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A Study on Developing the Supply Chain for a High Value Crop: Cultivation of Lemon Grass in Patna, (Bihar) India

Krishna M. Singh and Burton E. Swanson¹

ABSTRACT

This case study explains the steps taken by the Agricultural Technology Management Agency (ATMA) in the Patna District of Bihar India to help very poor farmers link up with reliable markets to produce and market high-value medicinal and aromatic crops. The lead crop, which is the focus of this case study, is Lemongrass a aromatic crop. The farmers in the study area were extremely poor and faced many constraints in attempting to increase their farm income, such as poor infrastructure, unscrupulous middlemen and the absence of reliable markets for their crops.

The ATMA was instrumental in helping these farmers get organized and in learning how to produce, extract essential oil from the herb and market lemongrass oil along with other medicinal and aromatic crops to buyers' specifications. In addition, the ATMA played a central role in coordinating and mobilizing the expertise of other organizations, including scientists from universities and research organizations, private sector firms, banks and non-governmental organizations (NGOs) to develop and test the production technologies, to train the farmers and farm leaders, to arrange for the needed inputs and so forth.

As a result of these extension activities, the participating farm families substantially increased their farm income, which improved their rural livelihoods through better nutrition and expanded schooling for their children, especially girls; in addition, rural employment was generated due to the need for post-harvest handling and processing of these crops. Therefore, this case study is a step-by-step explanation of how ATMA helped farmers to overcome these constraints and how the supply chains for Lemongrass and other medicinal crops were established in the Patna District of Bihar, India.

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BACKGROUND

Introduction

The use of herbal, medicinal and aromatic plants (HMAPs) is older than recorded history and in most of the countries of South Asia; these plants play a significant role in the subsistence economy of the people, especially those living in the rural interiors. The collection, simple processing and trading of HMAPS contribute significantly to the cash income of the small and marginal farmers of these regions. Therefore, by sustainably using and growing economically remunerative HMAPs, there is an ample scope to maintain both the rural livelihoods and environmental sustainability.

Present Study

The present case study reflects process adopted for popularizing the cultivation of Lemongrass, an aromatic crop in the state of Bihar, through adoption of the market-oriented production of aromatic crops in order to increase the earning potential of the farmers. It has been tried to explain the establishment of the supply chain and its management with reference to aromatic plants in general and lemongrass in particular and its impact on the farmer's economy along with problems and constraints faced in developing the system and solutions arrived at.

ATMA: the Lead Agency that is Helping to Link Producers to New Markets

The Agricultural Technology Management Agency (ATMA) concept was pilot tested through a World Bank-financed National Agricultural Technology Project (NATP) during 1998–2005 and further through Government of India programme "Support to State Extension Programmes for Extension Reforms". ATMA established in the Patna District of Bihar became the lead agency that orchestrated and facilitated a series of development activities resulting in a sustainable supply chain being established for selected HMAPS in that district. Given the wide range of similar successes and impacts on farm income and rural employment achieved by the ATMA approach in other districts, the Government of India (GOI) is currently extending this model and approach to all districts (nearly 600) in the country. A diagram representing of ATMA model is presented in Annex-I

THE LEMON GRASS CASE STUDY

Lemongrass cultivation due to its many advantages has come as boon for the farmers of Patna district in particular and Bihar state in general; some of them are as follows:

- They can be grown even on less fertile and marginal lands.
- They resist drought and can grow successfully where no other crop generally grows provided, some care is taken by the farmers in terms of providing life saving irrigation.
- There is little damage to the crop from animals and insect-pest, as they normally keep away from it due to its bitter taste.

- Attractive economic returns with little risk on the part of the growers.
- Selling the Lemon grass oil is not a problem because of its ever increasing demand and a large number of buyers.

The main constituent of lemongrass oil is citral, which makes up around 80% of the total; and minor constituents are: linalool, geraniol, citronellol, nerol, 1.8 cineol, linalyl acetate etc. Lemon grass contains an essential oil which is sherry colored with a pungent taste and lemon-like odour. The perfume industry has found that Lemongrass oil can give almost the same effect in blends as more expensive scents such as Verbena and Melissa, therefore making the price of the product less expensive.

The plants need a warm, humid climate in full sun. They grow well in sandy and sandy loam soils with adequate drainage. Since the plants rarely flower or set seed, propagation is by root or plant division popularly known as 'slips'. The plants are harvested by hand about four to six times each year depending on the growth of the herb, with the productive populations lasting between four and seven years in the state of Bihar.

Extensive breeding programs by different research institutions like Central Institute for Medicinal and Aromatic Plants (CIMAP), Lucknow, India, and Regional Research Laboratory (RRL), Jammu, India have developed many varieties of lemongrass, like Krishna, CKP 25, Pragati, and Pramaan. Amongst them Krishna and CKP 25 varieties have been found most suitable for cultivation in Bihar plains.

The slips are transplanted at a distance of 30 x 45 cm spacing during the months of June/ July after the onset of monsoons in the state which saves the farmers from immediately irrigating the crop. It has been found that, using 20 tonnes FYM per hectare before planting of crop gives very good results. Although these organic inputs are not enough to result in production that is comparable to the production after use of chemical inputs, but the use of these organic inputs are saving the expenses and resulting in best quality of Lemon grass oil. The production technology was obtained from Fragrance and Flavour Development Centre, Kannauj and refined at the local Krishi Vigyan Kendra (Farm Science Centre) at Agwanpur, Barh, Patna through On-farm testing of the crop.

The Setting: Patna District in Bihar India

Prior to the introduction of ATMA in the Patna district of Bihar, the primary cash crop was sugarcane. However, sugarcane production was declining in and around Patna due to falling prices. In addition to sugarcane, farmers were using traditional cropping technologies to grow other cereals, vegetables, oil seeds, and pulses, primarily for self consumption. Farmers who produced traditional crops like wheat, paddy, maize, potatoes and onions for sale were dissatisfied since production expenses were increasing but revenues remained constant or were declining due to falling prices as a result of expanding production across the country.

Most of the production by small-farm households was either consumed or allocated to money lenders to repay debt, further exacerbating the economic condition of the rural poor. Because farmers had little to spare in the form of marketable surplus, it was very difficult to introduce any new cropping systems. To help farmers escape this vicious debt trap, the ATMA pursued

a strategy that would help farmers diversify into higher-value commodities and products. Three criteria were used to evaluate alternative crops and products within the district:

1. There had to be a continuing market demand for the crop or product.
2. The crop must be well suited to the existing agro-climatic conditions. And,
3. The production technology to be used must be relatively low-cost to reduce the farmer's risk.

In other words, each ATMA is expected to pursue a ***market-driven, farmer-centered and environmentally friendly approach to agricultural diversification***.

The following case study outlines the steps followed by the ATMA in the Patna District to first assess and then develop a financially sustainable supply chain for the production and post-harvesting handling of Lemon Grass and other HMAPs by groups of farmers in the district. These steps are outlined in Figure 1 at the end of this case study. It should be noted that many of these activities need to be carried out more or less at the same time; therefore, there needs to be a good coordination across the different organizations that are providing services to the farmer groups.

Getting Started: Conducting a PRA to Assess Local Conditions and Potential Markets

In order to identify what marketable crops might successfully be introduced into the study area, local conditions were assessed using various Participatory Rural Appraisal (PRA) techniques. Because of national and international demand and the new laws passed by the Government of India making it compulsory for companies to meet their raw material requirements through cultivated sources, the cultivation of medicinal and aromatic plants quickly emerged as one of the most viable options.

During this PRA exercise, more than 40 species of HMAPs were found growing wild in Patna District, some carrying a very high market value. However, most farmers were unaware of the commercial importance of these crops, making it necessary to conduct extension activities, such as exposure visits, to create farmer awareness about these potential economic opportunities. In addition, farmers were informed both about the need to conserve the biodiversity of these plants as well as the growing demand for some HMAPs by Cosmetic and pharmaceutical companies. In the process, farmers were informed about the economic importance of these crops as a viable alternative to the traditional food crops being produced in the district.

As a result of these extension activities, farmers soon became receptive to the idea of cultivating HMAPs. Finally, after discussion among the research and extension workers that jointly carried out the PRA, it was agreed that even small and marginal farmers could successfully engage in cultivation of these crops. As a result of this assessment, the decision was taken by the ATMA Management Committee and Governing Board to give priority to the development of HMAPs within the Strategic Research and Extension Plan (SREP) for the district. Therefore, the next step would be to identify those HMAPs that have a strong market demand and that can be profitably grown by small-scale farmers in the district with minimal risk. The ATMA began by assessing the production potential of Lemon grass cultivation in the

district while, at the same time, beginning to organize farmers into Farmers Interest Groups or FIGs.

Organizing Producers into Farmer Interest Groups and Farmer Associations

Given the need to scale-up for the production of different high-value crops or products, the ATMA began almost immediately after being established to begin organizing producer groups. Organizing these groups was challenge due to different social and economic issues. Since Indian society is highly fragmented along caste, religious and economic lines (including size of land holdings), it is difficult to bring all of these different social and economic groups together into one organization to carry out a common economic activity. Therefore, the strategy adopted was to organize these FIGs around people from similar social and economic backgrounds and who shared similar goals and objectives. The typical (village-level) FIG had between 10 and 15 farmers. In addition, those village-level FIGs that share a common interest, such as the production and marketing of HMAPs, would generally organize into a block-level Farmer Association (FA) and these FAs, in turn, would eventually become federated at the district level into Farm Federations (FFs).

The key in setting up these producer groups at the village, block and district level was to create the framework that could produce a substantial quantity of HMAPs on a sustainable basis, thus making it economically viable for the company to continuing sourcing the material from the same groups of farmers. In addition, a substantial farmer base that could be mobilized to produce specific crops to specification would be highly beneficial in negotiating future contracts and in securing good financial returns for its members. It was assumed from the outset that even small and marginal farmers could participate in cultivation of HMAPs if they followed the group approach.

Assessing the Market Demand for Specific HMAPs

In order to successfully produce Lemon grass in the district, it was necessary to identify those crops where there was a stable and growing market for the product. The identification of potential markets proved to be a difficult task, since most cosmetic and pharmaceutical companies engage in an inefficient, secretive and somewhat opportunistic process of sourcing HMAPs. As a result, the trade in HMAPs has been largely unregulated and carried out through a plethora of small-scale traders. To find genuine buyers and to determine the demand for these crops, several public agencies working in this field were contacted. In addition, the Internet was used to identify companies who are manufacturing products based on Lemon grass oil and its various derivatives. However, the initial interaction with most buyers did not prove to be encouraging, since most merchants were not interested in entering into a long-term contract, and the amount of raw materials needed depended on market demand for their products.

Next, a more systematic and intensive effort was undertaken by the ATMA to investigate the market demand for specific HMAPs Lemon grass in the present case. Therefore, all known companies working in the aromatic crops sector were contacted through e-mail, telephone and personal meetings in an attempt to identify their requirements for Lemon grass oil. Since the majority of companies and buyers were located elsewhere in the country, they were not eager to enter into any type of formal agreement with an unknown group of

producers. However, the operating assumption of the ATMA staff was that a firm commitment from one or more buyers was essential if they were going to be successful in recruiting farmers to produce non-traditional crops for which they had no other use. Therefore, securing a credible market was considered essential to the success of this activity.

After a number of unsuccessful attempts to identify manufacturing firms that might be interested, the strategy shifted to finding local buyers. In addition, the decision was taken by the ATMA to avoid involving middlemen in any negotiations between the manufacturing firm and the farmers. Of the companies that were short-listed in Bihar, two companies were found to be receptive to the idea of forming a partnership between the growers and the company. The firm identified was: M/s. Vijay Herbs & Natural Essential Oils, Bhopal, M.P. and a successful supply chains was established with this firm.

Assessing the Potential for Producing Lemon grass in Patna District, Bihar

The ATMA, working in close collaboration with the local KVK (Farm Science Center), was able to establish that the cultivation of Lemon grass for extraction of essential oil was especially well suited for small-scale farmers in Patna district due to the following reasons/advantages:

1. It can be grown on less fertile, marginal lands.
2. It is drought-resistant and can successfully grow where no other crop generally grows.
3. There is little crop damage from animals as they avoid this crop due to its bitter taste.
4. After conducting field trials, it was determined that this crop can provide attractive economic returns, with little risk, to producers.

Assessing the Market Demand for Lemon grass oil

At the same time that the ATMA was investigating the technical feasibility of producing Lemon grass in the district, it was also entering into discussion with a potential buyer for this crop. The first company to enter into a formal contract with producer groups to produce Lemon grass was M/s. Vijay Herbs & Essential Oils Ltd., Bhopal. This firm had recently established a fractional distillation facility in the state of Madhya Pradesh, with a subsidiary office situated in Patna. Given the ATMA's initial inquires about the firm's Lemon grass oil requirements, the firm's managing director contacted the ATMA Project Director to explore the potential of procuring specific raw materials. This firm was very interested in working out an agreement with farmers in the district, as the company's new export order required having access to large quantities of Lemon grass oil.

The leaders of ten, newly-established Farmers Interest Groups (FIGs) interested in cultivation of Lemon grass and who had the capacity to setup distillation facilities, were invited for an open discussion with the Managing Director of this company in the presence of the ATMA leadership. The purpose of these meetings was to address any questions these FIG leaders might have and to discuss the FIGs' concerns regarding the production technology, the suitability of the crop, production costs and/or the post-harvesting handling and marketing of the HMAPs. The FIG members were shown a draft of the agreement and asked for their input. In this case, any remaining doubts that the FIG leaders might have had were removed by the managing director and a contract was signed, with the ATMA director becoming the facilitator for both the FIGs and the company. The pricing was based on a six-month average market

price for the material in the Delhi market. This was done in a very fair and transparent manner so that the FIG members did not have any doubts regarding the price (i.e., to minimize the price uncertainty from the producer's point of view). Since the company has shown its inclination to enter into a 5-year contract with the producers, any uncertainty in the minds of the FIG members was removed.

Training FIG members to Produce and Handle Lemon Grass

Training the interested members from the first five FIGs was carried out by a team of experts, including: scientists from Agricultural Universities; Central Institute for Medicinal and Aromatic Plants (CIMAP), Lucknow; Fragrance and Flavour Development Center (FFDC), Kannauj; and the Center for the Entrepreneurship Development (CEDMAP), Bhopal. The local Krishi Vigyan Kendra (KVK or Farm Science Center) in Patna District was the other key organization in this process, since they were carrying out field research on the production technologies that appeared most suitable for the district. The KVK became a key demonstration and training site for future groups of farmers who were trained in the technologies of producing and handling these different HMAPs.

Technical publications were prepared in the local language that explained cultivation practices using organic methods. These extension materials enhanced farmer learning and were carefully written to explain the economics of producing and marketing HMAPs. To augment capacity building among each FIG, an effort was made to select farmers who were more responsive to adopting new cultivation techniques. These selected farmers then acted as resource persons within each FIG to provide technical support to the other members. Finally, inputs such as seeds, organic manures and organic plant protection measures were obtained through ATMA on a cost sharing basis. The planting material (slips) were procured and made available from CIMAP, Lucknow on actual cost basis.

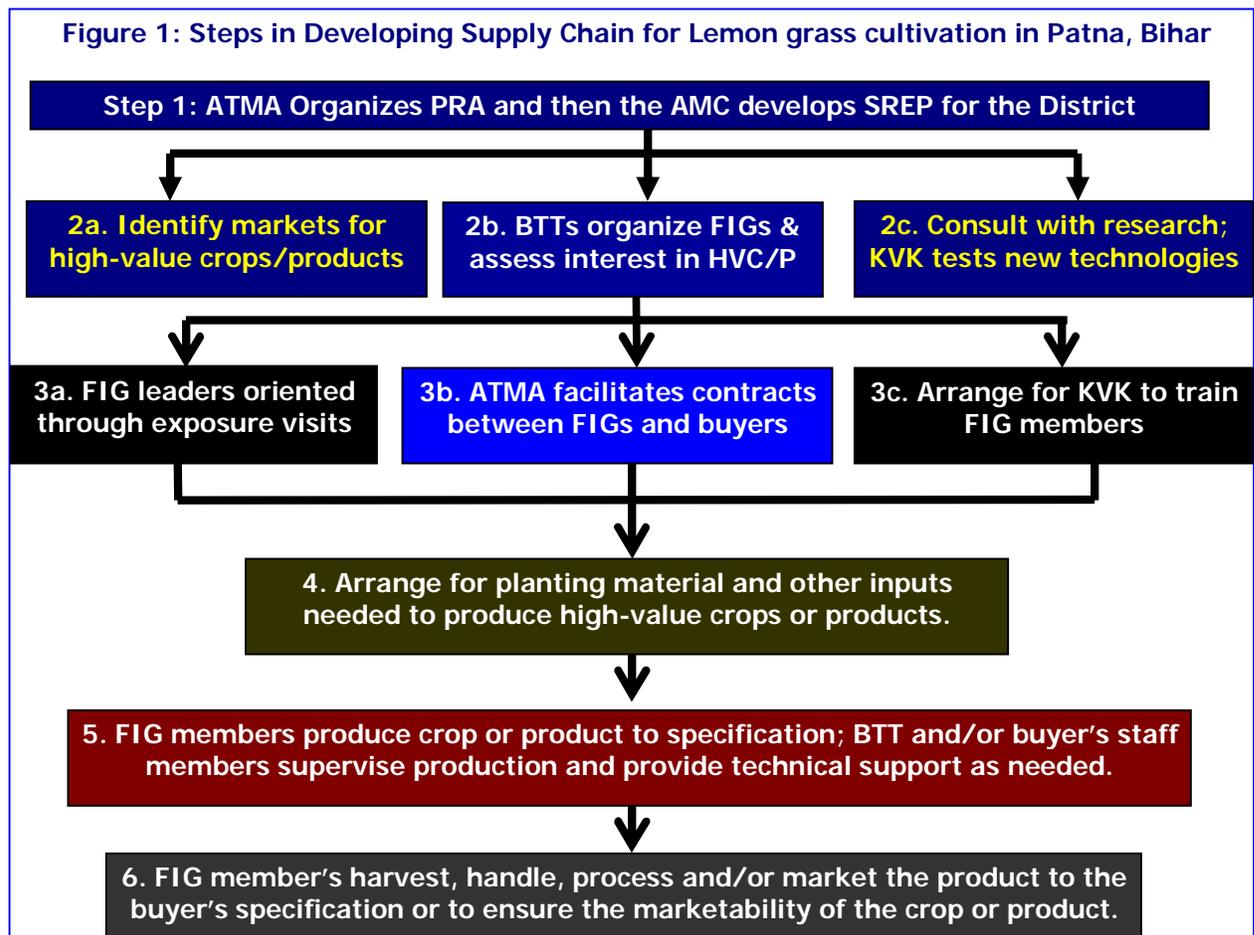
Facilitating the Production, Processing and Post-Harvest Handling of Lemon grass

The production of the first Lemon grass crops was carefully monitored by both ATMA and company representatives. The Central IPM Center also worked with the FIGs to ensure an organically-grown crop. Visits by the representatives from the purchasing company were also organized periodically. Distillation plants for extraction of oil of Lemon grass from its leaves were sourced from M/s. Swaraj Herbals Ltd, Barabanki, U.P. an ISO 9001 company, after getting the desired technical inputs from the scientists from CIMAP, Lucknow.

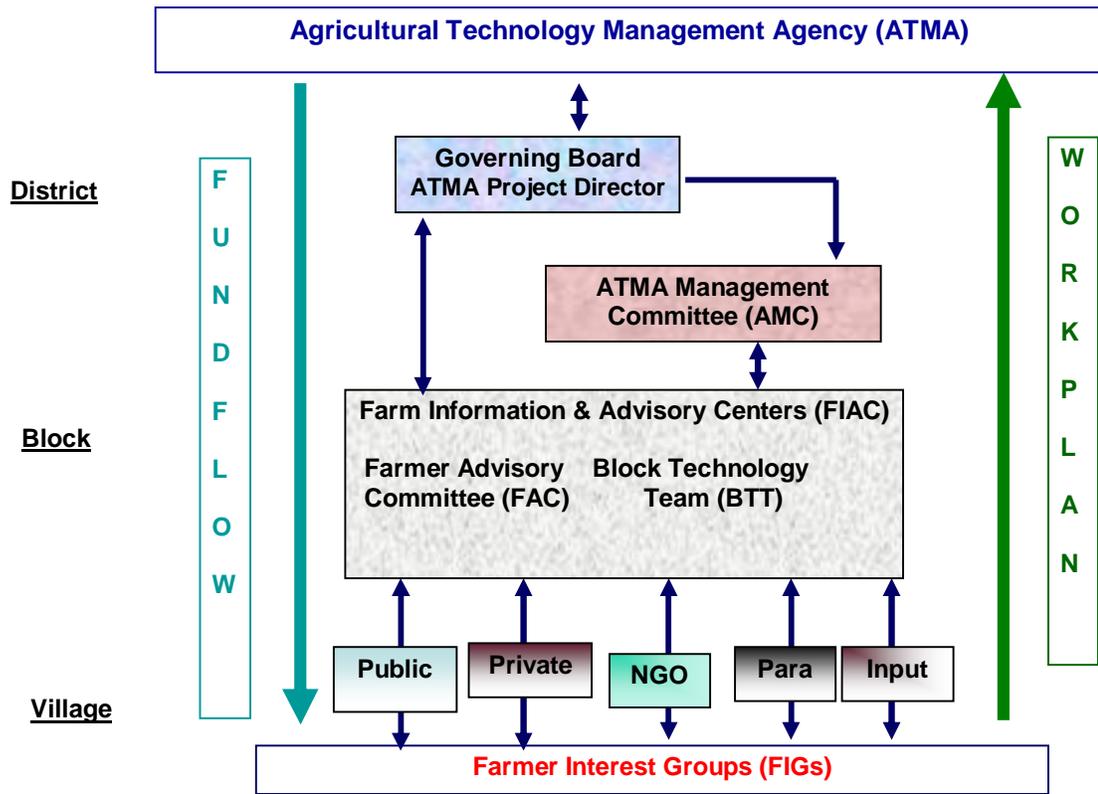
After harvest, the crop was shade-dried four to five hours, and then cut into small pieces and packed for distillation in the low cost Field Distillation Units for extraction of oil. This process required 6-8 hours for each batch. Quality tests were performed on the oil samples taken from each lot by the company. The purchase price was Rs. 300 per Kilograms which was paid to the FIGs after obtaining satisfactory test results about the Citral content which had to have a minimum of 70 percent Citral content. Representatives from ATMA were present at each stage of this process to ensure that the terms of the contract were carefully adhered to by both the FIGs and the company.

The Result: Farmers Quickly Respond to New Market Opportunities

When this activity was launched in 2000, there were ten Farmer Interest Groups (FIGs) with a combined membership of about 130 farmers who began with the cultivation of lemon grass in Patna district. Within one year, 10 more FIGs had organized and were interested in participating in this new crop. By April 2005, the ATMA had established a network of 50 FIGs who were pursuing lemon grass cultivation. The number of new members and FIGs in this network is expected to increase rapidly as more and more farmers become interested in cultivation of lemon grass and other aromatic plants. At the state level, there is already a Farmer Association that is promoting cultivation of Aromatic plants as a means to increase farm income and to enhance rural livelihoods. To document the profitability of Lemon grass, a cost-benefit analysis for this crop is included in Annex II.



Organizational Structure of ATMA



Economics of Lemon Grass Cultivation:

Lemongrass Variety	Krishna and CKP 25
Spacing in mts.	0.30 x0.45
No of Plants per Acre	22,000 slips (Approx.)
Type of plant Material	Slips

Cost Involved in Infrastructure Development (Fixed Costs):

1	Distillation unit with platform and overhead shed	Rs. 70,000/-
3	Shallows Tube Well and Pump set	Rs. 31,000/-
4	Store room	Rs. 20,000/-
5	Total	Rs. 1,21,000/-

Cultivation costs for Lemon grass cultivation (per Acre.)

Cost (Rs. per acre)	I Year	II Year	III Year	IV Year	V Year	VI Year	Total cost of cultivation
Land Preparation	3500						3500
Plant material (30000 slips @ Rs.2.20 per slip from CIMAP, Lucknow) (with a mortality rate of 25%)	66000						66000
Transportation of planting material from FFDC, Kannauj	5000						5000
Transplanting of slips	3000						3000
Cost of FYM and fertilizers	2500						2500
Irrigation (15 nos @ Rs. 300/- per irrigation)	4500	4500	4500	4500	4500	4500	27000
Plant Protection measure	500	500	500	500	500	500	2500
Intercultural operations	1500	500	500	500	500	500	4000
Harvesting, loading, Distillation and Marketing	7000	9000	9000	9000	9000	9000	52000
Total cost of cultivation (Variable cost)	93500	14500	14500	14500	14500	14500	166000
Total fixed cost	121000						121000
Total Cost							287000

Exchange rate USD 1= Rs. 50.00

Yield and Production Parameters

Particulars	I Year	II Year	III Year	IV Year	V Year	VI Year
Minimum Yield level of oil in kg.	60	80	125	125	125	125
Return from sale of oil (In Rupees)	18000	24000	37500	37500	37500	37500
Maximum Yield level of oil in kg.	80	150	180	180	180	150
Return from sale of oil (In Rupees)	24000	45000	54000	54000	54000	45000
Sale of slips (no.)	5000	25000	25000	25000	25000	50000
Return from sale of slips sold @ Rs. 1.00 per slip (In Rs.)	5000	25000	25000	25000	25000	50000
Av. Gross returns (In Rs.)	26000	59500	70750	70750	70750	91250
Lemon grass Farm gate sale price (Rs/Kg.).						Rs. 300.00
Maintenance Cost (2 nd year onwards)						Rs.14500.00
Economics life: in Years						6

Financial Analysis *

Items	I Year	II Year	III Year	IV Year	V Year	VI Year
Expenditure	214500	14500	14500	14500	14500	14500
Income	26000	59500	70750	70750	70750	91250
Net Income	(-)188500	45000	56250	56250	56250	76750
D.F.@ 15%	0.87	0.756	0.658	0.572	0.497	0.432
Discounted Cost	186615	10962	9541	8294	7206.50	6264
Discounted Benefits	(-)22620	44982	46553.50	40469	35162.75	39420
Net present worth	(-)163995	34020	37012.50	32175	27956.25	33156
N.P.V						324.75
B.C.R						1.00198

*Cost and Returns Rs./Acre

NPV= Σ (Discounted benefit stream) - Σ (Discounted cost stream)

B C Ratio= Σ (Discounted benefit stream)/ Σ (Discounted cost stream)