INCREASING THE VALUE AND QUALITY ASSURANCE FOR THE FRESH VEGETABLES AND HERBS SUPPLY CHAIN TO SUN INTERNATIONAL HOTELS IN ZAMBIA

Report on:

BUSINESS PLAN AND EXIT STRATEGY
(Feasibility Study)

REPORT PREPARED FOR RAPID PROJECT/RCSA

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Feasibility Study

Executive Summary

The project was initiated after discussions were held between Sun International and ASNAPP. This feasibility study is intended to indicate the options available for smallholders to supply the high value hotel market. The study revealed that Livingstone currently imports over half of all its vegetable needs from other areas and even as far as from South Africa. There is therefore a market that can be exploited. The major constraints to production that were identified were the problems of seasonality of production and the problems of quality of produce. The proposal is therefore to address the seasonality constraint by two main interventions, firstly by having low cost greenhouses, vegetables can be produced during less optimal periods like the rainfall season when diseases are a major problem. The seasonality problem will also be overcome by developing a cropping program for year round production that will be implemented by the farmers association.

The second constraint identified was that of quality requirements by the client and it is proposed to have the farmers association establish and run a control system that their members will follow. This is major undertaking and so it is important for the project facilitators to provide training and back up support for the implementation of the quality programme.

Two options were suggested for implementation of the project. The first has Sun International set up their hydroponics unit at the hotel complex for production of salad crops. There will also be construction of low cost tunnels on farms that support disabled persons. The final component of this option is to have a group of progressive smallholders produce a range of vegetables not suitable for greenhouse production. The second option involves having a larger group of smallholders each with a small area produce vegetables for the hotels. The farmers will be arranged in an association which will be responsible for implementing and running the cropping programme and quality control programme.

An evaluation of the economics of the project indicates that the farmers will increase their incomes per hectare by about five times. The major constraint to this project is transport and it is proposed to identify business development loans that can be provided to an entrepreneur who will be contracted by the growers to provide transport

Introduction

This study is to determine the feasibility of implementing a program for the supply of high quality fresh vegetables and herbs by smallholder farmers to Sun International hotels in Livingstone, Zambia. The project is supported by USAID/W through the ASNAPP project and USAID Zambia through the IDE Zambia project. The study will assess the profitability for farmers of a proposed four-year cropping programme and development plan for the production of vegetables in the field as well as under plastic and with the use of hydroponics.

The farmers will need to be able to contribute some of their own resources including agricultural equipment and taking out loans for the purchase of irrigation equipment for the project. They will however have the support of and access to technical

expertise for marketing and logistics as well as agronomic advice from ASNAPP and IDE.

Features of Smallholder Vegetable Production

Smallholder horticultural production is undertaken mainly for producing vegetables for home consumption. There are a number of growers however who are specialising more in horticultural production because they have realised that they can increase their income levels. There is a general shortage of resources and skills in smallholder horticulture and farmers face a number of constraints including lack of marketing facilities and outlets as well as poor market information and communication infrastructure. Water availability is a key factor in determining successful cropping. Many of these constraints can be overcome by training and technology acquisition and a number of development agencies are active in this area. The question of market access however is critical for the success of any initiative to improve smallholder horticultural production.

It has been observed that many smallholders are entrepreneurial and they will respond to agronomic advice and market conditions when they are able to. A good example of this is the production of (relatively) new crops like paprika by smallholders or their interest in joining export vegetable out grower schemes like that run by Agriflora Ltd. They have an advantage because they do not require a large amount of capital to get into production. Smallholders are therefore flexible and able to exploit new opportunities and can change to new cropping programs quickly. It has also been observed that when they are well trained and supported, their overall productivity and produce quality can be very high.

Market Opportunities

The project is aiming at taking advantage of the presence of new investments in tourism in the Livingstone area. Sun International has built two new hotels and they are attracting a large number of foreign and local tourists. Discussions have been held with Sun International officials and they have expressed an interest in purchasing vegetables and herbs from local growers provided they are of acceptable quality. Sun International has indicated that they are currently investigating various sources of supply of produce since they are having to import most of their requirements from South Africa. The quantities and range of some of the products they are interested in is shown in the next table. This shows the potential size of the market, which is actually greater since the consumption of other institutions, has not been taken into consideration.

The other potential market is the local market. In discussions held with traders and fresh produce companies in Livingstone it was estimated that Livingstone imports over half of all its vegetable requirements from places like Kalomo, Choma and even as far as Kapiri Mposhi. Many traders also come from Botswana to purchase vegetables from growers in the Kazungula area who also supply Livingstone. There is possibility therefore of selling to some of these regional export markets as well as locally and to other hotels and lodges.

CONSUMPTION OF SELECTED VEGETABLES AT SUN HOTELS IN 2003

Vegetable	**Per Month (Kg)**	**Potential Annual (Kg)**
Green Beans	350	4200
Broccoli	220	2640
Butternut Squash	260	3120
Cabbage (White)	425	5100
Carrot	675	8100
Cauliflower	265	3180
Cucumber	382	4584
Eggplant	550	6600
Lettuce (Mixed Greens)	940	11280
Mushroom (Oyster)	370	4440
Onion (large)	1010	12120
Green Pepper	495	5940
Potato (Irish)	2900	34800
Sweet Potato	340	4080
Pumpkin	677	8124
Spinach	215	2580
Tomato (first grade)	2230	26760

Project Development Plan I

There are two possibilities for implementation of the project.

The first option involves having Sun International establish their hydroponics production unit and a second low cost greenhouse will be located on a farm supporting disabled persons. The third group involved in this option is a group of progressive smallholders located near Livingstone town.

The hotel hydroponics unit will produce a range of crops suitable for protected cultivation, in particular the salad vegetables like lettuce. This unit is designed to produce a high volume of vegetables that will generate funds that can go into a revolving fund. The revolving fund will be used for community development projects in the Livingstone area. This may include supporting disadvantaged communities or developing the capacity of local growers to produce good quality crops through purchase of irrigation equipment and inputs.

The Sun International hydroponics project will be set up in conjunction with a low cost hydroponics unit on a nearby farm that will be managed by the farmers. It is proposed that this unit be on Linda Farm run by the Zambia Association for Persons with Disabilities, an organisation supporting blind and disabled persons. This will allow disadvantaged communities to embark on income generating projects. Disabled persons should find work in hydroponics to be challenging and rewarding because of the well defined spatial arrangements and agronomic activities. The hydroponics unit will consist of low cost plastic tunnels with plants growing in sterile sand media. The plants will be irrigated with a drip system with nutrients added to the irrigation water. The low cost tunnels can also be supported directly by the Sun International hydroponics unit, especially in terms of disease control and fertigation support and advice.

It is also proposed to have vegetable production by a group of growers in the Jack Mwanampapa area who have specialised in horticulture to grow the range of crops required by Sun International that are not suitable for production under hydroponics. These farmers have already invested in treadle pumps and have demonstrated a high level of innovation and willingness to embark on new ventures. These farmers will have an established market at the hotel and with the help of IDE facilitation will have higher quality produce for sale throughout the year.

Implementation Strategy

The two hydroponics units will be established with the input and advice of the University of Stellenbosch ASNAPP program which has a lot of expertise in this field. The initial steps will be water quality testing and design of the appropriate system. The next step will be the construction of the unit that will take place in conjunction with the training of staff who will be responsible for growing crops in the unit. If personnel are not available, it is suggested that use be made of the ZEGA training program which may be able to identify suitable personnel.

The Linda farm producers will have to be properly organised and motivated so that they can fully participate in this project. There will be a need for the development of a clear project implementation plan with objectives, duties and responsibilities of the farmers, Sun International and the development partners.

Facilitation for the linkage between the smallholders and the hotel will be provided by IDE and ASNAPP who will also provide technical support to the farmers. The activities of ASNAPP and IDE will also include helping the smallholder develop an effective quality assurance program for implementing safety and quality standards within the group. The monitoring of this program by ASNAPP and IDE is intended to assure the client that the produce is of a high quality. The client will also be assured of continuity of supply of produce since they will be advising the smallholders on their cropping program.

Specific arrangements will be made to have a dedicated transport entrepreneur who will be involved in the project through a negotiated contractual arrangement.

There may be need for the farmers group to be turned into an officially recognised institution or association. Individual farmers will still be responsible for the actual production of the crops but the association will be the body involved in the marketing and quality control activities. The group should appoint competent representatives who will have the responsibility of working with the project facilitators (IDE, ASNAPP and others). The main organising committee will have the responsibility of planning and implementing a cropping schedule and a quality control program.

Site and Location

Sun International has already identified a suitable site for the greenhouse within the hotel complex and all requirements such as power and water are available. The low cost plastic greenhouse is to be set up on Linda Farm for the Handicapped. This farm is managed by the Zambia Association for Persons with Disabilities. The farm has an area of 13 hectares and has water (the Maramba river) and electricity and is located about 3 km from Livingstone town.

Smallholders in the Jack Mwanampapa area and who have good potential for high quality horticultural production since water for irrigation is available and have

experience in growing vegetables will be the main group involved in open field production. The site is near town and therefore labour and inputs are readily available.

Crop Production Programme

The objective is to achieve year round production of a range of high quality vegetables for supply to Sun International hotels.

The programme will be determined by the needs of the market (especially the hotels) but it is likely that each farmer will grow at least five to six different vegetable crops in two or three growing sessions during the year. This will allow for a range of crops to be produced and for continuity of supply of each crop. The farmers' management committee together with extension advisors on the ground will work out the specific crops individual farmers will grow but one possible programme can be as shown below.

The crops that will be produced are tomatoes, peppers (green, yellow and red), lettuce (mixed greens and red salad bowl), eggplant, fresh marrow, fennel, leek and celery using hydroponic technology. The crops that will be grown by smallholders in the open are green beans, beetroot, broccoli, cauliflower, butternut, cabbage (red and white), carrot, cucumber, garlic, gem squash, onion, patty pan, pumpkin and spinach.

The scheduling for field vegetable production is accomplished by using three cropping periods in a year. The first cropping period can be from December to March. This is the main rainfall period and crops and management needs to adapt to warm wet conditions. The major requirement is to have good disease control.

The second period can be from April to August. This is during the cool dry season and the growth rate is slightly slower. Crops like onions and peas do well at this time.

The third is from August to November. This period is usually hot and dry and irrigation is very important. Generally pest and disease problems are reduced.

Proposed Cropping Sequences for field vegetable production:

First Year			**Second Year**		
First Crop	**Second Crop**	**Third Crop**	**First Crop**	**Second Crop**	**Third Crop**
G Beans	Cabbage	Onion	Broccoli	Carrot	Cucumber
Cabbage	Onion	Carrots	Spinach	Cucumber	Cauliflower
Patty Pan	Spinach	G Beans	Cucumber	G Beans	Garlic

Third Year			**Fourth Year**		
First Crop	**Second Crop**	**Third Crop**	**First Crop**	**Second Crop**	**Third Crop**
G Beans	Cabbage	Onion	Broccoli	Carrot	Cucumber
Cabbage	Onion	Carrots	Spinach	Cucumber	Cauliflower
Patty Pan	Spinach	G Beans	Cucumber	G Beans	Garlic

Inputs Supply and Delivery Requirements

The most important items of equipment for continuous production are the irrigation systems. As previously stated, the farmers who have been selected already have treadle pumps and may only need to consider obtaining low cost drip systems in order to improve on irrigation efficiency and to reduce disease incidence. The drip systems can be obtained with the assistance of IDE that has an internationally renowned reputation for smallholder irrigation technology.

In order to improve on packing and handling procedures, it is proposed to have a grading shed or shelter at each farm. This is a simple structure that is intended to provide shade and to keep produce off the ground. Local materials such as wooden poles and grass thatch will be used for the construction of the shed.

Inputs such as seeds and agrochemicals will need to be sourced. The farmers group already have experience in sourcing desired varieties but it is hoped that the link with IDE will help in speeding up the process and will be used to ensure that the most suitable inputs.

The transport of vegetables to the hotels and other markets is a very important activity of this project. It is proposed to have dedicated transport companies or entrepreneurs who will be contracted to ferry the produce. This can be a costly part of any farming enterprise and so there is need for the facilitators to help with negotiating terms and conditions. In order to encourage allegiance to the project, it is proposed that small loans be given to the transport entrepreneurs (to improve their businesses) by affiliate organisations (such as ZATAC).

Management

Individual growers will have overall responsibility for the management of their fields and crops so as to ensure that all operations are implemented efficiently. Marketing is a major activity of the project however and will be implemented through the farmers association who will take responsibility for ensuring smooth communication with transport operators and good contact with major markets. In order to ensure successful implementation of the project, association members should be sent for specialist training at relevant institutions (specializing in business development training) as well as study tours to successful out grower schemes.

Implementation Timeframe

The project will be implemented in various phases that will be completed according the following timeframes but these may run concurrently.

Objective	Activity	Time to completion
Sun International hydroponics unit	Design, develop and commission hydroponics unit at hotel complex	2 months
Community level hydroponics unit	- Establish agreement between disabled community, hotel and facilitators - Design, develop and commission hydroponics unit on farm	- 1 month - 2 months
Smallholder market linkage	Formalize agreement between farmers association, Sun International and facilitators	1 month
Farmer managed cropping programme	- Develop operational structure of association - Establish quality control program - Conduct water and soil tests - Commence crop production	- 1 month - 3 months - 1 month - Continuous
Transportation linkage	Develop and identify transport mechanisms and facilitate business development links	2 months
Monitoring crop production and marketing	- Training of growers in IPM/ICM methodology - Monitoring of quality assurance program and control systems	- Continuous - Continuous

Project Development Plan II

The second option also involves having Sun International establishing their hydroponics production unit but it is proposed that there be a larger number of smallholders involved in producing vegetables. The hydroponics unit will produce high volumes of crops like salad vegetables (such as lettuce) that do well under controlled environments. The large number of smallholders will be able to produce a higher volume of vegetables. This will improve the probability of Sun International receiving a wide range of high quality vegetables since the production base will be much bigger.

As a result of the investment in the drip irrigation system, farmers will have higher quality produce and will be able to sell to other commercial establishments in the area.

Implementation Strategy

The basis for this project is to have a separate organisation (i.e. ASNAPP and IDE) oversee the implementation of programs for production of high quality vegetables for sale to Sun International hotels and other markets. Facilitation and training will be provided by IDE and ASNAPP so the association develops an effective internal control system for implementing safety and quality standards within the group. The monitoring of this program by ASNAPP and IDE is intended to assure the client that the produce is of a high quality. Since it is the producers who will be implementing and managing the system, there is a high possibility of sustainability.

The second key aspect of this proposal is to have guaranteed supply of produce because there will be three groups of producers who will follow a cropping schedule

for year round vegetable production. Each group will have about 20 active growers although the number may be higher. Recommended groups that should be included are farmers from Sinde area. This site has very good water sources (artesian water) and the growers have been growing vegetables for more than 10 years. Another highly recommended group are the farmers from the Jack Mwanampapa area. The third group that should be included are the farmers in the Kazungula area who have good water, good soils and have been producing vegetables for a long time. The fourth group for consideration are farmers from the Katapazi area. These growers have been supplying Livingstone with vegetables for a long time and should fit in well with this project.

The sizes of the vegetable production fields to be used for this project should be limited to 300 m^2. This strategy is intended to ensure intensive management of the crop resulting in high quality and high productivity. It will also help avoid the farmers becoming dependent on one market (the hotels) since they will also have their other farming activities. The small land area means that farmers will not be over-burdened in terms of time and resources.

In order to reduce dependence on one market, the farmers should investigate alternatives. Discussions held with a commercial establishment in Livingstone (Fairways Market) indicated they were interested in working with a large number of smallholders as long as there was continuity of supply and acceptable quality.

Specific arrangements will need to be made to have dedicated transporters who will be encouraged to be involved in the project through agreements to provide them with loans and contracts.

The first step will be the organisation of the farmers into the necessary associations. These groups will be responsible for the actual production of the crops. The groups should appoint competent representatives who will have the responsibility of working with the project facilitators (IDE, ASNAPP and others). The main organising committee will have the responsibility of planning and implementing a cropping schedule and a quality control program.

Site and Location

Smallholders in the Livingstone area, which falls under agro-ecological region I and has a good potential for horticultural production if water for irrigation is available, will produce the crops.

The project area is located in agro-climatic region I which is characterised by rainfall of 600 to 800 mm and the 30 year mean annual rainfall for Livingstone is 763mm, although it is important to note that this is a drought-prone area. The coolest months are June and July, which have minimum temperatures of about 6 ^oC and maximum temperatures of about 25 ^oC. Frosts do occur although the incidence is not high with about 4 days when there is likelihood of frost. The warmest months are September and October (just before the start of the rainfall season) when the mean maximum temperatures get to about 32 – 34 ^oC.

The Sinde area is 41 km from town and the farmers from Jack Mwanampapa are about 7 km away. The Katapazi site is about 30 km away and the Kazungula area is about 100 km away. Most of the sites are near town and therefore labour and inputs are readily available.

Crop Production Programme

The project that is being proposed is for vegetable and herb production that will take advantage of the proximity to Sun International hotels who have indicated a willingness to purchase quality produce from smallholders. The aim is to produce vegetable crops year round so as to guarantee continuity of supply to the market. This is a high value market and the necessary support services and logistics will be made available to the growers through ASNAPP and IDE.

The programme is to be determined by the needs of the market (the hotels) but it is likely that each farmer will grow at least five to six different vegetable crops in two or three growing sessions during the year. This will allow for a range of crops to be produced and for continuity of supply of each crop. The farmers management committee together with extension advisors on the ground will work out the specific crops individual farmers will grow.

The total land area and number of growers producing vegetables for the hotel can be calculated by estimating the yields the growers will achieve for each crop. It is assumed that only 50% of the crop will be of a quality acceptable to the hotel. The table below shows estimates of the number of growers (or number of plots) required to produce the annual consumption of eight different vegetables. The plot sizes used by individual growers are 300 m^2 so that a quality product is obtained. It can be seen that there is a wide variation from ranging from14 to 56. This means that there should be at least three groups of about 20 active farmers who will need to divide the different crops between the growers.

Number of Growers to Produce Annual Requirement of Vegetables for Sun International

Crop	**Quantity Required (kg)**	**Yield estimate t/ha (kg/m^2)**	**Number of growers/plots**
Green Bean	4148	5 (0.5)	56
Butternut	3144	15 (1.5)	14
Cabbage	6756	25 (2.5)	18
Carrot	8100	14 (1.4)	38
Cauliflower	3180	15 (1.5)	14
Cucumber	4584	9.5 (0.95)	32
Onion	12 120	17 (1.7)	47
Broccoli	2592	7 (0.7)	25

The crops that will be grown by smallholders in the open are green beans, beetroot, broccoli, cauliflower, butternut, cabbage (red and white), carrot, cucumber, garlic, gem squash, onion, patty pan and pumpkin. The crops that will be produced under plastic and using hydroponics technology are tomatoes, peppers (green, yellow and

red), lettuce (mixed greens and red salad bowl), eggplant, fresh marrow, fennel, leek and celery.

The year is first split into three cropping periods that can be determined by seasonal variation. The first cropping period can be from December to March. This is the main rainfall period and the crops selected and the agronomic management need to adapt to warm wet conditions. Crops will grow vigorously during this period if there is good disease control.

The second period can be from April to August. This is during the cool dry season and the growth rate is slightly slower. Crops like onions and peas do well at this time.

The third is from August to November. This period is usually hot and dry and irrigation is very important. Generally pest and disease problems are reduced.

Proposed Cropping Sequences

First Year			**Second Year**		
First Crop	**Second Crop**	**Third Crop**	**First Crop**	**Second Crop**	**Third Crop**
Tomato	Cabbage	Onion	Tomato	Cauliflower	G Beans
Cabbage	Tomato	Carrots	Cabbage	Onion	Okra
G Beans	Lettuce	G Pepper	Broccoli	Carrots	Garlic

Third Year			**Fourth Year**		
First Crop	**Second Crop**	**Third Crop**	**First Crop**	**Second Crop**	**Third Crop**
Tomato	Cabbage	Onion	Tomato	Cauliflower	G Beans
Cabbage	Tomato	Carrots	Cabbage	Onion	Okra
G Beans	Lettuce	G Pepper	Broccoli	Carrots	Garlic

Inputs Supply and Delivery Requirements

The main requirement for success in horticultural production is to have a reliable water source and delivery system. It is proposed therefore to use small scale manual pumping devices (treadle pumps) for irrigating the crops. Use of a drip system will enable more efficient utilization of water and labour and since the foliage is not wetted, there is also a reduction in disease incidence. The pumps and drip systems will be obtained from IDE that has an internationally renowned reputation for smallholder irrigation technology.

In order to improve on packing and handling procedures, it is proposed to have a grading shed or shelter at each farm. This is a simple structure that is intended to provide shade and to keep produce off the ground. Local materials such as wooden poles and grass thatch will be used for the construction of the shed.

Where there is need for temporary storage of produce, an evaporative cooler may be used. This appropriate technology storage structure works on the principle that air is cooled as it moves across a moist surface. If the walls of a shed are made of grass thatch (or even charcoal) and are moistened, the interior of the shed has a much lower temperature than the ambient and produce can keep for several days. Local materials such as wooden poles and grass thatch will be used for the construction of the store.

A number of agricultural input suppliers exist in town and these will be used whenever possible for the supply of seeds and agrochemicals that will be needed for cropping. A link will be established with IDE extension personnel in the area who will be used to ensure the efficient and timely supply of inputs.

The transport of vegetables to the hotels and other markets is a very important activity of this project. It is proposed to have dedicated transport companies or entrepreneurs who will be contracted to ferry the produce. This can be a costly part of any farming enterprise and so there is need for the facilitators to help with negotiating terms and conditions. In order to encourage allegiance to the project, it is proposed that small loans be given to the transport entrepreneurs (to improve their businesses) by affiliate organisations (such as ZATAC).

Management

Individual growers will have overall responsibility for the management of their fields and crops so as to ensure that all operations are implemented efficiently. Marketing is a major activity of the project however and will be implemented through the farmers association who will take responsibility for ensuring smooth communication with transport operators and good contact with major markets. The association will be responsible for the overall management of the scheme including crop scheduling and quality assurance. It is important to emphasize that project implementation has to be inclusive and participatory and the growers need to understand what they are being asked to do and agree to take on the responsibilities of management, operation and maintenance. In order to ensure successful implementation of the project, association members will be sent for specialist training at relevant institutions (specializing in business development training) as well as study tours to successful out grower schemes.

Implementation Timeframe

As in option 1

Agronomic and Technical Development

The enterprise will consist mainly of growing and packing of vegetables for sale. The major capital expense will be the installation of a small scale drip system for year round crop production and the erection of a shed for preparation, packing and handling of the vegetables. It may also be necessary to construct evaporative coolers using appropriate materials such as grass thatch or charcoal. Most of the vegetables will be produced using the conventional method, which is growing them in the open. However, in order to extend the season of availability, some of the vegetables will be grown under plastic.

Treadle Pumps and Low cost drip systems

The treadle pump will be promoted for use in the irrigation system. This is a manual pump, which can be either a pressure delivery pump or a suction-lift pump. Smallholders in many countries including Kenya and Malawi are successfully using this pump for irrigation. The treadle pump is best used for lifting water from depths of no more than 7 m and so is ideal for shallow wells and streams. The delivery head can reach 15 m depending on the design. The quantity of water delivered varies according to the design but from 0.4 to 1.2 litres/sec is possible. The pump essentially replaces

the hand lifting and carrying of water by buckets. It is a low cost option instead of using a small petrol- or diesel-driven pump. The treadle pump is likely to reduce the labour requirements and the quality of irrigation can be improved and the overall task of cultivation becomes easier and less time consuming.

The treadle pump can be used in combination with drip kits. Some drip kits are already being tested in the Lusaka area and it would be very beneficial to the project to extend their use to Livingstone. Drip and drum kits retain the water efficiency benefits of conventional drip systems while removing the factors that prevent their uptake by poor farmers – purchase cost, requirement of a pressurized supply and its associated pumping costs and complexity of operation and maintenance.

These units have a drum raised 3 or 4 meters from the ground with laterals coming out and running down each row. This height provides a low head of pressure that means the system can be operated without a pump. The raised storage tank can be filled manually or an alternative is to use the output from a treadle pump. The major problem that will be encountered with drip systems is clogging of the very small flow paths in the individual emitters. The low cost systems being promoted by IDE use simple cloth or wire mesh filters to prevent large particles entering laterals. Generally these systems use simple holes and baffles in the laterals, which can be unclogged by the farmer using a pin or fine wire to clear any emitter that becomes blocked (this should not be practised with commercial systems!). This may be feasible over a 0.10 area with up to 2 500 emitters to maintain, but it would be unrealistic on larger systems. A criticism that has been made against low technology systems is the variation in flow leading to non-uniform discharge. This may be a problem over long lateral lengths of over 80 m, but it is less significant in the short laterals that are found in small plots.

Hydroponics Systems

Hydroponics or soilless culture is a method of growing crops without the use soil, (a supporting medium may be provided) and all water, oxygen and nutrient requirements are provided by the system. Many hydroponics systems also provide ideal requirements for the leaves, stem, flowers and fruit by controlling light intensity, temperature, humidity as well as air quality and movement. It should be noted however that successful hydroponic systems include both open air and greenhouse environments. The nutrient solution may be applied to the rooting medium and then allowed to drain off as waste (called an open system). If the solution is recirculated to a feeder tank and reused in successive watering within the hydroponic system it is termed a closed system. It is important that the pH, electrical conductivity (EC) and nutrient balance of the solution are measured frequently and adjusted as necessary. This will require regular chemical analysis and automated pH and EC monitors.
In closed systems the management of pH and EC is easier than in open systems but the management of nutrient balance is more difficult. A water-based system is where there is no media and the roots are kept moist by a continuous fine spray. Water-based systems have to be closed systems and are mainly used for short-term crops such as lettuce and herbs. Media based systems use inorganic material such as sand or rockwool or organic materials like coconut fibre or sawdust. Media systems are normally used for longer term vegetable and flower crop production. The media is usually in container and the nutrient solution is applied by a low pressure, low flow irrigation system. Plastic bags and polystyrene boxes are the most commonly used media containers.

Economic and Financial Evaluation

The farmers who are to be considered for this project are already producing vegetable crops for sale in and around Livingstone. Their current level of profitability is indicated in the table below. The figures show overall expenditure and income for the production enterprise for three farmers in the Livingstone area.

Actual Farm costs, revenues and profits (Zambian Kwacha)

ITEM	**Farmer**		
	1	2	3
Farm size (ha)	1.0	1.3	1.5
Seed costs	270 000	115 000	270 000
Manure costs	40 000	-	44 000
Fertilizer costs	80 000	70 000	80 000
Fungicide costs	-	-	-
Pesticide costs	80 000	110 000	80 000
Labour costs	-	-	-
Transport costs	-	-	10 000
Total Costs	470 000	295 000	584 000
Total Income	1 310 000	5 400 000	5 420 000
Profit	840 000	5 105 000	4 836 000
Profit per hectare	840 000	3 926 923	3 224 000

Growers who will be able to produce and sell high quality vegetables to the hotels are likely to encounter the following costs and revenues.

a) Costs: The major cost items will include the purchase of hybrid seed since disease resistant varieties will be recommended for off season production. The farmers will need to use adequate fertilizers and manures to encourage crop growth. A range of pest and disease control chemicals will need to be purchased. This is because different diseases have different recommended control procedures. Another major cost item will be the purchase of packing materials (preferable wooden/plastic crates) and the cost of transport.
b) Revenues: The revenues will be generated from the sale of the vegetables. It is expected that about 50 percent of the farmers produce will be of high quality and will go to the hotels. These will be sold at a price premium over the prevailing market prices. The remaining vegetables can be sold to other institutions and to the local market.

The expected returns have been calculated as follows. It is assumed that each grower has a 0.1 ha production area for growing three crops at a time with each crop having an area of 300 m^2. All financial figures are in Zambia Kwacha (K).

a) Tomato

	Per 300 m^2 Plot
Yield (kg)	360
Selling price	K 1 000
Gross Income	K 360 000
Operating Costs	K 90 450
Gross Margin	K 269 550

b) Cabbage

	Per 300 m^2 Plot
Yield (kg)	750
Selling price	K 350
Gross Income	K 262 500
Operating Costs	K 138 675
Gross Margin	K 123 825

c) Carrot

	Per 300 m^2 Plot
Yield (kg)	420
Selling price	K 1000
Gross Income	K 420 000
Operating Costs	K 103 000
Gross Margin	K 316 500

d) Green Bean

	Per 300 m^2 Plot
Yield (kg)	150
Selling price	K 2 500
Gross Income	K 375 000
Operating Costs	K 151 000
Gross Margin	K 223 500

e) Cucumber

	Per 300 m^2 Plot
Yield (kg)	285
Selling price	K 1 000
Gross Income	K 285 000
Operating Costs	K 69 000
Gross Margin	K 216 000

f) Onion

	Per 300 m^2 Plot
Yield (kg)	510
Selling price	K 1 000
Gross Income	K 510 000
Operating Costs	K 125 400
Gross Margin	K 384 000

In addition to the variable costs, the farmers may also need to invest in several infrastructure items needed to ensure high output crop production. These include an irrigation system and postharvest handling sheds.

Proposed Capital Development Investment Schedule (In Kwacha

Item	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Treadle Pump	350 000			
Drip Kit	705 000			
Evaporative Cooler		250 000		
Grading Shed		200 000		
TOTAL	1 055 000	450 000		

The treadle pump and drip kit should be purchased in the first year as they will be needed for crop production. The evaporative cooler and the grading shed can be constructed at a later date once the cropping programme is launched.

Project Viability and Projected Cash Flow

WHOLE FARM CASH FLOW FOR FIRST FOUR YEARS* (per 0.1 ha)

	Year 1	**Year 2**	**Year 3**	**Year 4**
Farm Income				
Farm Gross Income	2 212 500	3 270 000	3 270 000	3 270 000
Cash Outflow				
- Capital costs	1 055 000	450 000		
- Operating costs	677 525	1 070 200	1 070 200	1 070 200
Total Cash Outflow	1 732 525	1 520 200	1 070 200	1 070 200
Farm Gross Margin	479 975	1 749 800	2 199 800	2 199 800
Cumulative Margin+				

* All figures are quoted in Kwacha

The results of the cash flow projections show that profitability per hectare is up to 21 000 000.00 Kwacha. This is higher than the current levels of profitability where some of the better farmers are earning almost 4 000 000.00 Kwacha per hectare.

The project will require some funding for facilitation work but the costs included here are very rough estimates and more detailed costings are required. This will include

training of farmers and travel and expenses for the extension staff of IDE and ASNAPP. These costs can therefore be picked up by USAID through the ASNAPP programme. A component for inputs has also been included and this will be used for supporting the low cost greenhouses and also inputs needed for field production. The inputs for the low cost greenhouses can be supported by Sun International since this will be mainly inputs to enable the disabled persons to go into production. The inputs for field crop production can include equipment such as knapsack sprayers.

Project implementation costs according to activity

Objective	Activity	Expected costs (US$)	Responsible Institution
Sun International hydroponics unit	Construction of hydroponics unit at hotel complex	?	Sun International
Community level hydroponics unit	- Facilitate agreement between disabled community, hotel and facilitators - Construction of low cost hydroponics unit on farm	20 000	ASNAPP
Smallholder market linkage	Workshop on linkage between farmers association, Sun International and facilitators	1000	ASNAPP
Farmer managed cropping programme	- Facilitate operational requirements of association	2000	ASNAPP
	- Conduct water and soil tests	1000	Sun International
	- Inputs for field crop production	5000	ASNAPP
	- Inputs for low cost greenhouses	5000	Sun International
Transportation linkage	Develop and identify transport mechanisms and facilitate business development links	1000	ASNAPP
Monitoring crop production and marketing	- Training of growers in IPM/ICM methodology	4000	ASNAPP
	- Monitoring of quality assurance program and control systems	1000	ASNAPP

Exit Strategy

The project was initiated as a result of communication between ASNAPP and Sun International staff that expressed interest in purchasing produce from smallholders. The success of the project hinges on the farmers meeting the quality requirements of Sun International. It is possible that Sun International will not happy be with the outcome of the project and does not purchase significant quantities of produce from the smallholders. It may also be that the farmers will not be happy with the terms of the agreement with Sun International (such as prices lower than prevailing market prices) and will not supply the hotels.

The project activities may still proceed and have a successful outcome despite the obstacles mentioned above. In order to prevent a situation where one or both of the partners end up with unrealised expectations the following should be considered.

The farmers will need to cultivate alternative markets. It has already been mentioned that Livingstone is currently under-supplied with produce and so it is likely that a large quantity of the farmers' produce will find customers in town. One of the commercial wholesalers (Fairways Market) has already indicated a willingness to be involved in a project that guarantees continuity of supply of vegetables.

There is also need to consider regional markets like Kasane in Bostwana and Victoria Falls in Zimbabwe that also have a lot of tourist investments. These markets are currently being supplied with produce from as far away as South Africa and should be willing to purchase good quality produce from nearer sources.

It is important to train the association well so that they will be able to continue with productive activities even after the facilitators have left. The project should therefore have a participatory approach and growers should not be given grants for purchase of inputs. Any items given in advance such as crop inputs or treadle pumps or drip kits should only be on a credit basis.

Conclusions and Recommendations

The project will be successful if the main effort is to be quality improvement and improvement in terms of continuity of supply. Particular attention should be paid to the quality requirements of the client. The growers will need to receive ongoing training on quality improvement techniques. An overall increase in quality of produce will result in increased market opportunities. There needs to be more emphasis on integrated crop management and less on the use of chemicals. There is a requirement for the facilitators to find funding for training and support of farmer activities. In particular emphasis should be placed on empowering and training of the grower associations so that they can take lead responsibility for ensuring success of the project.

Appendix: Recommended Varietal Characteristics

Crop	Quality Criteria	Disease Resistance	Seasonality	Remarks
Green Beans	7-9 mm pod diameter, 12-14 cm pod length	Rust, Common & Halo Blight	Susceptible to frost	Need to pick early and frequently
Beetroot	Dark red – purple root colour	Downy mildew	Select for warm season	
Broccoli	400-600 g head, dark green colour		Select for warm season	
Butternut squash	1-2 kg fruit size	Powdery Mildew		Select semi-bush/compact growth habit
Cabbage	2-4 kg size, Leaf colour (green or red)	Black rot, Fusarium	Warm season	
Carrot	Good root size and colour	Alternaria		Select for thin core
Cauliflower	0.8-1.5 kg head, white colour		Warm season	
Cucumber	20x6 cm fruit size, straight, dark green colour	Powdery mildew, Leaf spot, Scab, Anthracnose		
Onion	Medium to large bulb size, white flesh		Select for bolting resistance	Select for Storability and early maturity
Pumpkin	Orange flesh colour	Powdery mildew		
Squash	Fruit colour and even shape			Various types available, consult with customer
Spinach	Dark green leaf colour	Downy mildew	Warm season	Select for bolting resistance/late bolting

Appendix: Gross Margin budgets

Crop :	TOMATO				
Yield	kg				12000
Price	K/kg				1000
Total Income		Per Ha			12000000
Inputs		Quant		Unit price	Cost
Labour -	Land prep				0
	Planting				0
	Weeding				0
	Irrigating				0
	Pest Control				0
	Harvesting				0
	Grading				0
Seed		g	250	600	150000
Fertilizers	AN	kg	150	2300	345000
	Compound	kg	600	1900	1140000
	Lime				0
	Other				0
Chemicals					0
	Dithane	kg	2	45000	90000
	Malathion	kg	1	90000	90000
	Other				
Miscellan					0
					0
Transport		boxes	480	4000	1920000
					0
Total Costs					3735000
Gross Margin		Kwacha			8265000

Crop : CABBAGE

Yield	kg				25000
Price	K/kg				350
Total Income		Per Ha			8750000

Inputs			Quant	Unit price	Cost
Labour -	Land prep				0
	Planting				0
	Weeding				0
	Irrigating				0
	Pest Control				0
	Harvesting				0
	Grading				0
Seed		g	600	2800	1680000
Fertilizers	AN	kg	200	2300	460000
	Compound	kg	600	1900	1140000
	Lime				0
	Other				0
Chemicals	Benomyl	kg	1	60000	60000
	Malathion	kg	1	90000	90000
	Other				0
Miscellan					0
					0
Transport		bags	300	4000	1200000
					0
Total Costs					4630000
Gross Margin		Kwacha			4120000

Crop : CARROT

Yield	kg				14000
Price	K/kg				1000
Total Income			Per Ha		14000000

Inputs			Quant	Unit price	Cost
Labour -	Land prep				0
	Planting				0
	Weeding				0
	Irrigating				0
	Pest Control				0
	Harvesting				0
	Grading				0
Seed		kg	4	175000	700000
Fertilizers	AN	kg	100	2300	230000
	Compound	kg	600	1900	1140000
	Lime				0
	Other				0
Chemicals					0
	Dithane	kg	2	45000	90000
	Malathion	kg	1	90000	90000
	Other				
Miscellan					0
					0
Transport		boxes	560	4000	2240000
					0
Total Costs					4490000
Gross Margin		Kwacha			9510000

Crop : GREEN BEAN

Yield	kg				5000
Price	K/kg				2500
Total Income			Per Ha		12500000

Inputs			Quant	Unit price	Cost
Labour -	Land prep				0
	Planting				0
	Weeding				0
	Irrigating				0
	Pest Control				0
	Harvesting				0
	Grading				0
Seed			50	70000	3500000
Fertilizers	AN	kg	100	2300	230000
	Compound	kg	300	1900	570000
	Lime				0
	Other				0
Chemicals					0
	Dithane	kg	2	45000	90000
	Malathion	kg	2	90000	180000
					0
					0
	Other				
Miscellan					0
					0
Transport		boxes	200	4000	800000
					0
Total Costs					5370000
Gross Margin		Kwacha			7130000

Crop : CUCUMBER

Yield	kg				9500
Price	K/kg				1000
Total Income		Per Ha			9500000

Inputs			Quant	Unit price	Cost
Labour -	Land prep				0
	Planting				0
	Weeding				0
	Irrigating				0
	Pest Control				0
	Harvesting				0
	Grading				0
Seed		kg	1	250000	250000
Fertilizers	AN	kg	100	2300	230000
	Compound	kg	400	1900	760000
	Lime				0
	Other				0
Chemicals					0
	Dithane	kg	2	45000	90000
	Malathion	kg	1	90000	90000
Miscellan					0
					0
Transport		boxes	380	4000	1520000
					0
Total Costs					2940000
Gross Margin		Kwacha			6560000

Crop :	ONION				
Yield	kg				17000
Price	K/kg				1000
Total Income			Per Ha		17000000
Inputs			Quant	Unit price	Cost
Labour -	Land prep				0
	Planting				0
	Weeding				0
	Irrigating				0
	Pest Control				0
	Harvesting				0
	Grading				0
Seed		kg	4	300000	1200000
Fertilizers	AN	kg	200	2300	460000
	Compound	kg	600	1900	1140000
	Lime				0
	Other				0
Chemicals					
	Dithane	kg	2	45000	90000
	Malathion	kg	1	90000	90000
Miscellan					0
					0
Transport		boxes	680	4000	2720000
					0
Total Costs					5700000
Gross Margin		Kwacha			11300000

Appendix: Climatic data

CLIMATIC RECORD FOR LIVINGSTONE

(Extracted from "The Agricultural Climates of Zambia", Meteorological Department, Lusaka, Zambia). Records date back to 1909

TEMPERATURE

Livingstone has the highest mean annual temperature of 21.7°C in the Southern Province of Zambia, probably with the exception of some stations in the Gwembe Valley which experience much higher temperatures. Frosts do occur at Livingstone although the incidence is not as high as at Choma. The annual temperature range at Livingstone is 10.5°C which is one of the highest in the country. The day-time temperature at Livingstone is 25.8°C and the night-time temperature is 21.6°C. The warmer nights at this location may be favourable for crops such as cotton, but they are less favourable for other crops which thrive under cooler night temperatures. Warm nights lead to greater respiration losses which tend to reduce potential crop yields. Mean monthly evaporation is greatest in October and lowest in June

RELATIVE HUMIDITY

Mean R.H. at Livingstone during December-February is much lower (68%) than at Kafue Polder or Choma. The lowest mean R.H. occurs in September (32%), rising to only 74% in February. The mean yearly humidity of 55% is among the lowest in the country.

SUNSHINE/RADIATION

Livingstone has abundant sunshine; the mean sunshine duration during the main crop growing period is 6.3 hours/day. The proportion of wet season sunshine to the annual total is 34%, which is about 8% higher than at Mwinilunga in the Northwestern Province, for instance. Mean global solar radiation too, is highest in the country. Here, the lowest radiation value is reached not during the rainy season but during the coolest part of the year. Conversely, the radiation peak (559 langleys/day) occurs in January.

RAINFALL

The mean annual rainfall at Livingstone is 763mm, about the same amount received at Sesheke. Raindays (between 1mm and 10mm) are also similar. It is important to bear in mind that Livingstone is a drought-prone area and in low rainfall areas such as parts of Southern Province, the normal amounts of rainfall are small and often do not satisfy the crop water requirements. In such cases small departures from the 'normal' will have an adverse effect on agricultural output. On the other hand in wet areas the normal amounts of rainfall are high such that the drought effect is felt only after a significant drop in the actual rainfall amounts.

Southern Province is blessed with abundant sunshine, radiation and higher day-time temperatures. But one of the unfavourable features of the climate is that rainfall rarely exceeds PET. The lengths of the growing season are short and mid-season dry spells pose a challenge to stable agricultural production. It is worth pointing out here, and even more so for marginal rainfall areas, that farmers realize that since a high proportion of rain falls in heavy showers and storms it is of the greatest importance to ensure that such rains are held where they fall and not allowed to run away down conservation ditches or causing damaging sheet erosion on the fields.

Table 1. Climatological Summary for Livingstone Period: 1950 - 1980 (Lat: 17°49'S Long: 25°49'E Elev: 986m)

Months	Temperature (°C)					Relative Humidity	Sunshine Hours	Solar Radiation	Wind Speed	Evap Totals	Rainfall			Frost Days
	Mean	Mean Max	Abs Max	Mean Min	Abs Min	Mean (%)	Mean	Mean Global (L/day)	Mean (knots)	Mean (mm)	Mean (mm)	Raindays ≥ 1 mm	Raindays ≥ 10 mm	
July	15.9	25.3	31.1	6.4	-1.6	43	9.8	487	4.6	150	0	0	0	2
August	18.9	28.3	35.6	9.1	-1.7	38	10.1	521	5.1	196	0	0	0	0
September	23.5	32.2	38.5	14.3	3.2	32	9.8	555	5.9	251	2	1	0	0
October	26.3	34.1	40.2	18.3	8.2	34	8.9	549	5.7	281	22	3	1	0
November	25.1	31.8	39.0	18.9	12.2	51	7.2	521	5.0	217	81	9	3	0
December	23.8	29.5	38.2	18.1	10.8	58	5.9	501	3.9	162	197	15	7	0
January	23.5	29.2	36.9	18.7	10.5	73	6.4	559	4.3	164	194	15	6	0
February	23.3	29.0	35.6	18.5	11.9	74	6.5	518	4.2	136	159	13	5	0
March	23.1	29.7	35.6	17.3	11.4	69	7.9	514	4.5	164	84	7	2	0
April	22.0	29.7	35.0	14.9	4.4	57	9.0	533	4.3	159	22	3	1	0
May	18.9	27.8	33.6	10.1	1.0	49	9.7	498	3.9	158	2	0	0	0
June	15.8	25.1	31.1	6.6	-3.7	48	9.5	480	4.3	132	0	0	0	2
Season	21.7	29.3	40.3	14.3	-3.7	55	8.4	520	4.6	2170	763	66	25	4
Avail. Years	30	30	30	30	30	30	30	4	30	18	30	30	30	30

Appendix: Smallholder Economic Data for 2003 Season

FARM COSTS, REVENUES AND PROFITS											
Farmer 1	**Farm Size**	**Crop**	**Seed Costs**	**Manure Costs**	**Fertilizer Costs**	**Fungicide Costs**	**Pesticide Costs**	**Labour Costs**	**Transport**	**Total Costs**	**Total Income**
James	1 Ha	Yellow Maize	K80,000.	K40,000	K40,000.	Nil		Family Labour	Own Ox-cart	K160,000	Home use
Sikulwa		White Maize	K65,000.	Nil	K40,000.	"		"	Bicycle	K105,000	K60,000.
		Rape	K50,000.	Dung=Free	Nil	"		"		K50,000	K500,000
		Onion	K50,000.	own		"	K40,000.	"		K90,000	K250,000
		Tomato	K25,000.			"	K40,000.	"		K65,000	K500,000
			/	/	/	"	/	"		/	/
TOTAL			K270,000.	K40,000.	K80,000.		K80,000.	"		K470,000	K1,310,00

FARM COSTS, REVENUES AND PROFITS											
Farmer 2	**Farm Size**	**Crop**	**Seed Costs**	**Manure Costs**	**Fertilizer Costs**	**Fungicide Costs**	**Pesticide Costs**	**Labour Costs**	**Transport**	**Total Costs**	**Total Income**
Chuungwe	3 Acres	Onion	K50,000.	Nil	K70,000	Nil	K70,000	Family Labour	Own Ox-cart	K190,000	K3,500,00
Ng'andu		Tomato	K20,000	own		"		"	Bicycle	K20,000	K200,000
		Rape	K40,000			"	K40,000.	"		K80,000	K1,000,00
		C.cabbage	K5,000			"		"		K5,000	K700,000
						"		"		/	/
			/		/	"	/	"		/	/
TOTAL			k115,000		K70,000		K110,000	"		k295,000	K5,400,00

FARM COSTS, REVENUES AND PROFITS											
Farmer 3	**Farm Size**	**Crop**	**Seed Costs**	**Manure Costs**	**Fertilizer Costs**	**Fungicide Costs**	**Pesticide Costs**	**Labour Costs**	**Transport**	**Total Costs**	**Total Income**
Kachana	1.5 Ha	Rape	K80,000.			Nil	k170,000	Family Labour	k10,000	K260,000	K1,500,00
Mataa		Egg Plants	K35,000	K4,000	K60,000	"	K30,000	"	Bicycle	K129,000	K1,920,00
		Impwa	K15,000	K40,000	K75,000	"	K95,000	"	"	K50,000	K1,500,00
		Spinach	K17,500			"	K97,500	"		K115,000	K500,000
							K30,000			K30,000	
			/	/	/	"	/	"		/	/
TOTAL			K270,000.	K44,000	K80,000.		K80,000.	"	K10,000	K584,000	K5,420,00

Livingstone RRA

Subject: The following data to be collected to obtain information on yield (Note: Crop Yield (kg))

Crop	Price		Farmer 1	Farmer 2	Farmer 3	Farmer 4	Farmer 5	Farmer 6
Maize	K13,000/Kg		50Kgs	/	/			
Onion	K5,000/Kg		50Kgs	700Kgs	/			
Rape	K1,000/Kg		500kgs	1000Kgs	150Kgs			
Tomatoes	K1000/Kg		500Kgs	200Kgs	/			
Egg Plants	K2,000/Kg		/	/	960Kgs			
Impwa	K1,500/Kg		/	/	1000Kgs			
Spinach	K500/Kg		/	/	100Kgs			
C.cabbage	K100/Kg		/	700Kgs				