provincial academy of agricultural sciences to form a task team for demonstration programs. WI-IDE will also work with the township governments to improve training and the incentive scheme for the extension staff (linking staff bonuses to smallholders' income, for instance). Another strategy may be to nurture private companies to provide paid extension services to the farmers.

C. Capital/Credit Strategy

Micro-credit is a key poverty alleviation strategy of the Chinese government. The interest rate is 4 percent per year and no collateral is needed (in any case, land cannot be used as collateral because farmers only lease and do not actually own the land). The government calculates the amount of credit available in each 'poverty area' by multiplying the approved loan amount by 20 percent of the number of households in the area. Political connections are helpful in being included in the 20 percent who can receive loans. Loans are accessed through the local banking system. Loan recipients are not free to decide where to spend the loan money, they must use it to purchase certain investments approved by the government. There has been a very low payback, and the government is unwilling to disperse more until earlier loans are repaid.

In the last three years, about 20 percent of rural households received micro-credit. The average loan per household grew from 700 Yuan (about $85) in 1998 to 2,000 Yuan (about $250) in 1999. In total, 700 million Yuan are currently in circulation as micro-credit loans in Guizhou province.

According to poverty alleviation officials, the government plans to continue to expand the program. Before they can do so, however, the need a better repayment mechanism. The government's present plan is to create a government company to provide credit for seedlings, pumps, and new crop varieties. The company will also act as the marketing company for the crops. Thus, when a farmer takes a loan, they sell their produce back through the company. The loan repayment is deducted from the value of the produce. The government sees IDE's irrigation-based model for improving productivity as an attractive option. This model, applied on a large scale, has the potential to greatly increase the impact of the available credit resources. WI-IDE will work with the provincial government to have the CARDEP project included in the micro-credit program.

In addition to the credit resources available through the government, the CARDEP model includes components with short capital recovery cycles that can provide the funds necessary for the longer-cycle components. Papaya cultivation and poultry raising, for example, have relatively fast return periods. Based on discussions with farmers in the marketshed, WI-IDE expects that a majority of the smallholders can gather enough money to invest in one or both of these commercial ventures. By the second year, they can move on to invest in the longer-cycle crops

For example, a farmer that raises 200 free-range chickens with a net profit of US$1.25 each will net a total return of $US 250 in one year. This is sufficient to fund the establishment of teak or persimmon orchards. Papaya yields fruit and generates profits within one year also. A grove of

50 papaya plants covering one-half mu will generate income of $US 500 in the first year (conservative estimate).

Table 2 below shows the income potential of a farmer investing in poultry, papaya, teak, and persimmon after six years.

Table 2: Income Potential from Various Sources

Income Source	Description	Annual Income after Six Years
Poultry	200 per year at $1.25 profit each	$US 250
Papaya	50 plants on 0.5 mu	$US 500
Persimmon	100 trees on 2 mu of land	$US 800
Teak	25 trees, each yielding one m^3 of exploitable timber per year	$US 600
Total		**$US 2,250**

Source:WI-IDE field data, 2002

D. Land Tenure Strategies

WI-IDE is aware of research needs in the field of land tenure and its effect on smallholders' market interactions. WI-IDE will work with research units from academic centres (e.g., Beijing University Department of Sociology and Anthropology) and the Ford Foundation to conduct applied research in conjunction with the CARDEP program. The objective will be to assess the potential impact of various land tenure policy options, which is at present a major reform issue in China. WI-IDE wishes to be in a position to undertake policy advocacy at higher levels.

3.6.2 Intervention Strategy: Input Markets

A.Technology Strategy

WI-IDE will collaborate with local and international research institutions to test and confirm the cash crops selected for promotion during the CARDEP program (off-season vegetables, persimmon, castor, papaya, teak, and poultry). Where possible, additional crops and varieties will be identified that have potential to generate high incomes for farmers in the marketshed. Methods for producing high-quality seeds at affordable prices and in quantities sufficient to meet the smallholder demand will also be identified or developed.

IDE has established a cooperative relationship with Guizhou Academy of Agricultural Sciences (GAAS), whose primary task is to develop new vegetable varieties and other crops that are suitable for the local area. However, the academy has not been well-connected with international counterparts due to lack of funding and capacity. WI-IDE will use its global connections to help local agriculture experts to initiate collaborative research with national and international partners to introduce new varieties.

B. Capacity-Building Strategy

WI-IDE will work with the local private sector to develop its capacity to provide necessary products and services to smallholders in the Duanqiao marketshed. A private-sector supply chain will be developed that can produce and distribute 1) affordable micro-irrigation equipment

including treadle pumps, water storage bags, and drip irrigation systems, and 2) affordable, good-quality seeds for vegetables, papaya, castor, teak, and potentially others.

Business development services will be provided to the supply chain members including manufacturers, distributors, and retailers of irrigation equipment and seeds. Training will include basic financial management, record keeping, stock control, promotion, and marketing skills. At the same time, relationships between the supply chain members will be strengthened.

C. Capital/Credit Strategy

Where necessary, WI-IDE will work with supply chain members to access capital for the expansion or improvement of their services to smallholders. Potential capital sources may include government, NGOs, or private investors.

3.6.3 Intervention Strategy: Output Markets

A.Technology Strategy

WI-IDE will investigate the feasibility of starting small-scale processing operations that will allow local smallholders to add value to their produce and increase marketing options. A small-scale tomato paste and/or canning plant is an example of the type of processing that will be covered. WI-IDE will assist in the start-up of those post-harvest processing operations that prove viable based on the above-noted feasibility studies.

B. Capacity-Building Strategy

WI-IDE will work with the local private sector to develop its capacity to provide post-harvest processing services to smallholders, such as the tomato paste plant described above. Business development services will be provided to the supply chain members including manufacturers, distributors, and retailers of irrigation equipment and seeds. Training will include basic financial management, record keeping, stock control, promotion, and marketing skills. At the same time, relationships between the supply chain members will be strengthened.

WI-IDE will work to facilitate linkages between the smallholders of the Duanqiao marketshed and large-scale produce buyers.

C. Capital/Credit Strategy

Where necessary, WI-IDE will work with private-sector entrepreneurs to access capital to establish post-harvest processing facilities. Potential capital sources may include government, NGOs, or private investors.

Table 3: CARDEP China Budget

	Year 1	Year 2	Year 3	TOTAL
Personnel	93,000	114,000	113,000	320,000
International/National Consulting	117,000	110,000	110,000	337,000
Contracts with R&D Organizations	51,000	67,000	98,000	216,000
Work with Private Sector	4,000	10,000	27,500	41,500
Travel	15,000	36,000	31,500	82,500
Training, Promotion & Technical Assistance	26,000	69,400	94,700	190,100
Equipment	28,600	21,000	-	49,600
Administrative	19,383	15,078	12,026	46,487
TOTAL DIRECT COSTS	**353,983**	**442,478**	**486,726**	**1,283,187**
Indirect Costs (13%)	46,017	57,522	63,274	166,813
GRAND TOTAL	**400,000**	**500,000**	**550,000**	**1,450,000**

4. GEOGRAPHIC EXPANSION PROJECTS

In the previous section a specific three-year CARDEP program has been outlined for Southwestern China. This three-year program is meant to be the cornerstone of a set of strategies and technologies to be applied throughout the region. Simultaneously, however, a series of satellite projects will be implemented with the objective of adapting the regional strategy to the specific conditions of the sub-regions. This will be done through intensive interaction with farmers and development agencies in the sub-region.

The satellite projects will involve the following activities:

1. Conduct a basic survey of water, agriculture, and socio-economic conditions in each area. This would involve an analysis of the high-value crop sub-sector, including identification of opportunities and constraints specific to that sub-region.

2. Based on the outcome of this survey, develop a specific water and small farmer productivity/income generation strategy.

3. Form a consortium of agencies (both government and non-government), interested and capable of participating in the proposed set of interventions. Begin the process of orienting and training these agencies in the approaches and technologies of SIMI.

4. Conduct field testing of the selected set of interventions and technologies. Based on these field tests, the interventions and technologies will be adapted to local conditions in preparation for later scaling up operations.

These satellite projects will be conducted within a 2 year time frame, with the intention of following with a scaled up SIMI intervention in the sub-region. SIMI has identified the following locations, and cost estimates for these projects that are collectively representative of the region, and capture both the natural greenhouse conditions as well as the cooler plateaus:

GEOGRAPHIC EXPANSION PLAN:

The following is a list of suggested areas for expansion, with associated estimated budgets for the satellite projects:

1. The Yun Gui plateau (Guizhou) – $225,000/Yr.
By encompassing the plateaus in addition to the valleys of natural greenhouse climates, SIMI broadens its interventions and the resulting seasonal impacts across two seasons; winter and summer. Aside from the obvious programmatic advantages and cost efficiencies of extending the cultivation season, this strategy brings a specific downstream advantage that output market development initiatives (not at the farm to market level but at the post-harvest / retail level) would have a ready supply of raw produce over a longer period of the year. Efforts are already underway to introduce summer vegetable cultivation on the plateaus. The Guizhou Academy of Agricultural

Sciences currently has 500 acres of the Yun Gui under pilot vegetable cultivation, and they will be a lead partner in the SIMI effort in the plateau areas.
2. Natural greenhouse in Sichuan Province, Liang Shang Prefecture – $175,000/Yr.
3. Natural Greenhouse areas in Yunnan Province – $175,000/Yr.
4. Natural Greenhouse areas in Guanxi Autonomous Region – $175,000/Yr.

NUMBER OF FARMERS

Geographic Region	**Smallholders Affected (3 Years)**
Yun Gui Plateau	3,000
Sichuan Province, Liang Shang Prefecture	4,000
Yunnan Province	4,000
Guanxi Autonomous Region	4,000
Totals:	**15,000**

SUB-PROJECTS:

Based on experience in current field programs, and intensive interaction with farmers, a number of sub-projects (for application of specific interventions or technologies) have been identified. This list is meant to act as a menu to be drawn from for application in the main CARDEP project and for field-testing in the satellite projects. The interventions in the projects will neither include all of these interventions in each sub-region, nor be limited to these as other opportunities arise:

1. Mass Marketing of water lifting and distribution technologies. An immediate demand exists for water lifting devices throughout the natural greenhouse areas where farmers are currently producing cash crops. The entry point to dissemination will be pressure treadle pumps, but SIMI will remain responsive to the changing technological requirements of the farmers. In this respect, SIMI will actively facilitate the process of water market development through the promotion of water storage devices and as the markets develop, small diesel pump sets. By providing a measurable volume of water, a water storage bag can help in the development of water markets, from either treadle or small diesel pumps. In addition, the water storage bags can be utilized as header tanks for drip irrigation systems and for low cost low-pressure sprinkler systems.

   SIMI will employ targeted market strategies with key demonstration sites to accelerate the adoption of the technologies and the realization of a sustainable critical mass in each of the greenhouse marketsheds.

2. The development of new diversified cash crop agronomic packages. This undertaking requires a complete assessment and mapping of the regional and national marketplace for all cash crops; fruits, vegetables, and herbs. This combination will be analyzed for crops that for short, medium, and long-term investment opportunities for smallholders. Particular attention will be paid to ensure that specific high value crops that have low ex-farm gate bulk will be found (such as Cardamom and some herbs) that can ease transport constraints in manually carrying produce from remoter villages to the arterial roads from

where the transport constraint diminishes. For each of the crops SIMI will develop agronomic packages to facilitate the dissemination of the crops to new farmers. These will include seeds, fertilizers, insecticides, pesticides, and key training information supported with pictorial booklets. The agronomic packages and techniques that will be demonstrated and promoted will include the low chemical farming methods that are required to meet the standards for use of the Chinese Green Foods Label. It should be noted that this is approximately equivalent to the European Standards for normal chemical farming.

SIMI will create strategically placed testing and demonstration farms in partnership with seed companies. These will serve to test the suitability of new cash crops to the local climate and soil conditions, as well as to act as demonstration and resource centers for smallholders that are encouraged to diversify their cropping.

The demonstration plots will additionally inform local farmers of current market prices for each of the crops, and demonstrate the variety of irrigation technologies that will be made available through SIMI. These farms will additionally become information centers that will broaden their role through experience to provide extension training for farmers who are encouraged to diversify their product range. Beyond the three years project described in the table below, the demonstration farms will be transitioned into nurseries, and seed / fertilizer / insecticide / pesticide providers, as well as information centers, and will be supported through commercialization of their activities in partnership with agricultural input companies in a similar model to that formed in the more developed vegetable cultivation areas along China's eastern coastline.

3. Nursery Development for fruit trees and high value timber crops. It will be important for SIMI to assist in the development of nurseries for fruit trees, high-value timber crops such as teak, and harvestable tree crops such as cinnamon. There are currently just a few nurseries, predominantly government sponsored as a part of the re-forestation program. As the government programs have focused predominantly on getting as much land reforested as possible, these tend to focus on volume supplies as giveaways for the reforestation program, and the technical knowledge as well as the available varieties is limited and of low value. Farmers interviewed during SIMI's field assessments would prefer to plant higher value crops, but the lack of availability, and the prohibitive cost in lieu of credit did not make this a feasible option. SIMI therefore needs to provide training and introduce regionally adapted varieties of fruit trees and harvestable tree crops such that the farmers can take their own decisions as to what to plant, and realize profits commensurate with their labor input.

4. Develop smallholder production for the Chinese Green Foods Label in collaboration with the Green Food Development Center. This will be undertaken on a test basis within the first three years by developing a small shelf-ready packaging operation that purchases vegetables from defined blocks of farms totaling upwards of 200 mu (approximately 70 farming families). This is the critical level that the Green Food Development Center calculates would enable smallholders to participate in crop/soil testing and the use of the Green Foods Logo. The Green Foods Development Center has offered SIMI a 50 percent discount on use of the logo in order to enable smallholders to gain access and benefit from the increased marketability of produce carrying the label. The company would purchase, grade, wash and pack produce for the premium city based marketplaces.

This would test the use of the logo for smallholder produce through a packaging company in a strategic location in the target area. Because the produce for this initiative would have to come from specific areas rather than simply purchased on the open market, it will enable SIMI to focus other operational efforts and pilot them in tight geographical spots within the target region. This tight geographical focus offers a number of programmatic advantages, including the provision of credit, farmer training, piloting new crop varieties, and the logistics of coordinating these diverse interventions.

It is envisaged that a success in this intervention will lead to contracted relationships between the farmers and the packaging enterprise, and the expansion of smallholder cultivation for premium green foods label markets.

5. Branding the regions produce for high-end consumer markets. The CARDEP marketshed falls near China's most famous waterfall, and is known as a region of pristine mountain beauty. In the same way that bottled drinking waters are promoted as being from fresh mountain springs, the same strategy will be used to break into the increasingly health-conscious city-based consumer market for food crops. The aim would be to gradually develop an association between the produce and healthy, fresh, spring clean water and air, to break into the national consumer market. This will take a sophisticated marketing effort that can be piloted city by city. A success in this strategy for shelf ready packages of vegetables, branded for example as 'Karste Mountain Produce', would open the door for a similar strategy to be employed for other products that are either currently processed, or could be processed as a part of a SIMI output market development initiative in subsequent years. This initiative will pilot a longer-term effort to elevate the produce from this entire region in the minds of Chinese consumers, reinforced by additionally combining with the use of the Green Foods Logo as described above. In order to achieve this, SIMI would employ expertise in output marketing and consumer brand building from the commercial sector within China. The long-term output from a successful intervention would be a saleable brand, purchased by, or licensed to intermediary packing / food-produce marketing companies.

6. Pilot credit interventions in partnership with government. Guizhou province has the 'worst' track record in China with a current average repayment rate of ten percent, the lowest in China. Yet there are resources available – significant resources. In Guizhou province there is an estimated 100 million dollars of credit available as yet un-disbursed. SIMI offers a potential solution to some of the credit problems that have plagued the government programs of past – clear investments that can repay themselves, and credit expertise that can pilot with government a number of credit strategies adapted from elsewhere to find the most suitable arrangements. Given the resources available within the system, the fact that credit is a constraint to farm intensification, and in some cases even cultivation, SIMI will pilot a number of credit strategies to accelerate the adoption of smallholder technologies and farm intensification, and potentially open access to significant credit resources for SIMI expansion.

ANNEXES

1. CARDEP CONSTRAINTS ANALYSIS MATRIX
2. CARDEP LOGICAL FRAMEWORK
3. CARDEP TIMELINE

ANNEX 1: CARDEP CONSTRAINTS ANALYSIS MATRIX

Country and geographic scope	China: Guizhou Province, Duanqiao Marketshed
Cash crops to be developed	Tomatoes, persimmon, castor-oil plant, papaya and teak.

	Technological Constraints	Capacity-Related Constraints	Capital/ Credit Constraints	Other Constraints
Farm Level	• Vegetable seed varieties are out of date; some of the tomato seeds grown were varieties introduced more than 10 years ago. • Poor quality seed. • There is no established and reliable source of seeds for papaya, teak, and also chicks for poultry raising.	• Agronomic training will be necessary for smallholders to grow papaya or teak since these are new crops in the marketshed. • No access to timely market information. • Smallholders are unable to grade and pack their produce at the point of harvest.	• Most smallholders have little or no access to affordable credit to buy inputs. • Interest rates from some local sources are as high as 30 percent for such advances.	• The lack of clear legal rights over land removes a potential collateral source for smallholders to obtain credit. • Land holdings are unnecessarily and uneconomically scattered because of non-alienability of land.
Input Markets	• There is no access to low-cost soil testing. • Technology for producing papaya seeds in high volumes is also unavailable.	• The ability to deliver seedlings and seeds to smallholders is limited by the business development services and technical training required.	• Lack of capital to create and run nurseries.	
Output Markets	• Large operators have little incentive to establish capacity at this level because of the lack of scale.	• Lack of business development services and technical training to establish and operate food-processing facilities. • Transport facilities for perishable goods from Guizhou province in the south to the populace north in areas like Beijing are chaotic and poor.	• Lack of credit for establishing local processing facilities.	

ANNEX 2: CARDEP LOGICAL FRAMEWORK FOR PHASE 1 (YEARS 1 – 3)

Country and geographic scope	**China: Guizhou Province and Duanqiao Marketshed**
3-Year Goal	**Increase the net income of** 5,500 **smallholders by an average of** $US 500 **at the end of third year**

OBJECTIVE	3-YEAR TARGET	ACTIVITIES OF WI-IDE	INDICATORS
Farm Level			
Technology Strategy			
Develop and test pressure treadle pump, water bags and drip systems.	Marketable pump ready within 4 months of program start Marketable bags ready in 6 months Marketable drip systems ready in 6 months	R&D of new technology Conduct farmer trials and laboratory tests.	Technologies are ready for market on schedule
Promote irrigation technologies.	5,000 pumps in use 5,000 water bags in use 500 drip systems in use	Create demonstration plots, conduct farmer field days, and create presentations and displays.	Number of pumps, bags, drip systems in use (G)
Capacity-Building Strategy			
Provide training to smallholders in agronomy, irrigation techniques and farm management.	5,500 farmers trained	Conduct workshops and one-on-one trainings in the field. Recruit "barefoot trainers" to support other farmers.	Number of farmers trained (G) Improvement in skill level (G)
Capital/ Credit Strategy			
Search for new mechanism to improve efficiency and sustainability of micro credit program	Credit available for 2,500 smallholders.	Experiment with new management scheme for micro-credit and make the program sustainable Work with the provincial and other local governments to expand opportunities for smallholders.	Number of smallholders receiving credit (G)
Input Markets			

OBJECTIVE	3-YEAR TARGET	ACTIVITIES OF WI-IDE	INDICATORS
Technology Strategy			
Develop local capacity to research and identify suitable high value crops for the targeted areas	Five cash crops selected for promotion.	Collaborate with regional, national and international agricultural institutes.	Numbers of suitable crops identified and searching capacity of partner institutes
Capacity-Building Strategy			
Increase private sector's capacity to deliver products and services.	Establish supply chain: 3 treadle pump manufacturers 1 water bag manufacturer 1 drip system assembler 5 retailers	Develop private-sector supply chain. Provide business development services.	Number of manufacturers, assemblers, and retailers established Quality of pumps/bags/drip systems produced
Capital/ Credit Strategy			
Link supply chain dealers with credit institutions.	Link entrepreneurs with credit where necessary	Work with local government officials and other NGOs.	Entrepreneurs receive credit where necessary
Output Markets			
Technology Strategy			
Assist in start-up of post-harvest processing facilities.	Identify suitable technologies for processing	Research and identify tomato processing technologies and other processing technologies	Technologies identified
Capacity-Building Strategy			
Develop business practices of members of the supply chain.	To be determined	Provide training in basic financial management, record keeping, stock control, promotion and marketing skills.	Number of businesses receiving training. Level of skill
Capital/ Credit Strategy			
Link private-sector to credit institutions.	Link entrepreneurs with credit where necessary	Identify potential sources of credit and link them with the supply chain	Entrepreneurs receive credit where necessary

ANNEX 3: CARDEP TIMELINE

Country and geographic area	**China: Guizhou Province and Duanqiao Marketshed**

Program Objective/Activity	**Phase 1***			**Phase 2**		
	1	**2**	**3**	**4**	**5**	**6**
Farm Level						
Technology Strategy						
Develop and test pressure treadle pump, water bags and drip systems.	X	X	X			
Capacity-Building Strategy						
Provide training to smallholders in agronomy, irrigation techniques and farm management.	X	X	X	X	X	X
Capital/ Credit Strategy						
Increase credit opportunities for smallholders.		X	X	X	X	
Input Markets						
Technology Strategy						
Select cash crops for promotion.	X	X	X	X		
Capacity-Building Strategy						
Increase private sector's capacity to deliver products and services.	X	X	X	X		
Capital/ Credit Strategy						
Link supply chain dealers with credit institutions.		X	X			
Output Markets						
Technology Strategy						
Assist in start-up of post-harvest processing facilities.		X	X	X	X	
Capacity-Building Strategy						
Develop business practices of members of the supply chain.		X	X	X		
Capital/ Credit Strategy						
Link private-sector to credit institutions.			X	X		

CHAPTER 3

Deccan Plateau

PART I

REGIONAL EVALUATION AND PLANNING

SUMMARY TABLE
EXECUTIVE SUMMARY

1. ASSESSMENT OF THE TARGET REGION
2. 15-YEAR PLAN

SUMMARY TABLE: DECCAN PLATEAU - INDIA	
Geographical Area:	An inverted triangle in central and southern India bounded by the Western Ghats in the west, the Eastern Ghats in the East, and the Gangetic plains in the north. About 800,000 square kilometers.
Target Population:	17 million smallholder families in the region that have the basic pre-condition to engage in high-value crop production.
Water-Related: *Water Source:* *Water Storage:* *Irrigation:*	 Open wells, deep bore wells, canal systems Cement tanks, catchment ponds, open wells Low-cost drip and sprinkler irrigation systems
High-value Crops:	Fruits: pomegranate, mango, citrus, gooseberry, papaya Vegetables: tomato, eggplant, bitter gourd Spices: chile, garlic, ginger, turmeric
Favorable Conditions:	Well developed output markets. Innovative farmers. Increased water availability in watershed development areas
Constraints:	Lack of access to low-cost water lifting devices or drip irrigation systems. Inconsistent seed/seedling quality. Low level of agricultural knowledge. Lack of access to credit.
Strategies for Implementation:	5. promotion of low cost micro irrigation technologies through private sector marketing system and mass promotional campaign 6. linking irrigation development to watershed development programs. 7. development of productivity packages, i.e. software packages for farmer training and increased profitability 8. increasing agricultural knowledge among input supply chain 9. linking supply chain to extension system 10. work through local NGO's for training and promotion 11. linking farmers to output markets, including export.
Immediate Steps:	I. Implementation of a CARDEP program in Maharasthra for the development and testing of an adaptable yet generic intervention strategy for the Deccan plateau. *Cost of the Program:* $1,350,000 for the first 3 years. J. The development of satellite programs to survey smallholders and the high-value crop sub-sector, the development of specific water and small farmer productivity packages, consortium building for implementation, and the field testing of specific interventions. Cost of geographic expansion programs $1,200,000 per year. K. Selected sub-project investment opportunities including mass marketing of low-cost micro irrigation technologies, promoting linkages to watershed development projects, application of low-cost water lifting devices to micro-irrigation, dissemination of fruit and vegetable productivity packages, development of market information systems, development of leader farmers as entrepreneurs, facilitating market linkages, developing low cost packing materials, and more.

EXECUTIVE SUMMARY

The Deccan Plateau of central India is a large geographical area (approximately 800,000 sq. km.) covering most of the states of Maharastra, Andhra Pradesh, and Karnataka, and part of Madhya Pradesh. It is it roughly in the shape of an inverted triangle with the upper side bounded by the plains of northern India, the eastern side bounded by the Eastern Ghats (hills), and the western side bounded by the Western Ghats. It is characterized by relatively low and highly variable rainfall (300-900mm per year), which comes during the months June to September, but which has been increasingly erratic both in quantity and timing in recent years. The land is low altitude upland with undulating, gently rolling terrain interspersed with rocky outcrops.

Being such a large area, the ethnic makeup of the people varies by region. In Karnataka they are Kannada speaking people, in Andhra they speak Telugu, in Maharasthra they speak Marathi, and in Madhya Pradesh they speak Hindi. There is a large range of socio-economic groups within each village, ranging from large landowners down to virtually landless labors. There are pockets of tribal peoples, especially in the more remote areas and in uplands. The tribal people tend to be generally poorer than the general population.

Most of the area has a well-established infrastructure, both physical and commercial. Roads and rails are well established and reliable. Almost all villages are connected to markets by drivable roads. There is, however, an almost universal shortage of electricity. In many rural areas, there is only four to six hours of electricity available per day for irrigation use, and this also comes at off-peak usage times. As in the rest of India, the population is largely agricultural (about 75 percent). The area is crossed by several large rivers, mostly flowing in an easterly direction from the Western Ghats towards the Bay of Bengal. There are many large irrigation projects which have been developed from these rivers, but this only reaches a small percentage of the population and there are very few opportunities for further, reasonably priced major irrigation development. Many of the farmers in this area are culturally open to innovative agricultural practices, but are constrained mainly by a lack of access to water and a lack of knowledge about appropriate cultivation practices and market opportunities. The water situation in general is becoming more severe year by year for two reasons: first, people have been tapping ground water at an unsustainable rate, so water tables are dropping, and second, the rainfall patterns seem to be more erratic than in the past. On the other hand, there has been significant implementation of watershed development schemes over the last several years which has managed to increase available water in certain micro-watersheds. Certain broad themes surfaced from the extensive field visits taken during this study:

The area is somewhat diverse in terms of agro-climatic and socio-economic conditions, but certain broad themes surfaced from the extensive field visits taken during this study:

1. Large-scale irrigation development is unlikely to have any impact on the area for the foreseeable future. It is simply too expensive to further develop this resource. All the easy projects have been done already
2. Water scarcity is the number one problem facing the region, and the region's farmers.
3. The watershed development programs that have been implemented so far have done a reasonable job of increasing the locally available ground and surface water, but have not done much in the area of increasing water use efficiency, or increasing the cultivation of higher value crops to get more agricultural and economic productivity out of each drop of

water. For this reason, micro-irrigation programs focused on high value crops are a perfect complement to these watershed projects.

4. Farmers have access to appropriate agricultural inputs, but it is clear that they have little access to the information necessary to put these inputs to the most productive use. Most of the farmers visited were performing well below their potential in terms of productivity. A serious attempt has not been made to develop productivity packages for small farmers.
5. Fruit crops are particularly well suited for development in this region because, a) the climate and soil are well suited to a range of fruit crops, b) fruits in general need less water annually than vegetable crops, and c) the markets for fruit crops are well developed in the region. These fruit crops include pomegranate, grapes, citrus, papaya, mango, and gooseberry. There are, however, also opportunities for growing spices such as ginger and turmeric, and fresh vegetables as well.
6. Markets are generally well developed, but new farmers coming into the market have a low level of knowledge about how to take advantage of these market opportunities.

It is estimated that there are about 17 million small farm families in this region (farming less than 1 hectare of land). With the deteriorating water situation, it is increasingly the rich farmers who have access to water for crop production. As the expensive borewells draw down the water table, and large farmers use subsidized electricity to pump water, access to water seems just a dream for many. But there is hope through rationalizing the use of water by introducing efficient water technologies (drip and sprinkler) specifically designed for small farmers, and through giving them access to the inputs, information, and markets that will be necessary to productively use the water on small pieces of land. A 15 year targeted program to bring access to micro-irrigation and consequent increases in productivity to these small holders is proposed. This program would involve the collaboration of the national government, local governments, donors, NGO's and the private sector. Each of these players would have clear roles and responsibilities based on their resources and proven capabilities. The objective would be to reach these small holders through such a program and to increase their incomes by $100-$500 per year. This would have a significant impact on rural poverty in the Deccan both by raising families above the poverty line, and by keeping others from slipping below that line. The program would consist of the following components:

- A strategy for developing and disseminating micro-irrigation technologies to smallholder families through a market-driven, private-sector supply chain. And in order to increase the productivity of each drop of water used, and especially focusing the use of these technologies in areas where watershed development programs have increased available water.
- A strategy for linking smallholder families to output markets, increasing the flow of information from those markets to the farmers, developing and disseminating post-harvest technologies, and increasing the farmers' capacity to analyze and plan their activities based on market information.
- A strategy for increasing production and productivity of high-value crops by the smallholders through design and implementation of sustainable information-flow methodologies, a focus on off-season and specialized crop production, and linkages to a strengthened private-sector input supply chain.
- Increased access to formal and informal credit opportunities for the smallholder, especially through expansion of linkages to micro-credit institutions and savings and credit groups.
- Advocacy of government and donor policies to support these efforts, especially through rational allocation of resources to the targeted activities and removal of market-distorting policies and practices.

The CARDEP program detailed within this plan will pilot the intervention strategy in the first three years of implementation. In parallel, SIMI will develop geographic expansion programs to survey smallholders and the high-value crop sub-sector, to develop specific water and small farmer productivity packages, for consortium building for implementation, and finally for the field-testing of specific interventions.

Deccan Plateau Budget Table

Activity	**3 –Year Budget** (in $ millions)	**Smallholders Reached** **In 3 Years**
CARDEP	1.35	10,000
Geographic Expansion	3.60	52,500
Total	**4.95**	**62,500**

1. ASSESSMENT OF THE TARGET REGION

1.1 Biophysical Resources

Nearly three fourth of the total area of India is located on a vast plateau region called "The Deccan Plateau," which has emerged as a result of a volcanic eruption that occurred millions of years ago. This area now covers large parts of four states, i.e. Madhya Pradesh, Maharashtra, Karnataka and Andhra Pradesh. Despite the vast geographical coverage, this area is characterized by many similarities:

- A large area is covered under thick forests.
- There is a large concentration of tribal habitation with poor socio-economic status as a result of low literacy level and health condition.
- Most of the tribes are primarily dependant on minor forest produce.
- The tribal areas are characterized by poor infrastructure; specifically, abysmal irrigation options due to deep water table (beyond 200 metres).

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The following table provides some major statistics in the following four states[28], which would give a better understanding about the main Deccan Plateau states:

	Madhya Pradesh	Maharashtra	Andhra Pradesh	Karnataka
Total area (in sq. km)	4,43,446	3,07,690	2,75,068	1,91,791
No. of administrative districts	45	31	23	20
Rural population (in '000)	50,842	48,396	48,621	31,069
% rural population to total population	76.82	61.91	73.11	69.08
No. of operational holding from 0–2 ha (in '000)	5,053	6,003	7,183	3,848
No. of households below poverty line (in '000)	5,334	6,045	3,265	2,875
Tribal population (in '000)	15,390	7,318	4,199	1,915
Rural literacy %	35.87	55.52	35.74	47.69
Per capita income (Rs)	2,878	6,184	4,507	4,075
Net cultivated area ('000 ha)	19,740	18,021	10,362	10,790
Net irrigated area ('000 ha)	4,775	2,470	4,029	2,194
% net irrigated area to cultivated area	24.40	13.70	38.50	20.30

[28] As per 1991 census

A. Climate

The Deccan Plateau has a tropical arid to semi-arid climate. Temperatures are high throughout the year and rainfall is in the range of 300 to 900 millimeters per year with the average being about 600mm. Annual variation in rainfall is high. Temperatures often exceed 40 degrees Celsius in the summer, and rarely go below 20 degrees in the winter. The monsoon rains come in the period June to October, and rainfall in the rest of the year is close to zero. Thus even in those places where rainfall is higher, it all falls in a three-four month period leading to dry conditions for eight months out of the year throughout the region.

B. Agriculture

Agriculture in the region is highly variable. Throughout the region, there are small numbers of large farms with considerable resources growing plantation crops and deriving their water from deep tube wells. This business is highly lucrative, especially since water, which should be the most expensive resource, is indirectly subsidized by the state governments through the nearly free distribution of electricity for irrigation purposes and heavy subsidies for drilling, pumpsets and other inputs under government schemes. There are signs that this is changing, as the state electricity boards are losing huge sums of money now that irrigation use has become a substantial part of their user demand. So several of the state boards are beginning to raise prices, but they are still a long way from the real price. These farms grow sugar cane, rice, grapes, pomegranates, coconuts, bananas, citrus, pulse crops and many other high value fruit crops. The smaller farmers, on the other hand, are largely subsistence farmers, unless they happen to be lucky enough to be in the command area of an irrigation project. They grow mostly rain-fed millet and sorghum as staple crops and a few pulses such as local varieties of lentil and chickpea. When rainfall is good, many can grow enough to feed the family for a substantial part of the year, but when rainfall is below average, there can be a severe shortage of food grains. To make up the shortfall, farmers engage in selling their labor, and selling off livestock. It is a precarious existence. Vegetable cultivation is done around the house using waste kitchen water, and with no particular attention paid to maximizing productivity. It is almost a hobby activity of women, who use the produce for a few leaves into their evening meal.

C. Water Resources

As mentioned earlier, water is the key constraint to any agriculture development in the region. Around 22 percent of the total cultivated area in the Deccan is covered under irrigation schemes, and even this is probably an over estimate given the documented inefficiencies of large canal schemes. This leaves about 80 percent of the land either growing rainfed crops, or struggling for increasingly scarce ground water. The geology of the area is highly variable. In the east, there are various layers of volcanic rocks laid down over a period of millions of years and with varying degrees of weathering and cracking. In the west and south there are granites and laterites, also with varying degrees of weathering. Soil thickness also varies from place to place. Because of this variation, existence of shallow or deep aquifers is a highly variable proposition. But there are many areas where shallow aquifers exist, and even more areas where deep aquifers exist. The shallow aquifers are often tapped by digging open shallow wells. These often have to be dug into solid rock and so are relatively expensive to dig ($500-$1000). But in many places, this is the only source of drinking water for people and livestock. The deep aquifers are accessed by bore

wells with submersible pumps used for moving the water. These deep wells are even more expensive depending on the depth ($1500-$3000), but once water is found, pumping is cheap with subsidized electricity. We heard many stories of open wells in a village going dry after the sinking of a few bore wells. Thus the rich are draining the water of the poor. There are still many thousands of open wells in the area, but many are drying up. But there is some good news:

Watershed Development and Small-Scale Irrigation Opportunities

Water development in the Deccan Plateau focuses on watersheds where land and water areas contribute runoff to a common point. It is essentially the land area that sheds or drains water into a pond, lake or river or any other storage reservoir. Watershed catchments, drainage basin and river basin are all synonymous. In the watershed approach, a watershed is considered as a manageable hydrological unit, which can be used for the planning management of land, water and other resources.

An important parameter for small-scale irrigation opportunities in the Deccan Plateau is the net addition to groundwater reserves through the set of practices typically applied for watershed development projects. During the fieldwork, the SIMI team was provided estimates of groundwater reserves that varied from almost zero[1] to a more typical range of 30-40 percent. Where additional groundwater is available, opportunities for additional well water can be used to extend the availability of water for dry season vegetable production using drip irrigation. This water can also be used for cultivating fruit trees. Where water availability is limited, increased water use efficiency and changes in government policy are necessary in order to make better use of limited water supplies. Therefore, small-scale irrigation as well as supporting technical assistance in horticulture, marketing, community organization and credit should be closely tied to major watershed development or watershed management efforts. This is now made easier by the presence of Village Watershed Committees, which achieve active participation by watershed residents in the planning, execution, implementation and protection of assets created by watershed development programs. Credit schemes and Self Help Groups are common features of watershed development program. *These can form important entry points for SIMI activities*.

The watershed approach was first adopted in India in 1974 under a centrally sponsored "Scheme of Soil Conservation in the Catchments of River Valley Projects," under the Indian Council of Agricultural Research. In 1982, 46 model watershed development projects were initiated in dry areas of the country and in 1986 the National Watershed Development Program for Rainfed Agriculture was launched by the Ministry of Agriculture. These programs have evolved away from research efforts and toward joint projects implemented by cooperative efforts and funding by national, state, local and NGO organizations with heavy financial inputs by the National Bank for Agriculture and Rural Development.

1.2 Supply Chain Capacity

One key factor in creating a sustainable system for high-value agriculture is the existence of a private sector supply chain to deliver agricultural inputs (irrigation technologies, fertilizers, seeds, and pest control) to small farmers at a fair market price and within a reasonable distance from the farm communities. In the Deccan plateau, there exists a reasonably effective system to deliver these inputs throughout the area. However, it has been found that, while inputs are available, there are issues of quality (especially of seeds), and of the low level of knowledge of the inputs dealers. Since the farmers are getting most of their agricultural information from the inputs dealers, this presents a severe constraint on increasing productivity, especially as it is related to selection of proper plant varieties, use of high quality seedlings, cultural practices, and plant protection practices. The connection between the input suppliers and the technical information available from the government extension system is very weak. There is also an issue of the capacity of the private sector to scale up to meet the demands of an expanded high-value crop production system. There is the potential for a lag time between the increased demand of new entrants to intensive cash crop cultivation, and the private sector's ability to meet those demands. Thus there is a need to raise the capacity of the existing network in terms of knowledge, access to appropriate sources of improved inputs, and financial capacity to meet increased demand.

1.3 Input-Throughput-Output Markets

The small cultivators of the Deccan are dependent on a chain of small enterprises and information sources in order to sustainably participate in a cash cropping system. This chain consists of commercial access to appropriate agricultural inputs, access to information about proper cultivation practices, and access to various markets to sell their produce. The state of agricultural inputs supply is described in the section above.

In the development community, dissemination of information about appropriate cultural practices and harvest operations is traditionally thought of as the domain of the government extension service, and in isolated cases as the domain of projects or NGO's. In fact, we were hard pressed during our field visits to find any small farmers who had qualitative access to the government extension system, and while projects and NGO's often do a good job at agricultural extension, they are very limited in coverage. As stated above, this has left the inputs suppliers as the *de facto* source of all agricultural information to the small farmers. When questioned, almost without exception, small farmers stated that they received information about cultural practices from the inputs suppliers. Thus there is a disconnect between development dogma and reality in the field. We did not find any development agencies, government or private, who considered the inputs suppliers as an important target group for capacity building. This is a glaring omission.

The area in general is well connected to markets which have a well-developed system of buyers, wholesalers, brokers, and transport systems, although some of them lack basic infrastructure needed to minimize post-harvest losses. These markets are also hooked into a well-organized system that feeds produce to national and even international markets (we found some farmers exporting to Dubai). There are however many farmers who are at some distance from local or regional markets. In this context, the development of marketing groups/cooperatives, local and regional collection centers, and an intervention to make commercial linkages between those centers and regional markets can go a long way towards facilitating downstream marketing. Communities that have been growing vegetables for some time seem to have little trouble

connecting to existing market systems. However we found that communities where there are large numbers of new producers had greater difficulties. It is these new producers who need more market based interventions.

There are also issues of post-harvest handling. Currently there is little awareness among farmers of grading produce in order to get a higher price for higher quality goods. There are also high transport and packing losses because of a lack of appropriate and inexpensive packing techniques and materials.

General awareness of market forces is very low among new farmers, including the value of middlemen, the level of post harvest losses, and seasonal fluctuations of supply, and the impact of these things on seasonal and geographic price differentiation. Farmers see themselves as at the mercy of, or even victims of the market, rather than seeing the market as a complex system that is full of unexploited opportunities.

The final key constraint encountered in output markets was the general lack of effective systems for disseminating market information to farmers.

1.4 Policy Issues

A. Irrigation Policy (including electricity)

The entire Deccan Plateau is a water-scarce area and increased demand for water for human and animal consumption plus irrigation will likely lead to a doubling in demand for water over the next 30 years. This increased demand cannot be met by intensified watershed development efforts as mean annual runoff is already less than five percent of annual rainfall in large areas of semi-arid India. Even higher figures found in other watershed areas will not be sufficient to conserve enough water within the watersheds to meet future demand based on current patterns of water use. Since irrigation is by far the largest user of groundwater in the Deccan Plateau, water saving technologies promoted by SIMI, are essential. However, policy reforms will also be necessary to value water and remove excessive subsidies encouraging deep tube wells and subsidies for well installation and water charges. These measures will keep encourage water saving irrigation technologies and the use of scarce groundwater for the highest value crops.

Direct and indirect water subsidies is one of the areas of greatest need of policy change in India. The subsidy on electricity for irrigation purposes is supposed to be for the benefit of the poor farmers, but as explained above, it actually works to their detriment. Pricing of electricity is directly related to the price of water as most water is pumped using electric pumps. Until the state governments normalize irrigation electric rates, there can be no rational use of water by the farmers. It pays to pump more water because water has no value once a well installed. Examples of subsidies included low fixed charges per year for water, subsidized borewell and pumpset costs, and low fixed charges per year per horsepower for electric pumps. Heavy subsidies for saplings, bucket kits and drum kits were also found. While these measures can increase the demand for some water-saving technologies, they are ultimately self-defeating and work against the SIMI goal of sustainability through the private sector means.

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electric rates, there can be no rational use of water by the farmers. It pays to pump more water because water has no value once a well is installed.

B. Watershed Management Policy

The government of India is already doing a great deal in the area of watershed development, but this needs to be accelerated. Only through the proper development of micro-watersheds will water be available to small farmers in a sustainable manner.

It is policy that drought-prone areas such as the Deccan region should be made less vulnerable to drought-associated problems through soil-moisture conservation measures, water harvesting practices, the minimization of evaporation losses, the development of the ground water potential and the transfer of surface water from surplus areas where feasible and appropriate. Pastures, forestry or other modes of development which are relatively less water demanding are to be encouraged. Only through the proper development of micro-watersheds will water be available to small farmers in a sustainable manner.

It is part of official Indian water policy that the management of land resources should be on a watershed basis. Water policy promotes and integrated and holistic development of rainfed areas will be promoted by conservation of rainwater by vegetative measures on watershed basis and augmentation of biomass production through agro and farm forestry with the involvement of the watershed community. All spatial components of a watershed, i.e. arable land, non-arable and drainage lines will be treated as one geo-hydrological entity.

Despite the distorting effects of subsidies official Indian water policy strongly promotes the rational utilization and conservation of the country's water resources. Use of in situ moisture management techniques such as mulching and use of micro overhead pressured irrigation systems like drip and sprinkler and green house technology are officially encouraged for greater water use efficiency and improving productivity, particularly of horticultural crops. Emphasis is also placed on promotion of water harvesting structures and suitable water conveyance systems Participatory community irrigation management will be encouraged. These aspects of official Indian water policy will be highly supportive of SIMI activities.

1.5 Capacity of Potential Partners

A. Government

The Central and state governments of India are both very interested in the development of small farmers in their areas. Unfortunately, this often takes the form of giving subsidies on inputs. The governments however can be counted on to support efforts to develop the small farmers. Government research stations which we visited are keen to help in this effort, but have little understanding of the needs of small farmers and thus no idea in which direction to focus research. A properly designed intervention strategy will help towards making all these state entities viable partners.

B. NGO's

India has a well-developed NGO Sector. This exists at both the local, state and national level. Many have been in existence for 20 years or more, and have a well-developed financial and implementing capacity. These NGO's can be excellent partners. They have high access to villagers and a high capacity for community organization. Some have technical capacity in irrigation and agriculture, but many do not. International NGO's such as CARE, Action Aid and

Oxfam are very active in these areas. Two medium-sized NGO's that we visited had active and effective programs. They are Myrada in Karnataka and The Social Centre in Maharasthra. In addition to having high capacity themselves, they work at building the capacity of smaller, village based NGO's. They have both formed their own networks of local NGO's, and most of their program is implemented by the local entities, while they work on NGO capacity building, technical assistance and channeling funds from donors. This model seems to work very well.

C. Business Sector

The private, for-profit sector, as in all of South Asia, is very dynamic. There are a plethora of large, medium and small enterprises capable and willing to do business in the Agriculture sector. There is a wide spread network of inputs dealers and produce traders in all the areas that we visited. Only their technical knowledge is low, but their financial and management capacity is high. We ran into one interesting business called Tata Rallis India. They were in the midst of setting up a system whereby they take farmer memberships at a concessional price. For this membership, the members get a free soil test every year, and monthly visits from an extension agent. They focused on specific fruit crops. They intend to make their money by selling inputs to the farmers and by wholesaling produce from the farmers into national markets. This seems like a good model to try to replicate.

D. Donors

DFID is a major donor in the agriculture sector. GTZ, SDC, and Danida have put massive amounts of money into the watershed development sector. The Dutch government has been implementing two minor irrigation projects in Andhra Pradesh called AP Lift and AP well. These projects focus on organizing communities to make use of lift and well irrigation. They are based on a group approach and have had trouble meeting their targets. Many farmers we met mentioned that they didn't like the group ownership of pumps, because it leads to conflict and often the machines end up not being used because of the failure of the groups to work together. There are other individual approaches that have come up indigenously whereby one person owns the pumps and hires it out to the members. This approach seems to work well

1.6 Specific Thematic Items

A. Market Development

SIMI will increase the production of high value fruits and vegetables. For SIMI to be successful in substantially increasing the incomes and welfare of smallholders three principal market related conditions must be in place:

1. Farmers must be able to identify and efficiently produce high value crops that are in demand.
2. Marketing mechanisms that aggregate production, ensure quality, and provide remunerative prices to local producers must be in place.
3. There must be market demand to accommodate substantially increased production levels

This section focuses primarily on the steps to be undertaken for the development of marketing mechanisms and the identification of suitable crops/appropriate technologies. A. Historically markets for agricultural products have been underdeveloped. The Deccan smallholders have been subsistence oriented and internal and external marketing of agricultural products has been limited to primarily surpluses generated during years of good rainfall.

B. Cooperatives and market associations

To develop market linkages farmers and farmer groups must empower themselves to aggregate adequate amounts of product that meets market standards.
To accomplish this farmers must at a minimum develop group-marketing functions and ideally they would develop more structured cooperatives. Cooperatives enable farmers' to more effectively negotiate with traders. Cooperatives of sufficient scale can form linkages with large traders and market outlets. Extensive training is required to expand the coverage of cooperatives and market associations.

C. Contract Growing

Contract growing systems offer great promise for smallholders to successfully benefit from commercialization of agriculture. Contract growing systems reduce farmer risk, provide access to appropriate technologies, and provide access to credit. Contract growing mechanisms are at a nascent but expanding stage in India. Contract growing has a comparative advantage for processor that need to assure minimum levels of production, producers and buyers of perishable products, and producers and buyers of specialty products with important quality characteristics. Unfortunately, the business climate and trust between producers and sellers are week in India. The high cost of organizing smallholders also inhibits contract-growing operations. Allied SIMI efforts need to assist in initially organizing smallholders to reduce the transaction costs and should work to increase trust through sponsorship of workshops *(see trade matching services below).*

D. Trade Matching Services

These services can be conducted in a variety of ways. The most advanced methods include the use of the Internet and specialized software. More basic approaches include trade fairs where producers and buyers can meet, understand each other's requirements, and develop deals and contracts. Allied SIMI efforts should pursue a variety of strategies to accomplish trade matching: Trade fairs for producers and buyers, Workshops for producers and buyers with the goal of developing contracts, Market tours/visits to important market outlets in India, Conventional publication of contact information for producers and buyers, Internet approach for more advertising and matching buyers and sellers of more specialized high value commodities.

E. Market Information.

Currently, the state governments are collecting and disseminating daily price information for major markets in India. This is a critical service to the commercialization of agriculture. However, this price information is getting limited distribution. SIMI allied efforts will need to work to develop mechanisms for further distribution of this price information. Possibilities include: increase fax/email distribution linked to local institutions and local black board systems, assisting input suppliers to access information, and localized radio broadcasts. Market information systems must also be able to provide market analysis to inform farmer production decisions.

It is crucial that price information on high value crops be regularly available during the relevant periods to stimulate farmer interest in cultivating these crops. The lack of an adequate market information system has been widely recognized as a major constraint in the commercialization process for developing nations. Asymmetrical market information is also an important cause of high marketing margins. (Bloom and Tulachan 1995). Poor market information coupled with the

fact that many high-value agricultural products are often perishable, results in a poor bargaining position for farmers. It should be remembered that small farmers are subsistence oriented and often have little faith in markets. They greatly fear price collapses and variations. The impact of constant price information on farmer decisions will be profound.

What is needed is a call-in system, to make this information available to farmers or farmers' groups who can call from the well-developed telephone system in rural India. Access to this information would give the farmers or farmers' marketing groups the opportunity to make decisions about where to sell/transport their produce, based on the best available market prices. It would also allow them to know if they are getting the right prices from the middlemen.

F. Post Harvest Handling

Improvements in post harvest handling are critical for the success of SIMI. Losses due to poor post harvest practices and facilities are extremely high in India. Development of appropriate packing and shipping materials is one possible area of intervention. IDE India has implemented a project to develop lower cost, more environmentally friendly packing materials for tomatoes in North India.

1.7 Local Voices

During the survey, the team was able to meet with several farmers. The following is a sample of feedback:

- Farmers in Bavinahali Village are irrigating small plots of land (about 1 hectare) by lifting water from a canal with electric pumps. They get about six hours of electricity in a day. They are growing a combination of field and cash crops. The cash crops are mostly tomatoes, from which they earn about $400 per acre. But the canal dries up in January, and then they cannot grow a second cash crop. When pressed, they said that many of the open wells in the area still had small amounts of water in them even during the dry season (this is typical of land near a canal system). But they didn't consider this amount of water as worthy of using for cultivation. They are currently flooding their fields. If they switched to drip irrigation, they could grow small plots of vegetables or water fruit trees in the hot dry spring season. It has often been found that introduction of drip irrigation changes farmer perceptions of their water sources. Sources that were previously deemed too small can now be used productively.

- A similar situation was found in Karur village in Mahbubnagar. There, only families with deep borewells were irrigating. But there were three ponds in the village, and a public water system with a surplus. IDE had introduced some bucket irrigation kits which were being used productively. By putting a pressurized treadle pump on a pond, and pumping into a drip system, more families could irrigate. Also by using surplus from the community system women could grow kitchen gardens for increasing family consumption of vegetables.

- In Tipehalli village, we witnessed what had become a major transformation of the village due to introducing drip irrigation after implementing a watershed development scheme. Previously, there were only 25 families in the village irrigating and growing pomegranates. But since the last two years, more than 200 additional families had started irrigating from newly revived or newly dug shallow open wells. These families were now earning more than $1000 per year each from the sale of their pomegranates. They even had an arrangement with a broker who comes to their field and picks the best fruit for sale to Dubai.

- In Jitti village, we met a farmer who had planted Drumstick (a kind of vegetable that grows on a tree and bears within one year). He earned about $150 in the first year, and expects that his yield will double in the second year. He had very light soils and could not even dream of planting an irrigated crop until he heard about drip irrigation.

1.8 Principal Constraints

A. Water Shortage

Due to seasonal and inconsistent rainfall, and high temperatures, most small farmers are unable to grow more than one crop a year, and this crop is dependent on good rainfall. Also because of overdraught, especially by deep tubewells, the open wells in many places, on which people have depended for water in the past, have had decreased supplies of water. This makes it impossible to grow any type of high value crops which require investment and regular supply of water and other inputs.

B. Farmers Need Access to Low-Cost Efficient Irrigation Systems

We found many farmers who had heard of drip and sprinkler irrigation, but who had assumed that it was really for wealthy, large farmers. IDE has developed systems that are affordable and appropriate to small farmers, but they need to be more widely disseminated and promoted actively.

C. Lack of Access to Productivity Packages

Due to a lack of effectiveness in the Agricultural extension system, little information about how to increase productivity and cash earnings is reaching the small farmers. We did not find any farmers who had sustained, qualitative interaction with the extension services. Also, the agriculture research system, while well intentioned, is out of touch with the average small farmer, and thus unable to develop the proper productivity packages which would be appropriate to the situation of the small farmer.

D. Watershed Management Programs Not Focused on Efficient Use of Water

It was a continuous theme as we visited various watershed development projects, that they had been successful at increasing the amount to water available to the farmers, but that the farmers were using the water to flood irrigate staple crops like sorghum, millet, or maize. Without linking watershed development to efficient use of water and increased productivity, the money spent on all that development is simply not being effective spent, i.e. it moves farmers from one level of subsistence, to a slightly higher level of subsistence. There is no chance to lift these people out of poverty.

E. Need More Watershed Management Projects

While there have been a number of watershed development projects, there are also still many areas that need them, but don't have them. These projects are the key to including the poor in development. And it is not just the fact that they have more water after the project, it is also that everyone's awareness about water is raised, and they realize that it is a community issue, and not a resource to be squandered by the wealthy at the expense of the poor.

2. 15-YEAR RECOMMENDED PLAN

2.1 Target Population and Expected Market Penetration

Broadly the SIMI target population is smallholders with less than 1 hectare of cultivated land and with an income below national poverty standards. However, due to lower productivity in the Deccan Plateau farmers with even larger landholdings are classified as below the poverty line. The Deccan Plateau has a target SIMI population of about 8.9 million households and 44.6 million people (Table 1).

Table 1: Population of the Deccan Plateau

Item	Numbers
Target households	8,927,500
Target population	44,637,500

There are potential structural constraints to achieving SIMI objectives. In this section it is shown that basic market conditions can support substantial increased production of HVCs in the Deccan Plateau at remunerative prices that will enable SIMI to have a profound poverty alleviation impact. A basic analysis is conducted using extremely conservative parameters and where needed assumptions that will substantially underestimate the potential impact of SIMI. In the Deccan Plateau SIMI will primarily work in the area of HV fruit crops. Analysis in this section is restricted to fruit production. Increased vegetable production and marketing is the focus of the SIMI Gangetic plain intervention.

Table 2 shows the size of the Deccan Plateau fruit market. The total market size is estimated to be 22 million metric tons annually. This figure is based on one half the India market being available for Deccan Plateau fruit producers. The estimate of 50 percent market access for the Indian Deccan Plateau represents a conservative figure as the Deccan Plateau is located at the heart of the Indian Subcontinent and is in proximity to major urban population centers.

Table 2: Deccan Plateau fruit market.

	Total fruit Production (Mt)	Deccan fruit Market Size (Mt)	Percentage of National Production in Gangetic Market Shed
India	44,042,400	22,021,200	50%

Currently total market revenue value is estimated to be USD 3.3 Billion for the market accessible to the Deccan Plateau. This is based on a composite fruit price of USD 150/Mt, which is an average of HV fruit crop prices in India.

Table 3: Current Deccan Plateau market conditions

Item	Value
Composite fruit Price ($/Mt)	150
Total Production (Mt)	22,021,200
Market Revenue ($)	3,303,180,000

The analysis of the Deccan Plateau market potential includes two components:

- Increased market demand from increased population and economic growth
- Increased efficiency of production associated with micro irrigation and productivity boosting micro irrigation agricultural technology packages

It is estimated that the Deccan Plateau fruit market will grow at an annual rate of 6.7 percent based a composite economic growth rate of 5 percent, population growth of 1.6 percent and an income elasticity of 1.1 (Table 4). This prediction is in line with historical trends; current annual growth rate is 5.3 percent. After 15 years a growth rate of 6.7 percent will lead to a more than two fold increase in the demand for fruits.

Table 4. Economic Growth Parameters

Item	Value
Annual Economic Growth	5.00%
Annual Population Growth	1.60%
Income elasticity	1.1
Annual Demand Growth	6.76%
Demand Growth Year 1	1.07
Demand Growth Year 2	1.14
Demand Growth Year 3	1.22
Demand Growth Year 4	1.30
Demand Growth Year 5	1.39
Demand Growth Year 10	1.92
Demand Growth Year 15	2.67
Note: demand growth is 5.3% annually	

Conservatively it is assumed that SIMI interventions will lead to a 15 percent outward shift in the supply of fruits. That is farmers will become 15 percent more efficient in producing high value fruit crops with micro irrigation and associated technology packages. The impact of this shift was estimated using a partial equilibrium model. Table 5 presents model parameters. The demand and supply elasticities represent conservative estimates (see Table 4 above).

The partial equilibrium analysis shows that under current market conditions production will rise from 22 million MT to 24 Mt annually (Table 4). Price will decrease from USD 150/Mt to USD 137/Mt but farmers will maintain profitability because they will be more efficient producers.

Table 5. Partial equilibrium model results

*Partial equilibrium model parameters	
Items	**Value**
Demand elasticity	1.2
Supply elasticity	0.5
Supply shift	0.15
Partial equilibrium model results	
New Price ($/Mt)	136.8
Old Price ($/Mt)	150
New Quantity (Mt)	24352862
Old Quantity (mt)	22,021,200

The total result is an ability of the Deccan Plateau market to absorb more 3.8 million Mt of fruit production at remunerative prices after one year and 39 million Mt after 15 years (Table 6). This implies a potential for 382 thousand hectares of HVC in the Deccan Plateau after one year and 3.9 million after 15 years leading to the potential to lift 1.2 million households out of poverty in the first year and 13 million households after 15 years. The size of this potential market exceeds SIMI objectives for poverty alleviation.

Table 6. SIMI Deccan Plateau market potential and penetration

Market potentials for SIMI	Year 1	Year 3	Year 5	Year 10	Year 15
Production (Increased demand)	1,488,633	4,774,597	8,519,839	20,335,940	36,723,604
Production (Improved efficiency)*	2,331,662	2,331,662	2,331,662	2,331,662	2,331,662
Total SIMI Production	3,820,295	7,106,259	10,851,501	22,667,602	39,055,266
Total Area SIMI Production	382,029	710,626	1,085,150	2,266,760	3,905,527
No. of SIMI Households	1,273,432	2,368,753	3,617,167	7,555,867	13,018,422

*Note: Composite yield of 10 Mt/hectare is used; note Deccan yields are lower than other areas of India
** It is estimated that households will crop 0.3 Ha in SIMI interventions to achieve a USD 500/ year income increase. This is more than the Gangetic Plain and the Nepal hills because productivity is very low in the Deccan area due to lack of water.

2.2 Basic Water/Micro-Irrigation Development Strategies

IDE has already developed a series of low-cost drip and sprinkler systems which have been specially designed for small farmers in India. They have been tested in the field, and there are already about 10,000 systems operating successfully. Because their systems are designed using parts that are already widely used in other drip irrigation systems, there is no problem in manufacturing them. One issue is further refining them into a wider range of kit sizes that fit the needs of specific farmers, such as a 500 square meter kit and a 1,000 square meter kit. This is in process and should be completed in the near future according to IDE staff. Beyond that, a wider system of private sector dealers needs to be established. The systems also need to be widely promoted using a professional style promotional and advertising campaign. Getting local NGO's involved in promotion is a good strategy in India. Also, by linking up with watershed development programs, it can be assured that water sources will be sufficient to satisfy the needs of large numbers of small farmers. Along with drip and micro-sprinkler systems, "pressure"

treadle pumps, which can pump water from shallow sources into a pipe at pressure, can be widely used to pump water into these systems from open wells, ponds, and canals.

2.2 Output Markets for Smallholders

Output markets in the Deccan are very well developed. Mainly because there already exist many large farmers who are involved in the same business of marketing fruits and vegetables into local, regional, national and international markets. Small farmers simply need to be hooked into these same markets. As the production expands however, there will need to be an extra effort to make sure that local markets don't get saturated. Market facilitation efforts should focus on facilitating export markets, and working to develop contract farming opportunities into which the small farmers can be linked. Intermediary producers associations would make it easier for these types of businesses to deal in the types of volumes of produce that they need.

2.4 Strategies for Implementation

A. On-Farm Technologies (inputs and management techniques)

A national team of experts (comprising of government and private experts in the field of horticulture) needs to develop a series of productivity packages for fruits and certain vegetables and spices. These packages will be developed based on assessment of the national market potential for fruit consumption, fluctuating market demand and price of certain commodities, and on the technical feasibility of growing vegetables in the off-season. . The packages should include the practice of intercropping vegetables between the young trees until they are bearing fruit. This will allow the farmers to put a piece of land into fruit production while still earning money from that land until the trees bear fruit. These productivity packages will include a well designed syllabus for training the farmers for growing each commodity, and a syllabus for training of trainers (this will be a joint effort of government, NGO, and private sector). Some contracting agency/agencies will act as a facilitator to set up a public/private extension partnership program. The government (high skill level-low access to farmers) will act as a wholesaler of the information in the productivity packages. NGO's, community based organizations, farmers groups, and private input businesses (low skill level- high access to farmers) will act as retailers of information. The donors and facilitating agencies will make sure that the government has the skill necessary, and will make the initial linkages between the government staff, and private businesses and leaders of other organizations. These people will then have continued access to the government extension services, and will act as a conduit through which the farmers can access information and practices.

B. Post Harvest Technologies and Output Markets

Since output markets are largely well developed in India, there should be two main thrusts of an output marketing program.

- Linking new producers into existing markets. This can be done by holding meetings between producers and traders in the local output markets. At the same time, training should be given to producers to make them aware of how the output markets work. Farmers can also be assisted to form marketing groups, or developing other systems to pool their produce for more efficient marketing. One such system is for farmers in a group to assign some of their members to market the produce and to receive a fee from each farmer for the service.
- Looking for new opportunities such as expanded export markets, contract farming, or agro-processing.

Facilitating agencies will be responsible for four areas: 1) making sure that farmers are linked into existing markets (domestic and export) by giving market training and holding workshops with farmers and merchants attending, 2) where existing markets are not sufficient, contracting agencies to set up marketing groups among farmers, in order to market their own produce. This involves a high level of community organization and training, and linkages between the groups and domestic or export markets, 3) working with the private sector to identify agro processing opportunities and to facilitate the relationship between the farm suppliers of produce and the industries, and to make sure that the industry is capable of marketing their own products, and 4) looking for linkups with companies that are in the export market in order to expand export of the commodities to Europe, the Middle East, and North America.

C. Supply Chain Development

In the case of India, there are two types of supply chains for agriculture inputs. Irrigation equipment is sometimes sold by specialty stores or hardware stores. These stores supply only irrigation equipment and tools to farmers and not other inputs. These stores need to be linked in with state level suppliers, and given training on the basics of horticulture, and installation, repair and maintenance of irrigation systems. These dealers should be involved in the promotional activities and training on irrigation given by the projects. Other agriculture inputs are sold through ag supply stores. These stores also need to be hooked into suppliers of the recommended inputs for the chosen productivity packages. The appropriate packages of irrigation technologies and agro-inputs will have been identified early on (and continually refined) by a panel of experts working with research institutions and other development agencies. It is then up to a facilitating agency to make the linkages between suppliers (domestic and foreign) of these commodities, and an appropriate chain of inputs dealers. Also the capacity of this chain will be built up through training on the specific productivity packages. The necessary supplies include seeds, fertilizer (macro and micro), pest control, and tools. The chain of dealers will then be linked up with the targeted farmers. In most cases, it should be attempted to involve the inputs dealers in the training of the farmers. This establishes an early linkage between them. The dealers should be encouraged to participate in order to expand their business.

D. Finance

The entire supply chain will have to be capitalized. While it was observed that currently, capital is not a major constraint for most of the inputs suppliers, it will no doubt become a constraint if their business doubles or triples as would be expected from a program such as this. In this case, the supply chain is well able to access traditional formal sources of credit such as public sector banks. The banks will need to have sufficient capital set aside for this purpose. Further development and expansion of micro-credit institutions for credit to the farmers will be necessary. The program will formally link micro-credit institutions with the communities where the production programs will be going on. Also the program can work with NGO's that promote savings and credit groups which have been quite successful in India. The program can also experiment with working with input suppliers to supply credit to farmers. It is well known that dealers issue goods on credit to those who are well known to them. A system should be designed that will teach dealers how to make home visits, assess credit risks, and charge customers extra for the service.

2.5 Policy Implications

First and foremost, the government must recognize that NGO's and the private sector are significant actors in the alleviation poverty in this program. The government must be willing to

work in true partnership with these entities. There already seem to be positive moves in this direction, but still a long way to go. The research institutions must get out into the field with the NGO's and see the problems of the small farmers. Programs can be designed in a program like this to promote farmer tours and interviews for researchers. Then the extension service must be willing to act through other agencies rather than seeing agriculture extension as their primary domain. Secondly, the government needs to start to rationalize the pricing on electricity. We realize that this is a hot political issue, but it is critical to the future development of ground water resources in the Deccan. Thirdly, some of the money that goes into large irrigation projects could be diverted to watershed development programs. This would bring water development out of the bottom lands where farmers are already better off, into uplands where the majority of the poor live.

PART II

IMMEDIATE INVESTMENT OPPORTUNITIES

3. CORE ACTION RESEARCH AND DEVELOPMENT PLAN (CARDEP): DEVELOPMENT OF AN INTERVENTION STRATEGY

4. GEOGRAPHIC EXPANSION

3. CARDEP: DEVELOPMENT OF AN INTERVENTION STRATEGY

3.1 Marketshed Description

Twelve districts have been identified in the Deccan plateau region of Maharashtra as priority areas for implementation of a three program. The districts are: Nandurbar, Dhule, Jalgaon, Jalana, Aurangabad, Ahmednagar, Solapur, Latur, Osmanabad, Amaravati, Wardha, and Yeotmal.

Maharashtra has some medium- and large-size dams built on its rivers for irrigation, but groundwater sources account for the majority (58 percent) of the irrigation water use. The percentage of cultivated land that is irrigated is less than half of the national percentage. The available water resources have not been used judiciously and renewable water resources (rain water, run-off water, etc) have not yet been exploited. The target districts have even less irrigated area because of scarce water resources and below average, erratic rainfall. Recurring drought conditions in some districts have led to a reduction in irrigated area and have created drinking water shortages. An estimated one third of the total 40,412 villages, suffer from drinking water scarcity every year. Because Maharashtra is a water scarce state, there are many grassroots NGOs working in watershed management and rural development in the target districts.

Table 1: Irrigated area in Maharashtra Compared with National Total

	Maharasthra	India
Gross Cropped Area (000 hectares)	17,895	141,108
% Irrigated Area	16%	35%

Maharashtra has a good network of roads and communication facilities available. Telephone services, as well as satellite television, have reached almost every village. Electric power supply has also reached every village, but the availability is very erratic due to increased loads, maintenance, repairs, non-payment of electric bills and delays in getting connection to the individual user. There are input and output markets for agriculture commodities down to the tehsil level, which can be 1 km to 25 km from a village. All commodities may not be marketed in these rural markets and farmer may have to go to district markets, which can be up to 100 km away.

The government has established four agriculture universities in the state and several research centers for specific crops. However, it is difficult for a small farmer to access information from these centers and the state extension service is unable to meet the needs of the farming community.

There is a network of banks down to the tehsil level and co-operative societies at the village level, but access to credit for a smallholder is still difficult because of the complicated application procedures.

3.2 Target Population

The target population in Maharashtra includes small and marginal farmers that have 2 ha of land or less and access to adequate water for agriculture. The total population of the target districts is approximately 25 million (5 million households) of which 60 percent are rural (3 million households). Table 2 indicates that 2 million of the households are smallholders (i.e., 64

percent with land holdings of 2 ha or less). Assuming that 50 percent of these smallholders can potentially benefit from CARDEP interventions, the potential target population is one million households. In the three-year timeframe of this program, it would be expected to reach two percent of this target group or approximately 20,000 smallholders.

The majority of these farm families are at or below the poverty line. They typically use their own family labor to cultivate rain fed crops. Vegetables can be grown if smallholders have access to water. Most smallholders do not have access to canal irrigation, but many have their own open well or access to water from a neighbor's well. Surplus produce is sold in local markets to supplement cash income. Marketing challenges that smallholders face include price instability, market monopolies, unsupportive government policies, lack of transparency in trade, and lack of market information among others.

Table 2 : Size of Operational Land Holdings in Maharashtra (1991 Census)

Land Holding Size (ha)	Number of Holdings (000)	Percentage of Total Holdings	Average Size of Holding (ha)
Below 0.5	1667	18%	0.25
0.5 to 1.0	1607	17%	0.75
1.0 to 2.0	2727	29%	1.46
2.0 to 5.0	2524	27%	3.15
5.0 to 10.0	724	8%	6.73
10.0 and above	170	2%	15.75
Total	9469	100%	2.21

Table 3 shows that agricultural productivity in Maharashtra is generally below national averages, especially for cotton and cereals. This is mainly due to inadequate irrigation and poor seed varieties and cultivation practices. The least educated in the family takes up farming as an occupation because there is no where to go. Better-educated family members normally try to migrate to cities and towns in search of work. Therefore, farming has become an unfavorable profession for most. Due to scarce water resources that prevail in the identified area and lack of "know-how," many farmers are unable to cultivate cash crops, which could generate higher incomes.

Table 3: Yield Comparison for Principal Crops (kg/ha)

Crop	Cereals	Pulses	Cotton (Lint)	Sugarcane
Maharashtra	990	505	123	71245
National Average	1639	563	240	65644
Maharashtra as a % of National Average	60%	90%	51%	109%

Source: Department of Agriculture and Cooperation, 1991

3.3 Water Strategy

For the Deccan Plateau area in Maharashtra, water is crucial for developing agriculture and enhancing rural incomes. The rainfall in the Deccan Plateau occurs during monsoon season (June-September) and is mostly concentrated in a 30- to 60-day period. Most of the streams flow only during monsoon and water availability during the dry season is greatly reduced. The total irrigated area is slightly less than 3 million ha, with potential for another 4 million ha if existing water resources are used efficiently. There are approximately 100 tehsils in Maharashtra that are drought prone, i.e one third of the total 315 tehsils in the state. Due to excessive pumping, and reduction in rainfall, the depth of the water table in general is going down as sufficient recharge is not taking place. There are various recharge techniques that can be used by the individual farmer

or by the community in order to recharge underground water tables. Different grass-roots NGOs are engaged in watershed development projects and promoting soil-water conservation and water recharging for the drought prone area. Many of these drought prone tehsils come under the target area. The project will use the following strategies for water management in the target area.

1. There are various bilateral, government, and NGO agencies working in the field of watershed management and rainwater/runoff water harvesting in micro and macro watersheds of drought prone areas. IDE will collaborate with such agencies and provide technical inputs in terms of water harvesting, storage, conveyance, distribution and water recharge to be promoted at the farmer level so that enough water is available for the cultivation of cash crops.

2. There are approximately one million wells in Maharashtra irrigating 56 percent of the total irrigated area, and it is estimated that another one million could be dug. Most of the wells owned by small and marginal farmers have inadequate water supply to cultivate cash crops. The project will promote affordable and appropriate technologies to suit the needs of smallholders so that they can use the limited water to practice commercial horticulture.

A. Water Lifting Technologies

Use of low-cost rope and washer pump and treadle pressure pump to lift water:

The majority of the farmers who are irrigating depend on ground water from open wells, which are 20 to 80 feet deep depending on the water table. There is a government scheme through which a smallholder receives some assistance to dig a well for irrigation. However, putting up a pump and getting an electric power supply connection is very difficult and expensive. Moreover, the power supply is inadequate and erratic. To overcome this problem, the project will introduce rope and washer pumps, which can lift water from up to 80 feet deep. For shallow wells up to 25 feet, theIDE treadle pump can be used to lift water. In order to store water in a tank to be used with drip irrigation, the pedal -operated pressure pump can be used.

B. Water Storage Technologies

Use of low-cost water tanks for storing water:

One important drawback in water harvesting is the cost of water storage for the individual farmer. IDE has been working on low-cost water storage in India, Nepal, Bangladesh and China for the last two years and has come up with a range of low-cost water storage systems for the individual farmer, which has brought down the cost of water storage from 5 cents a liter to 0.5 cents per liter. The range of water storage structures that IDE has developed include a two-layer polyethylene bag (developed by IDE China) and low-cost concrete tanks.

C. Affordable Micro Irrigation Technology (AMIT)

Low-Cost Drip/Sprinkler System for efficient use of available water resources to irrigate high value crops: The conventional drip system has a high initial cost and is suited to large holdings of more than an acre. IDE has developed low-cost drip/sprinkler systems for smallholders, which are currently being promoted in India, Nepal, China, Bangladesh, Vietnam, and Zambia. AMIT systems are in the form of ready-to-use kits, assembled and packaged so that they can be sold off-the-shelf, and installed and used by farmers on their own. IDE's experience has been that affordable micro- irrigation technology enables smallholders to cultivate cash crops with small amounts of water and increased crop intensity. This enables farmers to increase their incomes two to three times more than income from traditional crops. Farmers can also increase their area under irrigation by using AMIT systems with available water.

3.4 High-Value Agricultural Products

Smallholders typically divide their plots into different crops: rain fed cereal crops and vegetables or cash crops, depending on availability of water. Therefore, it is important to design a crop mix based on local conditions that will provide the maximum benefit to the smallholder. Some crops as described in Table 4 below have been identified for the start-up phase, as high-value crops, which are suitable for the agro-climatic conditions of the Deccan Plateau and can be cultivated by smallholders. Many progressive farmers are cultivating these crops and have gotten excellent returns.

Table 4: High-Value Cash Crops for the Deccan Plateau

Crop	Description	Time to yield	Markets
Pome-granate	Grows in light- to medium-, well-drained soil. Requires hot, dry climate, low water requirement, drought resistant. Harvest up to 3 times per year. Popular due to low cost and high returns; 27,000 ha under cultivation in Maharashtra.	18 to 20 months -	Local, regional, national, and export markets. Market is dominated by middlemen and is not transparent. Processing opportunities are largely unexplored. Medicinal uses could be developed. Farmers have earned net income ranging from US$ 700 per acre to US$ 7000 per acre
Papaya	Suitable to local agro-climatic conditions. Requires loamy soil and warm, dry climate. Low water requirement. Many varieties available that give high yields. Seed selection is important because of virus attacks on the tree and male and female flower ratio.	Within the first year.	Commonly grown on many small farms for home consumption. Local, regional and national markets exist. Processing plants available for manufacturing papain and cherry.
Mango	Largest fruit crop by area in Maharashtra (200,000 ha). Low maintenance compared to other fruit crops. Can withstand heavy rainfall as well as dry conditions. The alternate or erratic bearing of mango is a major drawback and depends on varieties and cultural treatment.	4 to 5 years - bear full fruit after 8 to 9 years.	Mostly sold locally as fresh fruit. Maharashtra is a major exporter of alphonso mangoes to Middle East and European markets. India produces about 59% of world's mangos but has only 13% export market share. Varieties like alphonso are in high demand on national and international markets. Processing options for mango: canning, pickling etc.
Amla (Goose-berry)	Suitable to local agro-climatic conditions. Low maintenance. Grows in all soil types except very sandy soils. Low water requirement. Good boundary plant; acts as wind break.	Budded plants will start yielding in 6 or 7 years.	Considered a medicinal fruit and is used in many Ayurvedic preparations. Some varieties yield high value fruits and there is a good market with companies making herbal products. Can also be pickled.
Citrus fruits (Orange & Lime)	Very well suited to local agro climatic conditions. Grows in a wide range of soils, light to medium soil with good drainage is best. Oranges are the second largest fruit crop in Maharashtra (110,800 ha). Harvest up to twice per year.	4 to 7 years -	Can be sold at local, regional or national markets. The main citrus fruits grown in Maharashtra are Mandarin orange, sweet orange, and lime
Spices (Ginger, Turmeric)	Ginger and turmeric are high value spice crops with similar life cycles. Both crops grow well in tropical and subtropical climatic conditions in light to medium soil. Partial shade is better for ginger. Warm and humid climate is good for turmeric.	8 to 9 months.	There are local, regional and national markets. Ginger is grown for its aromatic rhizome both in fresh and dried form. Around one third of ginger produced in India is exported to other countries. Spices Board exists at the national level. Organic cultivation of ginger can fetch high value export price.

A. Vegetables

In addition to the crops summarized in Table 4, vegetables like tomato, garlic and bitter gourd, if planted at right time, can fetch very good prices. Most of the vegetables are short duration and are harvested within three to four months. Therefore, farmers can cultivate multiple crops in a year. Compared to the fruit crops, the returns of vegetables are much quicker, which helps the

smallholder to manage daily expenses and cash flow. Vegetable cultivation requires manual labor and the smallholder, by using family labor, has a comparative advantage over larger farmers.

The present production of vegetables is approximately one third of the total requirement of the country. The majority of vegetables produced in a region will reach the market at the same time, resulting in low prices for farmers' produce. Slight changes in the production schedule, harvesting earlier or later than the majority of producers, can benefit the farmer immensely. There is also a tendency for farmers to follow trends en masse; all farmers in a region grow the same crop, leading to a market glut and low prices. With minimal market information and coordination, farmers can take avoid potential gluts and take advantage of other crops.

There are local, regional and national markets available for major vegetable crops. Some vegetables are exported to the Middle East. Relatively easy access to the Mumbai port is an advantage to farmers in Maharashtra.

Vegetable-growing operations can be classified into six categories, all of which will be considered within this program, according to the situation and needs of the smallholders.

– *Home Garden / Kitchen Garden*: The home garden is mostly developed to produce vegetables for family consumption and accordingly it is smaller.
– *Market Garden*: The market garden produces vegetables for the local market. Most of these gardens are located within 10 km to 15 km from the rural / urban market. The cropping pattern will depend on the demand in the local market.
– *Truck Garden*: The truck garden produces selected vegetables for distant (export) markets by intensive cultivation. The crops will be selected based on market demand and agroclimatic conditions.
– *Processing Garden*: This garden is developed around a processing factory and the vegetables produced are mainly supplied to the processing factory. This type of garden will grow vegetables suitable for canning, dehydration, freezing etc.
– *Forced Garden:* In the forced vegetable garden, the vegetables are produced out of the normal season. The technologies like low-cost greenhouses or low tunnels can be used for this purpose. The vegetables produced in the off season normally fetch a very high price compared to the normal season.
– *Vegetable Seed Production*: The seed production garden is used to multiply the seeds and it is priced at a much higher price than normal vegetables. There are many seed companies in Maharashtra and they require small plots for seed multiplication.

3.5 Constraints Analysis

1. Farm Level

a. Technological Constraints
Lack of low-cost water lifting devices: Many smallholders have their own wells, dug with assistance from the government, but the cost of lifting devices, especially electric or diesel pumps, is too high for small and marginal farmers.

Lack of availability of low-cost water storage structures: The existing water storage for low-cost drip costs approximately 5 cents per liter to 10 cents per liter, which is costly for the smallholder and limits the use of low-cost drip systems.

Lack of availability of quality horticulture plants/seeds: The required varieties of horticulture plants are not available at the existing government and private nurseries. Farmers can produce seeds for some crops, but due to the lack of proper process/treatment the quality is not good.

b.Capacity-Related Constraints
Lack of agricultural extension: Information on new technologies, varieties, markets etc. from agriculture universities, research institutes etc. is not reaching the smallholder.

Inadequate knowledge of improved agricultural practices like organic farming techniques: Some of the cash crops under consideration can obtain a high price as organic products in the export market. The smallholders lack information on cultivation practices such as organic methods and certification.

Lack of knowledge in developing nurseries for specific crops: Some of the cash crops need to be planted every year after harvesting the previous crop.

Lack of knowledge regarding markets, prices, etc.: Most small farmers are not aware of market information for crops under consideration (when, where, how to sell, and prices).

Lack of knowledge in post-harvest technologies like grading: Many farmers do not grade or sort the produce by size and quality according to the buyer's requirement.

Lack of knowledge in water recharge techniques: Most farmers do not recharge their wells during the rainy season and water table keeps going down every year.

c. Capital/Credit Constraints
Lack of micro credit: Most smallholders do not have access to institutional micro credit for farm inputs and operational costs.

Bottlenecks in getting loan from the banks: Most banks providing credit to farmers have complicated procedures that make it very difficult for small farmers to get credit from banks for major activities like well digging, pump purchase, etc.

d. Other Constraints
Lack of regular electric power supply: Electric power supply in Maharashtra is worsening. It is irregular and inadequate.

Lack of outside labor for specific operations on the farm: Since most of the workers want to migrate to cities and towns in search of work, availability of agricultural labor in rural areas is reduced. The smallholders have to depend on family labor.

2. Input Markets
a. Technological Constraints

Lack of suitable lifting devices for smallholders to fill storage tanks: To fill the storage tank for a drip system, suitable low-cost water lifting devices, which can work manually, are not available.

b. Capacity-Related Constraints
Lack of supply chain for low-cost drip and water storage tanks: IDE has set up component manufacturers for low-cost drip in several places in Maharashtra. However, a local network of

dealers and assemblers is not yet available in the area.

Subsidy-driven market for drip systems: There is a subsidy provided by the state government for purchasing drip systems. However, it is available only for large systems and reaches only influential farmers. Most farmers are aware of the subsidy and therefore refuse to pay full price for a system.

Inadequate plant nurseries for crops under consideration: The existing nurseries are not sufficient to supply plants for the cash crops under consideration.

Lack of knowledge related to technology and products: The existing supply chain of agri-input dealers lacks knowledge in agricultural technologies—low-cost drip, water storage tanks, etc.—and therefore cannot provide good information and advice.

Lack of knowledge regarding cultivation practices of crops under consideration: The existing supply chain of agri-input dealers does not have knowledge regarding cultivation practices of the crops under consideration. Therefore, they are unable to recommend suitable inputs required by the crops that the farmers want to grow.

Recommendation on the basis of profit margins from specific products: The agri-input dealer recommends products based on maximum profits, not what is best for the farmer.

Absence of agri-input dealers in some rural markets: There are some rural markets where agriinput dealers are not available and farmers have to travel long distances to procure the required inputs.

c. Capital/Credit Constraints
Limited credit from the manufacturer to the dealer: The credit provided by the manufacturers to the dealers is normally 30 to 40 days. Depending on the product, there is often no credit provided by the manufacturer.

Bottlenecks in bank procedures: Most of the banks in rural areas have tedious procedures for giving credit, which makes it difficult for small enterprises to get credit to set up, run or expand business.

Limited micro-credit organizations: There are few micro-credit organizations that can provide credit to small enterprises. Oftentimes, micro-credit institutions that work with NGOs do not have enough resources or finances available to provide credit to small enterprises.

3. Output Markets

a. Technological Constraints
Lack of processing industry/technology for some crops under consideration: Processing of crops like pomegranate, ginger etc., is not available in the project area.

b. Capacity-Related Constraints
Lack of dissemination of market information: The information on different markets, existing prices, price fluctuations etc. is not readily available to the smallholders and the existing output supply chain.

Lack of output supply chain for some crops and for remote areas: The output supply chain is not available for crops like gooseberry, ginger, turmeric etc. and farmers have to sell it in local markets.

Lack of professional approach in agriculture output market: The agriculture output market is mostly dominated by traditional business people who are not willing to invest in new opportunities.

c. Capital/Credit Constraints
Lack of institutional credit to new micro-enterprises: New micro-enterprises in output market do not have access to institutional credit to set up exporting/trading businesses.

d. Other Constraints
Monopoly of existing traders in agri-business: Agricultural trade is dominated by business people in local, regional and national markets. It is difficult for new entrepreneurs to enter these markets and compete.

3.6 Intervention Strategy

1. Farm Level

a .Technology Strategy
Devise suitable cropping patterns: The goal is to provide the best cropping pattern to the smallholder so that the farmer has the comparative advantage in cultivating these crops and gets maximum returns. The project will conduct extensive studies of the cash crops under consideration and identify suitable varieties for each area, cultivation practices, output market etc. and address the constraints in cultivating these crops and marketing them. The project will partner with local agricultural universities, research institutes, agriculture trade organizations, exporters and NGOs working in the area.

Appropriate water technologies: IDE has extensive experience in the dissemination of affordable and appropriate technologies for smallholders in India. IDE's core strength lies in developing affordable technology and making it available at the village level by creating a private-sector supply chain. Considering the severe water scarcity in Maharashtra, dissemination of suitable water technologies at the farm level will be an important part of the project. The project will test technologies like the rope pump, pressure pump and low-cost water storage tanks. Upon successful test results, these technologies will be introduced in the area by involving watershed NGOs and promoting water resource conservation and development through their organized groups.

Horticulture plants and quality seeds: To cultivate the cash crops under consideration, knowledge regarding nurseries will be essential at the farm level. The project will identify specific nursery techniques for the cash crops and promote them through NGOs and the supply chain. NGOs also will be trained in nursery cultivating techniques. The project will work with seed developers so that the seeds for some crops are produced at the farm level with proper inputs and treatment.

Dissemination of information: To provide agriculture and market information, the project will make use of latest developments in information technology by setting up agri-clinics through NGOs, agri-input dealers, agriculture experts, etc. agri-clinics will have computerized data bases of crop-related information with access to the Internet. It will provide services to the agriculture

sector, viz. soil & water testing, expertise on specific inputs and crops, market information etc. The agriclinic can be run by NGOs, agri-input dealers in the supply chain, and agricultural professionals. In some parts of the country big agribusiness companies like ITC, Tata-Rallis etc. have set up their own agri-clinics to provide support to farmers.

c. Capacity-Building Strategy
Farmer training for improved cultivation practices: A level of expertise is required to produce the required quality of cash crops under consideration. Similarly, organic cultivation of certain crops can fetch very high export prices. The project will develop specific crop manuals in local languages,
which will give the required information to the smallholder along with nursery raising techniques, post-harvest technologies, water-recharge technologies etc. These crop manuals can be made available to the smallholders through a supply chain of agri-input dealers, NGOs, agri-clinics etc. Farmer training will be organized through NGOs and supply chains for selected groups.

d. Capital/Credit Strategy
Linkages for micro-credit: Since the project will be working with local NGOs that have organized groups in the villages (Self Help Groups), the project will seek to involve the NGOs in micro finance in
order to cultivate the cash crops under consideration. Because NGOs have a limited resource base and have to be financed through external sources, the project will be working as a facilitator to get these
NGOs financed.

e.Other Strategies
In order to circumvent the problem of erratic power supply, the project will develop and promote manually driven rope pump and pressure pump technology as mentioned above.

The production package for the smallholder will be developed in such a way that requirement of outside labor is reduced.

2. Input Markets

a.Capacity-Building Strategy
Supply chain for low cost drip and other inputs: The basic input for the cultivation of cash crops is water and to manage it efficiently, drip systems and water storage will be essential. IDE has developed these technologies and the project will create the supply chain in the CARDEP area so that these products are available to the smallholder at an affordable price. The low-cost drip developed by IDE is priced at almost half the price of the subsidized drip and is similar in quality. Small farmers will be made aware of this fact and encouraged to use low-cost drip. Water lifting technologies like the rope pump and the pressure pump will be tested and if found successful, can be introduced in the market.

Horticulture nurseries: Enough nurseries will be developed for cash crops under consideration so that the saplings of specific varieties are available to smallholders. There are nurseries run by government and progressive farmers, but they are not sufficient to cater to the needs of smallholders in the identified area.

Training of supply chain: The project will train members of the supply chain regarding technologies that will be used in CARDEP and supplied by the dealers. The project will develop internal training expertise on the various technologies used.

The supply chain members also need to be trained on the treatment of the cash crops under consideration. This will be done through internal and external expertise.

The agri-input dealers typically have a tendency to recommend costlier inputs to the farmers. IDE will educate dealers and farmers on specific inputs that will be used for the crops under consideration.

b. Capital/Credit Strategy
Linkages for institutional credit to the supply chain: The institutional credit facility for the supply chain will help to get the technologies used on a larger scale. The project will work to develop linkages between credit institutions and the supply chain.

c. Other Strategies
Supply chain in remote areas: Building up a supply chain where agri-input dealers are not present will need more effort and time. The supply chain will identify such areas and involve local NGOs / CBOs(Community based Organization) for technologies until a private business is established.

3. Output Markets

a. Technology Strategy
Technology gaps: The project will identify gaps in terms of grading, packaging, storage, marketing and
processing the cash crops under consideration. The project also will explore solutions to address these
gaps so that benefits to the smallholder are maximized.

b.Capacity-Building Strategy
Market information: The market information for farmers and other stake holders regarding output markets is not readily available. The project will work to establish a mechanism for the collection and dissemination of this information through agri-clinics, electronic and print media.

Output linkages: The project will build market linkages for areas where an output marketing chain is not present, or if it is more profitable, to use an alternative chain for the smallholders.

Training of agribusiness enterprises: If more opportunities are available in the agri-business sector (domestic trade, export, processing etc), the resulting competition will benefit smallholders. The project will conduct a detailed study of output markets and do an analysis of the cash crops under consideration, as well as provide training to the enterprises involved in output marketing.

c. Capital/Credit Strategy
Credit Linkages: The project will build linkages for providing credit to new enterprises in output marketing, specifically export markets.
d.
Other Strategies
New enterprises: The project will identify areas that have not been exploited by the private or public sector in agriculture output markets and create enterprises for the benefit of small farmers.

3.7 Organizational Approach: Awareness Raising Among Potential Stakeholders

Awareness rasing among potential stakeholders would be carried out in two manners. First of all, composing an advisory board of key members of the stakeholder community would be a major outreach pathway into this community. Thus it is very important to make sure that the crucial stakeholders are actively involved in the project board. Secondly, the project office should have a stakeholder liaisson officer whose job it is to involve the various actors in constructive ways in the project. This would also obviously be the role of the Project Manager. This being such a broad reaching initiative, it is crucial that bringing in the involvement of the various stakeholders be one of the primary foci of the project office.

From the very beginning, the project will need to conduct seminars and workshops, and invite prominent people from the various sectors, as well as members of the practitioner communities. These workshops will serve to communicate the goals and objectives of the project, progress and achievements, and as an avenue to solicit the involvement in a broad range of participants.

It is also crucial that the project have a well developed public relations component which will develop simple but effective means of communicating the goals, objectives, and strategies of the project to the professional community. This should include professional brochures, power point presentations, and short videos. These will act as a quick means to communicate the message of the project.

3.8 Goals for First and Second Three Year Periods

Table 5: Goals for First and Second Three Year Periods

	1st Three Years	2nd Three Years
Number of farmers involved	20,000 (cumulative)	50,000 (cumulative)
Increase in farmer income per family per year *	$120	$240
Number of small businesses offering input and output marketing services to farmers in the program	500	1000
Annual volume of sales of inputs to participating farmers	$600,000	$3,000,000
Profit of input providers to participating farmers	$60,000	$150,000
Volume of produce sold through output chain	$2,400,000	$12,000,000
Profit of output chain members	$240,000	$1,200,000

Total annual profits generated by project	1st Three Years	2nd Three years
Farmers	$2,400,000	$12,000,000
Inputs	$60,000	$150,000
Outputs	$240,000	$1,200,000
Total	$2,700,000	$13,350,000

*Note: Farmers are expected to increase their income by about $80 in their first year of participation, and by about $500 in year 6, so the above numbers are a composite of farmers starting in years one to six.

Table 6: CARDEP Deccan Plateau Budget

	Year 1	Year 2	Year 3	TOTAL
Personnel	86,858	110,639	130,382	327,879
International/National Consulting	46,000	40,000	45,000	131,000
Contracts with R&D Organizations	30,000	22,000	25,000	77,000
Work with Private Sector	5,000	10,000	10,000	25,000
Travel	71,000	75,500	86,000	232,500
Training, Promotion & Technical Assistance	131,700	165,000	119,900	416,600
Equipment	51,800	-	5,000	56,800
Administrative	20,120	19,339	21,196	60,655
TOTAL DIRECT COSTS	**442,478**	**442,478**	**442,478**	**1,327,434**
Indirect Costs (13%)	57,522	57,522	57,522	172,566
GRAND TOTAL	**500,000**	**500,000**	**500,000**	**1,500,000**

4. GEOGRAPHIC EXPANSION

INTRODUCTION

In the previous section a specific three year program has been outlined for the region. This three year program is meant to be the crucible of a set of strategies and technologies to be applied throughout the region. Simultaneously, however, a series of satellite projects will be implemented with the objective of adapting the regional strategy to the specific conditions of the sub-regions. This will be done through intensive interaction with farmers and development agencies in the sub-region. The intention is to gradually expand the approach being applied in the three year program throughout the region.

The satellite projects will involve the following activities:

5. Conduct a basic survey of water, agriculture, and socio-economic conditions in each area. This would involve an analysis of the high-value crop sub-sector, including identification of opportunities and constraints specific to that sub-region.
6. Based on the outcome of this survey, develop a specific water and small farmer productivity/income generation strategy.
7. Form a consortium of agencies (both government and non-government), interested and capable of participating in the proposed set of interventions. Begin the process of orienting and training these agencies in the approaches and technologies of SIMI.
8. Conduct field testing of the selected set of interventions and technologies. Based on these field tests, the interventions and technologies will be adapted to local conditions in preparation for later scaling up operations.

These satellite projects will be conducted within a two- year time frame, with the intention of following up with a scaled up SIMI intervention in the sub-region.

GEOGRAPHIC EXPANSION PLAN

The following is a list of suggested areas for expansion, with associated estimated annual budgets for the satellite projects:

1. The three year CARDEP program will be implemented in twelve districts in the state of Maharasthra, India: Nandurbar, Dhule, Jalgaon, Jalana, Aurangabad, Ahmednagar, Solapur, Latur, Osmanabad, Amaravati, Wardha, and Yeotmal. $450,000/yr.
2. Seven Districts in southern and western Andhra Pradesh. $250,000/yr.
3. Seven Districts in eastern Karnataka $250,000/yr.
4. Eight more districts in central and eastern Maharasthra. $320,000/yr
5. Six Districts in southern Madhya Pradesh. $200,000/yr.
6. Four Districts in southern Gujarat. $180,000/yr.

NUMBER OF FARMERS

Geographic Region	Smallholders Affected (3 Years)
Southern and western Andhra Pradesh (7 districts)	7,500
Eastern Karnataka (7 districts)	7,500
Central & eastern Maharasthra (8 districts)	21,000
Southern Madhya Pradesh (6 districts)	7,500
Southern Gujarat (4 districts)	9,000
Totals:	**52,500**

SUB-PROJECTS

Based on experience in current field programs, and intensive interaction with farmers, a number of sub-projects (for application of specific interventions or technologies) have been identified. This list is meant to act as a menu to be drawn from for application in the main CARDEP project and for field testing in the satellite projects. The interventions in the projects will neither include all of these interventions in each sub-region (as defined by the needs assessment of the sub-region), or be limited to these as other opportunities arise:

1. Mass marketing of low-cost drip and micro-sprinkler technologies. This will involve adaptation of the technologies to local conditions, supply chain development, and a mass promotional campaign.
2. Promote linkage of low-cost micro-irrigation systems with watershed development projects: There are a large number of watershed developement programs in the Deccan which have been successful in increasing the available ground water in specific micro-watersheds. This increased availability of a scarce resource needs to be linked to application of that water in an efficient manner (micro irrigation) for income generation (high value fruits and vegetables). The project will work together with all watershed development programs in the region to assure that they include micro irrigation in their program.
3. Application of low-cost water lifting technology linked to micro-irrigation: Currently almost all water lifting in the region is done by expensive electric pumps. This will also cost more as the state electricity boards slowly increase the prices of electricity to a more rational level. There exist manual water lifting devices such as the pressure treadle pump and the rope and washer pump whose application would essentially lower the entrance cost for water lifting by small farmers. These technologies will be demonstrated and promoted through a private sector supply chain for linkage with micro irrigation systems.
4. Dissemination of high value fruit and vegetable production packages: In order to increase farmer incomes and expand marketing of higher priced fruits and vegetables, develop fruit crop and off-season vegetable production packages. This will involve using horticultural experts to develop a series of cultivation strategies to grow high value high value fruits and vegetables .
5. Development of a private sector/public sector information dissemination system for high value crop production: It has been found that farmers are getting almost all their information about crop production from two sources: agricultural supply shops, and their neighbors. A system has been developed to use these two sources as the retailers of

information to the farmers, while linking them to the greater knowledge resources of the Agricultural Research and Extension system. In this approach, the ag-inputs suppliers, and specially selected leader farmers, are given intensive training in the proposed high-value crop production packages. This would include such subjects as selection of seed varieties, nursery management, soil fertility management, integrated pest management, and produce marketing. These training programs will be conducted locally using the local Ag extension and research staff as the resource people. This makes the connection between the trainees and the information resources in the area for future reference, and gives them the knowledge and skills to tranfer this information to the farmers.

6. Marketing linkage workshops for farmers and produce traders: It has been found that there is a communication and understanding gap between the farmers (especially new producers of high value crops) and the output marketing chain. One effective means to close this gap has been found to be the holding of meetings to which all market players (producers, middlemen, wholesalers) are invited. Each group is allowed to give a summary of their needs and concerns. This helps the other groups to understand the nature of the production and market environment and to come to mutually beneficial marketing arrangements.
7. Development of a call-in market price information service: Working with public sector agencies, a system will be developed whereby farmers can call into a central information clearing house and get pricing information for various commodoties in different markets in the sub-region. This allows farmers to make informed decisions about what price to charge for their produce, and to which markets to ship them.
8. Development of leader farmers into agriculture inputs sub-dealers: The trained leader farmers will be encouraged and assisted to become sub-dealers of agricultural inputs in their local communities. This will include seeds, fertilizers, pest controls, and tools. This brings the source of inputs closer to the community in a difficult transportation environment, and encourages leader farmers to disseminate information as a means to augment their income.
9. Expand access to high quality inputs through ag input dealers: By sourcing quality input wholesalers based on the needs of the productivity packages, and linking rural agro inputs suppliers to these wholesalers, the project will increase availability of appropriate high quality seeds, fertilizers, and pest control in the rural areas.
10. Organize small farmers to supply vegetables in bulk to exporters: In India there is an expanding export of fruits and vegetables to the Middle East and Europe. With the collaboration of local NGO's, farmers will be organized and trained to supply fruits and vegetables to these exporters through linkages made by the project. Training will focus on production packages as well as post harvest sorting and handling.
11. Develop low cost packing material for fruits and vegetables: In order to reduce post harvest and transport losses, low cost, locally available packing materials and techniques will be developed and disseminated through a private sector marketing chain. Promotion will be carried out with the farmers and the fruit and vegetable selling merchants.

ANNEXES

1. CARDEP CONSTRAINTS ANALYSIS MATRIX
2. CARDEP LOGICAL FRAMEWORK
3. CARDEP TIMELINE

ANNEX 1: CARDEP CONSTRAINT ANALYSIS MATRIX

Country and geographic scope	India – Maharashtra: 12 districts of Deccan Plateau area.
Cash crops to be developed	Pomegranate, papaya, mango, citrus, gooseberry, spices and vegetables.

	Technological Constraints	**Capacity-Related Constraints**	**Capital/ Credit Constraints**	**Other Constraints**
Farm Level	• Lack of proper crop mix to give maximum returns. • Lack of low-cost water lifting technologies. • Lack of low-cost water storage structures. • Lack of quality horticulture plants, seeds. • Lack of dissemination of agriculture information.	• Lack of knowledge in improved practices viz. organic farming. • Lack of knowledge in raising nursery. • Lack of knowledge regarding markets. • Lack of knowledge in post-harvest technologies viz. grading etc. • **Lack of knowledge in water recharge.**	• Lack of micro-credit. • **Bottlenecks in obtaining loans from the banks.**	• Lack of water and regular electric supply. • **Lack of outside labor.**
Input Markets	• Lack of supply chain for low-cost drip and water-storage structures for small holders. • Subsidy-driven market for drip systems. • Inadequate plant nurseries. • Lack of suitable lifting devices.	• Lack of knowledge related to technology & products. • Lack of knowledge regarding cultivation practices of crops under consideration. • **Misinformation provided by profit-seeking suppliers.**	• Limited credit from manufacturer to the dealer. • Bottlenecks in bank procedures. • Limited micro-credit organizations.	• Lack of supply chain of agri-input dealers in some rural markets.
Output Markets	• Lack of processing industry for some crops under consideration.	• Lack of dissemination of market information. • **Lack of supply chain for output marketing in some remote areas.**	• **Lack of institutional credit to new micro-enterprises in output marketing.**	• **Monopoly of existing traders in output market**.

ANNEX 2: CARDEP LOGICAL FRAMEWORK FOR PHASE 1 (YEARS 1 – 3)

Country and geographic scope	India – Maharashtra, 12 districts of Deccan Plateau area.
3-Year Goal	**Increase the net income of** 10,000 **smallholders by an average of** $US 450 **per year after the third year**

OBJECTIVE	3-YEAR TARGET	ACTIVITIES OF WIIDE	INDICATORS
Farm Level			
Technology Strategy			
Suitable cropping pattern.	**Cropping pattern selected for each of 12 districts and database created for at least 20 cash crops suitable to the area.**	**Identification of partners to get data viz. Agriculture Research Inst., NGOs, traders, farmers etc.** **Data collection and analysis.**	**20 crop files available with WIIDE.**
Development of appropriate water technologies viz. rope pump, pressure pump, water storage etc.	**New products ready for market by end of Year 2.**	**Testing of new products, field demonstration and test marketing.**	**New products being manufactured by at least one manufacturer.**
Promotion of low-cost drip, horticulture crops, seeds etc.	**10,000 low-cost drip systems installed and being used for horticulture crops.**	**Collaboration of NGO/bilateral watershed projects for the project.** **Supply chain for low-cost drip and its promotion for cultivating horticulture crops.**	**Sales report of the supply chain.**
Dissemination of information.	**Package for disseminating agri-information identified and 20 agri-clinics established .**	**Identification of different media viz. print, electronic, information technology.**	**Monthly / annual progress report.**
Capacity-Building Strategy			

OBJECTIVE	3-YEAR TARGET	ACTIVITIES OF WIIDE	INDICATORS
Improve technical and managerial skills of smallholders through training, exposure visits etc.	**1,000 smallholders receive skills training.**	**Develop crop manuals to provide information on latest techniques.** **Coordinate training programs with partner organizations.**	**Number of crop manuals.** **Monthly / annual progress report.**
Capital/ Credit Strategy			
Improve smallholder access to credit through linkages with micro credit organizations and their refinance.	**Access to micro credit for at least 5,000 smallholders.**	**Identify NGOs working in micro-credit. Establish linkages between NGOs and credit institutions**	**Number of smallholders accessing credit.**
Input Markets			
Technology Strategy			
Create supply chain for low-cost drip and water storage.	**50 dealers, 100 assemblers.**	**Identification of potential dealers, assemblers etc and training them**	**Monthly /annual report**
Develop horticultural nurseries.	**50 Nurseries**	**Establishing commercial nurseries with NGO, farmer, etc.**	**Monthly /annual report**
Capacity-Building Strategy			
Training of dealers for low-cost drip and other inputs for CARDEP.	**50 low cost drip dealers trained.**	**Developing training modules.** **Providing training to the dealers.**	**Training modules.** **Monthly /annual report**
Develop local capacity of agri-input / seed suppliers.	**50 agri-input dealers trained.**	**Providing crop manuals for CARDEP.** **Organizing training program.**	**Monthly /annual report**
Capital/ Credit Strategy			
Build linkages for credit to supply chain.	**20 dealers and 50 assemblers have access to credit through linkages developed.**	Identify NGOs, banks etc. working in credit for rural enterprises. Establish linkages between NGOs and credit institutions e.g. rural banks.	**Number of dealers with access to credit.**

OBJECTIVE	3-YEAR TARGET	ACTIVITIES OF WIIDE	INDICATORS
		Linkage between the credit institute and supply chain.	
Output Markets			
Technology Strategy			
Study gaps in post-harvest technologies used in the area for crops under consideration.	**Analysis of output market and processing of each crop under consideration.**	**Identification of partners to do output market study and processing opportunities.**	**Report for each crop under consideration.**
Capacity-Building Strategy			
Disseminate market information.	**Linkage developed between 50 agri-clinics and 10,000 farmers.**	**Identification of partners to run agri-clinics.** **Training and establishment.**	**Number of agri-clinics.**
Create market linkages for crops under consideration.	**New Linkage developed between out put market and 2,000 farmers.**	**Investigate new market linkage for crops under consideration.**	**Number of farmers with access to new market linkages.**
Develop capacity building of output supply chain.	**At least 100 output suppliers trained.**	**Identification of issues on which out put chain requires training & information.** **Providing training to the chain members.**	**Number of output suppliers trained.**
Capital/ Credit Strategy			
Building linkages for credit to supply chain.	**50 output suppliers have access to credit through linkages developed.**	Identify credit institutes for output market enterprises. Establish linkages between credit institutions and market enterprises.	

ANNEX 3: CARDEP TIMELINE

County and geographic area	**India – Maharashtra, 12 districts of Deccan Plateau area.**					
Program Objective/Activity	**Phase 1***			**Phase 2**		
	1	**2**	**3**	**4**	**5**	**6**
Farm Level						
Technology Strategy						
Developing Suitable Cropping Pattern	X					
Development of Appropriate Water Technologies	X	X				
Promotion of low cost drip, horticulture crops, seeds etc.	X	X	X	X	X	X
Developing package for dissemination of information	X					
Capacity-Building Strategy						
Develop crop manuals to provide information on latest techniques	X	X				
Organizing training programs with partner organizations	X	X	X	X	X	X
Capital/ Credit Strategy						
Establish linkages between NGOs and credit institutions	X	X	X			
Improve smallholder access to micro credit	X	X	X	X	X	X
Input Markets						
Technology Strategy						
Creating supply chain for low cost drip and water storage.	X	X	X	X	X	
Establishing horticultural nurseries.	X	X	X	X	X	
Capacity-Building Strategy						
Training of dealers for low-cost drip and other inputs and cash crop cultivation.	X	X	X	X	X	X
Developing local capacity of agri-input / seed suppliers to provide knowledge to farmers.	X	X	X	X	X	X
Capital/ Credit Strategy						
Establishing linkages between dealers and credit institutions.	X	X	X	X	X	X
Output Markets						
Technology Strategy						
Study gaps in post-harvest technologies used in the area for crops under consideration.	X					
Capacity-Building Strategy						
Dissemination of market information by setting up agri-clinics.	X	X	X	X	X	
Market linkages for crops under consideration.	X	X	X	X	X	
Capacity building of output supply chain.	X	X	X	X	X	X
Capital/ Credit Strategy						
Building linkages for credit to supply chain.	X	X	X	X	X	

CHAPTER 4

Gangetic Plains

PART I

REGIONAL EVALUATION AND PLANNING

SUMMARY TABLE
EXECUTIVE SUMMARY

1. ASSESSMENT OF THE TARGET REGION
2. 15-YEAR PLAN

SUMMARY TABLE: GANGETIC PLAINS BANGLADESH, INDIA, NEPAL	
Geographical Area:	A large square area covering Bangladesh, West Bengal, Bihar, Eastern Uttar Pradesh, and the Tarai area of Nepal.
Target Population:	27 million smallholder families in the region that have the basic pre-condition to engage in high value crop production.
Water-Related: *Water Source:* *Water Storage:* *Irrigation:*	 Diesel shallow tube wells, treadle pumps, deep tube wells. Cement tanks, metal/plastic tanks Furrow irrigation, drip irrigation
High-value Crops:	Fruits: banana, papaya, mango Vegetables: onions, egg-plants, potatoes, parbles, cucumbers, leafy vegetables, cauliflowers, ground nuts, arum, cauliflower, kakroll, mukhikacu, and radish Spices: chile, betel leaf
Favorable Conditions:	Abundant shallow ground water, potential for well-developed water markets, good access to output markets, high population density
Constraints:	Lack of access to good quality inputs and tools, watering highland difficult using furrow irrigation, high damage of produce in transport, low level of agricultural knowledge, lack of access to credit for landed poor,
Strategies for Implementation:	12. promotion of treadle pumps, low-cost diesel pumps, and efficient water selling markets 13. linking irrigation to high value productivity packages developed by experts with input from farmers. 14. focus on off-season production 15. increasing agricultural knowledge among input supply chain 16. linking supply chain to extension system 17. linking to existing micro-credit organizations 18. developing and promoting post harvest packing and processing businesses.
Immediate Steps:	L. Implementation of a CARDEP program in Bangladesh, India, and Nepal for the development and testing of an adaptable yet generic intervention strategy for the the gangetic plains. *Cost of the Program:* $1,800,000 - first 3 years. M. The development of satellite programs to survey smallholders and the high-value crop sub-sector, the development of specific water and small farmer productivity packages, consortium building for implementation, and the field testing of specific interventions. Cost of program for regional satellite programs - $1,900,000 per year. N. Selected sub-project investment opportunities including promotion of manual deep water lifting devices, promotion of lay-flat pipe distribution systems, facilitation of water markets, introduction of low cost diesel pump technology, expansion of treadle pump promotion, introduction of pressure pumps with micro irrigation systems, dissemination of off-season vegetable production packages, development of informations systems, development of leader farmers as input providers, building capacity of input traders to supply agro information, facilitating market linkages (upstream and downstream), developing low cost packing materials, and more

EXECUTIVE SUMMARY

The Gangetic Plains area of South Asia is one of the poorest and most densely populated areas in the world. It covers three countries (Bangladesh, India, and Nepal) and has a population of more than 400 million people. It is a very flat, low-lying area with rich alluvial soils. It is also known for being prone to nearly annual natural disasters coming from two sides: Floods coming from cyclonic activity from the Bay of Bengal, and floods coming from the many rivers which criss-cross the region. This combination of high population density, a history of poor governance, and recurrent natural disasters has made it difficult for the areas farmers to break out of the cycle of poverty. But on the positive side, it is a place rich in three of the key natural resources which are important to agriculture productivity: water, fertile soils, and abundant labor. In recent years, the increase in the use of shallow ground water has allowed the area to increase production of food grains, to the point where much of the area is self-sufficient in foodgrain production. This increase in production of staples, however, while largely eliminating the threat of starvation, has done little to alleviate the chronic poverty of the region. This poverty is characterized by lack of access to appropriate productivity enhancing technologies, chronic malnutrition, increasing fragmentation of land holdings, and increasing landlessness.

Because of the above-mentioned richness in basic resources (water, soil, labor), the area has great potential for interventions to increase incomes of small-holders. In order to bring about this increased productivity, however, an effort is needed to bring appropriate production technologies to the farmers, and raise the farmers' awareness of their place in the active markets of the region.

In the last 10-15 years, there has been a revolution in the area in access to year-round irrigation from ground water resources using shallow tube wells. This revolution has especially had impact in Bangladesh and parts of India. In Nepal, the water resources are still largely under-utilized, mostly because of the area's isolation and lack of access to appropriate technologies. Despite this revolution, however, the water is largely being used for grain production, and is not being used in the most productive manner. Given the current access to water, it should be possible to vastly increase small farmers' productivity and incomes, if appropriate packages of high value crops are introduced in a systematic manner, and if the vibrant private sector is mobilized to deliver inputs to farmers and buy produce from them.

Each of the three countries studied have slightly different developmental problems, and call for slightly different emphasis in the solutions. The major themes which emerged from this study are as follows:

7. In Bangladesh, there has been a massive development of the ground water resource through Treadle pumps, Chinese diesel shallow tubewells, and deep tube wells. This to the point that the villages we visited had between 70 percent to 100 percent access to year-round irrigation water. This has been accomplished largely through the availability of a range of water options for farmers, i.e. buy a treadle pump, buy a diesel shallow tube well, buy water from an owner of a shallow tube well, or buy water from the owner of a deep tube well. Thus the area is characterized by the development of "water markets" which work to the benefit of all farmers, giving them a wide range of options of varying cost to obtain water. The water markets in India were only slightly less developed, but the water markets in Nepal are still very undeveloped. The development of these water sources was done largely through the private sector, with government and NGO's taking a purely facilitation role.

8. This revolution in access to water has been translated into some increase in income and food security, but has not been taken to it's ultimate potential of productivity and income increases. This largely because of inadequate access to information and to appropriate, income-generating agricultural packages.
9. There is no evidence so far that the arsenic problem in the ground water in Bangladesh and India is translated into a problem affecting the irrigated food supply. Of course this needs more study.
10. The area is characterized by well developed markets, but many of the poorer farmers are little aware of market dynamics, or how to maximize their benefits through interactions with the market. Especially in the area of off-season vegetable production. The large population centers of Dhaka, Calcutta, Patna, and many other cities of more than a million populations are a huge market for produce.
11. Bangladesh has started exporting fresh vegetables to Europe, but the dispersed nature of the small, poor farmers has made it difficult for them to take advantage of this potential market.

It is estimated that there are about 30 million small farm families in this region (cultivating less than 1 hectare). Many of these farmers already have access to irrigation water, and those who don't are sitting on top of a large unused ground water resource. The key to poverty reduction is access to water *and* maximizing productive use of that water. During our visit, we saw many trial plots and spoke to researchers who knew exactly how to attain that productivity, but there is little connection between these well meaning people and the millions of farmers toiling away in their fields. A 15 year program is proposed with the following two objectives: first, to finish the water access revolution by following the Bangladesh water market development model in parts of India and Nepal, and second to increase the productivity of that water by developing and disseminating appropriate "productivity packages", especially of off-season vegetables. This program would involve the collaboration of the national government, local governments, donors, NGO's and the private sector. Each of these players would have clear roles and responsibilities based on their resources and proven capabilities. The objective would be to reach these small holders through such a program and to increase their incomes by $100-$500 per year. This would have a significant impact on rural poverty in the Gangetic Plains both by raising families above the poverty line, and by keeping others from slipping below that line. The program would consist of the following components:

- A strategy to promote the orderly development of water markets in those areas with minimal penetration. This would involve promotion of the use of Treadle pumps, promotion of the introduction of low-cost diesel operated pumping sets, and facilitation of the establishment of orderly markets for purchasing water from these pumping sets. All this would be accomplished by establishment and support of a private sector network to deliver, install, and maintain these technologies in a sustainable manner. Promotion of the technologies would be carried out by government, NGO's, and the private sector acting in partnership
- A strategy for linking small-holder families to output markets (including export), increasing the flow of information from those markets to the farmers, developing and disseminating post-harvest technologies, and increasing the farmers' capacity to analyze and plan their activities based on market information.
- A strategy for increasing production and productivity of high-value crops by the small-holders through design and implementation of sustainable information-flow methodologies, a focus on off-season and specialized crop production, and linkages to a strengthened private-sector input supply chain.

- Increased access to formal and informal credit opportunities for the small-holder, especially through expansion of linkages to micro-credit institutions and savings and credit groups.
- Advocacy of government and donor policies to support these efforts, especially through rational allocation of resources to the targeted activities and removal of market-distorting policies and practices.

The CARDEP program detailed within this plan will pilot the intervention strategy in the first three years of implementation. In parallel, SIMI will develop geographic expansion programs to survey smallholders and the high-value crop sub-sector, to develop specific water and small farmer productivity packages, for consortium building for implementation, and finally for the field-testing of specific interventions.

Gangtetic Plains Summary Three-Year Budget Table

Activity	**3 –Year Budget** (in $ millions)	**Smallholders Reached** **3-Years**
CARDEP	1.8	15,500
Geographic Expansion	5.7	55,500
Total	**7.5**	**71,000**

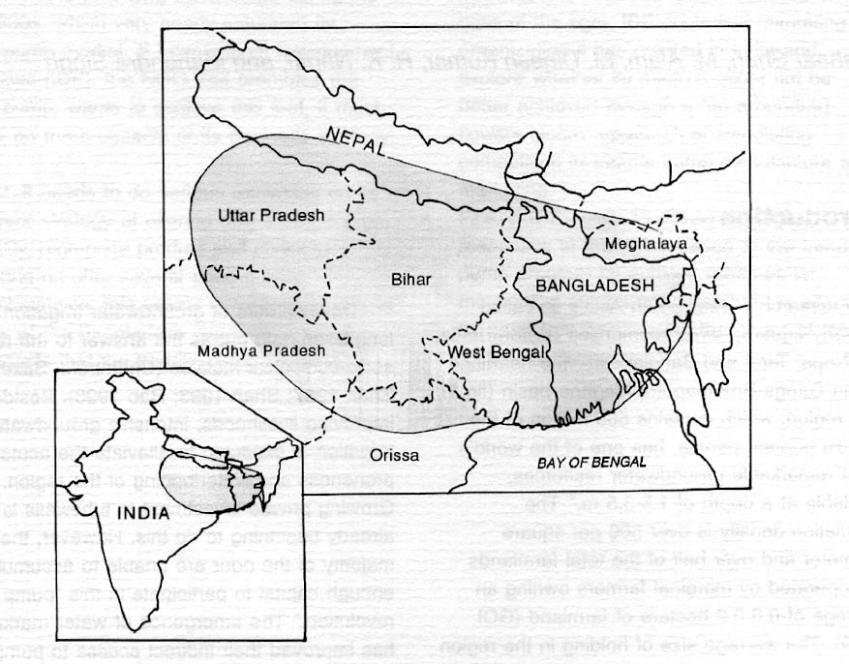
I. ASSESSMENT OF THE TARGET REGION

1.1 Target Population

The Ganga-Brahmaputra-Meghna (GBM) basin covers an area of 1.75 million square kms and is home to over 558 million people in part or all of 16 Indian states, Bangladesh, Nepal and Bhutan and in the Tibet region of China which lies to the north of the eastern and central Himalayas. The three rivers constitute an interconnected system with an annual discharge of 1350 billion cubic meters (BCM) of water. Additionally, the annually replenishable groundwater resource of the GBM region is estimated to be around 231 BCM. One-tenth of mankind lives in the GBM region.

The area of Bangladesh, eastern India, and the Nepal Terai has been described as South Asia's poverty square. It is the heartland of the Ganga-Brahmaputra-Meghna basin, contains 500 million of the world's poorest people, and has available a huge groundwater reservoir at a depth of 1.5-6.0 meters, replenished every monsoon season, only a fraction of which is currently utilized.[29]

Figure 1: Map of the Gangetic Plains



[29] Shah, Tushaar, Alam, M, Kumar, M.D and Nagar, R.K., and Singh, M. Pedaling out of Poverty: Social Impact of a Manual Irrigation Technology in South Asia. Research Report 45, International Water Management Institute, Colombo, Sri Lanka, 2000.

In this poverty square, the majority of people live in rural areas and derive their principal income from agriculture. But the region has low agricultural productivity, and the farms are small and fragmented. For example, 75 percent of the landholdings in Bihar in 1981-82 were less than one hectare[30], and 75 percent of the farms in Bangladesh were less than two acres in 1978[31], with farm size in both Bangladesh and India steadily decreasing over time. A typical farmer in Bangladesh farms a total of one and a quarter acres divided into five separate quarter acre plots.

According to Shah, "development of groundwater irrigation has long been held out as the answer to the region's socio-ecological malaise"[32]. But prior to 1986, the majority of farmers lacked access to affordable irrigation devices that fit the needs of their small plots. The cheapest diesel pump on a tubewell cost $500, and did not pay for itself on less than five acres. The available simple manual water lifting devices that were cheap enough to be affordable, like a bucket with a rope, were not efficient enough to be practical. A standard hand pump was often used for irrigation, but the arm action required to activate it is bio-mechanically inefficient and leads to rapid tiring. In the early 1980's, the Rower Pump, introduced by the Mennonite Central Committee and disseminated by International Development Enterprises (IDE), and the Treadle Pump, introduced by Rangpur-Dinajpur Rural Service (RDRS) in Bangladesh and mass disseminated by IDE, provided an affordable water lifting device that fit the needs of small plots and could be mass marketed through the local private sector.

Broadly the SIMI target population is smallholders with less than 1 hectare of cultivated land and with an income below national poverty standards. The Gangetic plains, which encompass parts of India, Bangladesh, and Nepal, have a population of 327 million people. About half of this population (164 million) is below national poverty standards (Table 1). SIMI aims to increase the incomes of adopting households by about $500 per year. This represents an amount of additional income that can lift a household out of poverty.

Table 1: Regional population in the Gangetic plain

	Population
Population India	189,801,000
Population Bangladesh	
Population Nepal	13,800,000
Total Population	327,101,000
Target Population	163,550,500

[30] Yugandhar, B N and Lyer, K G, eds., Land Reforms in India, Bihar Constitutional Constraints. Volume 1, Sage Publications, New Delhi, 1993.
[31] Jannuzi, F T, and Peach, James T. Bangladesh: A Strategy for Agrarian Reform, In Studies in Agrarian Reform, Prosterman, R L, Temple, M N and Hanstad, T M, ed. Lynne
Rienner Publishers, Boulder Colorado, 1990.
[32] Shah, 2000, op cit.

1.2 Biophysical Resources

The Gangetic Plains are part of the second largest hydrologic system in the world, comprising the Ganges-Brahmaputra-Meghna (GBM) river basin covering nearly 1.75 million km^2 over five countries. The plains and deltas of these rivers generally represent a similar potential for shallow ground water extraction as the regions covered in the Gangetic Plains Case Study.[33]

The Gangetic Plain is the most important region of India socially and economically. The plain stretches from the Indus River in Pakistan to the Punjab Plain and from the Haryana Plain to the delta of the Ganges in Bangladesh. Topographically the plain is homogeneous, with only floodplain bluffs and other related features of river erosion and changes in river channels forming important natural features. Two narrow terrain belts, collectively known as the Terai, constitute the northern boundary of the Gangetic Plain. Groundwater from these areas flows on the surface where the plains begin and converts large areas along the rivers into swamps. The southern boundary of the plain begins along the edge of the Great Indian Desert in the state of Rajasthan and continues east along the base of the hills of the Central Highlands to the Bay of Bengal. The hills, varying in elevation from 300 to 1,200 meters, lie on a general east-west axis. The Central Highlands are divided into northern and southern parts. The northern part is centered on the Aravalli Range of eastern Rajasthan. In the northern part of the state of Madhya Pradesh, the Malwa Plateau comprises the southern part of the Central Highlands and merges with the Vindhya Range to the south. The main rivers that flow through the southern part of the plain--the Narmada, the Tapti, and the Mahanadi--delineate North India from South India..

The middle Ganga extends from the Yamuna River in the west to the state of West Bengal in the east. The lower Ganga and the Assam Valley are more lush and verdant than the middle Ganga. The lower Ganga is centered in West Bengal from which it flows into Bangladesh and, after joining the Jamuna (as the lower reaches of the Brahmaputra are known in Bangladesh), forms the delta of the Ganga. The Brahmaputra (meaning son of Brahma) rises in Tibet (China's Xizang Autonomous Region) as the Yarlung Zangbo River, flows through Arunachal Pradesh and Assam, and then crosses into Bangladesh.

A. Climate

Average annual rainfall in the Gangetic Plain increases moving west to east from approximately 600 millimeters in the Punjab Plain to 1,500 millimeters around the lower Ganga and Brahmaputra.

B. Agriculture

The Gangetic Plain is the most intensively farmed zone of India and one of the most intensively farmed in the world. Rainfall, most of which comes with the southwest monsoon, is generally adequate for summer-grown crops, but in some years vast areas are seared by drought. Wheat is the main crop in the west, rice in the east. Pulses, sorghum, oilseeds, and sugarcane are among other important crops. Mango orchards are common. Other fruits of the subregion include guavas, jackfruit, plums, lemons, oranges, and pomegranates.

[33] Ahmad, Q.K., Biswas, Asik K., Rangachari, R. and Sainju, M.M. (eds). 2001. Ganges-Brahmaputra-Meghna Region. A Framework for Sustainable Development. University Press Limited, Dhaka.

C. Water Resources

The GBM region is rich in water resources with the average annual water flow of around 1,350 billion m^3 (BCM) of which nearly half is discharged by the Brahmaputra. Compared to the annual average water availability of 269,000 m^3 per km^2 for the world, the GBM region averages 771,400 m^3 per km^2. In addition, the GBM, the GBM region has an annually replenishable groundwater resource of about 230 billion m^3 (Ahmad, et.al,(eds), 2001)

The ground water potential of India has been assessed as 171 BCM in the Ganga sub-system, and 26 BCM in the Brahmaputra sub-system. Economically exploitable groundwater in Nepal is estimated by Rangachari and Verghese as an annual recharge of 21 BCM. The total surface and groundwater resources in the GBM region is more than sufficient to meet any future needs, even when considering the gradual increase in use of these resources as water consuming in the drier areas of South Asia shift to areas of more abundant water.[34]

The area is characterized by an abundance of water resources including shallow aquifers (1-6 meters from the surface), deep aquifers, and rivers. The rivers are difficult to use for canal irrigation schemes because of their tendency to flood during the rainy season (thus endangering engineering works) and because of a near zero slope in the land. The exception to this is some areas of the Terai of Nepal and the northern parts of Bihar where water is coming down from the Himalayas. But because of the large shallow ground water resource, it is hardly necessary to tap either the rivers or the deep-water aquifers (which are relatively expensive to tap). As an example, using shallow ground water resources, the dry season production of rice recently surpassed the monsoon season production. Tapping shallow ground water is relatively cheap, and is more "democratic", being equally distributed beneath the land of both rich and poor. It is said that there are areas of Bangladesh where the shallow aquifers are dropping, but during our survey we didn't encounter evidence of this, and the experts are divided on this. The shallow aquifers are recharged yearly by the monsoon rains to near surface level, and drop slowly over the months of the dry season, but usually remain within 5-6 meters of the surface, well within the suction range of shallow tube wells. This condition of abundant shallow aquifers is prevalent throughout the region including most of Bangladesh, Bihar, Eastern Uttar Pradesh, and the Terai of Nepal. In our survey in the three countries, we didn't come upon a single instance where the water level dropped below the suction limit at any time during the year.

There are, however, pockets of upland where water tables are too deep for suction pumps. This includes the Barind tract of Bangladesh, a small pocket north of Dhaka, and the area of the Nepal Terai at the base of the foothills. Even in these areas, the water level doesn't drop below 15 meters and can be accessed by inexpensive deep treadle pumps or hand pumps recently developed by IDE in Bangladesh.

[34] R. Rangeachori and B. E. Verghese, 2001. Making Water Works to Translate Poverty into Prosperity. The Ganga-Brahmaputra-Barak Region. In: Ahmad, et.al. 2001., page 81.

Thus, neither quantity of water, nor location of this water is a problem in the area. The only problem is reasonably priced technologies to access the water. And these types of technologies are already in use to varying degrees in all three countries.

1.3 Supply Chain Capacity

One key factor in creating a sustainable system for high-value agriculture is the existence of a private sector supply chain to deliver agricultural inputs (irrigation technologies, fertilizers, seeds, and pest control) to small farmers at a fair market price and within a reasonable distance from the farm communities. In the Gangetic plains area there exists a reasonably effective system to deliver these inputs throughout the area. However, it has been found that, while inputs are available, there are issues of quality (especially of seeds), and of the low level of knowledge of the input dealers. Since the farmers are getting most of their agricultural information from the input dealers, this presents a severe constraint on increasing productivity, especially as it is related to selection of proper plant varieties, use of high quality seeds, cultural practices, and plant protection practices. The connection between the input suppliers and the technical information available from the government extension system is very weak. There is also an issue of the capacity of the private sector to scale up to meet the demands of an expanded high-value crop production system. There is the potential for a lag time between the increased demand of new entrants to intensive cash crop cultivation, and the private sector's ability to meet those demands. Thus there is a need to raise the capacity of the existing network in terms of knowledge, access to appropriate sources of improved inputs, and financial capacity to meet increased demand.

1.4 Input-Throughput-Output Markets

The small cultivators of the Gangetic plains are dependent on a chain of small enterprises and information sources in order to sustainably participate in a cash cropping system. This chain consists of commercial access to appropriate agricultural inputs, access to information about proper cultivation practices, and access to various markets to sell their produce. The state of agricultural inputs supply is described in the section above.

In the development community, dissemination of information about appropriate cultural practices and harvest operations is traditionally thought of as the domain of the government extension service, and in isolated cases as the domain of projects or NGO's. In fact, we were hard pressed during our field visits to find any small farmers who had qualitative access to the government extension system, and while projects and NGO's often do a good job at agricultural extension, they are very limited in coverage. As stated above, this has left the inputs suppliers as the *de facto* source of all agricultural information to the small farmers. When questioned, almost without exception, small farmers stated that they received information about cultural practices from the inputs suppliers. Thus there is a disconnect between development dogma and reality in the field. We did not find any development agencies, government or private, except IDE, who considered the input suppliers as an important target group for capacity building. This is a glaring omission.

The area in general is well connected to markets which have a well-developed system of buyers, wholesalers, brokers, and transport systems, although some of them lack basic infrastructure needed to minimize post-harvest losses. These markets are also hooked into a well-organized system that feeds produce to regional and national markets. Communities that have been growing vegetables for some time seem to have little trouble connecting to existing market systems. However we found that communities where there are large numbers of new producers had greater difficulties. It is these new producers who need more market-based interventions.

There are also issues of post-harvest handling. Currently there is little awareness among farmers of grading produce in order to get a higher price for higher quality goods. There are also high transport and packing losses because of a lack of appropriate and inexpensive packing techniques and materials.

General awareness of market forces is very low among new farmers, including the value of middlemen, the level of post harvest losses, and seasonal fluctuations of supply, and the impact of these factors on seasonal and geographic price differentiation. Farmers see themselves as at the mercy of, or even victims of the market, rather than seeing the market as a complex system that is full of unexploited opportunities.

The final key constraint encountered in output markets was the general lack of effective systems for disseminating market information to farmers.

1.5 Water Policy Considerations for India

In general water policy in India is supportive of the SIMI intervention strategies. Indian policy recognizes water as a key national resource that that requires management across state borders. This includes both surface and groundwater. The development and exploitation of the country's groundwater resources in a sustainable manner is a key national priority. The following section draws heavily on India's National Water Policy.

A. Information System. An important priority of Indian water policy is a well-developed information system. A standardized national information system is established with a network of data banks and data bases on the Central and State level agencies. India has a wealth of information available for planning the SIMI initiative.

*B. MaximizingAvailability***.** Resource planning in India is focused on hydrological units such as a drainage basin as a whole, or for sub-basins. Indian policy strongly emphasizes that water should be made available to short fall areas by transfer from other areas including transfers from one river basin to another, based on a national perspective.

C. Project Planning. The emphasis on water resource development is multipurpose. Provisions for drinking water are given primary consideration. In addition projects are tasked to provide irrigation, flood mitigation, hydroelectric power generation, navigation, pisciculture and recreation wherever possible. This fits well with the SIMI strategy of taking surplus water from drinking systems for utilization in efficient small-scale micro irrigation. Indian policy put special emphasis for the benefit of tribal or other disadvantaged groups such as Scheduled Castes.

D. Ground Water Development. Indian policy emphasizes reassessment of ground water potential accounting for water quality and economic viability. Exploitation of ground water resources is regulated so as not to exceed the recharging capacity and with a focus on social equity. This emphasis is supportive of the SIMI smallholder strategy and the increased value per water unit that SIMI seeks to achieve. National policy is that water rates should be such as to convey the scarcity value of the resource to the users and to foster the motivation for economy in water-use. In practice this ideal is not always followed, for example in many areas of Indian electricity is rationed but not costed at its economic value.

E. Participation of Farmers and Voluntary Agencies. Water policy in India emphasizes the involvement of farmers in the management of irrigation systems, particularly in water distribution and the collection of water rates.

F. Diesel Pump Sets. A concern for SIMI in both India and Nepal are restrictions on importation of small diesel engines primarily from China that allow more efficient exploitation of groundwater resources. The efficacy of these small diesels has been shown in Bangladesh. India is protecting inefficient local producers to the detriment of smallholders.

1.6 Agriculture Policy Considerations for India

India has a strong national agricultural policy emphasizing the need for rapid agricultural growth to achieve self-reliance at national level but also for household food security and to bring about equity in distribution of income and wealth resulting in rapid reduction in poverty levels. However, in practice the continued application of large-scale subsidies and price distortions has a negative impact on India's agricultural sector.

The National Policy on Agriculture seeks to actualize the vast untapped growth potential of Indian agriculture, strengthen rural infrastructure to support faster agricultural development, promote value addition, accelerate the growth of agro business, create employment in rural areas, secure a fair standard of living for the farmers and agricultural workers and their families, discourage migration to urban areas and face the challenges arising out of economic liberalization and globalization. Over the next two decades, it aims to attain:

1. *A growth rate in excess of 4 per cent per annum in the agriculture sector*
2. *Growth that is based on efficient use of resources and conserves our soil, water and bio-diversity;*
3. *Growth with equity, i.e., growth which is widespread across regions and farmers;*
4. *Growth that is demand driven and caters to domestic markets and maximizes benefits from exports of agricultural products in the face of the challenges arising from economic liberalization and globalization; and*
5. *Growth that is sustainable technologically, environmentally and economically.*

A. Food and Nutritional Security

A major agricultural policy thrust is given to development of rainfed and irrigated horticulture, floriculture, roots and tubers, plantation crops, aromatic and medicinal plants, bee-keeping and sericulture, for augmenting food supply, exports and generating employment in the rural areas. Availability of hybrid seeds and disease-free planting materials of improved varieties, supported by network of regional nurseries, tissue culture laboratories, seed farms will be promoted to support systematic development of horticulture having emphasis on increased production, post-harvest management, precision farming, bio-control of pests and quality regulation mechanisms

and exports. This emphasis is very supportive of SIMI efforts to stimulate and facilitate the development of appropriate technology packages.

B. World Trade Organization

Indian policy seeks to address the impact of WTO. Upon dismantling of Quantitative Restrictions on imports as per WTO Agreement on Agriculture, Commodity-wise strategies and arrangements for protecting growers from adverse impact of undue price fluctuations in world markets and for promoting exports is to be formulated. Apart from price competition, other aspects of marketing such as quality, choice, health and bio-safety will be promoted. Exports of horticultural produce and marine products will receive particular emphasis. A two-fold long term strategy of diversification of agricultural produce and value addition enabling the production system to respond to external environment and creating export demand for the commodities produced in the country will be evolved with a view to providing the farmers incremental income from export earnings.

C. Input Subsidies and Agricultural Capita

The Agriculture sector has been starved of capital in India. Concurrently, there has been a decline in public sector investment in the agriculture sector. Public investment for narrowing regional imbalances, accelerating development of supportive infrastructure for agriculture and rural development particularly rural connectivity are priority policies. For this reason India is adopting a time-bound strategy for rationalization and transparent pricing of inputs to encourage judicious input use and to generate resources for agriculture. Input subsidy reforms will be pursued as a combination of price and institutional measures to reduce costs of these inputs for agriculture. Resource allocation regime will be reviewed with a view to rechannelizing the available resources from support measures towards asset formation in rural sector. The policy emphasis on asset formation is strongly supportive of SIMI; however, distorting input subsidies may reduce incentives for farmers to adopt efficient micro irrigation technologies that are not associated with subsidies.

D. Marketing

National policy gives emphasis on the development of marketing infrastructure and techniques of preservation, storage and transportation with a view to reducing post-harvest losses and ensuring a better return to the grower. The establishment of cold chains, provision of pre-cooling facilities to farmers as a service and cold storage in the terminal markets and improving the retail marketing arrangements in urban areas will be given priority. Dissemination of market intelligence is receiving particular attention. Currently dialing market prices for major vegetables and fruits are available nationally through the Internet and other sources on a daily basis. This will strongly support SIMI efforts to link producer decisions to the best available market information.

E. Smallholder Policy

Indian agriculture is characterized by pre-dominance of small and marginal farmers. Institutional reforms are being pursued to achieve greater productivity and production. The approach to rural development and land reforms focuses on the following areas:

1. Consolidation of holdings all over the country on the pattern of Northwestern States.
2. Redistribution of ceiling surplus lands and waste lands among the landless farmers and unemployed youth with initial start up capital;
3. Tenancy reforms to recognize the rights of the tenants and sharecroppers;
4. Development of lease markets for increasing the size of the holdings by making legal provisions for giving private lands on lease for cultivation and agri business;

5. Updating and improvement of land records, computerization and issue of land pass-books to the farmers; and
6. Recognition of women's rights in land.

F. Credit

Indian policy to promote progressive institutionalization of rural and farm credit will be continued for providing timely and adequate credit to farmers. The rural credit institutions will be geared to promote savings, investments and risk management. Particular attention will be paid to removal of distortions in the priority sector lending by Commercial Banks for agriculture and rural sectors. Special measures will be taken for revamping of cooperatives to remove the institutional and financial weaknesses and evolving simplified procedure for sanction and disbursement of agriculture credit. The endeavor will be to ensure distributional equity in the disbursement of credit. Micro-credit will be promoted as an effective tool for alleviating poverty. Self Help Group – Bank linkage system, suited to Indian rural sector, will be developed as a supplementary mechanism for bringing the rural poor into the formal banking system, thereby improving banks outreach and the credit flows to the poor in an effective and sustainable manner. This is strongly supportive of SIMI efforts, as availability of some limited credit to smallholders will important in the establishment of SIMI.

1.7 Water Policy Considerations for Bangladesh

In Bangladesh water policy takes on premier importance, as the country is subject to devastating floods and highly dependent on water management for agricultural productivity. National water planning in Bangladesh dates back to 1964 when a 20-year Master Plan was prepared with emphasis on large-scale flood control and irrigation projects. The National Water Policy adopted in early 1999 lays down the broad principles of development and rational utilization of water resources. Broadly these objectives are:

1. To address issues related to harnessing and development of all forms of surface and groundwater and management of these resources in an equitable manner
2. To ensure the availability of water to all elements of society including the poor and the underprivileged
3. To accelerate the development of sustainable public and private water delivery systems with appropriate legal and financial measures and incentives including delineation of water rights and water pricing
4. To bring institutional changes that will help decentralized the management of water resources and enhance the role of women in water management, and
5. To develop a state of knowledge and capability that will enable the country to design future water resource management plans by itself with economic efficiency, gender equity, social justice, and environmental awareness.

In recent years there has been a growing perception that water management in Bangladesh must include preservation of inland fishery resources. Flood control and irrigation schemes have resulted in isolation of flood plains and in combination with over fishing this has resulted in low stock levels and dramatic declines in inland fisheries output. This disproportionably impacts the welfare of the poor. An important strategy for Bangladesh to maintain stocks is to maintain small bodies of water for stocking the annual flood plain. This will require better use of water resources and overall reduction in water usage for agriculture. The SIMI imitative would allow a decrease in water use but with an increase in incomes.

1.8 Agriculture Policy Considerations for Bangladesh

Agriculture has accorded highest priority in Bangladesh. The commitments in this respect are reflected in the National Agriculture Policy (NAP) of 1999 that includes:

1. Timely supply of agricultural inputs at affordable prices,
2. Appropriate action plan for agricultural credit and marketing of agricultural products,
3. Government support to agriculture,
4. Priority for the development of agro-based small and medium industries,
5. Enhanced rate of private sector- participation in different sectors of agriculture i.e. seeds, fertilizer, agro-machinery and also in establishing agribusiness.
6. Agricultural Mechanization
7. Pest Management
8. Greater coordination between the Government, NGOS and Private sector
9. Food based Nutrition
10. Environmental Protection in Agriculture and finally
11. Involvement of Women in Agriculture.

Bangladesh Agriculture is now in the process of transformation from subsistence farming into commercial farming. This process opens a vista to private sector investment in the areas of production of high value crops, production of seeds (especially hybrid seeds), of chemical and blended fertilizers, agro-processing enterprises, etc. The policy reforms that have taken place offer greater scope and opportunities for private sector participation and a suitable environment towards promoting agribusiness and investment.

This environment is highly supportive of the SIMI initiative. Bangladesh agriculture is largely free of distorting price incentives. The success of this policy has been shown by improved agricultural productivity in Bangladesh and effective self-sufficiency in rice production. This environment has been conducive to the IDE Bangladesh program of promoting treadle pump.

Specific objectives of Bangladesh agriculture include:

1. Achieve self-sufficiency in food grain production through a sustainable growth in rice and wheat production.
2. Achieve increasing and profitable production of minor crops and thereby maintain a balanced crop production.
3. Increase rural employment through the adoption of modern agricultural practices
4. Achieve low and stable consumer food prices and improve the nutritional status of the population.
5. Develop food production that is suitable and sustainable.
6. Establish macroeconomics policies that enable farmers to be responsive to domestic and world market opportunities.
7. Provide high quality infrastructure and government services that will enable farmers to produce and market products at low cost.
8. Rely on competitive markets to supply agricultural inputs at low cost.
9. Provide incentives to establish labor-intensive production and processing agro-based industries.

Liberalization policy has cut across the Bangladesh agriculture sector and includes important impacts:

(a) Liberalization of trade in minor irrigation sector has encouraged the private sector to supply minor irrigation equipment across the country. This happened gradually with a stepwise removal of restrictions of the import of small diesel engines in1986-87, followed by the withdrawal of duty on such imports in 1988-89. The subsidy on Deep Tube Wells (DTW) was removed in 1992 and BADC-the government organization was removed from the procurement and distribution of minor irrigation equipment. These reform measures had a tangible effect on increasing the demand for irrigation equipment and consequently the rate of increase in area under minor irrigation.

(b) Privatization of trade in fertilizer with an objective to transfer the fertilizer management and distribution services exclusively in private sector; Imports of all fertilizers are now being done by private sector except urea. The private sector is not restricted from importing urea. All fertilizers are being distributed through private sector dealers. The Government is providing no subsidy on fertilizers at the farm level and is selling all fertilizers at full cost pricing. This has led to the increased availability and wider adoption of chemical fertilizer at the farm level.

(c) Liberalization of trade and foreign exchange for enhanced participation of private sector in agricultural machinery of agriculture business.

(d) Liberalization of production, processing, distribution and import of seeds to ensure the participation of private sector seed dealers in seed industry development. The private sector is now allowed to import any improved germplasm for research and development and to develop its own facilities for producing foundation seeds. They are also allowed to import and sell seeds except five notified crops (rice, wheat, sugarcane, potato and jute). For notified crops, there are procedural formalities to be observed by the private sector before any import.

(e) Import of agricultural equipment, including power tiller, was liberalized - resulting in a positive effect on the import of power tillers. The area under power tiller utilization has grown at about 3.5 percent per annum after introduction of the liberalization policy.

1.9 Capacity of Existing and Potential Partners

A. Government

In Bangladesh, the Bangladesh Agriculture Research Institute (BARI) is doing a lot of research in high value horticulture crops. They have done a lot of good work, but are very poor in capacity to extend the technologies to the farmers. The same is the case for the Nepal Agricultural Research Council (NARC) in Nepal. But in Bihar (the only state visited in the Indian Gangetic plains), the entire government system is in disarray. There don't seem to be any good partners in the government system in Bihar. The extension systems in all three countries are filled with well-trained and well meaning people who are working in a system that doesn't encourage them to get out to the field and work with farmers, especially small farmers. In this regard, the Nepal extension service seemed to be the best of the three. Government policies in both Bangladesh and Nepal are quite liberal and moving in the right direction, at least in terms of targeting poverty alleviation as a big problem. But in Bihar, again, there does not seem to be any direction at all. Thus there are varying degrees of capacity of the government entities, but it seems possible to work with the research institutions if an effective means of extending their work to the farmers can be found. The extension services can be mobilized to provide technical assistance to projects, but in a limited manner.

B. NGOs

Bangladesh probably has one of the best-developed NGO sector in the developing world. There are at least 4 large national NGO's that actually rival the government in budgets and outreach. We visited with BRAC in the field, and with their Director Mr. Abed in his head office. This NGO seems highly innovative. They are very interested in working with a SIMI-like project. Most of the NGO's are working with micro-credit, and there have been complaints that this credit has not been tied to productivity. BRAC is well aware of this and is already moving to take appropriate steps and willing to work with others in this direction. Other large NGO's in Bangladesh include Grameen Bank, Proshika, Asha, and TMSS. All have multi-million dollar budgets and a well established management and financial capacity. All have credit programs, and most have savings and credit groups which could be mobilized to invest in productive technologies. International NGO's like IDE and CARE also work in the agriculture sector.

Nepal is less developed in the sector in terms of size of NGOs, but we ran into a few smaller programs that seemed to be effectively implemented. One micro-credit NGO called Nirdhan, and an agriculture based NGO called MADE. They have been operating for about 5 years each and have established a reputation for effective implementation. There are also many international NGO's such as CARE, Plan International, and IDE operating in the Terai.

In India (again, only Bihar), there are a scattering of small local NGO's, but we were unable to gauge their effectiveness. What they lack in size, they make up for in numbers. As in other areas of India, almost every village has some kind of NGO operating. Apparently they operate with varying degrees of effectiveness, and it is best to work with them through umbrella NGO's such as AFPRO.

C. Business Sector

The private, for-profit sector, as in all of South Asia, is very dynamic. There are a plethora of large, medium and small enterprises capable and willing to do business in the agriculture sector. There is a widespread network of inputs dealers and produce traders in all the areas that we visited. In Bangladesh we met with Treadle pump manufacturers who had been operating successfully for more than 15 year. In all three countries, we met with inputs dealers and irrigation suppliers who were experienced business people. These people are anxious to associate with projects that can help to extend their business, and in all places where IDE had a program, we found the business people actively involved in promotion of products. But almost universally, their knowledge level of agriculture is very low, but they are interested to learn more.

D Donors

In all three countries, DFID is involved in the agriculture sector. In Bangladesh and India, SDC has been supporting IDE's activities through their small enterprise development sections. In Bangladesh, you will find almost every international donor, and there seems to be no shortage of development funds for good projects. These include Danida, Norad, GTZ, Lutheran World Federation, USAID, and many others. USAID is very involved in the agriculture sector. In Nepal, both World Bank and Asian Development Bank are involved in the ground water development sector. And these agencies are also quite involved in Bangladesh. Bihar, because of governance issues, has less active donors. But we stress here, that the need is greatest in Bihar, and a strategy that can work through NGO's and the private sector will be well received by local people.

1.10 Specific Thematic Items

A. Market Development

SIMI will increase the production of high value and off-season vegetables. For SIMI to be successful in substantially increasing the incomes and welfare of smallholders three principal market related conditions must be in place:

4. Farmers must be able to identify and efficiently produce high value crops that are in demand.
5. Marketing mechanisms that aggregate production, ensure quality, and provide remunerative prices to local producers must be in place.
6. There must be market demand to accommodate substantially increased production levels.

This section focuses primarily on the steps to be undertaken for the development of marketing mechanisms and the identification of suitable crops/appropriate technologies. The size of market demand relative to SIMI objectives is addressed in Section III. A. Historically markets for agricultural products have been underdeveloped. The Gangetic plains smallholders have been subsistence oriented and internal and external marketing of agricultural products has been limited to primarily surpluses generated during years of good rainfall.

B. Contract Growing.

Contract growing systems offer great promise for smallholders to successfully benefit from commercialization of agriculture. Contract growing systems reduce farmer risk, provide access to appropriate technologies, and provide access to credit. Contract growing has a comparative advantage for processors that need to assure minimum levels of production, producers and buyers of perishable products, and producers and buyers of specialty products with important quality characteristics. Unfortunately, the business climate and trust between producers and sellers are weak in India. The high cost of organizing smallholders also inhibits contract growing operations. Allied SIMI efforts need to assist in initially organizing smallholders to reduce the transaction costs and should work to increase trust through sponsorship of workshops (*see trade matching services below).*

C. Trade Matching Services.

These services can be conducted in a variety of ways. The most advanced methods include the use of the Internet and specialized software. More basic approaches include trade fairs where producers and buyers can meet, understand each other's requirements, and develop deals and contracts. Allied SIMI efforts should pursue a variety of strategies to accomplish trade matching: Trade fairs for producers and buyers, workshops for producers and buyers with the goal of developing contracts, market tours/visits to important market outlets in India, conventional publication of contact information for producers and buyers, and the use of the Internet for more advertising and matching buyers and sellers of more specialized high value commodities.

D. Market Information.

Currently, the state governments are collecting and disseminating daily price information for major markets in all three countries. This is a critical service to the commercialization of agriculture. However, this price information is getting limited distribution. SIMI allied efforts will need to work to develop mechanisms for further distribution of this price information. Possibilities include: increase fax/email distribution linked to local institutions and local blackboard systems, assisting input suppliers to access information, and localized radio broadcasts. Market information systems must also be able to provide market analysis to inform farmer production decisions.

It is crucial that price information on high value crops be regularly available during the relevant periods to stimulate farmer interest in cultivating these crops. The lack of an adequate market information system has been widely recognized as a major constraint in the commercialization process for developing nations. Asymmetrical market information is also an important cause of high marketing margins (Bloom and Tulachan 1995). Poor market information coupled with the fact that many high-value agricultural products are often perishable, results in a poor bargaining position for farmers. It should be remembered that small farmers are subsistence oriented and often have little faith in markets. They greatly fear price collapses and variations. The impact of constant price information on farmer decisions will be profound.

What is needed is a call-in system to make this information available to farmers or farmers' groups who can call from the well developed telephone system in rural India. Access to this information would give the farmers or farmers' marketing groups the opportunity to make decisions about where to sell/transport their produce, based on the best available market prices. It would also allow them to know if they are getting the right prices from the middlemen.

E. Post Harvest Handling.
Improvements in post harvest handling are critical for the success of SIMI. Losses due to poor post harvest practices and facilities are extremely high in India. Development of appropriate packing and shipping materials is one possible area of intervention. IDE India has implemented a project to develop lower cost, more environmentally friendly packing materials for tomatoes in North India.

F. Connection to Export Markets.
The export of fresh vegetables to the Middle East and Europe by container load from Dhaka is a growing industry. We recently met a businessman who is shipping about 2 containers of fresh vegetable a week to Dubai. By linking small farmers with merchants who can collect and sort their produce, and then market to the exporters, SIMI would be connecting them into an expanding market.

1.11 Local Voices

During the survey, the team was able to meet with several farmers. The following is a sample of feedback:

In Nepal we met a woman farmer who had been growing vegetables for quite a number of years. Previously she had dug a hole in the field and lifted the water with a bucket on the end of a stick on a pivot. She saw someone using a Treadle pump and convinced her husband to buy one. Now the whole family uses the pumps, and they have tripled their land under vegetable cultivation. She also received some vegetable production training from IDE staff and found it helpful. The family vegetable consumption definitely went up after purchase of the Treadle pump. She was earning more than $100 per season. With the surplus, they gave their son the money for a down payment for a tractor. He now earns his living hiring the tractor to large farmers. Their total land holding is about 1 hectare, but they grow vegetables on about 0.2 hectares.

In Bihar in Parori village, we met a farmer who has been using a Treadle pump for 3 years. Last year he purchased a second pump so he could irrigate more land. In his village, out of 300 households, 50 are irrigating with treadle pumps, there are about 20 diesel pump owners, and more than 100 families purchasing water from these diesel pumps. The prices are stable, and he felt that the water prices were fair. He was growing about 0.2 hectares with his first pump, and has now increased to about 0.3 hectares. He earned about $100 last season before, and about

$150 this season. His biggest problems are getting quality seeds, and dealing effectively with pest problems.

In the same village, we met a man who owned a diesel pump. He owns 2.5 ha. of land, but actually it is shared by 4 brothers, so he only owns one fourth of that. They jointly bought the pump. They are selling water to 6 other farmers and charging about $1 per hour for use of the pump.

In Bangladesh, we met a group of farmers who are all growing vegetables by buying water from diesel pumpset owners. They were satisfied with the arrangement, and were earning in the range of $100 to $200 per season. None of them had ever seen an agricultural extension agent in the village. One elderly man said loudly that he has lived in the village for 55 years and never once seen a government worker. Everybody laughed, but in reality, it is no joke. They had heard of treadle pump, but were happy with the arrangement of buying water.

In another village in Bangladesh, we met a wealthy gentleman who had purchased a broken deep tube well from the government at a concessionary price. He was supplying water to almost 200 families in the village at the same rate as the shallow-tube well owners. We met later with a group of villagers, and they all stated that they were very happy with the arrangement, and that there were almost no scheduling problems. We found this amazing that a single entrepreneur could operate a system that effectively supplied water to 200 families at a reasonable price. A great example of privatization!

In another village in Bangladesh, we found that all the farmers were using treadle pumps, but they were all growing only rice. When asked why, they stated that their fields were too wet to plant vegetables on time. When asked if they knew about other , late growing varieties, they said no, they didn't have any access to information about different varieties of vegetables.

In all the villages that we visited, there were no farmers growing off-season produce. They all grew the same vegetables at the same time.

1.12 Principal Constraints

1. Farm Level

a. Technological Constraints
Appropriate technology for tillage, irrigation and harvesting designed for smallholders is almost non-existent. The technologies are usually focused on the large commercial farm owners and on the major cereal crops.

Obtaining timely access to good quality and affordable fertilizer and pesticides is also a constraint. Fertilizer in Bangladesh is a political commodity, easily affected by the political agenda. People in distribution and transportation quickly use the issue for various political motives and narrow self-interests. Government policies have at times lead to inefficiencies in fertilizer and pesticide distribution.

Availability of quality seeds is also a constraint to smallholders. A small drop in the percentage of germination may become significant for a smallholder. Shortages of certain seed varieties can also occur.

Marketing problems are much more important for vegetable producers than producers of other

food crops. Among the marketing constraints are transport damage and lack of storage facilities Among vegetables, spinach, bitter-gourd and gourd producers are the most likely to report losses due to damage during transportation or spoilage due inadequate storage facilities. Not surprisingly, spoilage is a major problem, as buyers are not always available the time after harvest. Timeliness of market delivery is crucial in determining prices.

Distribution of Fertilizer, Pesticide, and Seeds

In Bangladesh BADC is the primary organization in marketing fertilizers. The fertilizers are first shipped to transit warehouses, intermediate warehouses at strategic points and Thana Sales Centres (TSCs) (a thana is an administrative unit consisting of about 80 to 90 villages). TSCs sell fertilizers to private dealers for retailing to farmers as well as directly to farmers. The other category of wholesalers is the Thana Central Cooperative Associations (TCCAs) that sells fertilizers to private dealers and agricultural cooperatives at the village level for retail sale to farmers. The share of cooperatives in the total sale was small, only about 12 to 17 per cent. Private dealers were appointed for direct sales to farmers though a licensing procedure and three or four dealers served seven to ten villages. The dealers were not supposed to sell outside a defined area. They would procure fertilizers from specified TSCs and sell to farmers at prices fixed by the government. The fixed price included a commission based on the distance from the TSC to the operation centre. Dealers were required to maintain registers, which were subject to occasional inspection by BADC officers. Excluding the commission, the prices of fertilizers were supposed to be uniform throughout the country. The system suffered from numerous problems arising from excessive bureaucratic controls.

Pesticides: BADC was given the task of procurement of plant protection materials, and the Agricultural Extension Department was supposed to conduct operations for crop protection. Because of numerous complexities in the storage and handling of poisonous materials and in dispensing these materials to farmers, and because of the recognition that a bureaucratic agency can hardly take timely measures against pests, the ground measures of crop protection including procurement and distribution of pesticides were privatized. Private importers began importing and distributing pesticides through private dealers and general retailers of consumer goods. However, import of pesticides by private dealers was allowed only for approved brands and dealers and with permission from MOA. The approval process might have implied hidden costs for traders, and import only by brand names was potentially oligopolisitic. According to a 1991 study by Canada's Agricultural Sector Team, pesticide prices in Bangladesh were as much as double of those in early 1960s despite the absence of tariffs (CIDA 1991).

Seeds: The traditional seed markets in Bangladesh involve farmers producing seed for their own use and sale to markets. Those who need seeds buy from the market. It is not uncommon for some farmers to specialize in the production of seeds. These traditional markets have been the channel of distribution not only among farmers within the country but also between farmers of Bangladesh and India particularly in the bordering areas. The other channel that provides the improved varieties is developed in research stations by the public system. BADC uses contract growers all over the country for the production of such seeds of various crops. The private sector has been provided to market seeds under the license and control of the DOA. The government has developed a seed certification mechanism for ensuring quality. The major constraints as reported by the farmers are the seeds are either of poor quality or not available in time. Recently, a few multinational seed companies have started their operations in Bangladesh.

b. Capacity-Related Constraints

Lack of knowledge about improved farming techniques is an extremely important constraint for smallholders. Their land remains underutilized and underproductive due to their lack of knowledge and information of scientific innovations in farming systems, cropping patterns, and new high-value crops. Knowledge of irrigation, pest control, and fertilizer management is rudimentary. Some crops, such as eggplant, tomatoes, potatoes and gourds, are more susceptible

to, and more difficult to manage for pests and diseases.

Marketing of horticulture crops is complex. Prices are variable in time and space, depending greatly and often unpredictably on location, time, quantity, and quality. This requires rapid and decisive responses to shifts in market opportunities based on timely and accurate information. Although diversification into vegetable growing provides an attractive opportunity for smallholders, they must be prepared and equipped to understand the market and manage increased risks. Many smallholders, however, lack essential knowledge about market needs and demands, prevailing prices, supply and demand situation of products, change in the taste of the users, etc. Market knowledge is a critical element in the success of smallholders. This lack of information can lead to missed opportunities or even economic failure of an entire harvest

The Importance of Market Timing

In 2001, smallholders engaged in vegetable production (tomatoes, cauliflowers, radish) in North Bengal were devastated by an over supply of products. Almost all of the producers harvested their vegetables about the same time, creating a glut on the vegetable market. Most farmers could not even recover the cost of their seed. On the other hand, the few farmers who produced early or late varieties made tremendous profits because of the gap between demand and supply

c. Capital/Credit Constraints

The lack of affordable credit is a serious constraint for smallholders. Traditional village moneylenders are the most easily accessible source of credit in the rural areas but their interest rates are high. As a result, the smallholders become less innovative, less entrepreneurial, and more risk averse in their decision-making.

Potential credit sources for smallholders can be classified into three broad groups:

– On one extreme are informal lenders, such as professional moneylenders, input dealers, friends, and relatives, who are virtually outside the control of the government system.

– On the other extreme are formal financial institutions such as commercial banks and agricultural development banks. These institutions are regulated by the central bank of the country.

– Between these two types of lenders are the formal but pro-poor financial institutions such as Grameen Bank and ASA; NGOs such as BRAC and Proshika; and government programs such as the cooperative-based lending organizations, including the BRDB's RD-12 project.

d. Other Constraints

Land scarcity limits diversification, at least in the short term. Therefore, any new cropping program has to be accommodated within the existing land area. Pervasive illiteracy among smallholders is a major constraint to changing attitudes and behaviors.

2. Input Markets

a. Technological Constraints

Seeds supplied by small-scale entrepreneurs are often poor in quality. Seed producers require a reliable method for producing high-quality seed, including quality control procedures.

b.Capacity-Related Constraints

Extension services provide inadequate coverage and are inefficient in their use of time and

resources. The service is not easily accessible, especially by female, landless, and marginal farmers. Too much emphasis is placed on delivering prescribed messages and not enough on responding to farmers' technology and information needs. There is a lack of accountability of extension staff for the quality of their work. The linkages between research institutions and extension services is weak.

c. Capital/Credit Constraints
Financing is required to establish private-sector suppliers of input goods and services to smallholders.

d.Other Constraints
High cost and low availability fuel and power.
Political motives and self-interest have a negative effect on the availability and distribution of inputs such as fertilizer and pesticides.

3. Output Markets
a. Technological Constraints
Harvesting, processing, storage, and packaging of crops are extremely important for seizing market opportunities. However, due to lack of available technologies, smallholders can hardly tap into this area. There is a need to identify or develop appropriate technologies that will aid smallholders in the marketing of their produce for economically rewarding returns.
Vegetables in general being highly perishable need quick access to market. The primary means of transportation still remains rudimentary to a large extent. Boat, bullock-cart, rickshaw vans still play a critical role in the transportation of agricultural products particularly in the remote villages. The cost of transportation as well as availability often dictates the accessibility to market. As a result, a large number of farmers trade their products at the farm site through middlemen thus losing their profitability.

b.Capital/Credit Constraints
Financing is required to establish private-sector suppliers of post-harvest processing, packaging as well as storage and transportation technologies.

2. 15-YEAR RECOMMENDED PLAN

2.1 Target Population and Expected Market Penetration

Broadly the SIMI target population is smallholders with less than 1 hectare of cultivated land and with an income below national poverty standards. As outlined in Table 4**,** the Gangetic plains, which encompass parts of India, Bangladesh, and Nepal have a population of 327 million people. About half of this population (164 million) is below national poverty standards (Table 2). This is the SIMI target population for the 15 year plan. SIMI aims to increase the incomes of adopting households by about 500$ per year. This represents an amount of additional income that can lift a household out of poverty in this region.

Table 1: Population of the Gangetic plains

	Population
Gangetic plains of India	189,801,000
Gangetic plains of Bangladesh	123,500,000
Gangetic plains of Nepal	13,800,000
Total Gangetic plains population of above 3 countries	327,101,000
Gangetic plains SIMI target population	163,550,500

There are potential structural constraints to achieving SIMI objectives. In this section it is shown that basic market conditions can support substantial increased production of HVCs in the Gangetic plains at remunerative prices that will enable SIMI to have a profound poverty alleviation impact. A basic analysis is conducted using extremely conservative parameters and where needed assumptions that will substantially underestimate the potential impact of SIMI. In the Gangetic plains SIMI will primarily work in the area of HV vegetable crops. Analysis in this section is restricted to vegetable production.

Table 2 shows the size of the Gangetic plain vegetable market. The total market size is estimated to be 47 million metric tons annually. This figure is based on one-half the markets of Nepal and India and 90% of the Bangladesh market being available for Gangetic plain vegetable producers. The estimate of 50% market access for the Indian and Nepalese Gangetic plains represents a conservative figure as the Gangetic plains is located at the heart of the Indian Subcontinent and is in proximity to major urban population centers.

Table 2: Gangetic plain vegetable market

Country	Total Vegetable Production (Mt)	Gangetic Plain Vegetable Market Size (Mt)	Percentage of National Production in Gangetic Market Shed
India	87,536,000	43,768,000	50%
Nepal	1,652,979	826,490	50%
Bangladesh	2,830,000	2,547,000	90%
Total	92,018,979	47,141,490	51%

Currently total market revenue value is estimated at $5.8 Billion for markets accessible to the Gangetic plain. This is based on a composite vegetable price of $124/Mt, the average of HV vegetable crop prices in India, Nepal, and Bangladesh (Table 4).

Table 3: Current Gangetic plain market conditions

Item	Value
Composite Vegetable Price ($/Mt)	124
Total Production (Mt)	47,141,490
Market Revenue (Mt)	5,845,544,698

The analysis of the Gangetic plain market potential includes three components:

1. Increased market demand from increased population and economic growth
2. Increased efficiency of production associated with micro irrigation and productivity boosting micro irrigation agricultural technology packages
3. Increased off-season marketing of vegetables

It is estimated that the Gangetic plain vegetable market will grow at an annual rate of 6.7 percent based an economic growth rate of 5 percent, population growth of 1.6 percent and an income elasticity of 1.1 (Table 4). This prediction is in line with historical trends; demand growth from 1992 to1996 was 5.6 percent and from 1997 to 99 was 6.5 percent. After 15 years a growth rate of 6.7 percent will lead to a more than two-fold increase in vegetable demand

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Table 4: Economic growth parameters

Item	Value
Annual Economic Growth	5.00%
Annual Population Growth	1.60%
Income elasticity	1.1
Annual Demand Growth	6.76%
Demand Growth Year 1	1.07%
Demand Growth Year 2	1.14%
Demand Growth Year 3	1.22%
Demand Growth Year 4	1.30%
Demand Growth Year 5	1.39%
Demand Growth Year 10	1.92%
Demand Growth Year 15	2.67

Note: 5% economic growth and 1.6% population represents a composite figure for the India, Nepal, and Bangladesh Gangetic plain. An income elasticity of 1.1 is a conservative assumption.

Conservatively it is assumed that SIMI interventions will lead to a 15 percent outward shift in the supply of vegetables. That is, farmers will become 15 percent more efficient in producing high value vegetable crops with micro irrigation and associated technology packages. The impact of this shift was estimated using a partial equilibrium model. Table 5 presents model parameters. The demand and supply elasticities represent conservative estimates.[35]

Table 5: Partial equilibrium model parameters

Items	Value
Demand elasticity	1.2
Supply elasticity	0.5
Supply shift (%)	0.15

The partial equilibrium analysis (Table 6) shows that under current market conditions production will rise from 47 million MT to 51 Mt annually. Price will decrease from USD 124/Mt to USD 113/Mt but farmers will maintain profitability because they will be more efficient producers.

Table 6: Partial equilibrium model results

Items	Value
New Price ($/Mt)	113.1
Old Price ($/Mt)	124
New Quantity (Mt)	50,881,081
Old Quantity (Mt)	47,141,490

The estimate of additional product that can be absorbed in the South Asian Gangetic plain market is based on the Nepal market analysis. That analysis shows that the Nepal market can support 42 percent more product through off-season production opportunities than is currently produced. Nepal has climatic niches that increase off-season opportunities. For the Gangetic plains this percentage of off-season production potential is assumed to be more than half of Nepal's and is set at 20 percent.

The total result is an ability of the Gangetic plain market to absorb more 17 million Mt of vegetable production at remunerative prices after one year and 94 million Mt after 15 years (Table 7). Improve seasonality provided the largest opportunity followed by improved efficiency and improved growth. This implies a potential for 874 thousand hectares of HVC in the Gangetic plain after one year and 4.7 million hectares after 15 years leading to the potential to lift 5.8 million households out of poverty in the first year and 31 million households (155 million people) after 15 years. The size of this potential market exceeds SIMI objectives for poverty alleviation.

[35] It should be noted that the demand and income elasticities used are consistent. It is assumed that cross price elasticity will have a small positive value (e.g. demand elasticity = demand elasticity + cross price elasticity.

Table 7. SIMI Gangetic plain market potential and penetration

Market potentials for SIMI	Year 1	Year 3	Year 5	Year 10	Year 15
Economic and population growth (Mt)	3,186,765	10,221,133	18,238,693	43,533,800	78,615,397
Improved efficiency (Mt)	4,871,591	4,871,591	4,871,591	4,871,591	4,871,591
Improved seasonality (Mt)	9,428,298	10,402,616.15	10,402,616.15	10,402,616.15	10,402,616.15
Total SIMI Production (Mt)	17,486,654	25,495,340	33,512,900	58,808,008	93,889,605
Total SIMI Area (Ha)*	874,333	1,274,767	1,675,645	2,940,400	4,694,480
No. of SIMI Households	5,828,885	8,498,447	11,170,967	19,602,669	31,296,535

*Note: Composite yield of 20 Mt/hectare is used

** It is estimated that households will crop 0.15 Ha in SIMI interventions to achieve a USD 500/ year income increase. This is less than Nepal (0.19) because costs are higher in Nepal and productivity packages are more advanced in the Gangetic plain.

2.2 Basic Water/Micro-Irrigation Development Strategies

The entire Gangetic plain is underlain by a rich shallow aquifer which is annually recharged by heavy monsoon rainfall and periodic flooding of its numerous rivers. In nearly all areas, this aquifer is within 2-8 meters of the ground level. Within most areas, there are also shallow (within 20 meters) sand layers that make access to this water through the use of tube wells viable. There do exist some upland portions, particularly the Barind tract of northwest Bangladesh where water tables are generally deeper than 8 meters, and where shallow tube wells will not suffice. These areas need special treatment, and there exist some technologies for this.

Also, given this abundance of ground water, each of the areas is at a different stage of exploitation of this resource. Bangladesh, with its well developed water markets, including inexpensive Chinese diesel pumps, treadle pumps, and active water selling, is the most developed, and it is estimated that somewhere between 70 and 80 percent of the population already have access to irrigation water. In India, it is somewhat less developed, with probably 50 to 60 percent access, and Nepal is lagging with 30 to 40 percent access. Of course these figures vary from locality to locality and only represent average numbers.

Given the above situation, over the next fifteen years, the following strategies need to be followed:

1. In Bangladesh, technologies for easily extracting water from water tables of 8 to 20 meters need to be disseminated in order to bring the water access revolution to the upland areas. Technologies such as the deep-set treadle pump, and the Jib an hand pump, already developed and tested by IDE can be applied to this purpose. The technologies need to be promoted through the private sector model already perfected by IDE and attached to productivity enhancing programs.
2. Simple technologies such as low-cost plastic lay flat hose need to be disseminated. These technologies allow wider distribution of water from shallow tube wells at a reasonable cost, with less wastage. They can also be used to lift water up to one meter to slightly elevated fields that before had no access to neighboring shallow tube wells.
3. In India and Nepal, lower cost diesel pumps need to be widely disseminated. With the more liberal trade policies that already exist in these countries, this should be possible now. These technologies would include Chinese diesel engines and low-horsepower kerosene engines. Again, a private sector model for dissemination that includes facilitation of imports, facilitation of the establishment of marketing networks in rural

areas, training of technicians in both repair and installation of the engines and tube wells, and wide promotion among the target farmers.

4. In India and Nepal, promotion of the quick spread of water markets should follow along with the increased purchase of diesel engines. This will mainly involve making the communities aware of how efficient water selling markets operate in other areas, and getting the sellers and potential buyers to sit down together and agree on a fair strategy for distribution. This process can be facilitated by NGO's or other community-based organizations (CBO).
5. All this should be accompanied by a well-developed software package on how to disseminate technologies and promote water markets through a sustainable, private-sector approach. Training packages would be developed to teach NGO's, CBO's and government agencies how to do this.

2.3 Output Markets for Smallholders

Output markets in the Ganges are very well developed. An extensive road network, and a system of local, regional and national markets serve the area. However, there are many interventions which could smooth the marketing of the farmer's produce. Some of these are:

1. Government needs to invest in the upgrading of market infrastructure, especially local collection centers.
2. Farmers need their awareness raised regarding the grading of their produce. They can increase profits, by separating their goods by quality and selling the better quality for a higher price.
3. Farmers need their awareness raised about off-season production opportunities. The number one marketing complaint of farmers is low prices. By producing off-season, these problems will be reduced.
4. Sustainable market information systems need to be developed. The best option would be a national or regional call-in system where farmers can get current prices in various markets. This will assure that farmers are getting the best price for their produce, and are not be cheated by middlemen.
5. Low-cost packing materials to reduce wastage during transport need to be developed and disseminated. Wastage during transport can be as high as 40 percent for certain commodities and ultimately affect the profitability of the farmers.
6. Export of vegetables to Europe and the Middle East needs to be facilitated. Entrepreneurs can be introduced to important contacts by international agencies, and trained on issues of quality and timely supply.

2.4 Strategies for Implementation

A. On-Farm Technologies (inputs and management techniques)

A national team of experts (comprised of government and private experts in the field of horticulture) needs to develop a series of productivity packages for vegetables. These packages will be developed based on assessment of the national market potential for vegetable consumption, fluctuating market demand and price of certain commodities, and on the technical feasibility of growing vegetables in the off-season. These productivity packages will include a well-designed syllabus for training the farmers for growing each commodity, and a syllabus for training of trainers (this will be a joint effort of government, NGO, and private sector). Some contracting agency/agencies will act as a facilitator to set up a public/private extension

partnership program. The government (high skill level-low access to farmers) will act as a wholesaler of the information in the productivity packages. NGO's, community based organizations, farmers groups, and private input businesses (low skill level- high access to farmers) will act as retailers of information. The donors and facilitating agencies will make sure that the government has the skill necessary, and will make the initial linkages between the government staff, private businesses and leaders of other organizations. These people will then have continued access to the government extension services, and will act as a conduit through which the farmers can access information and practices.

For areas where there is high access to water, this is the final step in making maximum utilization of the water. Not "more crop per drop" but "more profit per drop" should be the mantra of the on-farm program. Certain crops such as monsoon tomatoes, early cauliflower, and early cucurbits will be the initial focus, with other opportunities coming up along the way. The researchers need to be coordinated to feed new off-season or specialty crops into the extension system. This will ultimately be the domain of the government, assisted by private agencies and the private sector.

B. Post Harvest Technologies and Output Markets

See output markets above.

C. Supply Chain Development

In the case of the Gangetic plain, there are two types of supply chains for agriculture inputs. Specialty stores or hardware stores sometimes sell irrigation equipment. These stores supply only irrigation equipment and tools to farmers and not other inputs. These stores need to be linked in with state level suppliers and given training on the basics of horticulture, and installation, repair and maintenance of irrigation systems. These dealers should be involved in the promotional activities and training on irrigation given by the projects. Other agriculture inputs are sold through ag supply stores. These stores also need to be hooked into suppliers of the recommended inputs for the chosen productivity packages. The appropriate packages of irrigation technologies and agro-inputs will have been identified early on (and continually refined) by a panel of experts working with research institutions and other development agencies. It is then up to a facilitating agency to make the linkages between suppliers (domestic and foreign) of these commodities and an appropriate chain of input dealers. Also the capacity of this chain will be built up through training on the specific productivity packages. The necessary supplies include seeds, fertilizer (macro and micro), pest control, and tools. The chain of dealers will then be linked up with the targeted farmers. In most cases, it should be attempted to involve the inputs dealers in the training of the farmers. This establishes an early linkage between them. The dealers should be encouraged to participate in order to expand their business.

D. Finance

The entire supply chain will have to be capitalized. While it was observed that currently, capital is not a major constraint for most of the inputs suppliers, it will no doubt become a constraint if their business doubles or triples as would be expected from a program such as this. In this case, the supply chain is well able to access traditional formal sources of credit such as public sector banks. The banks will need to have sufficient capital set aside for this purpose. Further development and expansion of micro-credit institutions for credit to the farmers will be necessary. The program will formally link micro-credit institutions with the communities where the production programs will be going on. This will especially be feasible in Bangladesh where micro-credit is well established and widespread. Also the program can work with NGO's that promote savings and credit groups which have been quite successful in many places. The

program can also experiment with working with input suppliers to supply credit to farmers. It is well known that dealers issue goods on credit to those who are well known to them. A system should be designed that will teach dealers how to make home visits, assess credit risks, and charge customers extra for the service.

2.5 Policy Implications

The proper policy environment is important to the implementation of the previously outlined strategy. In general, the current policy environment in all three countries is generally favorable to this strategy, and all three countries have poverty alleviation as one of their prime objectives. They also are beginning to focus more on small-scale solutions for the small producers. Some of the key issues are:

1. The government research institutions need to be directed to focus on the small farmers, and specifically on development and dissemination of low-cost, small-scale technologies appropriate to the needs of those farmers. Efforts need to be made to make proper linkages between the research institutions and the extension services to get good technologies off the shelf.
2. Government extension services need to look more and more towards the private sector and NGO's as their natural allies and partners in the effort to get technologies to farmers. The high farmer access level of these private sector entities can naturally complement the high information level of the government organizations. Specifically, government should be not only looking at their own projects, but as a resource for the projects of others who have good track records at reaching small farmers.
3. The subsidy environment should be conducive to the smooth and rational flow of goods to the farmers. Subsidies on the cost of inputs have generally not been effective in increasing access to these inputs to the small farmers. It is usually large farmers that access the subsidies. Thus subsidies on inputs such as fuel and fertilizer should be eliminated and moneys directed towards other areas. The smooth flow of information through appropriate intermediaries is a natural area for the government to direct its moneys. Also, the development of appropriate infrastructure such as roads and markets is another important area of government intervention.
4. International trade and tariff structures should be as liberal as possible. This would allow the smooth flow of appropriate goods to farmers, and make local industries more competitive. This is especially a problem in India, but the environment there is slowly changing. The high price of diesel pumps in India and Nepal is a direct result of protective tariffs on imported machinery.
5. In all three countries, irrigation investment should be tilted more towards software than developing new structures, and should favor small-scale local solutions over large-scale solutions. This will lead to more sustainable and effective irrigation interventions.
6. Governments can play a role in promotion of agricultural exports through trade agreements with developed countries.
7. Regulations and taxes on small businesses should be minimized to facilitate the smooth functioning and growth of this sector.

PART II

IMMEDIATE INVESTMENT OPPORTUNITIES

3. CORE ACTION RESEARCH AND DEVELOPMENT PLAN (CARDEP): DEVELOPMENT OF AN INTERVENTION STRATEGY

4. GEOGRAPHIC EXPANSION

3. CARDEP: DEVELOPMENT OF AN INTERVENTION STRATEGY

3.1 Marketshed Description

The Gangetic plain is one of the poorest and most densely populated areas of the world. The area is home to more than 300 million people with a mean population density of more than 700 people per square km. The agricultural sector dominates the economy in terms of its contribution to national income as well as employment. Agriculture accounts for more than half of the Gross Domestic Product (GDP) and employs two-thirds of the labor force. Food-grain production, primarily rice monoculture, is central to the economy. Approximately 80 percent of the total cultivated area is planted with rice, which accounts for about 93 percent of total cereal production (Alauddin and Tisdell, 1997). The rapidly increasing population has largely offset improvements in agricultural output during the past 50 years. The average per capita income is US$ 387. Increasing population pressure has reduced the average land holding size to less than one hectare. Because of the tight land constraints, increasing agricultural production by expanding the cultivated area is not an option. Continuous improvements in agricultural technology are therefore key to keeping food production in pace with population growth. Agriculture in the Gangetic plain is in the process of transformation from subsistence to commercial farming. Bangladesh is already exporting vegetables and other high-value crops to European markets. Policy reforms have taken place that offer greater scope and opportunities for private sector investments in agriculture. This move towards global markets also opens a wide range of potential private-sector investments in the production of high-value crops, seeds (especially hybrid seeds), chemical and blended fertilizers and agro-processing enterprises, among others.

The rich groundwater resources have been widely tapped in Bangladesh and many areas of India, but while this access to water has increased grain production drastically, it has not resulted in significant poverty reduction because the water is used mainly on rice, which has a relatively low economic value.

A three year project is proposed that will aim to a) complete the revolution in access to water that has already been started, and b) drastically increase the economic productivity of that water use, especially among small holders, by promoting the change over to high value cash crops, especially off-season vegetables.

The project will be discussed as a three-country program (Bangladesh, India, Nepal), but can be implemented separately in each country.

3.2 Target Population

The target population of the project is the small and marginal farmers holding less than 1 hectare. These land holdings are generally broken up into three-five parcels. The farmer's main livelihood comes from farming operations, and mainly from rice production. Those farmers growing mainly rice will be assisted to move to cash crop production, and those already growing cash crops will be assisted to increase incomes by introduction of appropriate irrigation and production technologies.

The areas selected are three districts in each country. In Bangladesh, one district each in Mymensingh, Bogra, and Noakhali, in Nepal, Siraha, Saptari, and Dhanusha districts in the Central Terai and in India, the three districts adjacent to Sitamarhi in North Bihar. These are representative of the rest of the Gangetic plains area. 10,000 farmers will be targeted in each of

the districts of Bangladesh and India, and 6,000 farmers will be targeted in each of the districts of Nepal. The total target will be 78,000 farmers over three years.

3.3 Water Strategy

In Bangladesh, the strategy will be to extend the water availability to near 100% by further developing water markets and by applying appropriate technical solutions to areas with technical difficulties. Low-cost, deep-set pump technology will be promoted in areas of low or dropping water tables. IDE has already developed several such technologies including the deep-set treadle pump, and the Jiban hand pump. A supply chain development program modeled on IDE's success with the treadle pump will be the preferred model of dissemination. This involves developing the manufacturing capability through training, assisting in developing a rural marketing network, training technicians for installation of the technologies, and conducting mass marketing campaigns to make farmers aware of the technologies. The sale of water technologies will be tied to the introduction of off-season production technologies which will be discussed later.

Another area of technology intervention will be the introduction of a range of piped water systems to move water around more efficiently. This will include thin polyethylene lay flat hose to move water across fields and up elevations of 1 meter or less. It will also include the further testing, adaptation, and promotion of low-cost drip irrigation systems where deep water tables make lifting of water more expensive. Treadle pumps will also be promoted, mainly tied to NGO credit programs to help them to reach poorer farmers.

In India, the same basic strategy will be followed, but there will be an additional component of promotion of low-cost diesel or kerosene pumps. This will involve the selection of the appropriate technologies, development of the marketing chains and training of repair and installation mechanics. Also a mass marketing campaign will be developed to promote use of these among farmers. Simultaneously, water markets will be promoted by facilitating the owners to sell water to their neighbors. Water users meetings will be set up to make buyers and sellers aware of each others needs, and to facilitate the quick take-up of this market system.

In Nepal, the importation of Chinese diesel pumps will be facilitated through working with the traders in Kathmandu who already import Chinese products. Linkages will then be made with the pump dealers in the Terai, and a massive training effort will be made to improve the quality of well drilling in the area. Mechanics will also be trained for repair and maintenance. Also as in India, there will be facilitation of water sales from diesel pump owners. And the third component will be massive promotion of Treadle pumps, thus giving farmers three options of water sources: Treadle pumps, diesel pumps, or purchased water. This will create a true active market where prices will be competitive.

3.4 High-Value Agricultural Products

A wide variety of tropical and sub-tropical vegetables is grown in the Gangetic plains. The per capita consumption of vegetables is currently well below recommended levels and the government and development community have placed strong emphasis on raising consumption by increasing the supply of domestic vegetable production.

Profitability data show that a wide variety of crops such as potatoes, vegetables, fruits and spices yield net returns per hectare that are significantly higher than those of HYV rice. Compared to dry-season HYV rice, net returns per hectare of land (estimated on a full-cost basis) are twice as

high for potatoes and three to five times as high for some vegetables and spices. Despite the high returns from vegetable production, especially when compared to boro rice, nonrice crops still play a relatively minor role in smallholders' crop mixes. This may be due to 1) price variability (the average annual variability of harvest prices around the estimated trend is 15 to 25 percent for most fruits and vegetables, including potatoes, and 20 to 40 percent for spices, compared to only 5 to 6 per cent for food grains) and 2) the perishable nature of vegetables, which results in more crop losses and higher transport costs. HYV potatoes show somewhat lower financial returns than other vegetables, but potato production has grown faster than vegetables in the past decade. This reflects its increasing use as a staple food, unlike the others, which are eaten primarily as condiments. In the target districts, smallholders produce onions, bananas, eggplants, potatoes, parbles, cucumbers, leafy vegetables, cauliflowers, chilies, ground nuts, arum, and radish among others. Crop selection generally depends on a number of factors such as water availability, crop water demand, market for the crops, availability of quality inputs, soil quality and land topography among others. There is a strong demand for cauliflower, chilies, eggplant, kakroll, mukhikacu, and cucumber in both local and international markets, particularly in the Middle East and in European markets during the winter months. There is a larger market for exporting vegetables to European or Southeast and East Asian markets to meet their off-season demand for high-value fruits and vegetables. These include a wide variety of produce that can be grown in the region. For example, export of French beans to European markets on a limited scale has already begun.

It can be seen that there are a wide variety of opportunities in vegetable production for farmers to earn good profits. In the early months of the project, a high powered team of horticultural experts will be assembled to recommend 4-6 particular crops for each of the three countries. The team will then make a recommended package of seed variety and cultivation practice to yield highest returns. Focus will be on new high value crops such as French beans, or an off-season variety such as monsoon tomato or early cauliflower.

Training programs will be developed for these production packages both for the farmers and for development workers. The project will work with a number of government, NGO, and private sector partners to disseminate the production packages to the farmers.

3.5 Constraints Analysis

1. Farm Level

a. Technological Constraints

Technology is a critical constraint for the smallholders. Lack of irrigation facilities is considered as the primary limitation. The cost of irrigation is relatively high for the smallholders. On average, it costs 40-50 taka/hour for irrigation by motorized pump, which may not be available at the right time.

Appropriate technology for tillage, irrigation and harvesting designed for smallholders is almost non-existent. The technologies are usually focused on the large commercial farm owners. Obtaining timely access to good quality and affordable fertilizer and pesticides is also a constraint. Fertilizer is a political commodity, easily affected by the political agenda. People in distribution and transportation quickly use the issue for various political motives and narrow self-interests. Government policies have at times lead to inefficiencies in fertilizer and pesticide distribution in Bangladesh. Availability of quality seeds is also a constraint to smallholders. A small drop in the percentage of germination may become significant for a smallholder. Shortages of certain seed varieties can also occur.

Marketing problems are much more important for vegetable producers than producers of other food crops. Among the marketing constraints are transport damage and lack of storage facilities. Among vegetables, spinach, bitter-gourd and other gourd producers are the most likely to report losses due to damage during transportation or spoilage due inadequate storage facilities. Not surprisingly, spoilage is a major problem, as buyers are not always available the time after harvest. Timeliness of market delivery is crucial in determining prices.

b. Capacity-Related Constraints

Lack of knowledge about improved farming techniques is an extremely important constraint for smallholders. Their land remains underutilized and underproductive due to their lack of knowledge and information of scientific innovations in farming systems, cropping patterns, and new high-value crops. Knowledge of irrigation, pest control, and fertilizer management is rudimentary. Some crops, such as eggplant, tomatoes, potatoes and gourds, are more susceptible to, and more difficult to manage, particularly for pests and diseases.

Marketing of horticulture crops is complex. Prices are variable in time and space, depending greatly and often unpredictably on location, time, quantity, and quality. This requires rapid and decisive responses to shifts in market opportunities based on timely and accurate information. Although diversification into vegetable growing provides an attractive opportunity for smallholders, they must be prepared and equipped to understand the market and manage increased risks. Many smallholders, however, lack essential knowledge about market needs and demands, prevailing prices, supply and demand situation of products, change in the taste of the users, etc. Market knowledge is a critical element in the success of smallholders. This lack of information can lead to missed opportunities or even economic failure of an entire harvest.

The Importance of Market Timing

In 2001, smallholders engaged in vegetable production (tomatoes, cauliflowers, radish) in North Bengal were devastated by an oversupply of products. Almost all of the producers harvested their vegetables about the same time, creating a glut on the vegetable market. Most farmers could not even recover the cost of their seed. On the other hand, the few farmers who produced early or late varieties made tremendous profits because of the gap between demand and supply.

d. Capital/Credit Constraints

The lack of affordable credit is a serious constraint for smallholders. Traditional village moneylenders are the most easily accessible source of credit in the rural areas but their interest rates are high. As a result, the smallholders become less innovative, less entrepreneurial, and more risk averse in their decision-making. Potential credit sources for smallholders can be classified into three broad groups:

- On one extreme are informal lenders, such as professional moneylenders, input dealers, friends, and relatives, who are virtually outside the control of the government system.
- On the other extreme are formal financial institutions such as commercial banks and agricultural development banks. These institutions are regulated by the central bank of the country.
- Between these two types of lenders are the formal but pro-poor financial institutions such as Grameen Bank and ASA; NGOs such as BRAC and Proshika; and government programs such as the cooperative-based lending organizations, including the BRDB's RD-12 project.

e. Other Constraints

- High labor requirements and the lack of labor availability during peak season.
- Land scarcity limits diversification, at least in the short term. Therefore, any new cropping
  program has to be accommodated within the existing land area.
- Pervasive illiteracy among smallholders is a major constraint to changing attitudes and behaviors.

2. Input Markets

a. Technological Constraints

Seeds supplied by small-scale entrepreneurs are often poor in quality. Seed producers require a reliable method for producing high-quality seed, including quality control procedures.

b. Capacity-Related Constraints

Extension services provide inadequate coverage and are inefficient in their use of time and resources. The service is not easily accessible, especially by female, landless and marginal farmers. Too much emphasis is placed on delivering prescribed messages and not enough on responding to farmers' technology and information needs. There is a lack of accountability of extension staff for the quality of their work. The linkages between research institutions and extension services is weak.

c. Capital/Credit Constraints

Financing is required to establish private-sector suppliers of input goods and services to smallholders.

d. Other Constraints

- High cost and low availability of fuel and power.
- Political motives and self-interest have a negative effect on the availability and distribution of
  inputs such as fertilizer and pesticides.

3. Output Markets

a. Technological Constraints

Harvesting, processing, storage, and packaging of crops are extremely important for seizing market opportunities. However, due to lack of available technologies, smallholders can hardly tap into this area. There is a need to identify or develop appropriate technologies that will aid smallholders in the marketing of their produce for economically rewarding returns. Vegetables are generally highly perishable and thus need quick access to market. The primary means of transportation still remains rudimentary to a large extent. Boat, bullock-cart and rickshaw vans

still play a critical role in the transportation of agricultural products, particularly in the remote villages. The cost of transportation as well as availability often dictates their accessibility to market. As a result, a large number of farmers trade their products at the farm site through middlemen thus losing their profitability.

b.Capacity-Related Constraints
There is very little capacity in the private sector to produce and distribute affordable and appropriate "output" technologies to farmers. Output technologies could include technologies for harvesting, storing, processing, packaging, and delivering crops.

c. Capital/Credit Constraints
Financing is required to establish private-sector suppliers of post-harvest processing, packaging as well as storage and transportation technologies.

3.6 Intervention Strategy

IDE has been developing markets for agricultural inputs, including micro irrigation technologies, for the past 18 years. Micro irrigation includes the foot-operated treadle pump for pumping ground water, drip irrigation system, micro-sprinkler and water storage systems. Input markets have been focused on poor farmers with minimal land. Specifically, IDE has been supporting the smallholders for production of cash crops to increase the cash income of small farm units. The goal has been to transform farmers from a subsistence to micro-enterprise market production orientation. IDE has worked with over 1 million farmers who have increased their annual net income, on an average, by more than US$100. The majority of these farmers were not commercial growers prior to involvement of IDE programs

This program will build on the methodology that follow: The steps involved are: 1) identify the needs of farmers through community interaction; 2) capacitate the smallholders to improve on crop production and management practices through capacity building and better orient and link them with the input and output market; 3) further develop and adapt appropriate technologies (a comprehensive hardware and software input package) to solve specific farm problems and tap new opportunities; 4) build delivery channels through capacity-building (training) and establishing market linkages, especially dealership networks; 5) build local capacity to deliver, advise, and service the technologies; 6) make farmers aware of enterprise opportunities; and 7) establish linkages between farmers and researchers, NGOs and the mainstream input markets. In the proposed program, the implementers in the entire process will continue to work as "facilitators," with an active role to develop the market through demand and supply side interventions at input, throughput and output markets. In this process the project will involve other relevant actors in the field.

The project, along with its collaborating partners, would stimulate market demand for new products and services and – through technical assistance and training – help local, private supply chain to sell their products and services to customers in an economically sustainable way.

The project will provide expertise for the proposed project in the form of: 1) capacity building of smallholders through intensive training in high value crop production and marketing, 2) promotion of increased vegetable production through promotional activities with farmer groups, and 3) creating linkages between private entrepreneurs and farmers/farmer groups through public meetings, workshops and personal contacts. In turn this will achieve the following goals: 1) assisting more poor farmers (including women) in becoming micro-entrepreneurs through vegetable production, 2) increasing the production and income of existing vegetable producers,

and 3) increasing local farmers' access to output markets in which to sell their produce on a sustainable basis.

1. Farm Level

a. Technology Strategy

The project will promote small-scale irrigation technologies (treadle pumps, drip irrigation systems, water storage bags, deep-set treadle pumps, pressure treadle pumps) in the program districts through a variety of promotional activities that have been refined during 18 years of technology promotion in Bangladesh. Activities will include:

– live product demonstrations in markets, fairs, and community meetings,
– farmers' meetings in villages where farmers hear from their peers about the pump's benefits,
– video van presentations showing professionally-produced entertainment movies with an irrigation theme in the local language,
– demonstration plots in farmers' fields,
– farmer's visits to other successful farmers who have benefited from the technology, and
– handbills, billboard paintings, banners, etc., and
_.supporting local NGOs and private-sector suppliers in their efforts to promote irrigation technologies.

The project will also continue to develop customized drip irrigation systems for use in the project districts. This will include both field and laboratory testing. We expect that the customized drip kits will be ready for market by the end of the first program year. Continued development of the water storage bag, micro-diesel engine and sprinkler irrigation systems will also continue. We expect that these technologies will also be ready for market by the end of the first program year.

a. Capacity-Building Strategy

The project will provide field-oriented farmer training in order to bridge the existing knowledge gap on high-value crops and cropping technique. Knowledge of irrigation and water management, quality seed, cropping system, integrated pest management and effective use of fertilizer will be provided through group sessions with the assistance from NGOs, extension departments as well as agriculture academic and research institutes. The project will conduct a series of training sessions for farmers' groups. The groups will identify lead farmers who will be given intensive agricultural training, focusing on integrated farming system, pest management, farm management, off-season production technologies, variety selection, crop diversification, vegetable marketing, micro irrigation and soil fertility management. Lead farmers will be introduced to the local agriculture extension agents to develop linkages between the agriculture extension system and the farmers' groups. They will also be taught training methodology so they can act as the local disseminators of technology to the other members of the farmers' groups. Project staff will act as mentors during training programs conducted by lead farmers. In an effort to establish a base of technical knowledge in the community, local technicians will be trained in installation and servicing of micro irrigation technologies. Lead farmers will be given new income opportunities through such activities as farm management and equipment rental, and will be encouraged to make the transition to agricultural traders. Regular group sessions will be conducted with the farmers groups with the participation of input dealers, output marketers, and lead farmers. These sessions will focus on new technologies and on strengthening the upward and downward commercial linkages with the farm producers. Increased participation in these farmers' groups will be facilitated by the use of mass information techniques. Posters, videos, and market demonstrations by project staff and local dealers will make the community at large aware of the activities going on in their communities. Based on group demand, other activities will be facilitated, such as the formation of marketing

cooperatives, tours to successful farm demonstrations in other areas and use of government technical staff for introduction of exotic crops, or other such activities.

At the end of each year, farmers' feedback meetings will be conducted which will be used as a planning tool for the project and for the service providers. Business Development Service (BDS) providers will be involved in the planning process and encouraged to use professional planning techniques in their own businesses.

c.Capital/Credit Strategy
The project will work with commercial banks and NGOs to channel credit resources to smallholders.
Group meetings with the commercial banks and NGOs together with smallholders can produce effective results. Credit terms for weekly installments to seasonal full payment could be encouraging for the smallholders. Since the credit amount is small, diversification of credit by sector can be a useful means – such as credit for inputs, farm management and the output market.

d.Other Strategies
The project will look for opportunities to support the work of NGOs working to improve rural education and literacy.

2. Input Markets
a. Technology Strategy
The project will work with small-scale seed producers to develop quality control methods to ensure the availability of high-quality seed to smallholders. Once an appropriate methodology is developed
it will be widely promoted among seed producers.

b. Capacity-Building Strategy
Business development services will be provided to new and existing manufacturers, distributors, and retailers of irrigation equipment and seeds. Training will include basic financial management, record keeping, stock control, promotion, and marketing skills. At the same time, relationships between the supply chain members will be strengthened. The project will start by holding a large number of community interaction workshops to obtain the input from farmers and supply chain regarding the proposed project, and to identify alternatives for participation. This will result in technology plans that will focus on facilitating the sale of the appropriate inputs and services in relation to the needs identified by the farming community. Local supply chains will be given an orientation on the project and technology package. Information about linkages to central supply markets in the major cities, and to farmers' groups will be introduced. Agriculture inputs dealers will be given extensive agricultural training, focusing on integrated pest management, soil fertility, and micro irrigation. These dealers will then be in a position to make informed recommendations to their customers regarding judicious use of ag inputs that would minimize input cost and maximize output.

c. Capital/Credit Strategy
Where necessary, the project will help manufacturers and retailers to access credit through financial
institutions, NGOs, or other sources. Access to capital will enable companies to purchase stock prior to peak demand periods and expand their operations to better serve smallholders.

3. Output Markets
a. Technology Strategy

Harvesting and post-harvest technology is extremely critical in the marketing of the high-value crops that smallholders will be growing. The project will work to identify and/or develop appropriate
technologies and methods for storing, processing, sorting, grading, and packaging produce for long distance transportation. The technologies may include post-harvest options at the farm level or for private-sector entrepreneurs who can serve many smallholders.

b.Capacity-Building Strategy
The project will work to improve or develop mechanisms for disseminating market information to smallholders. This will involve the creation of linkages between data gathering organizations and those who can deliver the information to smallholders (e.g., media outlets, extension services, retailers). The project will help to train and equip private-sector suppliers that can produce and distribute affordable post-harvest products and services. This may include, for instance, suppliers of on-farm processing equipment or entrepreneurs wanting to establish a medium-scale processing facilities. Business development services will be provided to these companies including basic financial management, record keeping, stock control, promotion, and marketing skills. At the same time, relationships between the supply chain members will be strengthened. Linkages between smallholder groups and output market traders will be established to increase opportunities to access the output market. The farmers' group would increase the bargaining and negotiating power. The enterprising farmers will be selected from the group for information collection about the market price and the supply and demand status.

c.Capital/Credit Strategy
The project will help suppliers of output products and services to access credit through financial institutions, NGOs, or other sources. Access to capital will enable these companies to expand their existing operations or move into new areas to better serve the output marketing needs of smallholders.

3.7 Organizational Approach: Awareness Raising Among Potential Stakeholders

Awareness raising among potential stakeholders would be carried out in two manners. First of all, creating an advisory board of key members of the stakeholder community would be a major outreach pathway into this community. Thus it is very important to make sure that the crucial stakeholders are actively involved in the project board. Secondly, the project office should have a stakeholder liaison officer whose job it is to involve the various actors in constructive ways in the project. This would also obviously be the role of the Project Manager. This being such a broad reaching initiative, it is crucial that bringing in the involvement of the various stakeholders be one of the primary foci of the project office. From the very beginning, the project will need to conduct seminars and workshops, and invite prominent people from the various sectors, as well as members of the practitioner communities. These workshops will serve to communicate the goals and objectives of the project, progress and achievements, and as an avenue to solicit the involvement in a broad range of participants. It is also crucial that the project have a well-developed public relations component which will develop simple but effective means of communicating the goals, objectives, and strategies of the project to the professional community. This should include professional brochures, power point presentations, and short videos. These will act as a quick means to communicate the message of the project.

3.8 Goals for First and Second Three Year Periods (All Three Countries)

	1st Three Years	2nd Three Years
Number of farmers involved	15,500	48,500
Increase in farmer income per family per year*	$120	$240
Number of small businesses offering input and output marketing services to farmers in the program:	1,500	3,000
Annual volume of sales of inputs to participating farmers	$3,120,000	$12,000,000
Profit of input providers to participating farmers	$312,000	$1,200,000
Volume of produce sold through output chain	$936,000	$72,000,000
Profit of output chain members	$936,000	$7,200,000
Thus total annual profits generated by the project are:	**THIRD YEAR** Farmers: $9,360,000 Inputs: $312,000 Outputs: $936,000 TOTAL: $10,608,000	**SIXTH YEAR** Farmers: $72,000,000 Inputs: $1,200,000 Outputs: $7,200,000 TOTAL: $80,400,000

*Note: Farmers are expected to increase their income by about $80 in their first year of participation, and by about $500 in year 6, so the above numbers are a composite of farmers starting in years one to six.

Table 1: CARDEP Gangetic Plains Budget

	Year 1	Year 2	Year 3	TOTAL
Personnel	152,700	160,335	168,352	481,387
International/National Consulting	90,000	95,000	95,000	280,000
Contracts with R&D Organizations	84,500	95,500	90,000	270,000
Work with Private Sector	27,500	30,000	27,500	85,000
Travel	39,500	41,500	41,500	122,500
Training, Promotion & Technical Assistance	72,300	72,600	98,400	243,300
Equipment	53,887	25,000	-	78,887
Administrative	10,586	11,038	10,221	31,845
TOTAL DIRECT COSTS	**530,973**	**530,973**	**530,973**	**1,592,919**
Indirect Costs (13%)	69,027	69,027	69,027	207,081
GRAND TOTAL	**600,000**	**600,000**	**600,000**	**1,800,000**

4. GEOGRAPHIC EXPANSION

INTRODUCTION

In the previous section a specific three year program has been outlined for the region. This three year program is meant to be the crucible of a set of strategies and technologies to be applied throughout the region. Simultaneously, however, a series of satellite projects will be implemented with the objective of adapting the regional strategy to the specific conditions of the sub-regions. This will be done through intensive interaction with farmers and development agencies in the sub-region. The intention is to gradually expand the approach being applied in the three year program throughout the region.

The satellite projects will involve the following activities:

9. Conduct a basic survey of water, agriculture, and socio-economic conditions in each area. This would involve an analysis of the high-value crop sub-sector, including identification of opportunities and constraints specific to that sub-region.
10. Based on the outcome of this survey, develop a specific water and small farmer productivity/income generation strategy.
11. Form a consortium of agencies (both government and non-government), interested and capable of participating in the proposed set of interventions. Begin the process of orienting and training these agencies in the approaches and technologies of SIMI.
12. Conduct field testing of the selected set of interventions and technologies. Based on these field tests, the interventions and technologies will be adapted to local conditons in preparation for later scaling up operations.

These satellite projects will be conducted within a two- year time frame, with the intention of following up with a scaled up SIMI intervention in the sub-region.

GEOGRAPHIC EXPANSION PLAN

The following is a list of suggested areas for expansion, with associated estimated annual budgets for the satellite projects:

1. The three year CARDEP program will be implemented in nine districts in three countries of the Gangetic plains: Three in Bangladesh (in Mymensingh and Bogra), three in Bihar, India (Sitamarhi area), and three in Nepal (Siraha, Saptari, Dhanusha). $600,000/yr.
2. Twelve more districts in Northern and Western Bangladesh. $400,000/yr.
3. Twelve more districts in Bihar, India. $600,000/yr.
4. Eight more districts of Central and Western Tarai of Nepal. $250,000/yr.
5. Eight districts of Coastal Orissa. $300,000/yr
6. Two districts in West Bengal, India (Cooch Behar, Jalpaiguri) and the Brahmaputra valley of Assam. $150,000/yr.
7. Four districts of Eastern Uttar Pradesh (Basti, Gorakhpur, Maharajgunj, Gondi) $200,000/yr.

NUMBER OF FARMERS

Geographic Region	Smallholders Affected (3 Years)
Northern & Western Bangladesh (12 districts)	15,000
Bihar, India (12 districts)	9,000
Central & Western Tarai of Nepal (8 districts)	9,000
Coastal Orissa, India (8 districts)	9,000
West Bengal (2 districts) & Brahmaputra Valley	4,500
Eastern Uttar Pradesh, India (4 districts)	9,000
Total	**55,500**

SUB-PROJECTS

Based on experience in current field programs, and intensive interaction with farmers, a number of sub-projects (for application of specific interventions or technologies) have been identified. This list is meant to act as a menu to be drawn from for application in the main CARDEP project and for field testing in the satellite projects. The interventions in the projects will neither include all of these interventions in each sub-region (as defined by the needs assessment of the sub-region), or be limited to these as other opportunities arise:

12. Promote Low Cost Deep Water Lifting Technology for Areas of Dropping Water Tables in Bangladesh **:** There are a few regions in Bangladesh (Rajshahi region, Northern Dhaka Region) where deeper water tables (10-20 meters) make it impossible to use suction lifting devices such as treadle pumps or shallow tube wells. In these areas, the deep-set treadle pump and the Jiban deep set hand pump will be promoted through a private sector marketing channel with a mass marketing campaign. These farmers will be encouraged to grow high value crops.
13. Promote low cost piped water systems: The use of low cost lay flat hose will be promoted through a private sector marketing channel and a mass marketing campaign. This will allow water from a shallow tube well or treadle pump to be carried further from the tube well, thus increasing the command area through making water distribution more efficient. The technology can also be used to bring water to lands as high as one meter above the level of the tube well. This will decrease the amount of higher level fields that are currently unirrigated.
14. Facilitate emergence of water markets: In areas of Bihar and the Tarai of Nepal, where water markets are undeveloped, the project will organize farmers' meetings where the idea of water selling will be discussed and promoted among farmers. Through a transparent process which reveals both needs of buyers and costs of sellers, fair pricing and efficient distribution mechanisms will be agreed upon.
15. Facilitate dissemination of low-cost diesel pump technology in Nepal: Working with private sector importers, the project will facilitate the importation of low-cost Chinese diesel pumps into Nepal. Importers will be motivated by marketing assistance offered by

the project. Training programs for diesel mechanics and shallow tube well installers will be designed and implemented. Private sector marketing channels will be developed in the rural areas of the Tarai, including the reliable supply of spare parts. A mass marketing campaign will be carried out to promote the use of the these pumps.

16. Expand treadle pump adoption in Nepal Tarai and India: Through further development of the private sector marketing channels and mass marketing campaign, promote the availability and adoption of treadle pump technologies by small farmers.
17. Introduce pressure treadle pumps, drip irrigation, and micro sprinklers throughout the region: Field trials will be conducted using pressure treadle pumps (delivers water at pressure into a hose pipe) to feed low-cost drip and sprinkler irrigation systems. These systems should vastly reduce labor requirements and increase yields by efficient use and uniform application of water. As demand for the systems increases, develop the private sector marketing channels and conduct marketing campaign.
18. Dissemination of off-season vegetable production packages: In order to increase farmer incomes and expand marketing of higher priced vegetables, develop off-season vegetable production packages. This will involve using horticultural experts to develop a series of cultivation strategies to grow high value, off season vegetables including: Early Cauliflower and Cabbage, monsoon tomato, and early cucumber, sponge gourd and bitter gourd. The set of practices will be put into a training packages which will both applied directly by the project, and taught to allied development agencies.
19. Development of a private sector/public sector information dissemination system for high value crop production: It has been found that farmers are getting almost all their information about crop production from two sources: agricultural supply shops, and their neighbors. A system has been developed to use these two sources as the retailers of information to the farmers, while linking them to the greater knowledge resources of the Agricultural Research and Extension system. In this approach, the ag-inputs suppliers, and specially selected leader farmers, are given intensive training in the proposed high-value crop production packages. This would include such subjects as selection of seed varieties, nursery management, soil fertility management, integrated pest management, and produce marketing. These training programs will be conducted locally using the local Ag extension and research staff as the resource people. This makes the connection between the trainees and the information resources in the area for future reference, and gives them the knowledge and skills to tranfer this information to the farmers.
20. Marketing linkage workshops for farmers and produce traders: It has been found that there is a communication and understanding gap between the farmers (especially new producers of high value crops) and the output marketing chain. One effective means to close this gap has been found to be the holding of meetings to which all market players (producers, middlemen, wholesalers) are invited. Each group is allowed to give a summary of their needs and concerns. This helps the other groups to understand the nature of the production and market environment and to come to mutually beneficial marketing arrangements.
21. Development of a call-in market price information service: Working with public sector agencies, a system will be developed whereby farmers can call into a central information clearing house and get pricing information for various commodoties in different markets in the sub-region. This allows farmers to make informed decisions about what price to charge for their produce, and to which markets to ship them.
22. Development of leader farmers into agriculture inputs sub-dealers: The trained leader farmers will be encouraged and assisted to become sub-dealers of agricultural inputs in their local communities. This will include seeds, fertilizers, pest controls, and tools. This brings the source of inputs closer to the community in a difficult transportation

environment, and encourages leader farmers to disseminate information as a means to augment their income.

23. Expand access to high quality inputs through ag input dealers: By sourcing quality input wholesalers based on the needs of the productivity packages, and linking rural agro inputs suppliers to these wholesalers, the project will increase availability of appropriate high quality seeds, fertilizers, and pest control in the rural areas.
24. Organize small farmers to supply vegetables in bulk to exporters: In Bangladesh there is an expanding export of vegetables to the middle east. With the collaboration of local NGO's, farmers will be organized and trained to supply vegetables to these exporters through linkages made by the project. Training will focus on production packages as well as post harvest sorting and handling.
25. Develop low cost packing material for vegetables: In order to reduce post harvest and transport losses, low cost, locally available packing materials and techniques will be developed and disseminated through a private sector marketing chain. Promotion will be carried out with the farmers and the vegetable selling merchants.

A RIPE OPPORTUNITY: PRODUCING MONSOON TOMATOES IN BANGLADESH

The production of monsoon tomatoes in Bangladesh was identified during SIMI fieldwork as an activity with a high potential to increase smallholder income. The main tomato season in Bangladesh last four months from December to April. Prices during this period are very low (approximately USD 0.09 per kilo for farmers). However, prices during the peak off-season (September to November) can be seven times higher. The reason for the high price differential in Bangladesh is that with current production practices farmers are unable to produce tomatoes during the monsoon. Bangladesh also lacks the diversity of agro-ecological zones found in India and Nepal that allow for more even annual production.[36] The purpose of the monsoon tomato strategy is to extend the tomato season to take advantage of high off-season. To produce during these months tomatoes must be cultivated during the monsoon summer months.

Research and on farm testing of monsoon tomato production were conducted by the Bangladesh Agricultural Research Institute (BARI) regional station in Jessore in 1997. BARI collaborated in the development of a monsoon tomato production system with AVRDC with support from USAID. Key Components of Bangladesh monsoon tomato systems include:

1. Use disease resistant tomato species (BARI 1-4)
2. Plant in flats, transfer to beds, transplant to 20 x 2 meter two-row raised beds
3. Build bamboo/polyethylene rain shelters
4. Apply hormone through hand sprayer to flowers
5. In some parts of Bangladesh, use tomatoes grafted to eggplant rootstock, produced in nurseries.
6. Apply irrigation / water management for the sheltered tomatoes. Irrigation will be required during the non-monsoon months.

Table 1: Impact of monsoon tomatoes

Item	Value
Market Potential (Mt)	104,356
Monsoon Tomato (Ha)	2,112
Annual Increased Value	46,631,750
Ha per HH for 500 USD	0.02
No. of Households	93,264
No. of People	494,297

A number of local NGOs were engaged to test the technology with on-farm research. Results were extremely promising. The analysis for monsoon tomatoes was done for increasing production to a level that would result in a price twice the minimum observed price. This very conservative approach showed that under current market conditions nearly 100,000 households could earn USD 500 per year producing monsoon tomatoes (**Table 1**). To produce this income each household would need only 0.02 hectares. Total annual income generated would be nearly USD 50 million. Despite very high returns the technology has not been disseminated. There are a number of reasons for this including a lack of local availability of the hormone and monsoon season hybrid varieties, an incomplete program do to withdrawal of USAID funding, and a failure to disseminate the technology to NGOs, DAE, and extension service providers from the research station.

[36] There are significant unofficial imports of tomatoes from India and Nepal in Bangladesh due to this price differential. Imports based on subtracting production figures from consumption figures indicate that Bangladesh imports 50% of its tomatoes.

ANNEXES

1. CARDEP CONSTRAINTS ANALYSIS MATRIX
2. CARDEP LOGICAL FRAMEWORK
3. CARDEP TIMELINE

ANNEX 1: CARDEP CONSTRAINT ANALYSIS MATRIX

Country and geographic scope	**Bangladesh – North(Kurigram and Gaibandha) and Chittagong Hill Tracts (Bandarban)**
Cash crops to be developed	**Cauliflower, onions, chilies, potatoes turmeric, ginger, and spices.**

	Technological Constraints	Capacity-Related Constraints	Capital/ Credit Constraints	Other Constraints
Farm Level	• Lack of affordable small irrigation equipment. • Lack of water efficiency and control. • Lack of affordable inputs (fertilizers, pesticides, tools). • Lack of quality seeds. • Lack of affordable small-farm machinery. • Pests and crop diseases. • Lack of labor availability during peak season.	• Lack of knowledge of farming technology/agronomy. • Lack of knowledge of market. • Conservative outlook, risk averse. • Availability and price fluctuation of inputs (seed, fertilizer, pesticides). • Lack of cooperative group action.	• Smallholders lack access to affordable credit for technology/farming. • Lack of land title deed to show as collateral when approaching formal credit institutions. • Minimum loan requirement. • Credit procedure of the NGOs not appropriate for agricultural sector.	• Pervasive illiteracy. • Lack of road infrastructure and electrification.
Input Markets	• Lack of affordable irrigation and small farming technology (irrigation, tillage equipment, seeder, weeder). • Lack of affordable inputs (fertilizers, pesticides, tools). • Lack of quality seeds.	• Low profit. • Weak manufacturer-retailer link. • Poor quality extension service. • Capacity and knowledge of input suppliers, especially technology. • Very little R&D addressing the needs of smallholders.	• Lack of capital to produce and stock micro-irrigation and small farming technology equipment particularly for small producers. • Lack of capital loans for the establishment/ expansion of small input companies. No R&D investment.	• Poor rural roads. • Inadequate fuel and power hampers input distribution and operation of irrigation and farming equipment. • Political motives and self-interest affects distribution of fertilizer.

ANNEX 2: CARDEP LOGICAL FRAMEWORK FOR PHASE 1 (YEARS 1 – 3)

Country and geographic scope	Bangladesh - North (Kurigram and Gaibandha) and Chittagong Hill Tracts (Bandarban)
3-Year Goal	**Increase the net income of** 9,500 **smallholders by an average of** $US 200 **at the end of third year**

OBJECTIVE	3-YEAR TARGET	ACTIVITIES OF WIIDE	INDICATORS
Farm Level			
Technology Strategy			
Promote irrigation technologies.	**5,000 treadle pumps installed** **3,000 drip irrigation kits installed** **1,000 micro-diesel engine** **500 micro sprinklers**	**Create baseline/needs assessment survey.** **Demonstration plots, farmer field days, presentations/displays in markets and at ag. shows, publicity events, radio programming, printed advertising.**	**Number of irrigation technologies sold and in use.** **Number of promotional activities and attendance at presentations.**
Develop customized drip irrigation system.	**Field-testing and customization in progress will be ready for market by end of 1st year.**	**Field and laboratory testing.** **Customization of drip system.**	**Performance characteristics.** **Rate of usage (sales).**
Water storage bag, micro diesel engine and micro sprinklers.	**Field-testing and customization in progress will be ready for market by end of 1st year.**	**Field and laboratory testing.** **Customization of technology.**	**Performance characteristics.** **Rate of usage (sales).**
Capacity-Building Strategy			
Improve technical and managerial skills of smallholders.	**9,500 smallholders receive skills training.** **Farmers have adequate knowledge and information about the market.**	**Facilitate training in farm management, agronomy, and post-harvest techniques.** **Coordinate efforts of WIIDE and partner organizations in providing training.**	**Number of smallholders trained.** **Improvement in skill level.** **Improved knowledge about technology and agronomy.**
Assist in group formation.	**80% of smallholders have access to a functioning Farmer**	**Coordinate efforts of partner organizations that assist with**	**Number of associations formed, number of members, and**

OBJECTIVE	3-YEAR TARGET	ACTIVITIES OF WIIDE	INDICATORS
	Association.	**group formation.** **Provide training and support to farmer association leaders.**	**number of leaders trained.** **Capability and effectiveness of association.**
Improve market information and knowledge.	**Develop capacities of the smallholders to access, analyze and make use of market information.**	**Create capacity development programs.** **Create linkage for collection and dissemination of market information to smallholders.**	
Capital/ Credit Strategy			
Improve smallholder access to credit.	**Affordable credit is available to 9,500 smallholders.** **Shape credit appropriate for smallholder farming.**	**Coordinate and linkage with credit giving organizations to provide credit.** **Advocate and lobby with the credit giving institutions.**	**Number of smallholders accessing credit.** **Appropriateness of credit for farming practices.** **Loan recovery rates.**
Create a literacy program.	**Increase smallholders' access to adult literacy programs.**	**Coordinate with government and NGO adult literacy programs with the farmers association.**	**Number of smallholders with title deeds.**
Input Markets			
Technology Strategy			
Open access to small and affordable irrigation and farming technologies.	**Develop and strengthen appropriate supply chain that caters to the smallholder market.**	**Create baseline/need assessment survey.** **Develop and strengthen supply chain.** **Conduct promotional activities to create demand.**	**Number of members in the supply chain.** **Profitability of the supply chain.**
Improve seed quality.	**Improve seed germination percentages**	**Develop quality consciousness among the supply chain members and smallholders.**	**Percentage of seed not germinating** **Availability of quality seeds.**
Capacity-Building Strategy			

OBJECTIVE	3-YEAR TARGET	ACTIVITIES OF WIIDE	INDICATORS
Create access to inputs for the smallholders.	**Develop and strengthen appropriate supply chain that caters to the smallholder market.**	**Develop and strengthen supply chain.** **Conduct promotional activities to create demand.**	**Number of members in the supply chain.** **Profitability of the supply chain.**
Develop the capacity of the micro-irrigation supply chain.	**Create independent supply chain that provides good-quality affordable micro-irrigation pumps to smallholders.**	**Develop and strengthen supply chain in the working area.** **Provide business development services.**	**Number of members in the supply chain.** **Quality of micro irrigation production.** **Pump price.**
Develop local capacity for drip system and micro sprinkler assembly.	**Develop drip and sprinkler assemblers who can provide quality services to smallholders.**	**Provide capacity building programs for assemblers.**	**Number of assemblers trained.** **Quality of service provided.**
Increase access of smallholders to input market.	**Create linkage with private supply chain with the smallholders' associations.** **Develop quality consciousness among the supply chain and smallholders.**	**Create linkage, motivation and coordination with supply chain.**	
Capital/ Credit Strategy			
Increase access to credit to the input suppliers and smallholders.	**Create linkages among credit institutes, supply chain members and smallholders.**	**Create linkage, motivation and coordination with credit institutions.**	**Access to credit.**
Output Markets			
Technology Strategy			
Create access to post-harvest technologies.	**Create linkages with the private sector to address the post-harvest needs of the smallholders.**	**Create smallholder needs assessment.** **Create linkage, motivation and coordination with credit institutions.**	**Number of smallholders who have access to post-harvest technology.**
Improve storage and transportation.	**Create linkages with the private sector to address the storage**	**Create linkage, motivation and coordination with storage and**	**Number of smallholders who have access to storage and**

OBJECTIVE	3-YEAR TARGET	ACTIVITIES OF WIIDE	INDICATORS
	and transportation needs of the smallholders.	**transportation service providers.**	**transportation services.**
Capacity-Building Strategy			
Increase capacities of the private sector.	**Develop capacities of the private sector to address the storage, transportation and other post-harvest (food processing, export) needs of the smallholders.**	**Deliver BDS services to the private sector.**	
Capital/ Credit Strategy			
Create access to credit for post-harvest equipment.	**Create linkages among credit institutes, supply chain members and smallholders.**	**Create linkage, motivation and coordination with credit institutions.**	**Availability of credit to output side entrepreneurs.**
Increase access to credit for the rural private sector.	**Create linkages among credit institutes, supply chain members and smallholders.**	**Create linkage, motivation and coordination with credit institutions.**	**Availability of credit to output side entrepreneurs.**

ANNEX 3: CARDEP TIMELINE

Country and geographic area	**Bangladesh – North (Kurigram and Gaibandha) and Chittagong Hill Tracts (Bandarban)**

Program Objective/Activity	**Phase 1***			**Phase 2**		
	1	**2**	**3**	**4**	**5**	**6**
Farm Level						
Technology Strategy						
Promote irrigation technologies.	**X**	**X**	**X**	**X**	**X**	**X**
Capacity-Building Strategy						
Improve technical and managerial skills for smallholders	**X**	**X**	**X**	**X**	**X**	**X**
Improve market information and knowledge	**X**	**X**	**X**	**X**	**X**	**X**
Capital/ Credit Strategy						
Improve smallholder access to credit.		**X**	**X**	**X**	**X**	
Input Markets						
Technology Strategy						
Create access to affordable irrigation and farm technologies	**X**	**X**	**X**	**X**	**X**	**X**
Improve seed quality	**X**	**X**	**X**			
Capacity-Building Strategy						
Create access to inputs for smallholders	**X**	**X**	**X**			
Develop capacity of micro-irrigation supply chain	**X**	**X**	**X**	**X**	**X**	**X**
Capital/ Credit Strategy						
Increase access to credit for input suppliers and smallholders.		**X**	**X**	**X**	**X**	
Output Markets						
Technology Strategy						
Create access to post-harvest technologies	**X**	**X**	**X**	**X**		
Improve storage and transportation.		**X**	**X**	**X**		
Capacity-Building Strategy						
Increase capacity of the private sector.		**X**	**X**	**X**	**X**	
Capital/ Credit Strategy						
Create access to credit for post-harvest equipment.		**X**	**X**	**X**	**X**	
Increase access to credit for the rural private sector.		**X**	**X**	**X**	**X**	

CHAPTER 5

Poor Hills of Asia

PART I

REGIONAL EVALUATION AND PLANNING

SUMMARY TABLE
EXECUTIVE SUMMARY

1. ASSESSMENT OF THE TARGET REGION

2. 15-YEAR PLAN

SUMMARY TABLE: POOR HILLS OF ASIA	
Geographical Area:	Stretching from Afghanistan, along the Himalayan mountain chain, through Pakistan, India, Nepal, Bhutan, China, Bangladesh, and into Myanmar, Thailand, Laos and Vietnam.
Target Population:	18 million smallholder families in the region that have the basic pre-condition (water, land, labor) to engage in high value crop production.
Water-Related: *Water Source:* *Water Storage:* *Irrigation:*	 Gravity flow from upland sources, springs, streams; Piped water from drinking water systems with excess capacity; Piped water developed for micro-irrigation systems; Rainwater harvesting On-farm Ponds; Cement Tanks; Plastic tanks Low-cost drip; low-cost sprinkler
High-value Crops:	Vegetables, fruits, spices, herbs, and seeds—especially as produced during seasons that may vary from those in the plains where population density is higher and markets are larger
Favorable Conditions:	Seasonal and perennial upland streams and springs, high social cohesion, group operational mentality within ethnic groups, high involvement of women in agricultural and social activities, increasing construction of roads and water supply systems.
Constraints:	Lack of awareness of market forces and market opportunities, combined with a subsistence agriculture mentality; lack of production systems technologies for the production of high-value crops under smallholder conditions; lack of productivity packages, underdevelopment of input supply systems; lack of systematic watershed management assistance; underdeveloped output markets; lack of financial resources for the capitalization of supply- and output market chains.
Strategies for Implementation:	1. Development and dissemination of gravity flow piped water sources for micro-irrigation systems. 2. Dissemination of affordable micro-irrigation systems through private sector supply chains. Development and testing of inputs and management techniques; 3. Development of post-harvest technologies and smallholder linkages into existing and new markets; 4. Supply chain development; 5. Facilitation of flow of capital for the financing of supply- and output market chains; 6. Promote a policy environment conducive to smallholder market participation.
Immediate Steps:	O. Implementation of a CARDEP program in Nepal for the development and testing of an adaptable yet generic intervention strategy for the poor hills of Asia. *Cost of the Program:* $1,650,000 for the first 3 years. P. The development of satellite programs to survey smallholders and the high-value crop sub-sector, the development of specific water and small farmer productivity packages, consortium building for implementation, and the field testing of specific interventions. Cost of program for regional satellite programs - $1,330,000 per year. Q. Selected sub-project investment opportunities including micro irrigation promotion, dissemination of vegetable production packages, development of hybrid drinking water/micro irrigation systems, development of information systems, and more.

EXECUTIVE SUMMARY

The hill areas of Asia comprise a large geographical area extending from Afghanistan in the west, along the Himalayan mountain chain, through Pakistan, India, Nepal, Bhutan, China, Bangladesh, and into Myanmar, Thailand, Laos and Vietnam in the east. These areas share the following similarities in terms of development constraints: poorly developed transportation/communication/commercial infrastructure due to rough terrain and geographical isolation leading to low access to information, technology and markets, a dearth of cultivable area when compared with the total land area, high seasonal variation of rainfall leading to flood/drought conditions, delicate environmental/soil conditions on steep mountain slopes, lack of development of, and regular access to water resources in the upland areas, high seasonal migration of males to the plains, and cultural diversity leading to poor social cohesion between groups and inter-group exploitation. The population is largely agricultural (90 percent) and among the poorest people in Asia. On the other side of this coin, these areas have some distinct potential advantages which work in their favor as follows: high climatic and agro-ecological diversity which is suitable for cultivation of a large variety of high value crops (vegetables, fruits, spices and herbs, and seeds) during seasons that vary from the plains, large water resources in the river valleys fed by both rainfall and snow-melt and large numbers of seasonal and perennial upland streams and springs, high social cohesion and group operational mentality within ethnic groups, relatively high involvement of women in agricultural and social activities, and the gradual construction of new roads and water supply systems leading to new development and market opportunities.

For the purpose of this study, and given limited time and resources, Nepal was chosen as the area to be studied as representative of the region. All data and analysis in this section pertains specifically to Nepal. Obviously, in such a diverse and broad geographical area, no one country or area can be completely representative of the entire region, but we believe that the broad themes will be widely applicable with specifics varying from location to location (in fact, this is true even within Nepal). Several broad themes surfaced from the extensive field visits taken during this study:

12. Large scale irrigation development up to now has been confined largely to canal irrigation schemes in the lowlands, has had a relatively low success rate, has been used mostly for grain production, and has had benefits that are skewed towards the wealthier farmers (land ownership of lowlands is skewed towards wealthier farmers).
13. There is a steady increase in the number of villages having access to piped water from upland water sources, largely for drinking water purposes.
14. Technologies exist to utilize upland, piped water sources for irrigation purposes and there use is spreading, but slowly. These piped systems are efficient, hardy and cause little environmental degradation or soil erosion when compared with canal systems. They consist of a variety of sprinkler and drip irrigation systems. Farmers using these systems to grow high value crops such as vegetables and fruits are showing significant impact on their income and livelihoods.
15. Upland water sources can be enhanced and soil erosion decreased by application of modern watershed development techniques. Linkage of upland irrigation development with watershed development is highly desirable.
16. In most cases access to appropriate agricultural inputs and technical information is low. Most farmers, even those growing high value crops, are still far below their limits of productivity.
17. Awareness of market forces and market opportunities is very low. The vast majority of farmers have not made the psychological shift from a subsistence agriculture mentality to one that analyzes markets and shifts practices according to opportunities arising from such analysis.

The hills of Nepal have a rural population of 9.3 million people comprising 1.6 million households. Seventy-seven percent of these are smallholders own less than 1 hectare of land and 48 percent own less than 0.5 hectare of land. A 15 year targeted program to bring access to micro-irrigation and consequent increases in productivity to these small holders is proposed. This program would involve the collaboration of the national government, local governments, donors, NGO's and the private sector. Each of these players would have clear roles and responsibilities based on their resources and proven capabilities. The objective would be to reach 15 percent of

these small holders through such a program and to increase their incomes by $100-$500 per year. This would have a significant impact on rural poverty in Nepal both by raising families above the poverty line, and by keeping others from slipping below that line. The program would consist of the following components:

- A strategy for developing and disseminating micro-irrigation technologies to smallholder families through a market-driven, private-sector supply chain. And in order to increase the productivity of each drop of water used:
- A strategy for linking smallholder families to output markets, increasing the flow of information from those markets to the farmers, developing and disseminating post-harvest technologies, and increasing the farmers' capacity to analyze and plan their activities based on market information.
- A strategy for increasing production and productivity of high-value crops by the smallholders through design and implementation of sustainable information-flow methodologies, a focus on off-season and specialized crop production, and linkages to a strengthened private-sector input supply chain.
- Increased access to formal and informal credit opportunities for the smallholder, especially through expansion of linkages to micro-credit institutions and savings and credit groups.
- Advocacy of government and donor policies to support these efforts, especially through rational allocation of resources to the targeted activities and removal of market-distorting policies and practices.

The CARDEP program detailed within this plan will pilot the intervention strategy in the first three years of implementation. In parallel, SIMI will develop geographic expansion programs to survey smallholders and the high-value crop sub-sector, to develop specific water and small farmer productivity packages, for consortium building for implementation, and finally for the field-testing of specific interventions.

Poor Hills Three-Year Summary Budget

Activity	3 –Year Budget (In $ millions)	Smallholders Reached
CARDEP	1.65	12,000
Geographic Expansion	4.00	34,300
Total	**5.65**	**46,300**

1. ASSESSMENT OF THE TARGET AREA

1.1 Target Population

Nepal's strikingly beautiful landscapes and rich cultures stand in stark contrast to the severe poverty of its people. Nepal remains one of the poorest and least developed countries in the world despite 40 years of intensive development efforts. More than half of Nepal's 23[37] million citizens live in absolute poverty. Per capita income is only $235 and more than 40 percent of the population is undernourished (USAID 1997). Agriculture is the primary occupation for over 80 percent of Nepal's economically active population. Nepal's poor are predominately rural subsistence farmers. Rapid population growth contributes to a difficult development environment. For the past decade GDP, has been growing at 4.6 percent but due to the high population growth rate per capita income has increased slowly.

Nepal stretches 885 km east to west and is an average of 193 km wide. It is a landlocked, predominately mountainous nation between the Tibetan region of China and India (Figure 1). Nepal has three distinct regions. A strip of land on the country's southern border referred to as the *Terai* is an extension of the Indian alluvial plain ranging in width between 26 and 32 kilometers. Most of the country is *Pahad* or mid-hills (70 percent), which range from 500 to 3,000 meters. The *Pahad* includes the *Mahabharat* range, high *Himalayan* foothills and fertile midland tectonic valleys, the largest and most fertile of which is the Kathmandu valley. Nepal's high *Himalayas* are extremely rugged and include eight of the world's ten highest peaks. The populations in the Terai, hills, and mountains are 11 million, 10 million, and 2 million (Table 1).

Figure 1: Map of Nepal

[37] World Bank Country data files, year 2000 estimates.

Table 1: Population distribution by region in Nepal

Item	Nepal	Terai	Hills	Mountains
Area	147,181 Sq. Km.	36,304 Sq. Km.	61,816 Sq. Km.	49,061 Sq. Km.
Household No.	4,311,747	1,981,068	2,008,999	321,680
Household Percent	100.0	45.90	46.60	7.50
Population	23,214,681	11,252,912	10,271,506	1,690,263
Population Percent	100.00	48.50	44.20	7.30
Male population	11,587,547	5,725,301	5,024,688	1,690,263
Male Percent	100.00	49.40	43.40	7.20
Female population	11,627,134	5,527,611	5,246,818	852,705
Female Percent	100.00	47.50	45.10	7.30

Source: Preliminary reports of Census (2001).

The SIMI target population for South Asia is smallholders with less than one hectare. In the Nepal hills, 77 percent of farmers own less than one hectare of land and 48 percent own less than 0.5 hectares of land. Of the 1.6 million households living in Nepal's hills, 1.3 million households have farms with less than one hectare and 0.8 million households have farms with less than 0.5 hectares of land (Table 2). SIMI interventions in Nepal will be targeted primarily for the 4.5 million farmers living on farms with less than 0.5 hectares of land.

Table 2: Landholdings in Nepal's hills

Landholdings	No. Of Households	Percentage of Households	Total Cultivated Area (ha)	Percentage of Cultivated Area
< 0.5 ha	784,165	47.5%	123,294	11.6%
0.5 ha-1 ha	470,294	28.5%	173,563	16.3%
1.0 ha-3 ha	330,682	20.0%	406,482	38.3%
More than 3 ha	33,291	2.0%	358,952	33.8%
3 ha-5 ha	24,910	1.5%	167,225	15.7%
5 ha-10 ha	5,992	0.4%	102,728	9.7%
Above 10 ha	2,389	0.1%	88,999	8.4%
Total	1,651,723	100%	1,062,291	100%

Source: National Sample Census of Agriculture (1991).

In Nepal land is the principal productive asset and the primary source of income for the majority of rural people. Rural poverty is primarily associated with a lack of land and a lack of economically active household labor (Nepal Human Development Report 2001). Small farm size with low productivity subsistence agriculture characterizes the rural poor. The Nepal Central Bureau of Statistics defines small farmers as those operating with less than 0.5 hectare in the hills and mountains.

The SIMI intervention is well suited to poverty alleviation in the Nepal hills. Most poor do have landholdings. The Nepal Rural Credit Review (NRB 1991) reports that just 3.8 percent of rural households in the hills are landless. Despite this, Nepal's hill population is suffering from extreme poverty. Nepal is also characterized by widespread inequality. The bottom 40 percent of the rural households operate only nine percent of the total agricultural land while the top six percent operate more than 33 percent of agricultural land (Vaidya 1998). The percentage of the population living below the poverty line in the rural hills is 53 percent based on the GoN poverty definition. More than 37 percent of the population is living on a dollar a day or less (ADB 2002). More than 55 percent of children in the hills are suffering from chronic malnutrition, average schooling in the hills is just three years, and literacy is 44 percent (Nepal Human Development Report (2001).

The Human Development Index (HDI) rank of Nepal in 1997 was 130 out of 146 countries indicating a low life expectancy at birth, low educational attainment and low income. This demonstrates the difficult development challenges confronting Nepal in human resource development. The Gender-Related Development Index (GDI) rank of Nepal in the same year was 131 out of 146 countries. The difference between HDI rank and GDI rank is –1, thus indicating that the country performs relatively worse on gender equality than on average achievements alone (UNDP, 1997).

1.2 Biophysical Resources

A. Climate

Nepal has a climate that ranges from subtropical summers with mild winters in the southern lowlands to an alpine climate with cool summers as well as severe winters in the mountains. Nepal has a monsoon climate. The country averages 1,500 mm of rain annually, with 80 percent falling during the monsoon season between June and September. Average annual precipitation decreases from 2,000 mm (70 inches) in the east to 899 mm (35 inches) in the west. Nepal's varied topography also results in a wide range of temperature conditions, ranging from sub-tropical in the *Terai* and lower *Pahad* to extreme cold at higher elevations.

B. Agriculture

Nepal's smallholder agriculture is characterized by diversity in farming systems influenced by differences in agro-ecological topography. Farming systems and crops vary widely depending upon altitude and climatic conditions. A large majority of households depend upon agriculture and allied activities such as livestock-rearing and forest product collection. Explaining the complex and symbiotic relationship between hill farmers and the environment, Carson (1992) says that Nepalese farming communities and individual farms possess highly integrated and interlinked production systems. Simply, productivity of one system depends greatly upon the productivity of others.

Despite investment in conventional irrigation and agricultural development projects, agriculture production is still largely determined by favorable weather conditions (EIU 1997). Yields have remained stagnant and have fallen dramatically relative to regional levels. Rice, wheat and maize are the major crops of Nepal. Farming systems and crop production in Nepal vary across the agro-ecological zones. Rice-based cropping systems, with wheat or maize as a secondary crop, are predominant in the Terai and middle hills, whereas in the high mountains maize, millet, barley and buckwheat are cultivated. Tea, cardamom, ginger and coffee are important cash crops of the middle hills. Likewise, wide ranges of temperate fruits in the high mountains, citrus in the middle hills, and tropical/sub-tropical fruits are also grown in the Terai and middle hill valleys.

Vegetable growing in kitchen gardens is practiced at all elevations. The Nepal Agricultural Perspective Plan has identified a comparative advantage for Nepal to produce and export fruits, vegetables, and other cash crops to India, particularly for off season production that receives high prices both in the Indian and domestic market. In the mid-hills under irrigated areas vegetables are grown as winter crops after rice. Vegetable farmers, however, who have developed irrigation facilities and drainage, grow vegetables very intensively round the year. In the hills under rain-fed conditions, vegetables (radishes, peas and cauliflower) are grown as summer off-season crops.

Farmers compensate for the small size of landholdings by intensifying land use and the application of labor. Smaller sized farmers have higher cropping intensities despite having a lower quality of land available (Table 3). This indicates that smallholders have labor resources that they are intensively applying to their holdings. If increased cropping intensity is accompanied by increased use of agricultural inputs, productivity could be considerably increased. However, the use of inputs and the proportion of area irrigated increases with farm size. This indicates that there is great potential to increase the productivity of small farms by increasing smallholder access to inputs to complement their labor input.

Table 3. Cropping intensity in the Nepal hills

Farm size	Total area under arable land (ha)	Total Cropped Area (ha)	Intensities (Ratio)
Under 0.2 ha	2,192	40,822	1.93
0.2 to under 0.5 ha	124,619	235,014	1.89
0.5 to 1 ha	244,405	449,316.	1.84
1 to under 2 ha	271,064	476,553	1.76
2 to under 3 ha	101,203	168,937	1.67
All farm sizes	872,171	1,538,274	1.76

Source: National Sample Census of Agriculture (1991).

A challenge to SIMI and development efforts in the Nepal Hills is the extreme fragmentation of landholdings (Table 4). For both social and risk aversion reasons Nepal's smallholder in the hills have an average of 3.85 separate

parcels. In the Hills there is an average of 4.2 parcels per hectare. This results in difficulties in organizing farmers in a given location and for the growing of non-traditional high value crops for commercial markets.

Table 4. Landholding fragmentation in the Nepal hills

Regions	Average No. Of Parcels Per Farm	Number of Parcels per Hectare
Nepal	3.96	4.2
Terai	3.85	3.1
Hills	3.92	5.1
Mountains	4.63	6.8

Source: National Sample Census of Agriculture (1991).

C. Water Resources

Nepal's hills have tremendous water resources. However, traditional smallholders have been constrained in making use of water resources and recent degradation of watersheds through deforestation and resulting erosion is reducing access to water resources. Nepal has a long history of developing and managing small-scale indigenous surface water irrigation systems. More recent attempts at developing larger scale "modern" irrigation systems have had limited success due to a failure to adopt sustainable management systems and a lack of stakeholder involvement.

In recent years there has been substantial growth in small-scale piped water systems to supply drinking water. These systems have excess capacity, which can be used for micro-irrigation. Nepal's hills are also characterized by a plethora of small point sources such as small streams and springs, which can be used to supply water for micro irrigation. These sources are close enough to homesteads for pipe connections for single or a few households to be economically viable. Water availability and the number of point sources for micro irrigation is greatly enhanced by sustainable management of watersheds. Deforested and eroded watersheds do not retain water needed to charge springs and supply small streams. IDE Nepal has shown demonstrated success with promotion of drip and micro-sprinkler systems in Nepal's hills (Table 5).

Table 5: Micro-irrigation systems by Nepal hill district

Districts	% Of Systems on HH with less than 0.5 ha.	% Of Systems on HH with less than 1 ha.	Micro-irrigation Systems in use
Bajhang	74.71	95.70	4
Bhojpur	29.41	59.95	130
Chitwan	46.09	71.05	86
Dailekh	77.47	94.39	663
Dhading	40.80	77.0	13
Gorkha	47.65	78.58	96
Gulmi	34.13	62.05	54
Kaski	56.43	83.97	388
Lamjung	51.32	80.54	144
Nuwakot	40.39	76.56	32
Okhaldhunga	30.01	60.79	8
Palpa	31.96	64.39	632
Panchthar	30.09	59.02	45
Solukhumbu	43.51	77.61	15
Surkhet	40.34	75.33	512
Syanja	50.97	84.25	92
Tanahun	45.02	74.98	882
Terathum	26.19	57.78	10
Total	47.2	76.5	3806

1.3 Supply Chain Capacity

One key factor in creating a sustainable system for high-value agriculture is the existence of a private sector supply chain to deliver agricultural inputs (irrigation technologies, fertilizers, seeds, and pest control) to small farmers at a fair market price and within a reasonable distance from the farm communities. In the hills of Nepal, there exists a reasonably effective system to deliver these inputs up to the level of district headquarters. Beyond that level, the system is relatively undeveloped. This is due mainly to a poorly developed road and communication infrastructure, rugged terrain, and relatively low population density. Even at the district headquarters level, it has been found that, while inputs are available, there are issues of quality (especially of seeds), and of the low level of knowledge of the inputs dealers. Since the farmers are getting most of their agricultural information from the input dealers, this presents a severe constraint on increasing productivity, especially as it is related to selection of proper plant varieties, use of high quality seeds, off-season cultural practices, and plant protection practices. The connection between the input suppliers and the technical information available from the government extension system is very weak. There is also an issue of the capacity of the private sector to scale up to meet the demands of an expanded high-value crop production system. There is the potential for a lag time between the increased demand of new entrants to intensive cash crop cultivation, and the private sector's ability to meet those demands. Thus there is a need to raise the capacity of the existing network in terms of knowledge, access to appropriate sources of improved inputs, and financial capacity to meet increased demand. There is also a need to expand the existing network outside of the district headquarters to small towns within striking distance of new production pockets.

1.4 Input-Throughput-Output Markets

The small cultivators of the hills of Nepal are dependent on a chain of small enterprises and information sources in order to sustainably participate in a cash cropping system. This chain consists of commercial access to appropriate agricultural inputs, access to information about proper cultivation practices, and access to various markets to sell their produce. The state of agricultural inputs supply is described in the section above.

In the development community, dissemination of information about appropriate cultural practices and harvest operations is traditionally thought of as the domain of the government extension service, and in isolated cases as the domain of projects or NGO's. In fact, we were hard-pressed during our field visits to find any small farmers who had qualitative access to the government extension system, and while projects and NGO's often do a good job at agricultural extension, they are very limited in coverage. This has left the inputs suppliers as the de facto source of all agricultural information to the small farmers.

When questioned, almost without exception, small farmers stated that they received information about cultural practices from the inputs suppliers. Thus there is a disconnect between development dogma and reality in the field. With one exception (USAID MARD project), we did not find any development agencies, government or private, who considered the inputs suppliers as an important target group for capacity building. This is a glaring omission.

On the output side, there is a large range of prevailing conditions depending on the particular location in relation to large regional markets. The markets that seem to be well connected to the national markets include Butwal, Pokhara, Narayanghad, Kathmandu and several smaller markets in the Eastern and Central Terai. Those hill communities that are near to these markets, or near to major roads that are close to these markets are well positioned to access local, regional, and national produce markets. These markets have a well-developed system of buyers, wholesalers, brokers, and transport systems, although some of them lack basic infrastructure needed to minimize post-harvest losses. This easy access, however, does not represent the situation of the majority of hill farmers, many of who are several hours or even days walk to a paved road that may be at some distance from major regional markets. These latter farmers are forced to rely mostly on local markets with limited ability to absorb large amounts of produce. In this context, the development of marketing groups/cooperatives, local and regional collection centers, and an intervention to make commercial linkages between those centers and regional markets can go a long way towards facilitating downstream marketing. Several international and national NGO's (CEAPRED, CECI, SAPPROS) have implemented just such programs with relative success. Communities that have been growing vegetables for some time seem to have little trouble connecting to existing market systems. However we found that

communities where there are large numbers of new producers had greater difficulties. It is these new producers who need more market-based interventions.

Contract farming would also present some good opportunities for vegetable producers, but this system is currently very underdeveloped in Nepal. Some of the opportunities would involve tomato ketchup, orange juice, vegetable seeds, oilseeds, and herbal products. In addition there are other processing opportunities such as a large variety of locally consumed pickles.

There are also issues of post-harvest handling. Currently there is little awareness among farmers of grading produce in order to get a higher price for higher quality goods. There are also high transport and packing losses because of a lack of appropriate and inexpensive packing techniques and materials.

General awareness of market forces is very low among farmers, including the value of middlemen, the level of post-harvest losses, and seasonal fluctuations of supply, and the impact of these things on seasonal and geographic price differentiation. Farmers see themselves as at the mercy of, or even victims of the market, rather than seeing the market as a complex system that is full of unexploited opportunities.

The final key constraint encountered in output markets was the general lack of effective systems for disseminating market information to farmers. The Federation of Nepal Chambers of Commerce and Industry has a very good system for gathering this information, but not a good system for disseminating it. The MARD project of USAID disseminated this information to their target farmers, but with the end of the project, the dissemination system has collapsed.

1.5 Policy Issues

A. Irrigation Policy

The Agricultural Perspective Plan (APP), a twenty-year plan implemented since 1997, provides a long-term vision for irrigation development in Nepal. This Plan has identified irrigation as one of the four priority inputs that are crucial for accelerating agricultural growth in Nepal. The Plan gives higher priority to groundwater irrigation systems in Terai and small to medium surface irrigation schemes in the hills and mountains. Although the Plan does not mention micro irrigation technologies such as the treadle pump for Terai its emphasis on shallow tube wells provides a favorable policy environment for treadle pumps. The Plan has explicitly recognized the importance of water harvesting, drip, sprinkler, turbine pumps and other forms of water-conserving irrigation technologies for the hills and mountains.

The Ninth Plan (1997-2002) outlines medium-term objectives, policies, and implementation strategies for irrigation development. One of the three stated irrigation sector objectives of the Plan is to raise water utilization efficiency of surface and groundwater projects. The Plan has embraced the objectives and strategies of the APP. One policy initiative taken by the Plan that is of relevance to SIMI is the phasing out of irrigation subsidies. One consequence of this policy change is that it will enhance the competitiveness of the proposed micro irrigation technologies.

B. Watershed Management Policy

The Ninth Plan aims to extend soil and watershed conservation programs from the current 55 districts to all 75 districts of Nepal. The Plan recognizes that flood control in Terai would not be successful without watershed conservation in the upper riparian watersheds. Priority has been given to the conservation of watershed areas of larger hydro electricity and irrigation projects. Conservation of *Chure* is also given high priority.[38] APP has also accorded high priority to the conservation of *Chure*. APP argues that the conservation of *Chure* is important for maintaining groundwater reserves in the Terai.

The Plan puts emphasis on integrated watershed management programs, which propose to integrate watershed management with socio-economic development and poverty alleviation. Under integrated watershed management programs, users groups are formed in the watershed areas and their capabilities to undertake income generation

[38] The *Chure* refers to low lying hills that border with Nepal's *Terai* region.

activities enhanced. They are also encouraged to undertake savings and credit activities. Implementation strategies include establishing participatory watershed management training centers, conservation and exhibition sites and watershed laboratories to mobilize people's participation in watershed management, and in developing human resources at the local level.

Some examples of watershed management efforts include Bagmati Integrated Watershed Management Programme (EU), Syangja-Andhikhola Watershed Management Project (CIS), Churiya Forest Development Project (GTZ), Watershed Management Project (JICA), Community Forestry and Watershed Management Project (JICA), Nepal-Denmark Watershed Management Project (DANIDA), and Participatory Watershed Management Training Program (FAO). The increased emphasis on watershed management will work to increase/maintain the availability of point sources for micro irrigation. Micro irrigation linked to high value crop production will also provide an important justification for watershed management activities.

Piped Water Opportunities in the Hills of Nepal

Nepal's hills have tremendous water resources. However, traditional smallholders have been constrained in making use of water resources and recent degradation of watersheds through deforestation and resulting erosion is reducing access to water resources.

In recent years, there has been substantial growth in small-scale piped water systems to supply drinking water. These systems have excess capacity, which can be used for micro-irrigation. Nepal's hills are also characterized by a plethora of small point sources such as small streams and springs, which can be used to supply water for micro irrigation.

Technologies exist to utilize upland, piped water sources for irrigation purposes and the use is spreading, but slowly. These piped systems are efficient, hardy and cause little environmental degradation or soil erosion when compared with canal systems. They consist of a variety of sprinkler and drip irrigation systems. Water availability and the number of point sources for micro irrigation is greatly enhanced by sustainable management of watersheds. Deforested and eroded watersheds do not retain water needed to charge springs and supply small streams. IDE Nepal has shown demonstrated success with promotion of drip and micro-sprinkler systems in Nepal's hills. Farmers using these systems to grow high-value crops such as vegetables and fruits are showing significant impact on their income and livelihoods.

C. Agricultural Policy

Nepal has recognized poverty alleviation as its major development problem. It has also been accepted that it is not possible to alleviate poverty in Nepal without developing the agriculture sector. The government has adopted the Agriculture Perspective Plan (APP) as its main blueprint for agriculture development. The government endorsed the APP in 1995 and initiated implementation in 1997. The plan includes an emphasis on HVC production and commercialization of hill agriculture through facilitation of complementary inputs; fertilizer, irrigation, credit, rural roads, marketing facilities, and technology packages. Systematic evaluation of the APP impact is not available.

GoN has taken a number of initiatives for implementation of the APP. The APP has been operationalized by its incorporation in the Ninth Plan and the annual plans of the government. New institutional arrangements have been made. The Ministry of Local Development has established a Department of Local Infrastructure and Agricultural Roads. At the district level, District Agriculture Development Committees (DADC) and Program Executive Committees (PEC) have been formed in all 75 districts to coordinate line agency inputs.

Some important policy changes have also been made based on Plan recommendations. The government has eliminated subsidies for fertilizers other than urea and reduced subsidies on urea. Private traders are now allowed to import fertilizers. They are also receiving the subsidies provided to AIC to ensure a competitive environment. Irrigation subsidies have been reduced. The agricultural research budget has also been increased by about 50 percent and research priorities identified in the APP have been adopted. These include the development of appropriate cropping patterns for intensively irrigated farming to be made possible by shallow tube wells; development of technological packages for the efficient utilization of fertilizer; high value crops such as off-season vegetables, and fruits; sericulture; and animal nutrition such as the development of fodder. In line with the APP, the GoN budget has allocated resources for the development of rural agricultural roads, providing electricity tariff subsidies for "cold storage" of agricultural products, rural electrification and credit systems for agriculture.

At the district level, criteria for the selection of crop and livestock pockets have been developed. The APP calls for concentration of extension efforts and input facilitation in favorable pocket areas at the district level. The DADC and PEC have begun selecting and implementing APP activities in pocket locations.

Anecdotal evidence and problems with implementation indicate mixed results to date. In the first two years of APP, the share of agriculture in total development expenditures has remained consistently below the level specified by the Ninth Plan. Fertilizer quality, especially of Diammonium Phosphate (DAP), has emerged as a new problem. Farmers are still not able to obtain fertilizers on time. Fertilizer consumption per hectare of cultivated area has not increased as expected by the APP. The main rural credit supplier, ADBN, does not have adequate resources to meet credit needs of the APP priority areas.

Enthusiasm for the APP fades as one moves from National Planning Commission level to field level. There is a feeling that APP is an extra burden in addition to the regular programs of these offices and that the additional burden is not receiving needed budget support. These officials think that they have obligations to follow other local level problems not specified by the APP. District offices, due to decentralization, must now respond to local requests that may not fit with the top-down APP approach

1.6 Capacity of Existing and Potential Regional Parnters

A. Government

The government structure in Nepal operates at three levels. His Majesty's Government (HMG) is the national government. Until recently, it was the primary avenue for all government-related development activities. Recently, however, there has been an effort to decentralize power and operational control of development activities to the lower 2 levels of administration, namely the District Development Committees (DDC) and the Village Development Committees (VDC). The development of agriculture in Nepal is governed by the 20 year Agriculture Perspective Plan. Development of minor irrigation and focus on high value crops in the hills is a major focus of this plan. Thus the government policy very much supports the types of interventions being investigated in this report.

For this reason, there are opportunities to partner with government at all three levels. At the central level, the Department of Agriculture now has a section devoted to minor irrigation, as well as long-existing sections devoted to horticulture development and agricultural marketing. As part of the World Bank Agriculture Research and Extension Project (AREP), the Department of Agriculture has given a measure of autonomy to the District Agriculture Development Offices (ADO's) to develop their own local programs in partnership with other agencies. WI-IDE has successfully collaborated with two ADO's in Tanahun and Sarlahi Districts under this program, and other ADO's have expressed interest. The DDC's and VDC's also now have their own development budgets, and have proven willing to collaborate on agricultural and irrigation interventions. These types of interventions must be negotiated on a local level.

B. NGO's

Although local NGO's have only been operating in Nepal for the last ten years, there are several strong NGO's in the Agriculture/Irrigation sector. Many of them are staffed with well-trained, ex-government staff that have either retired, or left the government sector for the private sector. NGO's with particular strength in agriculture include: CEAPRED, LIBIRD, MADE, and SAPPROS. They are all also strong in community organization, CEAPRED in particular has a history of working with marketing cooperatives, and SAPPROS has a history of working with small-scale irrigation technologies. The above-mentioned NGO's all have sufficient management and administrative capacity to handle programs of several hundreds of thousands of dollars per year, and perhaps even larger. There are also several international NGO's who are capable of handling even larger programs with multi-partnerships. These would include WI-IDE, Helvetas, CECI, and CARE.

C. Business Sector

The private, for-profit sector, as in all of South Asia, is relatively dynamic. There are a plethora of large, medium and small enterprises capable and willing to do business in the agriculture sector. The most relevant group of businesses for the input sector is the so-called "Agro-Vets". These are businesses that wholesale or retail agricultural and veterinary supplies at the national, regional, and local level. As mentioned earlier, these agro-vets usually exist up to the district headquarters level in the hills. Many of them also carry micro-irrigation equipment, and those that don't are interested in learning more. There are also many businesses on the output side, most of which are simply trading concerns, but there are also many agricultural processing businesses such as ketchup factories, juice makers, pickle makers, and tobacco companies. WI-IDE has found that most of these businesses are willing to participate and partner with development agencies, as long as they find it to their benefit to do so, i.e. there is some increase in business or profits resulting from their participation or partnership. As mentioned above, the technical and management capacity of the small businesses is weak, but those surveyed are anxious to upgrade their skills.

D. Donors

In the irrigation sector, the major players are the World Bank and Asian Development Bank. Both agencies are funding major canal schemes in the hills of Nepal. In the agriculture sector, DFID is involved in the seed sector, agriculture research, and rural livelihoods. SDC is planning a program to promote the production and marketing of coffee. Danida supports local NGO's involved in the agriculture sector. USAID did have a strong program in agriculture, but has recently phased it out because of pressure from budget cuts. They are hoping to continue their program in the future.

1.7 Specific Thematic Items

A. Market Development

SIMI will increase the production of high value fruits and vegetables. For SIMI to be successful in substantially increasing the incomes and welfare of smallholders three principal market related conditions must be in place:

7. Farmers must be able to identify and efficiently produce high value crops that are in demand.
8. Marketing mechanisms that aggregate production, ensure quality, and provide remunerative prices to local producers must be in place.

9. There must be market demand to accommodate substantially increased production levels

This section focuses primarily on the steps to be undertaken for the development of marketing mechanisms and the identification of suitable crops/appropriate technologies. Historically markets for agricultural products have been underdeveloped. Nepal's smallholders have been subsistence oriented and internal and external marketing of agricultural products has been limited to primarily surpluses generated from the Terai region. Informal channels with limited infrastructure and quality control systems characterized what marketing systems that did exist. In recent years, as expressed in the APP, efforts to develop Nepal's agriculture have resulted in improvements in Nepal's marketing systems. However, smallholders still have difficulties in accessing markets and volumes of commodity that local markets can handle are limited. Smallholders also lack access to information and production technology for high value commodities that are in demand. Basic strategies that have been successful in Nepal for market development and which will be linked to SIMI efforts are now described,

B. Cooperatives and Market Associations

To develop market linkages farmers and farmer groups must empower themselves to aggregate adequate amounts of product that meets market standards. To accomplish this farmers must, at a minimum, develop group-marketing functions and ideally they would develop more structured cooperatives. Cooperatives enable farmers' to more effectively negotiate with traders. Cooperatives of sufficient scale can form linkages with large traders and market outlets. Federated cooperatives in Eastern Nepal have shown considerable success in marketing off-season vegetables to Indian markets and on a more local scale federated cooperatives are supplying Kathmandu valley markets with a variety of vegetables and high value crops.[39] Extensive training is required to expand the coverage of cooperatives and market associations.

C. Contract Growing

Contract growing systems offer great promise for smallholders to successfully benefit from commercialization of agriculture. Contract growing systems reduce farmer risk, provide access to appropriate technologies, and provide access to credit. Contract growing mechanisms are at a nascent but expanding stage in Nepal. The Agricultural Enterprise Center is facilitating basic contract growing mechanisms for vegetable and oil seeds.[40] Seed production contract growing systems have been established in many areas. Contract growing has a comparative advantage for processors that need to assure minimum levels of production, producers and buyers of perishable products, and producers and buyers of specialty products with important quality characteristics. Unfortunately, the business climate and trust between producers and sellers are weak in Nepal. The high cost of organizing smallholders also inhibits contract-growing operations. Allied SIMI efforts need to assist in initially organizing smallholders to reduce the transaction costs and should work to increase trust through sponsorship of workshops (see trade matching services below).

D. Trade Matching Service

These services can be conducted in a variety of ways. The most advanced methods include the use of the Internet and specialized software. More basic approaches include trade fairs where producers and buyers can meet, understand each other's requirements, and develop deals and contracts. Allied SIMI efforts should pursue a variety of strategies to accomplish trade matching, trade fairs for producers and buyers, workshops for producers and buyers with the goal of developing contracts, market tours/visits to important market outlets in Nepal and India, conventional publication of contact information for producers and buyers, Internet approach for more advertising, and matching buyers and sellers of more specialized high value commodities.

E. Market Information

Currently, the AEC is collecting and disseminating daily price information for major markets in Nepal and relevant markets in India. This is a critical service to the commercialization of hill agriculture. However, this price information is getting limited distribution. SIMI allied efforts will need to work to develop mechanisms for further

[39] Federated cooperatives consist of member groups from village units that elect members to participate in a larger cooperative. This allows for greater area coverage, product aggregation, and reduced management costs.

[40] The development of the AEC was supported by USAID. It is a unit of the Federation of Nepal Chamber of Commerce and Industries (FNCCI)..

distribution of this price information. Possibilities include: increase fax/email distribution linked to local institutions and local black board systems, assisting input suppliers to access information, and localized radio broadcasts. Market information systems must also be able to provide market analysis to inform farmer production decisions.

It is crucial that price information on high value crops be regularly available during the relevant periods to stimulate farmer interest in cultivating these crops. The lack of an adequate market information system has been widely recognized as a major constraint in the commercialization process for developing nations and has been found to be particularly significant in Nepal. Asymmetrical market information is also an important cause of high marketing margins in Nepal (Bloom and Tulachan, 1995). Poor market information coupled with the fact that many high-value agricultural products are often perishable, results in a poor bargaining position for farmers. It should be remembered that farmers in Nepal are subsistence oriented and often have little faith in markets. They greatly fear price collapses and variations. The impact of constant price information on farmer decisions will be profound.

What is needed is a call-in system, to make this information available to farmers or farmers' groups who can call from the well-developed telephone system in rural Nepal. Access to this information would give the farmers or farmers' marketing groups the opportunity to make decisions about where to sell/transport their produce, based on the best available market prices. It would also allow them to know if they are getting the right prices from the middlemen.

F. Marketing Infrastructure

In the past, more importance was given for constructing buildings and other physical facilities without assessing real market needs. Infrastructure work should be initiated according to the felt need of the stakeholders, not by projects and government officials. There are numerous examples in Nepal were producers and traders do not feel they are stakeholders in the management of marketing infrastructure and are not utilizing the infrastructure. However, lack of proper marketing infrastructure is resulting in high post-harvest losses, limiting ability to access more distant lucrative markets, and resulting in higher marketing margins. SIMI allied efforts should draw on the findings and results of the recently completed Small Marketing Infrastructure Development Project. This project developed a series of recommendations to better develop and manage market infrastructure.[41] These findings included a socio-metric approach to selecting representatives for market management that include relevant stakeholders (e.g. producers and buyers). The development of marketing infrastructure must also be done by facilitating private investment in facilities such as cold storage.

G. Post-Harvest Handling

Improvements in post-harvest handling are critical for the success of SIMI. Losses due to poor post-harvest practices and facilities are extremely high in Nepal. Currently, market functions are embryonic and need to be greatly improved to a level suitable for integration into both the domestic and Indian markets. No estimate of post-harvest loss is available but for comparison post-harvest loss in Bangladesh, which has considerably more developed marketing facilities, is 35 percent (Rashid, 1998). Improvements are required in all post-harvest functions of grading, storing, transportation, processing, and packaging. These market functions are suitable for private enterprises to perform and would represent a positive impact on local economies. The focus will be to identify bottlenecks in the marketing system and activities, which will offer the highest returns in terms of increased high-value product sales in a sustainable manner. SIMI allied efforts will assist in developing and providing training and information that such enterprises require. Promotion of local shipping point markets/collection centers with basic facilities will also be important in improving product quality. These collection points can be developed as basic packinghouses.

[41] Small Marketing Infrastructure development Project, Proceedings, July 2000.

1.8 Local Voices

During the survey, the team was able to meet with several farmers. The following is a sample of feedback from various hill farmers:

In Tansen, we met with a group of six leader farmers who were working with a WI-IDE program. They had been selected for intensive training, and were being encouraged to start to buy and sell inputs to their neighbors, and to act as informal trainers for the local communities. It was an extremely enthusiastic group. They had already received their training, and were looking forward to becoming micro-entrepreneurs and assisting their neighbors. Their experience so far had been positive, but they are finding that it takes time to gain their neighbors trust (that they know more because of the training). One of the women leader farmers came from a village where the women were carrying 15 buckets of water per day up the hill a few hundred meters, for both household and irrigation purposes (drip irrigation). They had been quite successful in growing off-season vegetables, but were all interested in developing some nearby water sources to ease their burden of carrying water.

In Chitundara VDC, we interviewed four farmers. They were part of a group of eleven farmers all of whom had started growing vegetables only last year. Three years ago, they had all grown only maize and some rain fed pulses. Then two years ago, drip irrigation was introduced and they were given training on vegetable production. In the first year their earnings had ranged from Rs. 3,200 to Rs. 7,500 ($50-$115) from a single season growing cucumber. In the second year, they had already earned Rs. 2,500 to Rs. 3,500 ($40-$55), and the season was only about half over. They expressed that they had problems with getting quality seeds. They had earlier had some marketing problems, but they had appointed one member of their group to do the marketing of the vegetables, and he was paid Rs. 2-3 per Kg. They had earlier not thought it possible to grow vegetables commercially, but now were quite confident.

1.9 Principal Constraints

A. Supply Chain Underdevelopment

Two problems were noted related to the development of the supply chain for micro-irrigation technologies and agriculture inputs. The first is the geographical limitation of the network of businesses. Most input suppliers are located in district headquarters or in large bazaars. Because of the rugged Terai and geographical dispersion of the population, there is often not a place to buy inputs within easy walking distance. This often leads to underutilization of inputs because of the difficulty in getting at them. The second problem has to do with the level of knowledge of the input suppliers, and their range of products. Because most input suppliers have limited knowledge about agriculture in general, and specifically about their products, they a) often give wrong advice to the farmers, and b) do not carry the proper inputs (seed varieties, fertilizers, pest controls, etc.).

B. Lack of Productivity Packages

Nepal institutions lack the mandate, incentives, and the capability to develop productivity packages for smallholders. The APP has given increased priority to the National Agricultural Research System to address the development of HVC varieties and technologies. However, the research system is inefficient, oriented towards cereal grain production because of past priorities, and lacking basic capability for HVC technology development. The Hill Agricultural Research Project and the Nepal Crop Diversification Project have taken initial steps to address this situation by establishing research funds focused on the development of HVC productivity packages. But efforts are at a nascent stage and have shown mixed results to date. The private sector has also failed to make widely available suitable HVC technology packages. This market failure stems from the diversity of climatic conditions in Nepal, the low purchasing power of smallholders, risk aversion of smallholders, lack of market information, and a lack of credit access for smallholders.

C. Watershed Management Needs Help

Though focus has increased on the need for watershed management, examples of successful implementation of watershed management activities has been anecdotal and limited to specific projects with high inputs. Deforestation continues (though perhaps at a decreased rate) leading to watershed degradation. Community forestry has increased

the management of local forests but is still prey to extraction strategies that degrade watersheds. Nepal has also shown an inability to mobilize for collection action within and across communities. Failure to manage watersheds decreases the availability of water for micro irrigation systems.

D. Underdeveloped Markets

As noted above, Nepal lacks basic marketing infrastructure, marketing institutions such as cooperatives or contract growing are at a nascent stage, smallholders lack access to basic market information, and marketing channels are inefficient with high costs and high post-harvest losses.

Nepal lacks public and private sector institutions to conduct market analysis and identify commodities and technologies that are appropriate for HVC. Nepal is not exploiting its comparative advantage with Indian markets and is failing to supply even local markets for HV commodities. The APP outlines a strategy based on export of HVCs to India yet Indian imports of even off-season commodities continue in Nepal due to a failure of market institutions to communicate the right signals to smallholder producers.

2. 15-YEAR RECOMMENDED PLAN

2.1 Target Population and Expected Market Penetration

A. Strategic Approaches

Broadly, the SIMI target population is smallholders in the hills with less than 1 hectare of cultivated land. In Nepal according to the 1991 Sample Census of Agriculture, there are more than 1 million households in the hills with less than 1 hectare of land. SIMI aims to increase the incomes of adopting households by $500 per year. This represents an amount of additional income that can lift the household out of poverty. There are a variety of potential structural constraints to achieving SIMI objectives including:

- Ability of markets to absorb additional production at remunerative prices
- Availability of water for micro irrigation of the required land area
- Sufficient land resources of the target population

The South Asian hills have a comparative advantage in the production of high-value crops (HVCs) that should enable substantial export of HVCs to the plain areas of South Asia. However, despite the emphasis of the Nepal APP for a shift to HVC commercial agriculture for export to India, Nepal has remained a net importer of fruits, vegetables, and other high-value crops. Exports to India of HVC have increased but are still limited in scale.

For this reason, SIMI interventions in Nepal will concentrate on the proven approach of developing off-season production through micro irrigation primarily for the Nepalese domestic markets. A number of recent development efforts in Nepal have shown strong success in promoting off-season vegetables including the USAID Market Access for Rural Development project, a variety of project efforts by the Center for Environmental and Agricultural Policy Research, Extension and Development (CEAPRED) focused on vegetable cooperative development, and the IDE country program which focuses on micro irrigation technologies to enable off season vegetable production.

The SIMI effort in the hills would shift to a focus on the development of HVC exports to the South Asian plains after successful penetration of local markets for these crops. The improvement in technology packages, market development, and market information for exploitation of domestic markets would facilitate this shift. Such a shift would be gradual in nature and would be expected to reach a critical mass after 10 years of SIMI initiation.

For analysis of economic feasibility and impact of SIMI on poverty in the Nepal hills an economic analysis of the off-season strategy is presented in Table 1.

B. Off Season Production in the Nepal Hills: Economic Feasibility and Impact

IDE Nepal staff based in Nepal conducted a market analysis of promoting off-season opportunities for seven key vegetables and two fruits. Market data for the Kalamati (Kathmandu) market was used to develop a demand function and assess seasonality of vegetable production.[42] National production for the selected commodities were estimated from a representative sample of district data collected from government agricultural offices.[43]

[42] This relationship was estimated econometrically.

[43] National statistic in Nepal does not include commodity specific production for horticultural products due to discrepancies in figures between government agencies.

A target price for feasible production was selected at 1.5 times the minimum observed market price. The quantity demanded at the target price was estimated from the demand relationship (scaled to the national level).[44] From this quantity the amount produced at observed price by month was deducted. The residual represents addition production induced through the SIMI initiative. Table 1 resents the economic impact of the SIMI intervention.

Table 1: SIMI economic impact.

	Current Situation			Five Year Projection		
Commodity	SIMI Production (kg)	SIMI Production Area (ha)	SIMI Increase in Revenue Value (Rs)	SIMI Production (kg)	SIMI Production Area (ha)	SIMI Increase in Revenue Value (Rs)
Tomato	186,664,614	5,333	2,519,972,283	227,106,044	6,489	3,065,931,592
Cauliflower	219,523,723	10,976	2,855,549,539	267,084,175	13,354	3,474,212,635
Cabbage	206,478,857	8,259	828,186,450	251,213,101	10,049	1,007,615,448
Cucumber	37,499,937	2,500	412,499,312	45,624,408	3,042	501,868,485
Sponge gourd	25,507,916	1,190	382,618,745	31,034,280	2,069	465,514,207
Bitter gourd	8,734,298	453	174,685,959	10,626,609	551	212,532,178
Bean	5,521,003	368	103,794,855	6,717,144	448	126,282,311
Orange	4,858,027	NA	143,068,887	5,910,532	NA	174,065,177
Lemon	703,601	NA	29,410,539	856,039	NA	35,782,418
Totals	695,491,976	29,080	7,449,786,568	846,172,331	36,001	9,063,804,451

*The project is based on 2% annual economic growth, 2% population growth, and an average income elasticity of 1.

Nepal's domestic market will be able to accommodate 7. 5 billion Rs (USD 99.3 million) from off-season vegetable production linked to SIMI promotion of micro irrigation technology. Given achievable yields this implies an increased production area of 29,000 acres. The SIMI approach is to target an annual increase in household income of USD 100 to 500. Current market conditions in Nepal will enable 15 percent of smallholders (owning < 1 hectare) to adopt micro irrigation technologies (Table 2) and achieve an annual increase in income of USD 458 (Table 3).

Table 2. Target hill population

Target Population:	Value
Households with less than 1 ha	1,040,340
Landholdings (ha)	442,439
Percent of SIMI beneficiaries	15
Target Households	156,051
Land of target HHs (ha)	66,366

[44] This assumes that Kalamiti market price serves as a proxy for national market price and could be used to extrapolate market-clearing conditions.

Table 3. Target population

SIMI Impact in $	Impact (Current)	Impact (5 Years)
Market Revenue	99,330,488	120,850,726
Marketing Cost	13,909,840	16,923,447
Production Cost	13,909,840	16,923,447
Farmer Income	71,510,809	87,003,833
Income per (ha)	2,459	2,417
Total Income per HH	458	558

2.3 Basic Water/Micro-Irrigation Development Strategies

A. Water Availability

A major issue is whether farmers will have sufficient water available to apply micro irrigation to take advantage of the available market for HVCs. Currently; national level representative findings are not available on the potential availability of water at the household level. However, a study of a typical hill Village Development Committee (VDC) conducted in Puyuthan District revealed that sufficient water resources are available for each household in a VDC to apply micro irrigation technologies on 0.0655 hectares of land (Table 4). Water resources available to the families included economically feasible point sources; in addition available rainwater from small-scale water harvesting systems was included.

Table 4. Surplus water available for each smallholder in the Nepal hills

Season	Point sources (Lt/day)*	Rain water Collection (Oct-May) (Lt/Day)	Collection (June-Sept) (Lt/day)**	Total available water (Lt/day)	Micro Irrigated Land (Ha)
Winter (Dec – March)	300	62.5	166.7	529.2	0.044
Summer (March - June)	200	62.5	***	262.5	0.011
Total					0.055

** Includes the use of a 15,000 Lt tank for water storage

***This cell is blank as water saved during monsoon season used up during 1st season.

Table 5 shows the amount of micro irrigated land possible from surplus water sources depending on the percentage of farmers adopting micro irrigation technologies and assuming that all farmers plant equal amounts of land. The analysis reveals that if 30 percent of all farmers adopt micro irrigation technologies there will be sufficient water resources for each adopter on average to achieve the US $500/year increase in income targeted. At a 30 percent water share there is more than enough water for 15 percent of the farmers to irrigate 0.18 ha of land. Table 5 details this for different levels of sharing surplus water. The market analysis in the above section indicates that 0.18 ha of drip irrigated intensive vegetable production will produce about $500 in additional income per household. This is well in excess of the SIMI target for the hills of 15 percent smallholders.

Table 5. Surplus water availability for micro-irrigation adopters.

	Micro irrigation adoption levels				
Percentage of micro irrigation adopters	0.50	0.40	0.30	0.20	0.10
Micro irrigation available ha/household Ha	0.11	0.14	0.18	0.28	0.55

The analysis shows that it is feasible for 15 percent of Nepal's hill farmers to adopt micro irrigation technologies and achieve average annual income increase of US $458. Current domestic markets for off-season production are

sufficient to absorb the increased off-season production. The analysis also shows that sufficient water resources are available to achieve the SIMI targeted outcome. However, investment will be required for smallholders to increase their access to point systems and adopt rainwater-harvesting systems.

The strategy for developing irrigation for the smallholders in the hills of Nepal focuses on a) source development, and b) efficient distribution systems. Development of water sources for micro-irrigation technologies uses the same technology as currently used to develop drinking water systems. In fact, there are plenty of opportunities to save money by developing systems to supply water for both household use and micro irrigation (so-called "hybrid" systems). Or the systems can be developed separately. Typically, developing a source involves some sort of structure at the source to collect water, a long pipeline to carry water to the village, and smaller pipelines to bring water to individual taps. Sometimes there are water tanks where the main pipeline divides into smaller pipelines. Development of this type typically is expensive (depending on the length of the pipeline, it may be $1,000 to $5,000), and must be managed by the users, as with drinking water systems. Compared with developing small canal systems, this is a relatively small amount of money, but the problem is that piped irrigation systems fall into a "no-man's land". It is neither drinking water (for which there are large government budgets), nor irrigation (according to the definition of the Department of Irrigation, an irrigation system must cover at least 10 hectares). So this irrigation policy must change, so that money is available from public moneys (World Bank and ADB irrigation projects are typically in the range of $40-$80 million) to develop water sources for micro-irrigation. Typically, a contractor would carry out the water source development with the assistance of the community, and some organization and training of a water users association or group is necessary.

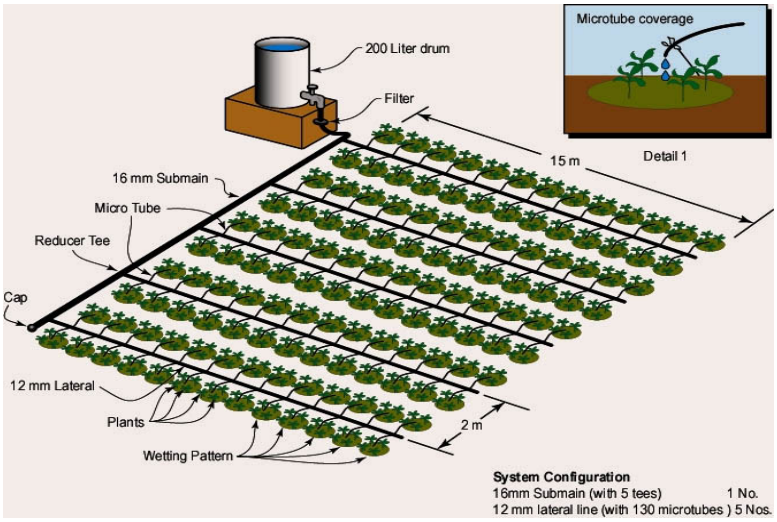
Secondly, efficient water distribution systems (drip and sprinkler irrigation) need to be further refined and widely promoted. The Agriculture Development Bank of Nepal (ADBN) introduced sprinkler systems to Nepal some 20 years ago, and they are being widely used. However, it was observed in the field, that farmers often are using the wrong types of sprinklers and are using them in the wrong way. ADBN is no longer involved in technical development of sprinklers. WI-IDE has been promoting micro-sprinklers that come in a kit with pipe and stands. WI-IDE has also introduced a series of locally manufactured drip irrigation kits that cover up to 500 square meters. A series of properly engineered packages needs to be refined/designed and promoted through government and non-government agencies, and through the private sector. Private sector importing/manufacturing and distribution networks need to be developed through technical training and providing some marketing assistance (linkages with the network and promotion of the products with farmers).

2.4 Output Markets for Smallholders

Development of the output marketing opportunities for smallholders would involve the following: (a) work to introduce high value crops, especially fruits and off-season vegetables to the small farmers through the development of productivity packages, (b) link farmers into existing national markets (fill off season demand, and import substitution), (c) link farmers into Indian markets (in the off season, these markets are virtually unlimited for Nepali farmers), (d) help farmers to develop marketing infrastructure such as collection centers and market price gathering systems, and (e) Work with entrepreneurs to develop agro-processing industries based on identified opportunities, and link farmers in with the agro-processors.

2.5 Strategies for Implementation

A. On-farm Technologies (inputs and management techniques) A national team of experts (comprised of government and private experts in the field of horticulture) needs to develop a series of productivity packages. These packages will be developed based on assessment of the fluctuating market demand and price of certain commodities, and on the technical feasibility of growing vegetables in the off-season. Vegetables are a better focus in the beginning than fruits, because the returns are quicker. Once farmers have generated a surplus, they can put aside some land for fruit cultivation. These productivity packages will include a well-designed syllabus for training the farmers for growing each commodity, and a syllabus for training of trainers (this will be a joint effort of government, NGO, and private sector). Some contracting agency/agencies will act as a facilitator to set up a public/private extension partnership program. The government (high skill level-low access to farmers) will act as a wholesaler of the information in the productivity packages. NGO's, community based organizations, farmers groups, and private input businesses (low skill level- high access to farmers) will act as retailers of information. The donors and facilitating agencies will make sure that the government has the skill necessary, and will make the initial linkages between the government staff, and private businesses and leaders of other organizations. These people will then have continued access to the government extension services, and will act as a conduit through which the farmers can access information and practices.



The drum kit is most useful for kitchen gardens and small commercial vegetables gardens.

B. Post-Harvest Technologies and Output Markets

Facilitating agencies will be responsible for three areas: 1) making sure that farmers are linked into existing markets (domestic and export to India) by giving market training and holding workshops with farmers and merchants attending, 2) where existing markets are not sufficient, contracting agencies to set up marketing groups among farmers, in order to market their own produce, which. involves a high level of community organization and training, and linkages between the groups and domestic or export markets and 3) working with the private sector to identify agro processing opportunities and to facilitate the relationship between the farm suppliers of produce and the industries, and to make sure that the industry is capable of marketing their own products.

C. Supply Chain Development

In the case of Nepal hills, supply of micro-irrigation technologies, and other agriculture inputs can be done through the same supply chain of agro-vets. The appropriate packages of irrigation technologies and agro-inputs will have been identified early on (and continually refined) by a panel of experts working with research institutions and other development agencies. It is then up to a facilitating agency to make the linkages between suppliers (domestic and foreign) of these commodities, and an appropriate chain of inputs dealers. Also the capacity of this chain will be built up through training on the specific productivity packages. The necessary supplies include irrigation devices (drip & sprinkler), seeds, fertilizer (macro and micro), pest control, and tools. The chain of dealers will then be linked up with the targeted farmers. In most cases, it should be attempted to involve the inputs dealers in the

training of the farmers. This establishes an early linkage between them. The dealers should be encouraged to participate in order to expand their business.

D. Finance

The entire supply chain will have to be capitalized. While it was observed that currently, capital is not a major constraint for most of the inputs suppliers, it will no doubt become a constraint if their business doubles or triples as would be expected from a program such as this. In this case, the supply chain is well able to access traditional formal sources of credit such as public sector banks. The banks will need to have sufficient capital set aside for this purpose. Further development and expansion of micro-credit institutions for credit to the farmers will be necessary. The program will formally link micro-credit institutions with the communities where the production programs will be ongoing.

2.6 Policy Implications

The policies of the government of Nepal regarding agricultural development are basically sound. It is implementation of these policies that is a problem. Thus there are few policy implications in the area of agriculture, but simply an application of the existing policies. Irrigation, on the other hand, is more complex. There is a major public policy debate concerning why some forms of irrigation are subsidized (canal), when other forms are not (tube wells, micro-irrigation). There has to be some rationalization of this process. The following guideline might be applicable: the parts of an irrigation system that are used by the community (canals, tanks, and main pipelines) can be subsidized, but community contribution should be maximized. Also long-term loans at favorable rates should be available to communities who wish to develop these systems on their own. Definitely, the 10-hectare minimum limit for the government irrigation systems should be scrapped in order to bring micro irrigation systems into the mainstream. Any part of the system that is on-farm (tube wells, drip system, sprinkler systems, small branch pipelines) should be paid for in full by the user. Micro-credit loans should be available for this purpose. It could be foreseen in the future that a World Bank irrigation scheme could be 50 percent water source development for micro irrigation systems.

PART II

IMMEDIATE INVESTMENT OPPORTUNITIES

3. CORE ACTION RESEARCH AND DEVELOPMENT PLAN (CARDEP): DEVELOPMENT OF AN INTERVENTION STRATEGY

4. GEOGRAPHIC EXPANSION

3. CARDEP: DEVELOPMENT OF AN INTERVENTION STRATEGY

3.1 Proposed Strategy for Implementation Management

Since this project would involve multiple participants, including NGO's, government, and the private sector, it is important to involve these stakeholders somehow in advising on the management and implementation of the project without making the mechanism so cumbersome that it hampers the decision making process and the smooth implementation of the project activities. Thus it is proposed that there be first, a project management office. This project would be in the hands of one, or perhaps a partnership of two implementing agencies (non-government). The project office would be an autonomous unit that would implement the activities of the project and be responsible for achieving the project objectives. Second, there would be an advisory board that would consist of representatives of all the stakeholders, i.e. government, NGO (local and international), private sector, and perhaps even farmers representation. This board would have two main roles: first to act as advisors to the project, in order to bring their various perspectives into the implementation process, and second to act as a communication conduit through which the project can reach out to the various stakeholders and through which the stakeholders can communicate with the project. The board would not, however, have operational control over the project, but would only be able to influence through advice or lobbying. It would be the role of the project manager to make the process inclusive enough that the board feels involved and empowered, and is willing to exert their influence to bring the various players on board for the implementation process.

The project itself would select certain specific marketsheds (a marketshed is defined as a geographical area within which the commercial activities flow into and out of a specific marketplace) within which to implement the program. They would set up project offices in those marketsheds. Professional staff whose job it would be to implement, or facilitate the implementation of the project activities would staff these offices. There would need to be professionals in the areas of agriculture, marketing, social mobilization, finance, and engineering. Each would be assigned specific activities, and would be responsible to the Area Manager, who is in turn responsible to the Project Manager. The project should have the capability of implementing some activities on their own, and others through local partners. In order to work with local partners, training modules would need to be developed in order to properly orient partners on the design, approach, and implementation strategy of the project.

The central project office would be staffed with professionals whose job it would be to make sure that the regional staff has all the resources they need to carry out the projects. There would also be professionals in agriculture, marketing, social mobilization, finance, and engineering, but their role would be one of coordinating, guiding, and supporting the field offices. They would also act as a conduit to national agencies.

3.2 Organizational Approach: Awareness Raising Among Potential Stakeholders

Awareness raising among potential stakeholders would be carried out in two manners. First of all, the above-mentioned board would be a major outreach pathway into the stakeholder community. Thus it is very important to make sure that the crucial stakeholders are actively involved in the project board. Secondly, the project office should have a stakeholder liaison officer whose job it is to involve the various actors in constructive ways in the project. This would also obviously be the role of the Project Manager. This being such a broad reaching initiative, it is crucial that bringing in the involvement of the various stakeholders be one of the primary foci of the project office.

From the very beginning, the project will need to conduct seminars and workshops, and invite prominent people from the various sectors, as well as members of the practitioner communities. These workshops will serve to communicate the goals and objectives of the project, progress and achievements, and as an avenue to solicit the involvement in a broad range of participants.

It is also crucial that the project have a well-developed public relations component that will develop simple but effective means of communicating the goals, objectives, and strategies of the project to the professional community.

This should include professional brochures, power point presentations, and short videos. These will act as a quick means to communicate the message of the project.

3.3 Strategy for the Formation of Consortia

This project should work vigorously, through both the project and the board to bring together a group of like-minded agencies to help achieve the goals and objectives of the project. These agencies could work through the project, but can also take independent action outside the project framework. It cannot be determined before the project gets underway, exactly what would be the nature and extent of these consortia, but the following list gives an idea of the potential members of such a consortium. Each of the consortium members can contribute in terms of financial, technical, or project support to the ultimate achievement of the goals of the project. Government: Department of Agriculture, Department of Irrigation, Department of Small and Cottage Industries, National Agricultural Research Council, Agriculture Development Bank. NGO: IDE, Winrock, CARE, CEAPREAD, SAPPROS, LIBIRD, CECI, MADE, REGARD, FORWARD, Nirdhan, CSD, RSDC, FNCCI. Donors: DFID, USAID, World Bank, ADB, Danida, and GTZ.

3.4 Technology Selection

Since water control is the entry point for any activity related to high-value crop production, water technologies are the most important starting point. There are two major categories of water technologies for the purpose of this project: water application technologies, such as drip and sprinkler irrigation systems; and water collection and transportation technologies, such as water storage tank, diversions structures, and pipelines.

In the case of drip and sprinkler irrigation, there has already been a lot of work done by IDE and others. There already exist appropriate technologies such as IDE's SLC drip systems and micro-sprinkler systems. These systems already have several years of proven track record in the field. The main purpose of the project is to make their use more widespread and more productive (of course, making them more productive will contribute to making them more widespread.

Regarding the water collection and transportation technologies, these are also already fairly well developed. As mentioned previously, the technology for this purpose is virtually identical to the technology currently used for drinking water systems in the hills of Nepal. Also, recently, IDE has made some innovation in the design of water storage structures that has reduced the size and cost of these structures significantly. So the development of water sources, and the transport and storage of water, should follow the basic technologies that are currently used, with some minor variations. The project should look at constantly developing and testing lower cost methods for all the water technology needs.

3.5 Input Packages to Develop and Implement

Although this project will mainly focus on the production of off-season vegetables, there are several opportunities in fruit and herb production which should be explored, and which can present good opportunities to small farm families. Specifically, citrus production in the lower hills and apple production in the high hills have been identified as good opportunities. A lot of research has been done on the production of these fruits, and promoting further production of these fruits would work on eliminating the main constraints to production (on farm production problems in citrus, and output marketing in apples). There are also large opportunities in the production of herbs for both domestic consumption, and export markets (including a large market in India). This area needs a lot of research and development, and was not a focus of this study, but has tremendous potential according to the experts.

Regarding vegetable production, there are basically three seasons of production in Nepal: Winter (September-January), Summer (February-May), and Monsoon (June-August). In each of these seasons, there are vegetables that

are normally grown in the main part of the season. One objective of this project would be to develop the production of off-season vegetables. Off season can mean either a) growing a vegetable during one of the seasons during which it is normally not grown, or b) growing it during the normal season, but planting either early or late in order to bring the crop into production just before or just after the main season when prices are higher. There are many opportunities along these lines, but the following are some of the main opportunities identified so far:

Early cauliflower: using early varieties of cauliflower with a short growing season, and proper cultivation practices, cauliflower can be planted towards the end of the monsoon and harvested in late September or October. During this time, the price of cauliflower is at least 3 times the main season price:

Early cucumber and gourds: these cucurvit crops can be started as early as January or February if simple plastic tunnel technology is used to cover the crops during the early stages. This allows the crops to be brought to market in March and April, when the market price is two to three times the main season price.

Monsoon tomato: The main constraint to growing tomatoes during the monsoon is that wilts and fungal diseases attack them. However, these diseases are not prevalent above 1500 meters altitude. Thus there are large opportunities to grow tomatoes during the monsoon in many areas of the hills of Nepal. Prices of tomatoes during the monsoon are two to five times the price than during the main season.

3.6 Goals for First and Second 3-Year Cycles

Table 1: Goals for the first and second 3-year cycles

	1st Three Years	2nd Three Years
Number of farmers involved	12,000 (cumulative)	32,000 (cumulative)
Increase in farmer income per family per year *	$120	$240
Number of small businesses offering input and output marketing services to farmers in the program	300	600
Annual volume of sales of inputs to participating farmers	$360,000	$1,920,000
Profit of input providers to participating farmers	$36,000	$192,000
Volume of produce sold through output chain	$1,440,000	$7,680,000
Profit of output chain members	$144,000	$768,000
Total annual profits generated by project	**1st Three Years**	**2nd Three years**
Farmers	$1,440,000	$7,680,000
Inputs	$36,000	$192,000
Outputs	$144,000	$768,000
Total	$1,620,000	$8,640,000

*Note: Farmers are expected to increase their income by about $80 in their first year of participation, and by about $500 in year 6, so the above numbers are a composite of farmers starting in years one to six.

3.7 Strategies for Input –Throughput-Output

Inputs: The strategy followed will involve the following:

1. Develop appropriate input packages using national agriculture and irrigation experts
2. Develop the private sector supply chain by giving training and making proper linkages to the suppliers. This may involve also developing new manufacturers domestically or linking with sources for import. The supply chain will be capable of giving proper advice to farmers as their skill level is increased
3. Massive promotional campaign to encourage farmers to adopt the practices developed by the project. The campaign will involve a variety of practices such as farmers' group meetings, advertisement, market demonstrations, etc.
4. Make linkages with credit institutions who can supply credit to supply chain members if finance becomes a constraint
5. Link with institutions that can finance the development of large number of upland water sources in the target areas.

Throughput:

1. Develop a system of information dissemination that involves using the government apparatus (extension and research system) as the "wholesalers of information to implementing agencies and the private sector. Building the capacity of the private sector supply chain and the local implementing agencies and farmers groups to pass information on to farmers and to access information from the government system.
2. Develop and implement training packages specifically designed to extend the information necessary for the farmers to grow off-season vegetables.

Output:

1. Conduct meetings between vegetable farmers and output marketing businesses in order to establish firm linkages and understanding between them.
2. Establish a sustainable market price information system on a national level by which anyone will be able to telephone to a central location and receive current market prices in various national and regional markets.
3. Work on establishing export linkages with the North Indian market
4. Work with entrepreneurs to establish agro-processing industries and link these industries with the farmers.
5. Establish a set of practices, and train the farmers in produce harvesting, grading, and packing.
6. Train all farmers in understanding the basics of how produce markets work, emphasizing the need to make adjustments to their growing plans based on market information.
7. Identify contract farming opportunities
8. Encourage and assist the establishment of farmers marketing groups in order to facilitate the flow of larger quantities of produce to market.

3.8 Strategies for Market Capitalization and Micro-Credit

Farmers:

1. Encourage funders and practitioners of micro-credit institutions to participate in the project and to link their activities to these high productivity activities
2. Link farmers to micro credit institutions

Input-Output:

Link the businesses involved with the target farmers to existing credit intuitions such as the Agricultural development bank. Make sure that the program is on the approved list of the major government banks to facilitate the availability of credit to participating businesses.

3.9 Continually Identify Constraints to Further Market Development

The project should have a mechanism to continually update its information regarding the opportunities and constraints to proper implementation of the program. Annual reviews should be carried out in which these

opportunities and constraints are surveyed and any changes should be taken not of and included in the next years project design. These reviews should include meetings with farmers, merchants, government and other stakeholders. Every action plan should be based on this information.

3.10 Estimated Budget (see Table 2)

The cost of this type of program for the first three years will be about $600,000 per year. This budget does not include the cost of water source development or credit. Water source development would take about another $350,000 per year, and about $200,000 dollars per year. In the second three years, the program cost would remain roughly the same, but water source development and credit needs would roughly double.

Table 2: CARDEP Poor Hills Budget

	Year 1	Year 2	Year 3	TOTAL
Personnel	163,000	171,150	179,708	513,858
International/National Consulting	62,000	76,000	72,000	210,000
Contracts with R&D Organizations	21,500	59,000	65,000	145,500
Work with Private Sector	8,500	27,500	27,500	63,500
Travel	37,000	45,000	45,000	127,000
Training, Promotion & Technical Assistance	130,000	65,800	81,300	277,100
Equipment	47,187	25,500	3,000	75,687
Administrative	17,539	16,776	13,218	47,533
TOTAL DIRECT COSTS	**486,726**	**486,726**	**486,726**	**1,460,178**
Indirect Costs (13%)	63,274	63,274	63,274	189,822
GRAND TOTAL	**550,000**	**550,000**	**550,000**	**1,650,000**

4. GEOGRAPHIC EXPANSION

INTRODUCTION

In the previous section a specific three-year program has been outlined for the region. This three-year program is meant to be the crucible of a set of strategies and technologies to be applied throughout the region. Simultaneously, however, a series of satellite projects will be implemented with the objective of adapting the regional strategy to the specific conditions of the sub-regions. This will be done through intensive interaction with farmers and development agencies in the sub-region. The intention is to gradually expand the approach being applied in the three-year program throughout the region.

The satellite projects will involve the following activities:

1. Conduct a basic survey of water, agriculture, and socio-economic conditions in each area. This would involve an analysis of the high-value crop sub-sector, including identification of opportunities and constraints specific to that sub-region.
2. Based on the outcome of this survey, develop a specific water and small farmer productivity/income generation strategy.
3 Form a consortium of agencies (both government and non-government), interested and capable of participating in the proposed set of interventions. Begin the process of orienting and training these agencies in the approaches and technologies of SIMI.
4. Conduct field-testing of the selected set of interventions and technologies. Based on these field tests, the interventions and technologies will be adapted to local conditions in preparation for later scaling up operations.

These satellite projects will be conducted within a two-year time frame, with the intention of following up with a scaled up SIMI intervention in the sub-region.

GEOGRAPHIC EXPANSION PLAN

The following is a list of suggested areas for expansion, with associated estimated annual budgets for the satellite projects:

1. The three-year CARDEP program will be implemented in six districts of the hills of Nepal: Dhading, Lamjung, Tanahun, Kaski, Syangja, Palpa. $550,000/yr
2. Six more districts of the Nepal hills: Kavre, Sindhupalchowk, Ilam, Panchtar, Baglung, and Myagdi. $200,000/yr.
3. The central highlands of Vietnam. $220,000/yr.
4. Uttar Anchal in the western Indian hills. $100,000/yr
5. The Northeast States of India: Northern West Bengal, Sikkim, Meghalaya and Assam. $170,000/yr
6. The Chittagong Hill Tracts of Bangladesh. $420,000/yr
7. Northwest Frontier Province of Pakistan. $220,000/yr.

NUMBER OF FARMERS

Geographic Region	Smallholders Affected (3 Years)
Nepal Hills	5,000
Vietnam Central Highlands	3,000
India – Uttar Anchal	5,000
India – Northeast	12,000
Bangladesh – Chittagong Hill Tracts	6,300
Pakistan – Northwest Frontier	3,000
Total:	**34,300**

SUB-PROJECTS

Based on experience in current field programs, and intensive interaction with farmers, a number of sub-projects (for application of specific interventions or technologies) have been identified. This list is meant to act as a menu to be drawn from for application in the main CARDEP project and for field-testing in the satellite projects. The interventions in the projects will neither include all of these interventions in each sub-region, nor be limited to these as other opportunities arise:

1.Mass marketing of low-cost drip and micro-sprinkler technologies. This will involve adaptation of the technologies to local conditions, supply chain development, and a mass promotional campaign.

2.Dissemination of off-season vegetable production packages: Taking advantage of the climatic variation in the various altitudes of the hills, this will involve using horticultural experts to develop a series of cultivation strategies to grow high value, off season vegetables including: Early Cauliflower and Cabbage, monsoon tomato, and early cucumber, sponge gourd and bitter gourd. The set of practices will be put into a training package that will both applied directly by the project, and taught to allied development agencies.

3. Development of hybrid drinking water/micro-irrigation systems: The technology for developing village gravity-fed drinking water systems from upland water sources is exactly the same technology as developing these water sources for micro-irrigation purposes. The expansion of these systems to meet the needs of both drinking water and micro-irrigation has two distinct advantages: first, the marginal cost of expanding the diameter of the pipe system for bringing a larger amount of water from a developed source is less than the cost of developing a new system. Thus this lowers the net cost of both the drinking water system and the micro-irrigation system. Second, this associates an income generating activity with the development of a drinking water system. This should lead to greater sustainability of the drinking water system, as lack of cash for investment in upkeep of drinking water systems is one of the major causes of their breakdown.

4. Development of a private sector/public sector information dissemination system for high value crop production: It has been found that farmers are getting almost all their information about crop production from two sources: agricultural supply shops, and their neighbors. A system has been developed to use these two sources as the retailers of information to the farmers, while linking them to the greater knowledge resources of the Agricultural Research and Extension system. In this approach, the agricultural inputs suppliers, and specially selected leader farmers from organized farmers groups, are given intensive training in the proposed high-value crop production packages. This would include such subjects as selection of seed varieties, nursery management, soil fertility management, integrated pest management, and produce marketing. These training programs will be conducted locally using the local Ag extension and research staff as the resource people. This makes the connection between the trainees and the information resources in the area for future reference, and gives them the knowledge and skills to transfer this information to the farmers.

5.Application of low-cost cold storage technology: Development and Consulting Services (DCS) in Nepal has developed low cost cold storage technologies which is applicable in the hill conditions. Entrepreneurs will be identified, assisted to find appropriate financing, and given technical assistance to locate these units in the rural areas. Having cold storage available at a reasonable price has continually been identified by

farmers as one of their needs. This allows them to extend the storage life of perishable vegetables, and to carry other products such as onions, potatoes, and oranges into a later season when the prices can double or even triple.

6.Marketing linkage workshops for farmers and produce traders: It has been found that there is a communication and understanding gap between the farmers (especially new producers of high value crops) and the output marketing chain. One effective means to close this gap has been found to be the holding of meetings to which all market players (producers, middlemen, wholesalers) are invited. Each group is allowed to give a summary of their needs and concerns. This helps the other groups to understand the nature of the production and market environment and to come to mutually beneficial marketing arrangements.

7. Development of a call-in market price information service: Working with public sector agencies, a system will be developed whereby farmers can call into a central information clearing house and get pricing information for various commodities in different markets in the sub-region. This allows farmers to make informed decisions about what price to charge for their produce, and to which markets to ship them.

8. Development of leader farmers into agriculture inputs sub-dealers: The trained leader farmers will be encouraged and assisted to become sub-dealers of agricultural inputs in their local communities. This will include seeds, fertilizers, pest controls, and tools. This brings the source of inputs closer to the community in a difficult transportation environment, and encourages leader farmers to disseminate information as a means to augment their income.

ANNEXES

1. CARDEP CONSTRAINTS ANALYSIS MATRIX
2. CARDEP LOGICAL FRAMEWORK
3. CARDEP TIMELINE

ANNEX 1: CARDEP CONSTRAINT ANALYSIS MATRIX

Country and geographic scope	Nepal – Terai: Districts of Saptari, Siraha, Dhanusha, Mahottari, Sarlahi, Rautahat, Bara.
Cash crops to be developed	Tomato, cauliflower, onion, pea, eggplant.

	Technological Constraints	**Capacity-Related Constraints**	**Capital/ Credit Constraints**	**Other Constraints**
Farm Level	• Lack of appropriate irrigation technologies. • Quality seeds, and right varieties not available at village level.	• Lack of technical knowledge about growing vegetables. • Lack of awareness of market opportunities, forces, and prices. • Lack of knowledge about safe pest control practices.	• Reliable sources of credit not available.	
Input Markets		• Lack of technical knowledge of input dealers about vegetable growing practices in order to make proper recommendations. • Lack of knowledge of input dealers about safe pest control practices. • Lack of awareness among input dealers of the potential of the small farm sector as good customers. • Lack of basic business planning methods among input dealers. • Lack of knowledge about advertising and promotion among input dealers. • Government extension system unable to reach large numbers of farmers due to systemic constraints.	• Capital sufficient now, but likely to run into capital constraint if business expands significantly.	
Output Markets	• Appropriate packaging not available for minimizing damage during shipping. • Lack of small collection centers on local level.	• Vegetable sellers unaware of new vegetable growing pockets. • Vegetable sellers unaware of need for sorting by quality. • Lack of basic business planning methods among vegetable sellers.	• Capital sufficient now, but likely to run into capital constraint if business expands significantly.	

ANNEX 2: CARDEP LOGICAL FRAMEWORK FOR PHASE 1 (YEARS 1 – 3)

Country and geographic scope	**Nepal Terai (Saptari, Siraha, Dhanusha, Mahottari, Sarlahi, Rautahat, Bara Districts)**
3-Year Goal	**Increase the net income of** 12,000 **smallholders by an average of $US 180 per year after the third year**

OBJECTIVE	3-YEAR TARGET	ACTIVITIES OF WI-IDE	INDICATORS
Farm Level			
Technology Strategy			
Increase availability of irrigation devices and quality seeds.	**100% of target farmers have access to irrigation water and quality seeds.**	Linkages with dealers who have been trained and who carry quality appropriate technologies through awareness raising meetings.	Number of farmers having access to irrigation water and quality seeds.
Capacity-Building Strategy			
Increase knowledge of marketing opportunities and how market works.	**At least 80% of farmers showing increased level of awareness of markets and 20% of farmers making direct selling arrangements.**	Conduct marketing training/workshops. Include vegetable sellers and ag extension people.	Level of knowledge of farmers of market. Number of farmers making marketing arrangements with vegetable sellers.
Increase level of awareness about technical information related to veg. production (esp. irrigation, off-season technologies, pest control, seeds, & soil fertility.)	**Increase productivity by 30%.**	Conduct agriculture training at village level for farmers (short training for farmers, and longer training for leader farmers)	Productivity of farmers, in terms of profit per hectare.
Capital/ Credit Strategy			
Increase credit opportunities for farmers.	**At least 20% of farmers using micro credit.**	WI-IDE will encourage micro-credit institutions to work with our farmers. Workshops will be held with credit givers and farmers.	Number of farmers using micro-credit
Input Markets			
Technology Strategy			
None			
Capacity-Building Strategy			
Increase knowledge among inputs dealers about vegetable growing practices, proper inputs packages, and pest control.	**150 dealers participating in training and showing adequate knowledge.**	Agriculture training for inputs dealers.	Number of dealers showing sufficient knowledge at end of training programs.
Increase sustained access of input dealers to ag knowledge.	**At least 35 agriculture extension agents involved in training of farmers.**	Include Ag extension agents in training programs and create relationship between agents and dealers.	Number of ag. Extension agents used as resource people in ag. Training programs.

OBJECTIVE	3-YEAR TARGET	ACTIVITIES OF WI-IDE	INDICATORS
Increase knowledge of business planning and marketing among input dealers.	**150 dealers participating in workshops and showing sufficient knowledge.**	Business/Marketing workshops.	Number of dealers showing sufficient knowledge at end of workshop.
Increase input dealers' knowledge of potential of small farmer market for increasing his business.	**At least 75 dealers participating regularly in promotion and training.**	Include dealers in promotion and training activities to farmers.	Number of dealers participating in farmer training programs and promotional meetings.
Introduce dealers to new vegetable pockets and make aware of market potential.	**At least 75 dealers introduced to new vegetable pockets.**	Involve input dealers in all training and marketing workshops at village level.	Number of dealers attending these training and promotion activities.
Capital/ Credit Strategy			
Make linkages between input dealers and local credit institutions.	**At least 30 dealers making new credit arrangements as a result of workshops.**	Conduct workshops in which all local dealers and bank managers or other credit institutions managers are present.	Number of dealers making new credit arrangements.
Output Markets			
Technology Strategy			
Make latest packaging materials available to merchants.	**At least 30 Vegetable sellers using new packaging materials.**	WI-IDE technical staff will introduce packaging materials and motivate sellers to use it in order to reduce losses.	Number of vegetable sellers using improved packaging materials.
Make improvements in collection centers.	**At least 20 improved collection centers.**	WI-IDE will act as liaison with local govt. to encourage improving collection centers. Will work with local business lobbies.	Number of improved collection centers.
Capacity-Building Strategy			
Improve level of basic business practices among veg. sellers.	**At least 50 vegetable sellers participating in workshops and showing improved knowledge**	Conduct business and marketing training for sellers. Include local ag extension people.	Improved level knowledge of business practices.
Introduce sellers to new vegetable pockets.	**At least 50 vegetable sellers participating n marketing workshops at farm level.**	Invite sellers to marketing workshops at farm level.	Number of sellers attending workshops.
Increase linkages between local, regional, and national marketers.	**At least 50 local, 20 regional, and 10 national merchants participating in workshops, and 50% making new business relationships.**	Conduct workshops in which all levels of sellers are invited.	Number of sellers attending workshops. And making new linkages with other market players.
Capital/ Credit Strategy			
Increase knowledge of credit availability.	**At least 20 vegetable sellers making new credit arrangements as a result of workshops.**	Conduct workshops in which local credit managers are brought together with vegetable sellers.	Number of sellers making new credit arrangements.

ANNEX 3: CARDEP TIMELINE

Country and geographic area	Nepal Terai (Saptari, Siraha, Dhanusha, Mahottari, Sarlahi, Rautahat, Bara Districts)

Program Objective/Activity	Phase 1			Phase 2		
	1	2	3	4	5	6
Farm Level						
Technology Strategy						
Increase availability of irrigation devices and quality seeds.	X	X	X	X	X	X
Capacity-Building Strategy						
Increase knowledge of marketing opportunities markets.	X	X	X	X	X	X
Increase level of awareness about technical information related to veg. production (esp. irrigation, off-season technologies, pest control, seeds, & soil fertility.)	X	X	X	X	X	X
Capital/ Credit Strategy						
Increase credit opportunities for farmers.	X	X	X	X	X	X
Input Markets						
Technology Strategy						
Capacity-Building Strategy						
Increase knowledge among inputs dealers about vegetable growing practices, proper inputs packages, and pest control.	X	X	X			
Increase sustained access of input dealers to ag knowledge.	X	X	X			
Increase knowledge of business planning and marketing among input dealers.	X	X				
Increase input dealers' knowledge of potential of small farmer market for increasing his business.	X	X				
Introduce dealers to new vegetable pockets & market potential.	X	X	X	X	X	X
Capital/ Credit Strategy						
Make linkages between input dealers and local credit institutions.	X	X	X	X	X	X
Output Markets						
Technology Strategy						
Make latest packaging materials available to merchants.	X	X				
Make improvements in collection centers.	X	X	X	X	X	X
Capacity-Building Strategy						
Improve level of basic business practices among veg. sellers.	X	X				