Report to the National Commission on Farmers

STRATEGIES FOR EMPLOYMENT GENERATION IN AGRICULTURE

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The Mothers Service Society
No. 5, First Cross Ext., Venkata Nagar
Pondicherry 605 011

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EXECUTIVE SUMMARY

The unprecedented commitment of the present Government of India to seriously address the need for employment generation is a propitious opportunity to implement strategies for generating full employment in the country. This report, which builds upon work done by the International Commission on Peace & Food in the early 1990s, confirms the potential to generate sufficient employment opportunities for all new entrants to the workforce as well as to absorb the current numbers of unemployed and underemployed. It includes strategies and policy recommendations designed to maximize the effectiveness of the Government's recently proposed initiatives for employment generation and rural prosperity. Implementation of these recommendations will be sufficient to generate 100 million additional employment and self-employment opportunities.

While many formal studies have been prepared to assess the growth and employment potential in India' formal private sector, less attention has been given to the conditions and strategies to promote rapid expansion and job creation in the rural and informal sectors. *This report focuses on strategies to increase employment opportunities in India's informal sector, with emphasis on agriculture, agro-industry, rural services and related vocations.* The report consists of three parts: an overview of employment in India, a business plan containing specific recommendations for implementation, and a detailed discussion of employment opportunities and strategies in agriculture.

The major findings and recommendations can be summarized as follows:

1. The Indian economy is already generating approximately seven million employment and self-employment opportunities per annum, almost all of them in the informal sector, but in there is a serious lack of accurate information on the types and numbers of these jobs. The most effective strategy for employment generation will be to provide the missing links and policy measures needed to accelerate this natural process of employment generation.

2. There is enormous scope for raising the productivity of Indian agriculture, doubling crop yields and farm incomes, and generating significant growth in demand for farm labour. The report present evidence to demonstrate that improving plant nutrition through micronutrient analysis and improving irrigation through deep chiselling of soil can result in a tripling of crop yields.

3. Rising rural incomes consequent to higher productivity will unleash a multiplier effect, increasing demand for farm and non-farm products and services, thereby stimulating rapid growth of employment opportunities in other sectors.

4. Indian agriculture is constrained by weak linkages between agricultural training and extension, crop production, credit, processing, marketing, and insurance. The report presents an integrated strategy for bringing together all these elements in a synergistic manner by

    a. Establishment of village-based Farm Schools to demonstrate and impart advanced technology to farmers on their own lands.

    b. Establishment of a network of sophisticated soil test laboratories capable of high volume precision analysis of 13 essential plant nutrients coupled with development of

c. Establishment of Rural Information Centres to act as a medium for transmission of soil test data and recommended practices, access to current input and market prices, and other essential information for upgrading agriculture.

d. Policy and legal measures to encourage contract farming arrangements between agri-business firms and self-help groups in order to increase small farmers' access to advanced technology, quality inputs, bank credit, processing, marketing and crop insurance.

e. Measures to strengthen farm credit and insurance programmes, including creation of linkages between crop insurance, crop loans, and farm school training to encourage farmers who seek credit and crop insurance to adopt improved cultivation practices.

5. In order to ensure ready markets for the crops that are produced, the report focuses on the potential for linking crop production with huge untapped markets and specific agro-industries, including energy plantations to fuel biomass power plants, bio-diesel from jathropa, ethanol from sugarcane and sugar-beet, edible oil from Paradise Tree, horticulture crops and cotton.

6. The report argues that the India labour force suffers from a severe shortage of employable skills at all levels and that intensive development of vocational skills will act as a powerful stimulus for employment and self-employment generation. In addition to Farm Schools to impart advanced skills in production agriculture, the report recommends establishing a network of government-certified, rural vocational institutes providing training and certification in hundreds of vocational skills not covered by the ITIs. In order to offset the shortage of qualified trainers and the costs of replicating institutions throughout the country, the report advocates creation of a national network of 'Job Shops' linked to the Rural Information Centres and offering televised multimedia training programmes and computerized vocational training programmes.

7. The report recommends that the National Commission on Farmers arrange for employment surveys to provide accurate information on the growing demand for different occupational categories, the natural rate of employment generation by category and skill level, and other issues required to promote full employment in the country.

PART I – OVERVIEW OF EMPLOYMENT IN INDIA

1. Profile of the Indian Workforce

- *Workforce:* Although accurate measures of employment and unemployment are difficult in India's largely informal economy, the current labour force consists of approximately 400 million men and women.

- *Growth in Labour Force:* It is estimated that the work force is currently growing by 7 million persons per year.

- *Sector-wise:* Of these, about 56% are engaged in agriculture as their primary occupation which is down from 65% in the early 1990s. Another 13% are engaged in manufacturing and the balance are employed in the service sector, which has grown from 25% to 32% of total employment over the past two decades.

- *Organized vs. Unorganized:* The organized sector provides less than 8% of the total jobs, about 3% in private firms and 5% in the public sector. The informal/unorganized sector is provides the other 92%.

- *Skills:* Only 6-8% of India's workforce has received formal training in vocational skills, compared with 60% or more in developed and most rapidly developing countries.

- *Unemployment:* Depending on the survey measure applied, unemployment is estimated to range between 25 and 35 million. Youth unemployment is 13%, but reaches a high of 35% in Kerala. Unemployment as a percentage of the workforce fell in the 1980s and rose slightly in the 1990s. Authoritative published data was not available to indicate trends after 2001-2.

- *Migration:* According to sample survey estimates, approximately 27% of India's population are migrants, including those who move from one rural or urban area to another or between rural and urban areas. Approximately 57% of urban male migration is for seeking better employment opportunities. The net migration from rural to urban areas is approximately 2 million per annum, of which about 1 million may be job seekers.

2. Observations about Employment in India

Several significant conclusions can be drawn from this summary data:

1. *High rate of 'natural' employment generation:* In spite of a large influx of youth into the workforce, unemployment is not rising dramatically. This indicates that the Indian economy is generating a very large number of additional employment opportunities by natural processes that are not well documented or understood. An understanding of these processes is will assist the formulation of effective strategies to accelerate employment generation and eliminate the remainder of unemployment and underemployment in the economy. *If the unconscious process of employment generation can achieve this much, surely a conscious understanding and application can accomplish far higher rates of job growth.*

2. *Urban employment:* Since high rates of urban unemployment would almost invariably lead to rising discontent and violence, the relative stability of India's urban environment suggests that the urban economy is generating sufficient employment opportunities to absorb most new entrants and migrants from rural areas.

3. *Mismatch between Education & Employment:* While the number of employment opportunities is rising more or less as required to keep pace with the growth of the workforce, the type and

4. *Gap in Occupational Skills:* At the other end of the labour spectrum, it is increasingly difficult to obtain workers with basic skills in carpentry, masonry, electricals, mechanics, and many other trades. Although India operates a large vocational training system, it provides training to less than 2 million persons annually, which is grossly insufficient to impart skills to the 7 million new job entrants as well as the huge number of current unskilled workers. Absence of reliable information on the actual growth in employment by specific occupational categories makes it difficult to determine either the number of jobs being created in each field or the unsatisfied demand for various types of skills.

5. *Casualization of the workforce:* Evidence of an increase in casual and migratory employment reflects a deterioration in the quality of jobs in rural areas as well as rising expectations of the workforce that impels increasing numbers to abandon traditional occupations in search of better employment opportunities.

6. *Agricultural Employment:* While the percentage of the workforce employed in agriculture is declining, total employment in this sector continues to rise, though at significantly slower rates than in the past.[1] A reduction in the proportion of the population employed in the primary sector is a natural and inevitable trend that is spurred by rising expectations and changing attitudes as much as by rising levels of farm productivity and mechanization. However, this does not mean that the potential for employment in this sector is being fully exploited. The findings of this report indicate that in the short term, strategic initiatives to modernize and diversify Indian agriculture can generate employment opportunities for very large numbers of people, thereby providing time for the more gradual expansion of employment potentials in other sectors.

7. *Surging Service Sector:* The traditional path of economic development was a progression from agriculture to manufacturing to services. India's recent success in IT and IT-enabled services is only one indication that this formula need not necessarily apply in the context of today's global economy where the demand for services internationally can rapidly expand employment opportunities domestically. In addition, changing social expectations within the country are stimulating rapid growth in demand for services that become prevalent in advanced industrial countries at a much later stage in their development, as indicated by the proliferation of courier companies, Xerox shops, Internet cafes, fast food restaurants and retail boutiques. The rampant clamour for education at all levels, surging demand for health care services, telecommunications, media, entertainment, and financial services are other expressions of this phenomenon. The publication of six English dailies and six Kannada dailies in the city of Bangalore is only one reflection of this wider trend. Research is required to more carefully document growth of the service sector, particularly its informal portion, to assess the potential demand and most effective strategies for accelerating growth of employment. *These trends suggest that rural India has the opportunity to leapfrog over the traditional path to development, moving directly from agriculture into services.*

3. Theoretical Basis for Full Employment

The International Commission on Peace and Food, in its report entitled *Uncommon Opportunities: Agenda for Peace & Equitable Development,* examined the process of employment generation in society and concluded that full employment was a realistic and achievable goal for all countries in the foreseeable future. It observed that efforts to achieve full employment are constrained by a vague sense of helplessness or inevitability based on the erroneous perception that the number of

employment opportunities generated in society is determined by forces that are either beyond the control of government and public initiative or too complex, costly and difficult to manage without severe adverse affects on the economy. Therefore, it may be useful to examine some of the major factors that presently limit the creation of new employment opportunities and the practical scope for action at these specific points.

Economically, employment generation is determined by how fully and productively society utilizes the material, technological, organizational and human resources at its disposal. The more productive the society is, the greater the quality and efficiency with which it produces goods and services, the greater the demand for those goods and services in the marketplace, the more employment opportunities and purchasing power created. This increased purchasing power then acts as an additional stimulus to the creation of new demand and employment opportunities.

Although early economists perceived that resources were limited, we now know that the potential for enhancing the productivity of resources is not. The Commission's report points out that the productivity of resources is the result of human resourcefulness. Since no society can or does fully exhaust its potentials for enhancing social productivity, the potential for employment generation is unlimited. Land, water and minerals may be limited, but the scope for increasing their productivity is not. Land is limited in India, but the scope for raising farm yields is not.

If this is the case for purely material resources, how much more true is it of technology, organization, knowledge, skill and other less tangible society resources? The enhancement in computer performance over the past 35 years according to Moore's Law is only one dramatic instance of a general truth about technological productivity in all fields. While the power of computers keeps increasing, the cost of producing them keeps falling because of technological developments that reduce their size, material consumption and labour inputs.

Technology alone does not result in human development. The application of technology through innovative social organizations has been the chief cause for the phenomenal gains of the past century. It was not the invention of the automobile but rather the innovation of a new organization of mass production by assembly line that enabled Henry Ford to transform the car from a luxury of the idle rich into a necessity for middle and working class families. It was not the invention of the computer, but the innovation of a new organization for electronic exchange of information in a standardized format that converted the Internet from the medium of academics and military planners into the most powerful communication tool in history and led to the emergence of the World Wide Web as a global library and global marketplace. India's dairy cooperatives, micro-finance self-help groups, STD booths, export processing zones, technology parks, and private computer training centres are all examples of organizational innovations that have stimulate development and create jobs.

What is true of technological and organizational resources is even more true for other social and human resources. Information is a resource that improves the quality of decision-making and makes possible the tapping of new opportunities. The quantity, quality and speed of all types of information exchange is multiplying exponentially. Through the enhancement of skills, knowledge and attitudes, the productivity of the human resource is growing by leaps and bounds. The USA, which awarded only a single PhD in 1880, now awards for than 35,000 annually. India produces more software engineers than the USA. Tamil Nadu, which had less than a dozen engineering colleges in 1980, has more than 200 today. Five lakh Indians are taking software training courses every year. Tens of thousands of four and five year old Indian children are surfing the internet or playing chess like future grandmasters. At the same time 45 per cent of the Indian population is still illitreate, only 60 per cent of 11-14 year olds are enrolled in school, two-thirds of children drop out before completing 10^{th} Standard, and only five per cent of the workforce in the 20-24 age category have undergone formal vocational training, compared to 28 per cent in Mexico and 96 per cent in Korea. There is enormous scope for enhancing the knowledge and skills of India's workforce.

If the technological, organization and human potentials are unlimited, what is it that determines the actual extent to which a society develops these potentials? It is the awakening of the society.

Socially, employment generation is determined by the aspirations of people, by rising expectations, by the urge to achieve and enjoy more. The higher the aspirations of society that actively yearn for fulfilment, the greater the energy and activity of the society and the greater the potential for employment generation. Government does not create jobs. No government can create and sustain full employment primarily by means of programmes. What government can and should do is to help awaken the people to the opportunities for higher accomplishment and to formulate policies and programmes that will help to release the initiative and support the efforts of the population for its own upliftment.

4. Social Factors Responsible for Employment Generation

Society progresses by the development of new activities and their gradual integration with all other existing strands of the social fabric. Therefore, employment generation is not so much a question of finding out where to engage people in work, as it is how to stimulate the natural growth of the factors that result in job creation. These factors are innumerable and their interactions are very complex. They include, for example,

- New products – motor vehicles, cell phones, cut flowers, designer clothes
- New services – Xerox, courier, yellow pages, Internet cafes, credit cards, neighborhood newspapers, various insurance products
- Growth in domestic demand – energy, motorcycles, cars, tourism, pharma, health care, insurance, financial services
- Growth in export demand – textiles, software, automotive components, mangoes, grapes, fish
- Technological innovation – Internet, mobile phones
- Higher quality &/or productivity – automotive and farm exports
- Organizational innovation – STD booths, World Wide Web, Internet cafe
- Higher skills – software, BPO, journalism, sales & marketing
- Better access to information – Internet job sites, E-choupals
- Increased speed – money flows, transport, communication, decision-making
- Legislation & law enforcement – e.g. safety and environmental regulations
- Administrative responsiveness – speed, transparency, less red-tape
- Environment/health consciousness – bottled water, recycling, organic foods
- Change of attitudes – regarding consumption, investment, entrepreneurship

5. Approaches to Accelerate Employment Generation

There are three broad approaches can be adopted to stimulate greater employment generation:

1) Expand existing activities: Introduce measures to stimulate more rapid proliferation of existing activities that are already growing rapidly, such as nursery schools, tutorial institutes, English language teaching, etc.

2) Adopt activities prevalent in other countries which have not yet come to India: Examples of new activities that have recently been adopted by India include credit rating agencies for businesses and individuals, collection agencies, trade shows, network marketing, health clinics, etc.

3) Promote culturally compatible activities based on Indian environment: Examples include mini-power plants, rural information centres, contract farming agencies, STD booths, chit funds, marriage halls, etc.

Several different modes of action can be adopted to stimulate these activities:

- Increase access to credit
- Provide incentives for new initiatives
- Strengthen or enforce legislation
- Impart training
- Use insurance as a stimulus

- Publicize opportunities in the media

The recommendations contained in this report encompass all three broad approaches and utilizes all the modes of action listed above.

6. *Prosperity 2000*

Development of agriculture is critically important for ensuring food and nutritional security for the hundreds of millions of people that still live below the poverty line, for raising rural incomes and generating employment opportunities, and for stimulating industrialization and overall economic development of the country. Raising the productivity of irrigated and rain-fed agriculture, combined with rainwater harvesting and water conservation techniques and assured access to remunerative markets for agricultural produce through linkages with agro-industries can dramatically raise rural incomes, generate millions of on-farm and non-farm employment opportunities, eradicate poverty and usher in a prosperity movement throughout rural India.

In 1991 the International Commission on Peace & Food (ICPF) conducted a country study of employment potentials in India and drew up a strategy entitled *Prosperity 2000* to generate 100 million additional employment opportunities within 10 years.[*] The strategy was adopted by the then Government of India and the *Small Farmers' Agri-Business Consortium* was established by the Government for implementation. Two subsequent studies were conducted that confirmed the feasibility of this strategy at the local level: a study of Pune District by the Agricultural Finance Corporation for the Government of Maharasthra and a study of Pondicherry by the Mother's Service Society. Although Rs 100 crores were allocated in the 1992 Union Budget by the then Finance Minister, Dr. Manmohan Singh, for a variety of reasons the Prosperity 2000 strategy was never implemented.

The thrust of the *Prosperity 2000* strategy was to directly utilize agriculture as an engine to raise on-farm incomes and purchasing power, generate additional on-farm employment opportunities, and stimulate rural industrialization and services. These would in turn increase demand for agricultural products, manufactured goods and services throughout the economy, creating a multiplier effect that generates jobs in other sectors. The specific focus on the strategy was on raising on-farm productivity and fostering closer linkages with industry and markets through innovative approaches to the organization of the rural economy.

In reviewing ICPF's strategy 13 years later, we find that some of the potentials it identified have been partially exploited, such as the dramatic increase in production of fruits and vegetables, export of grapes and mangoes from Maharashtra to Western Europe, the rise in production and per capita consumption of sugar, and grow of inland aquaculture. The report examined the current levels of food consumption and dietary nutrition among the Indian population-at-large and projected growth in demand that would result from the gradual rise in living standards for fruits, vegetables, sugar and dairy products. The actually rise in demand for fruits and vegetables has nearly matched ICPF's projection.

In retrospect, we find that the technological and market potentials identified in the original study remain valid today. The scope for improving farm productivity, the potential for improving linkages with processing industries, and the scope for dietary enhancement is as great as before. However, the organizational mechanisms required to fully tap these potentials need to be re-examined in the light of the current role of government and private agencies in the development process. In addition, we need to take into account changing external conditions that open up new opportunities and present new challenges, especially the rise in international energy prices and the increasing opportunities for textile exports after the removal of quotas in January 2005.

[*] *Prosperity 2000*, Dr. G. Rangaswami, project leader, The International Commission on Peace & Food, 1991.

7. Vocational Training

The speed of a nation's development is directly related to the quantity and quality of vocational skills possessed by its workforce. The wider the range and higher the quality of vocational skills, the faster the growth and more prosperous the society.

In the coming decade, an additional eight million young people will enter India's labour force every year in search of employment. Currently only 5% of the country's labour force in the 20-24 age category have formal vocational training, compared with 28% in Mexico, 60 to 80% in most industrialized nations, and as much as 96% in Korea.

The availability of employable skills is one of the major determinants of how readily new job seekers find employment. The very low level of employable skills makes the search for work much more difficult. It reduces the market value of the job seeker and adds to the costs of employers that must train new recruits from scratch.

India has over 4200 industrial training institutes imparting education and training 43 engineering and 24 non-engineering trades. Of these, 1654 are government run ITIs (State governments) while 2620 are private. The total seating capacity in these ITIs is 6.28 lakh. Most of this training is conducted in classroom style in the form of 1 to 2 year diploma courses.

In addition, about 1.65 lakh persons undergo apprenticeship vocational training every year in state-run enterprises. If a wider definition of applied courses is taken that includes agricultural, engineering and other professional subjects, the total number receiving job related training is about 17 lakh per annum, which still represents only 14% of new entrants to the workforce.

The limitations in the existing approach to vocational training have been highlighted in the Planning Commission Report of the Task Force on Employment Opportunities (2001). They include outdated courses for which there is little demand, shortage of suitably trained faculty, inadequate infrastructure, and unreliable testing.

There is a great unmet need for shorter vocational training programmes that job seekers can take on their own time and at their own pace and at relatively low cost. In addition there is also need for a wide range of vocational courses for those who are already employed but seek to broaden or upgrade their skills to keep pace with changing needs and to further their career opportunities.

The ITI's offer training on a very narrow range of skills, primarily those required by manufacturing industries. These include 43 engineering related skills and 24 non-engineering trades. But the range of skills required by the country for its development includes literally hundreds for which no formal training is presently offered.

The lack of vocational training applies at all levels, from basic mechanical skills needed for operating and repairing equipment to jobs in sales, administration and management, including specialized occupations such as bookkeepers, insurance agents, pharmaceutical marketing, travel agents, food service managers, journalism, etc. It applies also to a wide range of value-added skills for enhancing the performance of workers in different occupations, such as safe driving, industrial safety, quality control, pollution control, water conservation, rainwater harvesting, energy conservation, customer service, etc.

The overall importance of upgrading vocational skills in India is highlighted by the following statement of the Task Force on Employment Opportunities:

"To summarise, the rate of growth of economy cannot be accelerated, in particular in the labour intensive sectors, if there is a general lack of skills among the work force. The example of software industry is sufficient to illustrate what can be done by the Indian youth if the right training facilities are afforded by the society. This requires strengthening of the existing training system. The role of public sector has to be restructured and conditions

created for inflow of funds at a much larger scale than at present. Role of private sector has to be expanded sharply if the requisite resources are to be brought in to bridge the large capacity gaps that exist. The vocational training policy has to respond to this challenge."[†]

The current situation in India is summarized below:

Students completing 8th-9th standard	300 lakhs
Students entering 10th-11th	150 lakhs
New entrants to workforce (per year)	70 lakhs
Those receiving vocational training in engineering, agriculture & other fields	20 lakhs
New entrants to workforce w/o training	50 lakhs
Existing unemployed youth (15-29) of which 80% are educated up to 10th	150 lakhs
Existing workers to be trained to raise non-ag skilled portion to 25%	350 lakhs
Additional vocational capacity required to fully address the country's need	100 lakhs

India's problem today is not a shortage of jobs. It is a shortage of employable skills. Provide skills and they will create their own employment and self-employment opportunities.

8. Guaranteed Employment

The generation of employment opportunities is as natural for a society as the spontaneous growth of plants on fertile soil. Every person born brings with him an assortment of material and other needs that natural create employment opportunities for himself and others to meet. The problem of shortage arises only when the structure of society prevents the spontaneous growth of employment opportunities. Employment is a problem of reconciling the potential with the actual. Like the shortage of water for agriculture in India, it is not a genuine question of economic scarcity but rather a problem of management.

Information about the actual process of employment generation in India is severely limited. We know that some seven to eight million persons are entering the labour force every year. We know that the rate of unemployment is relatively stable over time. Therefore, we must conclude that the society is spontaneously creating approximately seven million jobs a year, of which only a few percent are in the private organized sector. This fact shows that the Indian economy is vibrant and fully capable of creating the additional employment opportunities necessary to absorb the unemployed and underemployed. Minor adjustments in the structure of laws, policies and institutions can accomplish it.

It was with this understanding that the International Commission on Peace & Food first proposed to the United Nations in 1994 that employment be considered a basic human right to be constitutionally guaranteed. At the time, the proposal appeared visionary and unlikely to be given serious consideration. Now, a brief decade later, the proposal has been endorsed by the Government of India and is in the process of being converted into law. Naturally, it is neither possible nor

[†] p.140-1

desirable that Government tries to directly create all the necessary jobs. What it can do is to make the necessary adjustments in laws, policies and institutions and supplement them with some selected programme initiatives that will accelerate the creation of new employment opportunities by the society. The recommendations given in this report are conceived to accomplish this objective.

The growth of any sector of the economy depends on the growth of and support it receives from other sectors and the extent of integration between activities in different sectors. Until now the growth of Indian agriculture has been severely constrained by the weakness of its linkages with other key sectors, including industry, agricultural education, banking, insurance, marketing and infrastructure. A conscious effort to strengthen these linkages can stimulate rapid growth in this sector resulting in rapid growth in employment opportunities. The recommendations contained in this report are intended to provide or strengthen critical linkages for a quantum jump in the growth of employment and income opportunities in India's rural farm and non-farm sectors.

PART II – BUSINESS PLANS

1. Overview of Plan

A. UNTAPPED POTENTIAL

This plan seeks to consciously accelerate the natural, unconscious process which is already creating large numbers of employment opportunities. The potential exists to achieve a quantum leap in development of the rural sector in terms of employment generation crop productivity, profitability of farming operations, household incomes, food and nutrition security, and energy self-sufficiency. These gains in turn would act as a powerful stimulus to overall growth of the Indian economy, multiplying demand for goods and services and consequently employment in the manufacturing and service sectors. Conversion of this potential into practical reality will require a high level of commitment as well as consistent and persistent implementation. This business plan charts out the essential elements of the action plan necessary to tap the potentials for rural prosperity.

B. COMPREHENSIVE & INTEGRATED APPROACH

The achievements of any economic activity depend on the simultaneous and coordinated delivery and interaction of five factors – market, technology, finance, human resources and organization. Providing or enhancing the availability of any of them can augment the overall results, but often the impact of isolated initiatives focusing on one or another of these factors is marginal due to the absence or insufficient support from the other four. The approach incorporated in this business plan is to simultaneously enhance the quality and availability of all five factors in a focused, coordinated and time-bound manner so as to provide conducive conditions for a multiplication of results that will ripple through the rural economy.

C. MISSING LINKS

The weak and missing links identified in this report are well known. Crop insurance programmes are not supported by adequate mechanisms for effective measurement of rainfall. Bank credit to farmers is hindered by the absence of effective measures to ensure repayment of loans. Delivery of quality farm inputs is constrained by the lack of effective means to prevent or punish adulteration. Improved productivity is constrained by the lack of soil test labs with the capacity to accurately test for micronutrients. Horticulture production is inhibited by the lack of storage facilities, etc. A comprehensive strategy must identify and address all these gaps in the rural economy.

D. ORGANIZATIONAL INNOVATION

Many of these missing links persist due to the absence of an effective and cohesive organizational strategy for filling in the gaps the way government institutions were able to do in Green Revolution or NDDB has done in the focused arena of dairy development. This plan places emphasis on a range of organizational mechanisms for implementation, including self-help groups and contract farming.

E. ROLE OF GOVERNMENT

1) *Policy measures:* Government policy with regard to lending policies of nationalized banks, crop insurance programmes, purchase of biomass power by state electricity boards,

2) *Legislation & law enforcement:* Providing an effective legal environment for development of the rural sector, including enforcement of provisions to prevent adulteration of inputs, strengthen the sanctity of farming contracts, enhance the capacity of lending institutions to recover loans, elimination of false certification by government offices, etc.

3) *Investment:* Investment by government in training programmes to upgrade skills in agriculture, infrastructure for cold storage facilities, rural information systems.

4) *Incentives for private initiative:* In order to energize private initiative and minimize bureaucratic inefficiencies often associated with delivery of services by government agencies, emphasis should be placed on providing incentives for development of private agro services such as soil testing labs, farm schools, and farm machinery rather than on investment and operation of these services by government.

F. ROLE OF SOCIAL INITIATIVE

While government has an important catalytic role to play, the prime mover for implementation of this plan must be the society-at-large. *In order to spread rapidly and have an impact of sufficient magnitude, the plan must release the initiative of pioneering individuals and firms at all levels of the society and generate a social movement that replicates and multiplies itself because it has captured the imagination of the people, released their energies, spurred their resourcefulness and harnessed their underutilized capacities.* Wherever possible, public initiative should be replaced, complemented or supported by fostering opportunities for private entrepreneurial initiative and self-employment.

2. Package of Strategies to Raise Crop Productivity

The report concludes that there is ample scope to raise average productivity on a wide range of crops by a factor of 100 to 200% or even more by focusing on improved methods for plant nutrition, land preparation and irrigation that have already proven highly effective under Indian conditions. Rapid dissemination and adoption of this technology can be accomplished through an integrated package of strateges that includes all of the following:

- Advanced Soil Testing Laboratories
- Computerized Expert Farm Advisory Systems
- Farm Schools
- Crop Production Planning
- Rural Information Centres
- Agri Service Centres
- Policy measures to promote contract farming & self help groups
- Policy measures to improve crop insurance

This integrated package of strategies is intended to provide the essential infrastructure for disseminating and implemented advanced agricultural production technologies that can double or triple farm incomes and stimulate significant employment opportunities for cultivation, harvesting, processing and transport. The soil test labs will provide essential information on current condition of the soil. The expert advisory system will provide guidance to farmers on how to optimize yields and income from their land. The farm schools will demonstrate the advanced production methods on lands in each village. The rural information centres will provide access to technical expertise and marketing information. The agri service centres will ensure access to the necessary equipment for deep chiselling of the soil to improve water conservation and irrigation.

The policy measures detailed below will promote strong linkages between farmers, industry, banks, and insurance companies. They will encourage banks to extend additional credit to farmers. They will also encourage business firms to enter into contract farming arrangements with small farmers

and SHGs for supply of quality inputs, bank credit, insurance, operation of farm schools, soil test labs and agri service centres.

The key to the success of the package will be the linkages created between its component parts. The farm schools should demonstrate the efficacy of complete soil test results, the expert advisory system, and deep chiselling of land. Banks and insurance companies should insist that farmers enrol in the farm schools and apply for soil test analysis as conditions for bank loans or at least offer differential rates to those who do so, since both measures will improve crop production and reduce risks. The promotion of contract farming will ensure the farmer and the bank of a ready market for the farmers' produce and provide an intermediary with the organizational capacities to facilitate banking, insurance and input procurement by small farmers.

A. ESTABLISHMENT OF A NATIONAL NETWORK OF ADVANCED SOIL TESTING LABS

The report documents the importance of reliable soil test analysis for 13 macro and micronutrients as a critical need for improving crop productivity. This requires sophisticated, finely-tuned analytic equipment (atomic absorption spectrophotometer, UV VIS spectrophotometer, etc.) that is unavailable in most soil testing laboratories. Implementation of the technology will require a quantum jump in the number of soil test laboratories and soil test analyses conducted throughout the country. Therefore it is advisable to establish new labs to supplement the existing network. Since the laboratory equipment requires frequent recalibration to maintain reliability, a national monitoring agency is also required to obtain and compare test results on standard samples one a monthly basis.

Initially it cannot be expected that farmers will fully understand the valuable of a complete soil test. Therefore, it is proposed that the Government conduct an intensive programme of free tests for the first one or two years, until the efficacy of the approach is demonstrated. Thereafter, fees can be charges to recover the cost of the tests and the cost of establishing additional laboratories. If a commercial fee structure is fixed of Rs 200 to 250 per test, then private entrepreneurs will be attracted to supplement the government effort by establishing additional labs.

1) Objectives: To establish a national network of sophisticated soil testing labs capable of testing large volumes of soil samples on a full spectrum of 13 macro and micro nutrients.
2) Anticipated Benefits: To provide farmers with essential tools for doubling or tripling crop yields and farm incomes.
3) Actions Required by Government:
   - Conduct an inventory of all existing soil test labs to ascertain the type, age, condition and test volume capabilities.
   - For labs that report having the required equipment, conduct calibration tests to ensure the equipment is working properly.
   - All labs that do possess the required equipment should be upgraded or supplemented by new labs.
   - Establish a national monitoring system to recalibrate all lab equipment on a monthly basis or as often as necessary to maintain test accuracy.
4) Programme Cost & Funding:
   - The objective should be to provide a complete soil test analysis for all cultivated lands at the commencement of each cropping season. Since accurate analysis requires limiting the sample size to three or four acres per sample, this will require approximately 25,000 to 50,000 tests per district per month. In the first phase there should be a minimum of one lab per district, each with the capacity to conduct a minimum of 10,000 complete soil analyses per month.
   - The cost of a new lab capable of processing 400 samples per day will be approximately Rs 30 lakhs for equipment.

- Subsidies for comprehensive soil testing programme -- The materials cost for each complete soil test approximately Rs 150. The total cost of materials, labour, interest, and depreciation will come to about Rs 200 per test.

B. DEVELOPMENT OF COMPUTERIZED FARM ADVISORY INTELLIGENT SYSTEM (FAS)

Soil test results will be of little value unless expert advice is available to the farmers to interpret the significance of nutrient levels and recommend appropriate steps to enhance soil nutrition. The required inputs will vary significantly from crop to crop. The most appropriate selection of inputs will also vary with fluctuations in input prices. In order to service millions of farmers with timely and reliable interpretation, it is proposed that expert systems be developed for all major crops specifying the optimum levels of each nutrient required to compensate for soil deficiencies and produce maximum yields and net income for the farmer.

1) Objectives:
   - Create computerized expert systems for all major crops to provide recommendations based on soil tests on steps needed for the farmer to achieve optimal yields and income.
   - The expert system should cover at least 20 major crops and be customized to different agro-climatic zones.
2) Anticipated Benefits:
   - Each farmer who submits soil for a soil test can receive an automated report specifying the crops most suitable for cultivation according to the soil profile and providing detailed instructions on how to enhance the soil to ensure proper plant nutrition for optimal yields and profitability.
   - Quality of information can be the best in the world.
   - Speed of service will be very high.
   - Cost of delivering information will be very low.
3) Actions Required by Government:
   - Recommending optimal cropping pattern options based on soil analysis, cost of inputs & prevailing market prices, including cost-benefit for each crop
   - Recommending optimal package of cultivation practices for specific crops based on field conditions & soil test results
   - Generating detailed crop production instructions for the specific crop and field conditions.
4) Issues to be addressed: Crop nutrition is a highly developed science practiced in many countries which has not received sufficient attention in India. Therefore it may be necessary to seek foreign expertise for developing the system.
5) Programme Cost & Funding:
   - Major cost may be for acquisition of expert knowledge.
   - Cost for development of expert systems for interpretation of soil test results customized to different regions and types of soil is roughly estimated at Rs 10 to 25 lakhs per crop.

C. FARM SCHOOLS

Rapid dissemination and adoption of advanced production technologies can best be achieved by establishment of model farm schools to demonstrate and train progressive farmers on the latest production technology. The Farm Schools can receive training and technical support on a continuing basis from a network of state level training centres (STC), from the soil testing labs, the farm equipment hiring service and the expert computer system. The characteristics of the farms schools should be as follows:

1) Objectives:
   - To establish a cost-effective system of on-farm training to farmers in every village of the country.
   - To double agricultural productivity and farm incomes by dissemination of advanced agricultural technologies for plant nutrition, pest management and water conservation. To demonstrate that annual income of Rs 50,000 or more can be achieved by application of advanced agricultural production methods on irrigated lands.

2) Anticipated Benefits:
   - Cost-effective system for training 25 million farmers a year in advanced methods of agricultural production.
   - Improve dissemination of technology by demonstrating advanced agricultural production practices on farmers lands in the village.

3) Strategy:
   - Promote the establishment of 50,000 village-based farm schools throughout the country, mostly as private institutions supported and supervised by government.
   - All agro-industries, KVKs, agricultural colleges and research institutes to set up village based farm schools on lands leased from farmers.
   - Agricultural graduates and lead farmers to be certified as instructors and offered incentives for establishing private farm schools to train local farmers.
   - Establish central and satellite farm production training institutes in each state to train and certify farm school instructors.
   - Farmers to pay for training received on a per-visit, per training session basis.
   - Multimedia training materials to be developed for training farm school instructors and for farmer training.
   - Computerised expert systems to be developed for crop selection, soil nutrition, identification and treatment of pests.
   - Farm schools to be linked to Rural Knowledge Centres to provide access to multimedia training materials, computerized expert systems, web-based technical and marketing information.

4) Issues to be addressed:
   - Credibility of the farm school instructors.
   - Quality of training provided to farmers.
   - Cost of training to the farmers.
   - Training of the farm school instructors.

5) Actions Required by Government:
   - Introduce agriculture production and farm management as mandatory courses for all agricultural graduates.
   - Develop certification programmes for each major crop to verify the competency of agricultural graduates and/or lead farmers to provide consulting services.
   - Establish centralized crop production training centers in each state for farm school instructors.
   - Establish monitoring system to verify the quality of training provided by the farm schools.
   - Make enrolment in farm school programmes a condition for farmers to qualify for crop insurance.
   - Provide incentives to farm schools for each farmer trained.
   - Provide bank loans for agricultural graduates who complete certification programmes to establish farm schools, soil testing labs and Rural Knowledge Centres.

6) Programme Cost & Funding:
   - Establishment and operation of central farm training institutes to train farm school instructors to be funded by Government. Based on a model project developed for Tamil Nadu, a state-wide system for farm school training, extension, soil labs, and agro-services, including multimedia training materials and computerised experts for farm management capable of generating and supporting 5000 farm schools will require an

- The cost of operating the system, including overheads and farmer training subsidies will be about Rs 5 crores per year, which comes to Rs 8000 per farm school or Rs 400 per farmer trained.2

D. RURAL INFORMATION CENTRES (RICS)

Mission 2007: Every Village a Knowledge Centre calls for establishment of the necessary information infrastructure to facilitate rapid dissemination of improved agricultural practices. While the Rural Information Centres will serve a multitude of functions and needs, their specific role in this integrated package of strategies will be to provide information related to crop production planning, delivery of expert information to farmers based on the soil tests, multimedia farm educational materials, agriculture inputs and marketing.

E. CROP PRODUCTION PLANNING

A comprehensive crop production planning system can be established on the Internet utilizing the RICs which will provide the farmer and the planners with valuable information for planning their crop production decisions, including real time information on the total area planted under each crop, anticipated crop production and impact on market prices.

1) Data should be entered into an internet database capturing latest information on cultivation patterns for each crop throughout the country. Village Authorized Officers can provide the updated information on a weekly basis to the RICs for entry.
2) Based on historical data on crop yields in each region, the database can estimate total area planted and total anticipated crop production on a real time basis.
3) The Department of Agriculture can project optimal crop production targets and notify farmers via the internet when total planted areas exceeds the optimal levels with warnings about possible impact on market prices at time of harvest and recommendations for alternative crops.

F. AGRI SERVICE CENTRES (ASCS)

The deep chiselling and other land preparation technologies described and recommended in this report require access to larger tractors and specialized tools which are not readily available and accessible to small farmers. Therefore the package calls for establishment of Agri Service Centres on or near each Farm School to provide access to this equipment on a hire basis. The ASCs can be promoted as private enterprises by agricultural graduates or other entrepreneurs. Banks can be encouraged to sanction loans for this activity.

1) Objectives:
   - To improve the rural infrastructure for economic development by promotion of
   - Rural Knowledge Centres for every village
   - Soil labs with capacity to test for 13 essential plant nutrients
   - Agri-service centres for hire of farm machinery required for deep chiselling of the soil and other land preparation processes.
   - Cold storage facilities for horticulture produce.
2) Anticipated Benefits:
   - Effective dissemination of information at the village level.
   - Rapid, cost-effective and broad-based delivery of computerized education and training relevant to the farm community.

- Significant improvement in crop yields and water conservation by deep chiselling of soils.
- Substantial reduction in fruit and vegetable spoilage due to availability of cold storage facilities.

3) Strategy:
   - Government to incentivize development and operation of these facilities by the private sector as far as possible to promote rural enterprise and ensure efficient operations.

4) Actions Required by Government:
   - Provide loans, incentives and subsidies for development of rural knowledge centres.
   - Purchase or provide incentives for development of rural information systems and training programmes that can be delivered through these centres.
   - Provide loans and subsidies for establishment of soil test labs, agri-service centres and cold storage facilities.
   - Certification and monitoring of soil test labs to ensure proper calibration of equipment and accuracy of results.

5) Programme Cost & Funding:
   - Subsidies for comprehensive testing of soils in every village on 13 essential plant nutrients before each cropping season.
   - Incentives and subsidies for establishment of rural knowledge centres, soil test labs, agri-service centres and cold storage units.

G. SELF-HELP GROUPS & CONTRACT FARMING

1) Objectives:
   - To provide an effective mechanism for promotion of sustainable Self-Help Groups (SSHGs) in agriculture by linking them with contract farming arrangements to ensure effective delivery essential services and market access to farmers.
   - To expand the areas under horticulture crops, cotton and other commercial crops as a means to raise farmer incomes, generate rural employment and enhance nutritional intake.
   - To provide assured markets to farmers for the off-take of their produce by expanding the application of contract farming now prevalent in the sugar and dairy industries to a wide range of other crops.

2) Anticipated Benefits:
   - Assured supply of inputs and credit and assured markets for produce.
   - Reduction in over-production of crops that results from lack of crop planning in response to changing market conditions.
   - More effective organizational mechanism for procurement of quality farm inputs, extension services to disseminate agricultural technology, identification of qualified farmers for bank credit and administration of bank loan programmes.

3) Strategy:
   - Extend the concept of registered crops now prevalent in the sugar industry to other crops.
   - Effectively utilize the organizational capabilities of agro-processing units, NGOs, and other agencies to provide integrated delivery of essential services to farmers, including
     - Promote establishment of SHGs
     - Deliver training and information to SHG members.
     - Deliver agri-services to SHG members.
     - Provide assured markets for crops.
     - Procure and deliver quality agricultural inputs to farmers.
     - Negotiate & arrange for bulk credit to SHG members against group guarantees.
     - Arrange for and administer crop insurance.

4) Actions Required by Government
   - Access to Credit: Credit must be made available to all farmers, even previous defaulters, in order to break the cycle of poverty. Nationalized banks must be instructed to extend new credit to all members of SHGs who sign group guarantees, make an initial payment toward loan arrears and agree to return the old banking dues in instalments over time.
   - Strengthen Legal Provisions for Loan Recovery: Unless there is a policy decision by the government and a procedure to ensure recovery, the potentials of SHGs and contract farming for development of the rural sector cannot be effectively tapped.
   - Incentives for Raising Productivity: Contract agents are the best agency for delivery of effective farm extension services. They will be motivated to improve crop yields and quality because it reduces the cost of production and increases the marketability of the produce. Incentives should be introduced for contract agents that establish farm schools, provide farmer training and achieve measurable improvements in crop productivity.
   - Enforcement of Penalties for Adulteration: Severe penalties may be levied and strictly enforced for supply or sale of adulterated materials.

H. CROP INSURANCE

1) Objectives:
   - Strengthen the crop insurance programme to cover deficit rainfall and other threats.
   - Strengthen the verification machinery to provide more reliable information on actual rainfall and crop yields.
   - *Link crop insurance to farm credit and training system to encourage farmers who seek loans to apply for insurance and enhance their crop production skills and cultivation practices.*

2) Anticipated Benefit:
   - Enhanced insurance coverage for farmers.
   - Enhanced protection for bankers which will encourage extension of more credit to farmers.
   - Incentives to farmers to enhance their crop production skills and cultivation practices.

3) Actions Required by Government:
   - Strengthen crop insurance programmes to cover drought as well as other factors. Insurers can stipulate that enrolment in farm school programmes adoption of advanced technologies is a precondition for insurance coverage.
   - The system for monitoring rainfall must be strengthened to provide accurate data on actual rainfall patterns at the village level.
   - An independent public body consisting of agricultural university staff, insurance agents, bank officers, SHG leaders, district level government officials, farmers group leaders and contract farming agents should be established for monitoring insurance claim administration in each district.
   - A time limit of 90 days must be established and enforced for the processing of all crop insurance claims by insurance companies.
   - *Make crop insurance mandatory in order to qualify for crop loans or by offering a preferential interest rate on insured crop loans.*
   - *Make farm school training a condition for securing crop insurance and/or crop loans or by offering preferential insurance rates to those who have received farm school training.*
   - *Insurance companies can be required to open up offices in any village which subscribes to a minimum insurance coverage. Higher premiums can be charged in exchange for the greater convenience to the insuree.*
   - *Village level insurance offices can each maintain a rain gauge to gather local rainfall data.*

3. Package of Strategies to for Specific Crops

A. HORTICULTURE

1) Objectives:
   - Raise total production of horticulture products by 100%.
   - Expand the area under horticulture crops by 4 million hectares.
   - Enhance horticulture yields by 60%
   - Upgrade the quality of horticulture produce to improve shelf-life and make it most suitable for processing.
   - Promote linkages with processing industries to improve marketability and export potential.

2) Anticipated Benefits:
   - Generate 8 million additional employment opportunities in horticulture and additional jobs in processing industries.
   - Reduce the cost of fruits and vegetables by increasing yields and reducing crop losses, thereby increasing the domestic market and export potential.
   - Improved product quality and processing will further increase India's horticulture exports.
   - Increased consumption of more affordable fruits and vegetables will improve dietary nutrition.

3) Strategy:
   - Farm school system to improve cultivation practices to increase yields and improve quality, while reducing the cost of cultivation and market prices.
   - SHGs and contract farming to promote linkages with processing industries.
   - Investment to strengthen cold chain facilities.

4) Issues to be addressed:
   - Availability of quality seed materials and inputs.
   - Dissemination of advanced production technology.
   - Measures to promote investment in storage facilities and processing industries.

5) Actions Required by Government:
   - Implement the policy initiatives described in section 2.G above to foster SHG and contract farming in horticulture.
   - Implement the policy measures described in section **Error! Reference source not found.** above to provide an effective system for dissemination of advanced crop production technologies.
   - Provide incentives and subsidies for
     -- expanding the areas under horticulture crops
     -- raising productivity and quality of crops'
     -- establishment of fruit and vegetable processing industries
     -- establishment of cold storage units and for cold chain transport.
   - Improve access to medium term credit for cultivation of fruit crops.
   - Implement the policy measures desribed in section 2.H above to strengthen the crop insurance programme.

6) Funding: Government of India has already sanctioned Rs 10,000 crores to double horticulture production, so no special financial arrangements are needed.

B. COTTON

1) Objectives: To raise the yield and quality of Indian cotton to ensure it is competitive against international competition.

2) Benefits: As textile exports increase with the lifting of import quotas, Indian farmers can benefit enormously by increased market provided the quality and cost of Indian cotton can be raised to levels commensurate with that of other countries.

3) Actions Required by Government:

4) See 2.G above on Self-Help Groups & Contract Farming.

C. ENERGY PLANTATIONS & BIO-MASS POWER

1) Objectives:
   - Cultivation of 10 million hectares of energy crops for power generation.
   - Establishment of 1000 mini-power plants generating a total of 40,000 MW of bio-mass electric power.
   - Minimizing the involvement of government in actual cultivation of crops or distribution of subsidies.

2) Anticipated Benefits:
   - Generation of 5 million year-round rural employment opportunities.
   - Generation of Rs 20,000 crores of on-farm income.
   - Generation of 40,000 MW of additional electric power with low capital cost and short gestation period.
   - Promotion of local medium scale industry.
   - Providing a local source of power in every rural district.
   - Reduction of transmission losses from 13-18% to 10% or less.
   - Reduction in soil erosion and rainwater run-off.
   - Improvement in rainfall and air quality due to extended area under tree crops.
   - Reduction in foreign exchange drain for imported fuels.

3) Issues to be Addressed:
   - Providing an assured market for energy crop cultivators.
   - Providing multi-year bank credit for tree cultivation.
   - Providing assured and remunerative off-take for the power generated.

4) Strategy
   - Extension of registered crop system presently in use by sugar mills to energy crops whereby the processor
     -- Ties up credit for farmers
     -- Ensures provision of quality planting material
     -- Commits to purchase the farmers' crop
     -- Ensures provision of quality inputs
     -- Provides extension services to increase crop yields
   - State Electricity Boards provide an assured market for power generated at remunerative prices.

5) Actions Required by Government
   - The successful implementation of this strategy depends primarily on the willingness of the Government to legislate suitable provisions to ensure a remunerative market to producers of renewable energy.
   - Licensing of rural power plants with command areas as is presently done for sugarmills.
   - Provison of multi-year crop loans to farmers for cultivation of energy crops, including advances to cover the labour involved in cultivation and maintenance of the crop until harvesting.
   - Legislation to strengthen and facilitate enforcement of farm-processor contracts.
   - Legislation to strengthen the banks' capacity to recover revenue from wilful contract defaulters.
   - Legislation requiring state electricity boards to purchase all bio-mass power produced by licensed mills at remunerative prices.

- Crop insurance programme to be strengthened to protect farmers against crop losses due to drought or pestilence.
- Government can provide subsidies/incentives to farmers in the form of reduced interest on bank loans for energy crop cultivation.
- Leasing of large tracks of fallow or wastelands to self-help groups, cooperatives, NGOs and corporates for cultivation of energy crops.
- Leasing of forest lands to corporates for cultivation of energy crops based on bonded guarantees to achieve and maintain targeted levels of forest cover.

6) Programme Cost & Funding
   - No capital investment is required by government in power plants or crop cultivation.
   - Subsidized interest rates to be provided to banks for multi-year loans for cultivation of biomass crops.
   - Revenue can be generated by leasing of forest lands to corporates for energy plantations.

D. BIO-FUELS FROM JATROPHA

1) Objectives:
   - Cultivation of 10 million hectares of bio-fuel crops for production of diesel oil.
   - Generation of 7.5 million year-round rural employment opportunities.
   - Establishment of 5000 small scale oil expeller industries.
   - Produce 20 MT of bio-diesel values at Rs 40,000 crores.
   - Minimizing the involvement of government in actual cultivation of crops or distribution of subsidies.

2) Anticipated Benefits:
   - Generation of 5 million year-round rural employment opportunities.
   - Generation of Rs 40,000 crores of on-farm income.
   - Promotion of small scale rural industry.
   - Providing economical source of energy in every rural area.
   - Reduction in soil erosion and rainwater run-off by cultivation of wastelands and fallow lands.
   - Improvement in rainfall and air quality due to extended area under tree crops.
   - Reduction in foreign exchange drain for imported fuels.

3) Issues to be Addressed:
   - Providing an assured market for energy crop cultivators.
   - Providing multi-year bank credit for tree cultivation.
   - Providing assured and remunerative off-take for the bio-diesel.

4) Strategy: Extension of registered crop system presently in use by sugar mills to energy crops whereby the processor
   - Ties up credit for farmers
   - Ensures provision of quality planting material
   - Commits to purchase the farmers' crop
   - Ensures provision of quality inputs
   - Provides extension services to increase crop yields

5) Actions Required by Government:
   - Set aggressive goals mandating the blend of bio-diesel with diesel oil in progressively higher proportions beginning with 5% in 2007 and rising to 20% by 2012.
   - Promote cultivation of bio-fuel crops over an area of 10 million hectares.
   - Formulate standards and specifications for bio-fuel in its pure and blended forms as well as procedures for determining the concentration and quality of blended fuels.
   - Licensing of rural bio-diesel units with command areas as is presently done for sugarmills.

- Provison of multi-year crop loans to farmers for cultivation of bio-fuel crops, including advances to cover the labour involved in cultivation and maintenance of the crop until harvesting.
- Legislation to strengthen and facilitate enforcement of farm-processor contracts.
- Legislation to strengthen the banks' capacity to recover revenue from wilful contract defaulters.
- Legislation requiring state electricity boards to purchase all bio-mass power produced by licensed mills at remunerative prices.
- Crop insurance programme to be strengthened to protect farmers against crop losses due to drought or pestilence.
- Government can provide subsidies/incentives to farmers in the form of reduced interest on bank loans for energy crop cultivation.
- Leasing of large tracks of fallow or wastelands to self-help groups, cooperatives, NGOs and corporates for cultivation of energy crops.
- Leasing of forest lands to corporates for cultivation of energy crops based on bonded guarantees to achieve and maintain targeted levels of forest cover.
- Launch an aggressive research programme to examine alternative crops and processing technologies for production of bio-fuels.
- Establish a testing programme to evaluate the fuel quality of bio-fuels derived from different varieties and genetic strains.

6) Programme Cost & Funding
   - No capital investment is required by government for crop cultivation or processing units.
   - Subsidized interest rates to be provided to banks for multi-year loans for cultivation of bio-fuel crops.
   - Revenue can be generated by leasing of forest lands to corporates for energy plantations.

E. ETHANOL

1) Objectives:
   - Promote large scale ethanol production for domestic fuel consumption and as a major export.
   - Eliminate the distress of sugarcane farmers and the cyclical fluctuations in the sugar industry.
   - Promote cultivation of sugar beet as a more profitable and sustainable source of sugar.
   - Promote cultivation of sweet sorghum as a profitable source of ethanol.

2) Anticipated Benefits:
   - Encouraging a shift from sugarcane to sugar beet and sweet sorghum can raise farmer incomes by 150-200%.
   - Production of an additional 10 million tons of sugar for ethanol production or export.
   - Production of 7 million tons of ethanol for domestic consumption and export.
   - Generation of Rs 20,000 crores of on-farm income.
   - Promotion of rural industry.
   - Reduction in environment pollution from automotive fuels.
   - Reduction in water consumption by switch-over to less water intensive crops.
   - Generation of foreign exchange inflow by export of ethanol or sugar and reduction in foreign exchange outflow for imported fuels.

3) Issues to be Addressed:
   - Providing an assured market for energy crop cultivators.
   - Providing assured and remunerative off-take for the ethanol.

4) Strategy:
   - Promote production of ethanol from molasses.

- Convert 10% of existing sugarcane lands to sugar beet and add an additional 5 lakh acres of sugar beet cultivation.
- Extend the registered crop system to sugar beet and sweet sorghum.

5) Actions Required by Government:
   - Raise the mandated level of ethanol blending in petrol to 10 or 15% with buy-back arrangements from the major oil companies .
   - Remove restrictions on the movement of molasses and establishment of ethanol plants.
   - Focus research and extension services on development and promotion of sugar beet as an alternative to sugar cane.
   - Provide incentives to sugar mills to add ethanol processing capabilities with state of the art technology such as molecular sieve technology for making anhydrous alcohol.
   - Integration of distillery with sugar plant to provide multiple options for making sugar or converting sugarcane directly into ethanol according to current market demand and pricing.
   - Licensing of new sugar beet to ethanol processing units with command areas as is presently done for sugarmills.
   - Launch an aggressive research programme to examine alternative crops and processing technologies for production of ethanol fuels.

6) Programme Cost & Funding
   - No capital investment is required by government for crop cultivation or processing units.
   - Investment incentives for expansion of ethanol processing capacity.

F. EDIBLE OIL FROM PARADISE TREE

1) Objectives:
   - Cultivation 10 million hectares of degraded forest lands with Paradise Tree for production of edible oil.
   - Generation of 5 million year-round rural employment opportunities.
   - Establishment of 5000 small scale oil expeller industries.
   - Produce 20 MT of bio-diesel values at Rs 40,000 crores.
   - Minimizing the involvement of government in actual cultivation of crops or distribution of subsidies.

2) Anticipated Benefits:
   - Generation of 5 million year-round rural employment opportunities.
   - Generation of Rs 40,000 crores of on-farm income.
   - Promotion of small scale rural industry.
   - Providing economical source of energy in every rural area.
   - Reduction in soil erosion and rainwater run-off by cultivation of wastelands and fallow lands.
   - Improvement in rainfall and air quality due to extended area under tree crops.
   - Reduction in foreign exchange drain for imported fuels.

3) Issues to be Addressed:
   - Providing an assured market for energy crop cultivators.
   - Providing multi-year bank credit for tree cultivation.
   - Providing assured and remunerative off-take for the bio-diesel.

4) Strategy: Extension of registered crop system presently in use by sugar mills to energy crops whereby the processor
   - Ties up credit for farmers
   - Ensures provision of quality planting material
   - Commits to purchase the farmers' crop
   - Ensures provision of quality inputs
   - Provides extension services to increase crop yields

5) Actions Required by Government:
   - Government to mandate blending of bio-diesel with diesel oil to ensure a ready market for the oil.
   - Licensing of rural bio-diesel units with command areas as is presently done for sugarmills.
   - Provison of multi-year crop loans to farmers for cultivation of bio-fuel crops, including advances to cover the labour involved in cultivation and maintenance of the crop until harvesting.
   - Legislation to strengthen and facilitate enforcement of farm-processor contracts.
   - Legislation to strengthen the banks' capacity to recover revenue from wilful contract defaulters.
   - Legislation requiring state electricity boards to purchase all bio-mass power produced by licensed mills at remunerative prices.
   - Crop insurance programme to be strengthened to protect farmers against crop losses due to drought or pestilence.
   - Government can provide subsidies/incentives to farmers in the form of reduced interest on bank loans for energy crop cultivation.
   - Leasing of large tracks of fallow or wastelands to self-help groups, cooperatives, NGOs and corporates for cultivation of energy crops.
   - Leasing of forest lands to corporates for cultivation of energy crops based on bonded guarantees to achieve and maintain targeted levels of forest cover.

6) Programme Cost & Funding:
   - No capital investment is required by government for crop cultivation or processing units.
   - Subsidized interest rates to be provided to banks for multi-year loans for cultivation of bio-fuel crops.
   - Strengthen the cold storage and transport chain to reduce crop losses and improve marketability.
   - Revenue can be generated by leasing of forest lands to corporates for energy plantations.

4. Higher Education in Agriculture

1) Problems to Be Addressed: The problems of India's agricultural education system are well known
   - Students seek agricultural education as a means of securing salaried employment in government, banks and universities, resulting in a huge surplus of unemployed and unemployable graduates.
   - Agricultural graduates do not acquire practical knowledge of agricultural production techniques needed either to become successful modern farmers or to be accepted as credible consultants by the farming community.
   - Advanced production methods developed in the universities do not get translated into practice.

2) Objective:
   - To increase the relevance and practical applicability of agricultural education.
   - To improve the linkages between agricultural colleges and the application of modern agricultural practices in the field.
   - To elevate the scientific education of modern farmers by attracting them into the higher educational system.

3) Anticipated Benefits:
   - The huge earning potential of farming as an occupation goes unrecognized.
   - Agricultural graduates will acquire knowledge and skills of greater practical relevance to farming.

- Increased employment/self-employment opportunities for agricultural graduates.
- Increased transfer and application of research results in the field.
- Improved productivity of Indian agriculture.

4) Strategy:
   - Introduce mandatory courses in Agricultural Production technology for all students.
   - Establish Agricultural Technology Institutions to offer education in Production Agriculture and to provide scientists with training in modern commercially proven technologies used in the various steps in crop production and quality improvement.
   - Modify admission policies to give preference to students who come from agricultural land-owning families and who have a stated interest in becoming modern, progressive farmers.

5. Self-Employment & Entrepreneurship for Agriculture Graduates

1) Objective:
   - To attract qualified manpower to establish model farms, farm schools, agro-processing units for horticulture crops, soil test labs, rural information centres and agri-service centres.
   - To generate remunerative self-employment opportunities for agricultural graduates in agriculture and agro-industry
   - To attract technically trained and experienced to apply their knowledge in commercial farming and for establishment of agro-industries and services.
   - To augment the transfer of scientific practices from the universities and research institutes into the field.

2) Strategy:
   - Most successful entrepreneurs and self-employed persons are workers who have acquired five or more years of practical experience before venturing out on their own. Technically qualified and experienced manpower who are presently employed in government or public sector institutions should be encouraged to take long term leave from their jobs in order to undertake commercial farming on their own or leased land and/or to establish agro-industries for food processing and/or agri-services such as soil test labs and agri-service enterprises from which they can earn far higher income while upgrading the application of technology as examples for the rural population to emulate.
   - Agricultural graduates who come from farming families and have an aptitude for agriculture can be encouraged to undertake commercial farming on their own or leased land and/or to establish agro-industries and agri-services from which they can earn far higher income than in salaried employment.
   - Special technical support can be provided to these agricultural and agri-business entrepreneurs to help them achieve financial self-sufficiency and high incomes.
   - In order to be effective, the self-employment opportunities must not only be financially remunerative but also socially prestigious. This can be achieved by providing special status to these entrepreneurs and according recognition and special awards for high performance.

3) Actions Required by Government:
   - Policy measures must permit and encourage technically qualified employees in government, public sector enterprises and banks to take long term leave to venture in agriculture and agri-business with jeopardising their right to return to the job without loss of seniority.
   - Special bank loan programmes should be offered to technically qualified persons with at least five years of work experience to establish commercial farms and/or agri-businesses.

6. Rural Vocational Training

1) Objectives: To expand and extend India's vocational training system to
   - provide training on hundreds of skills required for the development of the country.
   - provide training to an additional 100 lakh workers annually in order to cover all new entrants to the workforce, all unemployed workers and employed workers who lack adequate vocational skills.
   - provide training on skills relevant to rural livelihood.

2) Strategy:
   - Initially create one model vocational training institute in each district.
   - Later this should be expanded to one for each block and eventually in each revenue village.
   - Utilize televised programming as a major element of the training curriculum in order to ensure quality and offset the shortage of qualified trainers.

3) Actions Required by Government:
   - Government can offer incentives, subsidies and training scholarships to encourage private entrepreneurs to establish and operate the vocational institutes.
   - Government can offer incentives and subsidies to encourage private business to develop approved training courses and materials.
   - Government should certify the quality of the institutes
   - Government should certify the quality of the training courses
   - Government should conduct examinations and issue certificates for those who complete the training courses.

7. Computerized Vocational Training [*]

1) Rationale:
   - Establishment of a complete network of traditional vocational institutes throughout the country will be extremely difficult for a variety of reasons:
     - The range of skills that need to be taught is very extensive.
     - It will be difficult to find sufficient qualified trainers or to attract them to the rural areas.
     - The cost of operating traditional institutions will be very high.
   - The importance of computer has been widely recognized as a means to improve efficiency in business, government and formal education, but its application in vocational training is not fully appreciated. Rates of learning on computer are four to ten times faster than they are in classroom setting and learning retention is likely to be much higher. This is true for both academic as well as vocational or skill-based subjects.
   - Computers offer several advantages for rapid and effective learning. In computerized learning,
     - *Multimedia* – Computerized courses combine written, spoken, graphic, animated and motion picture imagery to communicate concepts and illustrate applications that cannot be done in a classroom setting.
     - *Interactive* – Students can interact with the training program at every moment to obtain more information, qualify their understanding and test their knowledge.
     - *Immediate Feedback* – Computerized training has the additional advantage that it can provide immediate feedback to each student at every step of the learning process, which live classroom teaching cannot do.

[*] The vast potential for computerized vocational training is cited in the *Report of the Committee on INDIA Vision 2020, Planning Commission, 2002, p.51*.

- *Paced Learning*– Students proceed at their own pace according to their own capacity, so it is never too fast for comprehension or too slow to hold their interest.
- *Eliminates need for teacher training* – Computerized courses ensure that the highest quality of knowledge and presentation are available equally to all students, whereas teaching standards in existing vocational institutions vary enormously.
- *Response to changing skill needs* – Computerized courses can be rapidly modified or replaced in response to changing needs in the employment market, whereas classroom courses are difficult to change, since it involves changing of textbooks and retraining of instructors, so they tend to remain the same for many years.
- *Uniform testing* – Computerized courses also make possible uniform testing and evaluation by the computer software itself purely on objective criteria.

- While is some instances, computerized training will need to be supplemented with hands-on training or apprenticeship experience, the need will actually be far less than expected. Computerized simulation has been proven an effective training tool even for learning complex vocational skills such as flying an aircraft or handling sophisticated military equipment.

2) Objectives: To establish a nation-wide network of computerized vocational training centers covering every village in the country and offering training courses on a wide range of occupational skills.
   - Establish 50,000 training institutes in the country: 40,000 training centres as privately owned businesses and 10,000 training centres in engineering colleges, arts colleges, ITIs and high schools that have spare computer lab capacity available for morning or evening use.
   - Provide vocational training to a minimum of 10,000,000 students per annum.
   - Generate self-employment for 40,000 entrepreneurs.
   - Generate employment in the training institutes for an additional 80,000 shop training assistants.

3) Strategy: Computerized vocational courses can be offered through:
   - *Liberal Arts and Engineering Colleges* – Using the existing computer facilities available at arts, science and commerce colleges, vocational training courses can be offered both to students and the general public.
   - *Industrial Training Institutes & Polytechnics* – Using the existing computer facilities available at polytechnics and other training institutions, vocational training courses can be offered both to students and the general public.
   - *Private Training Institutes* – The Government should promote the establishment of thousands of private training institutes ("job shops") to make vocational training available in every locale, on a parallel to the STD booth.
   - *High Schools* – Public and private high schools equipped with computers can also be included in the network of training institutes.

4) Range of Skills: Computerized programmes can provide complete or partial training on a very wide range of physical, social and mental vocational skills, including
   - Commercial – bookkeeping, selling skills, inventory control, telemarketing, advertising, shop assistant, etc.
   - Agriculture – farm management, crop production planning, soil lab technician, IPM, organic farming, composting, irrigation methods, plant nutrition.
   - Mechanical –repair and maintenance of electrical and electronic equipment and machinery of all types including pumps and motors, computers, TVs, cell phones, ACs, vehicles, etc.
   - Industrial – quality management, safety management, environmental management
   - Educational – presentation skills for teachers, teaching assistants, school management, human resource development.
   - Design – graphic, computer, textile, interior, landscape, furniture, floral.

- Legal & financial – law clerk, insurance agent, accountant , bank clerk
- Tourism – travel agents, food service managers, housekeeping supervisors, laundry supervisors and technicians.
- Media – reporting, sub-editing, video editing, still & motion photography, film making, image processing.
- Language – vocabulary, grammar, spelling, punctuation, writing and pronunciation in any language, secretarial, stenographer.
- Internet – information researching, publishing, e-commerce, marketing, website development.
- Health – dieticians, pharmacists, medical representatives, medical lab assistants

5) 'Jobs Shops':
   - The concept is that private individuals will establish the training centres or "Job Shops" in both urban and rural areas under a self-employment scheme.
   - Each centre will provide training on a range of occupational skills.
   - Training material will be offered in a CD-Rom format, so that no internet connection is required. This will improve accessibility, reduce the cost and eliminate connectivity problems. (Supplementary internet based training may also be offered where feasible.)
   - Each centre will consist of one to ten computer terminals and a library of training CDs.
   - Customers will be able to rent the computer time and CDs on an hourly or course basis. For example, if a course on sales training requires 50 hours to complete, the customer will pay a total fee for the course and be entitled to 50 hours of computer use for completing the course (e.g. within a period of three to six months time.)

6) Training Course Material:
   - Each centre will maintain a library of popular training courses from which clients may select the topics of their interest. A sample list of topics is appended to indicate the range of skills that can be offered.
   - The availability of computerized training material for a large number of vocational skills is critical to the success of the project. Some of the training material can be drawn from the large number of educational CDs already created in India and overseas (e.g. bookkeeping, sales training, etc.).
   - But a large number of new training programmes will have to be created by collaboration between the Government and companies with expertise in the design and development of computerized training courses, such as NIIT, Aptech, Pentasoft and others. These firms will be interested to produce the course material, if they are assured of a large market for the courses.
   - Wherever feasible, course will be certified by a recognized institution to signify that they are of acceptable quality.

7) Actions Required by Government: The role of the Government should include the following
   - Arrange for delivery of vocational training courses through all state-owned and managed engineering colleges, ITIs, Polytechnics, liberal arts colleges, high schools and related training institutions that are already equipped with computerized training equipment.
   - Provide financial assistance and incentives under one of the Central Government self-employment schemes to promote establishment of 40,000 private training institutes as a self-employment programme for entrepreneurs.
   - Approach financial institutions such as IDBI and the nationalized banks to provide loans to entrepreneurs for establishment of private training institutes.
   - Negotiate with computer software companies for the design and production of a wide range of vocational training courses. Each course can be developed in conjunction with a recognized institutional authority that will certify the contents of the course.
   - Negotiate for bulk purchase of approved training software on behalf of private training institutes in order to minimize the cost of training.
   - Provide training to entrepreneurs on how to set up and manage a private institute, including training on marketing and pricing of courses.

- Provide scholarships to very low income youth to offset a portion (from 25 to 75% depending on income group) of the cost of training.
- Eliminate all taxes and duties on computer parts and equipment in order to bring down the price of PCs to a level affordable by much larger numbers of people.
- Institute a cash award for anyone who invents a low cost computer that will significantly reduce the cost of the PC.

8) Funding Requirements:
   - The Government can utilize existing computer infrastructure in educational and training institutions to set up the network of institutes. It need not invest in hardware.
   - To the extent that public institutions will be part of the network, the Government will have to invest in purchase of training software. Assuming that 25,000 public institutions participate in the programme and that each centre requires Rs 2 lakh of educational software, the total cost would be Rs 500 crores.
   - There will be no direct investment by the Government in private training centres, but the Government may offer incentives to encourage establishment of these businesses.
   - The Government can also provide scholarships to encourage poorer persons to take the vocational courses.

8. Research Issues

In order to identify the fastest growing job and skill categories so that conscious effort can be taken to match skills with job opportunities, the following areas of research should be commissioned by the National Farmers Commission.

A. NATURAL JOB CREATION

1) How many jobs are being created by the Indian economy?
   a) In which sectors & fields?
   b) By what process are they being created?
   c) How can the natural process be magnified and accelerated?
   d) How are rural migrants being absorbed in the cities?

B. OCCUPATIONAL DEMAND

1) Identify high growth occupational categories at all levels.
2) Measure the growth in pay/income levels for each category.
3) Identify occupational categories that are shrinking or for which growth in demand is decelerating.

C. EMERGING ACTIVITIES

1) Identif emerging occupations in all sectors,
   a) Farm managers & Soil technicians
   b) Servicing for cell phones, ACs, computers, VCDs, etc.
   c) Home delivery, floor cleaner, masseuse

D. SKILLS FOR NATIONAL DEVELOPMENT

1) Compile a complete list of skills needed for India's development to next higher level.

2) Examine the process of employment generation in other countries when they were at similar stages of development.
3) Study which job categories grew rapidly in these countries during a comparable periods.

PART III – POTENTIALS OF INDIAN AGRICULTURE

1. *The Dilemma of Indian Agriculture*

In the last four decades since the launching of the Green Revolution, Indian agriculture has made great strides in introducing improved genetic material, raising crop productivity, expanding the areas under irrigated cultivation, diversifying cropping patterns and producing food surpluses. Yet in spite of these tremendous achievements, the country's present performance in agriculture is unsatisfactory for a number of reasons:

Low Crop Productivity: While the wage rates paid to Indian farm labour are among the lowest in the world, the unit cost of production is among the highest for almost all crops due to low crop yields. Table 1 compares the average productivity of Indian and US farms on a range of crops. The table shows the enormous gap in productivity between the two countries. Such low yields offset the advantage of low labour cost and make India crops uncompetitive on the international market.

Table 1: Comparative Crop Productivity (kg/hectare)

Crop	USA	China	India
Maize	8900	4900	2100
Paddy	7500	6000	3000
Soy beans	2250	1740	1050
Seed Cotton	2060	3500	750
Tomato	6250	2400	1430

While the differences in productivity shown in this table are extremely high, the actual differences in field production are even greater. For instance, the average yield of tomato in Tamil Nadu is approximately 10 to 12 tons per acre, whereas leading farmers in California achieve over 60 tons average on extensive cultivation of 2000 acres, a difference of 500 to 600 percent. A lead farmer in Tamil Nadu applying the same California technology has already achieved three to four times the Tamil Nadu average.

High Cost of Food: In spite of low labour costs, low crop productivity results in a relatively high cost for food production resulting in lower incomes for farmers. High cost of food results in lower food consumption among population at-large while limiting access to international markets for export of surplus. India has accumulated huge stocks of foodgrains, sugar and other commodities which it is unable to export because the price is higher than the international market is willing to pay.

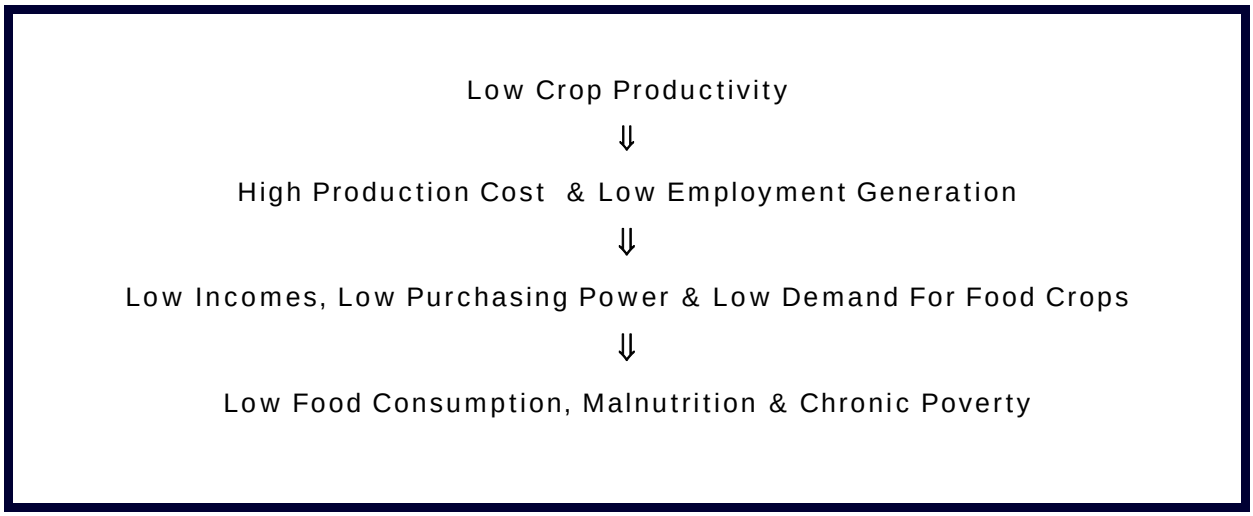
Low Purchasing Power: High cost of food results in low per capita consumption and malnutrition. Nearly 60 percent of the Indian workforce is engaged in agriculture. Low crop yields result in low incomes for farmers and farm labour. In spite of huge food surpluses, nearly half of the Indian population suffers from chronic under-nourishment because they lack the purchasing power to procure all the food their families require and to rise above the poverty line. The most vulnerable are children, women and the elderly among the lower income groups. Chronic energy deficiency among the elderly has declined from 62 percent in the 1970s to 50 percent in the 1990s, but remains a serious problem among those in lower income groups.

Lack of Markets: Efforts to raise and diversify crop production are stymied by the common phenomenon that increasing production results in falling prices, inability to market the produce and losses for farmers.

Low Water Productivity: India is endowed with abundant water resources and the second largest irrigated area in the world, yet it suffers from a perennial shortage of water both for agricultural and non-agricultural purposes due to wastage and very low productivity of water in agriculture, which accounts for 95% of the country's total water consumption. To cite a single example, cotton farmers in Tamil Nadu consume approximately seven times as much water and generate about $1/5^{th}$ the yield as their counterparts using extensive cultivation and furrow irrigation methods in California. That means that the productivity of each litre of water used for cotton cultivation in California is 35 times higher than in Tamil Nadu.

Underutilised Rain-fed and Wastelands: India possesses 50 million hectares of degraded wasteland that lie outside the national forests in addition to 30 million hectares inside protected areas. In spite of this huge extent, the country is a net importer of forest products to the extent of $2.5 billion annually. A vast extent of rain-fed farm lands and privately held wastelands that are not being effectively utilized to address the problems of malnutrition, underemployment and poverty, because the water available from monsoon rains is permitted to run off and the farmers lack an assured market for their produce.

Figure 1: Vicious Cycle of Poverty



2. *Solutions to the Problems of Agriculture in India*

1) *Raising Crop Productivity:* Increasing crop yields per unit of land is essential for escaping from the dilemma. Higher productivity will –

- Bring down the cost of food for the local population, thereby making it more affordable and improving food and nutritional security.
- Raise the incomes of farmers and farm workers, enabling them to consume more and rise above the poverty line.

- Generate additional employment opportunities.
- Make surplus farm production competitively priced for sale on the international market.

2) *Diversification:* Diversifying cropping patterns from foodgrains to commercial, horticulture and orchard crops will reduce production of surpluses and generate higher farm incomes.

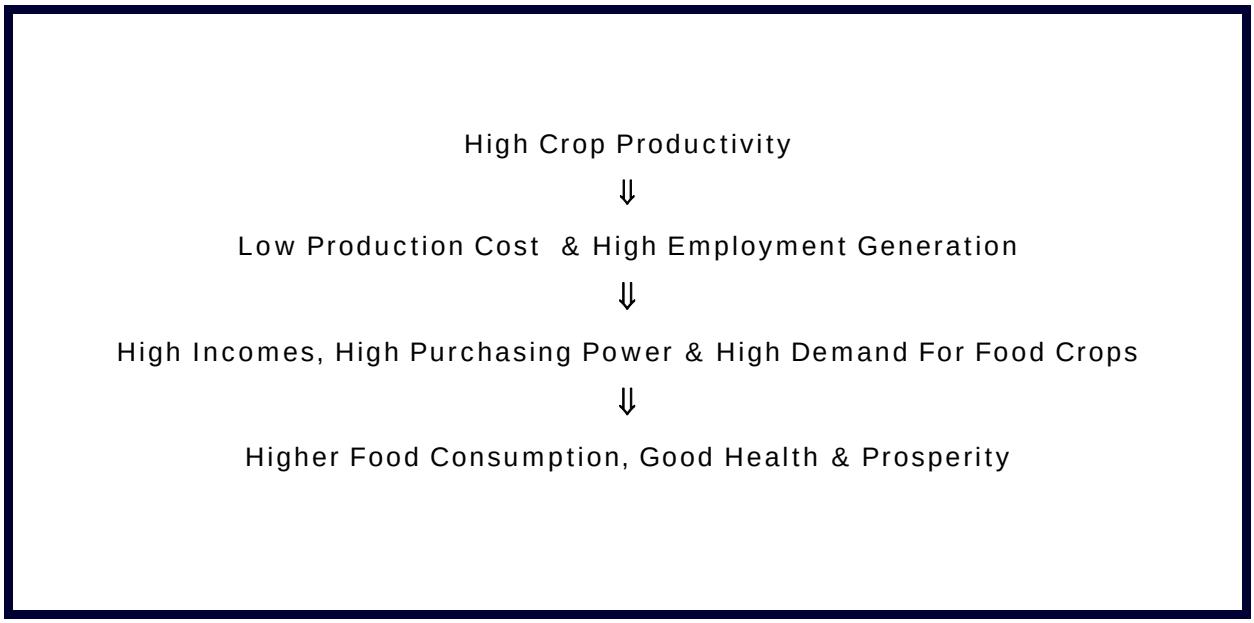
3) *Rotation:* Rotation of crops every season in response to availability of water and changing market demand will reduce crop surpluses and improve farm profitability.

4) *Raising Purchasing Power:* Higher farm yields and incomes and employment opportunities will increase the purchasing power of the rural population, resulting in greater demand for a diversified basket of food items that can eliminate malnutrition and poverty while also acting as a stimulus to manufacturing and the service sector.

5) *Raising Efficiency of Water Usage:* Advanced techniques for rain-water harvesting coupled with improved methods for water management can dramatically improve the productivity of both irrigated and rain-fed cultivation in the country.

6) *Linkages with Agro-industries:* Links to agro-industries such as biomass power plants, bio-fuels and edible oils can provide an assured market to farmers at remunerative prices and generate significant non-farm employment opportunities.

Figure 2: Virtuous Cycle of Prosperity



3. *Creating Assured Market for Agricultural Produce*

Raising agricultural production will not usher in rural prosperity unless farmers can be assured of a remunerative market for the crops they produce. The project envisions a multi-pronged approach to assure remunerative markets based on the following six strategies:

1. Diversification of crops to avoid concentration of cropping patterns on perishable or widely cultivated crops.

2. Reducing production costs to make Indian crops competitive on international markets.

3. Focus on crops with virtually unlimited market potential, particularly energy crops and edible oils.

4. Processing of perishable crops into value added products.

5. Improved storage and post harvest handling to prolong shelf life of perishable crops.

6. Linkages with agro-industries to provide an assured local market for crops.

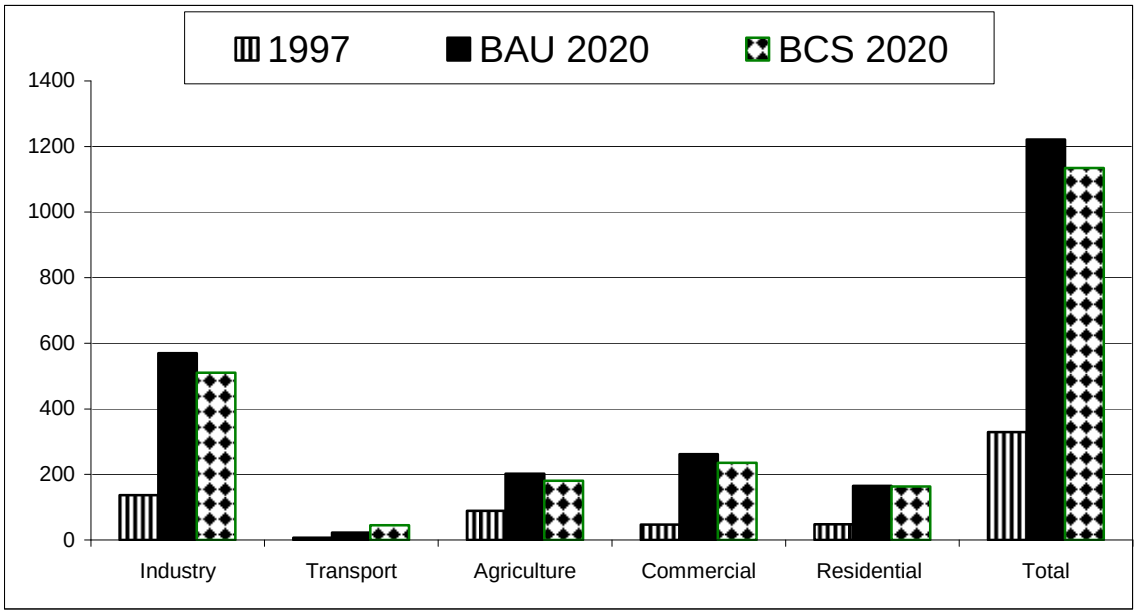
The specific crops and markets listed below indicate the scope for creating assured remunerative markets.

4. *Energy Crops*

A. BIO-MASS POWER

India has an unlimited need for energy. Figure 3 depicts several possible scenarios for the projected growth in demand for power in India over the next 20 years. Even the best case scenario (BCS) shows the demand for power will triple during this period.

Figure 3: Project Power Demand in India by 2020 (in TWh)



Most of the increased power demand will have to be met by expansion of thermal power generation capacity based on imported coal and fuel oil.

Energy that is now a severe drain on the growth of the local economy can be converted into an engine for economic growth by an alternative approach. If the country makes a strong commitment to the development of bio-mass power and bio-fuels, it can act as a powerful stimulus to rural job creation and prosperity, while radically reducing India's dependence on imported fuels.

India has a vast extent of privately held, rain-fed farm lands and cultivable wastelands that can be utilized for development of energy plantations consisting of fast-growing tree crops such as bamboo, casuarina, eucalyptus and prosopis, which can serve as the raw material for a nation-wide network of small, decentralised bio-mass power plants. These power plants, ranging in size from 6-25 MW, can generate thousands of megawatts of power from renewable, forest-based fuel sources in a cost-effective manner. The average investment comes to only Rs 3 crores per MW, which compares favourable with the Rs 5 crores cost of coal-based units. Power can be generated and profitably sold at a price equivalent to that currently being paid to private power producers. The decentralized plants will provide an essential infrastructure for rural industrialization and help

reduce transmission losses that average 20 percent or more. Already, in the last few years more than 20 biomass power plants have been established in Andhra Pradesh and an additional 20 plants have recently been licensed.

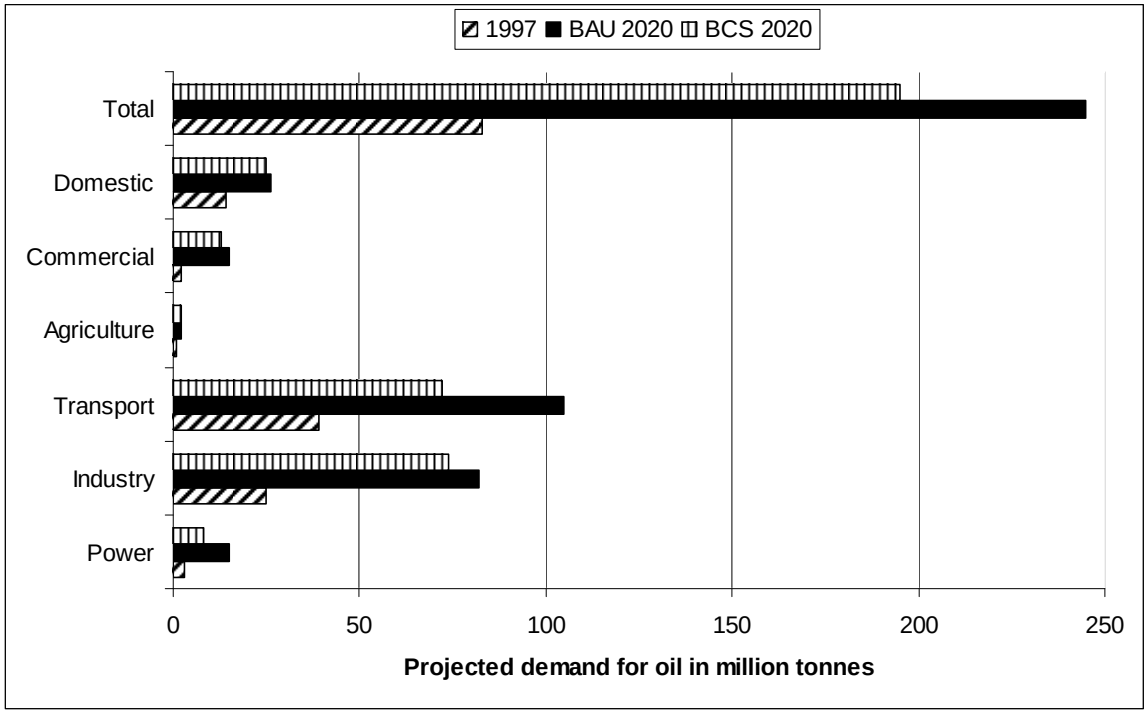
Recent developments in Tamil Nadu with regard to paddy husk and begasse illustrate the huge potential market for biomass energy crops. A few years ago rice mills were disposing of paddy husk at no charge. Today it is being burned in mill boilers and sold to a biomass power plant for Rs 800 per ton. A few years ago begasse was being sold for Rs 50 per ton. Today it is sold for Rs 700 per ton, just Rs 100 less than sugarcane itself.

The soaring demand for power will necessitate a tripling of installed generation capacity from 101,000 to 292,000 MW over the next two decades. Establishment of 10 million hectares of energy plantation crops such as casuarina, eucalyptus and bamboo would be sufficient to generate 40,000 MW of power generation and provide year-round employment for 5 million people. This strategy would reduce India's dependence on imported fuel oils, stimulate private investment in the power sector, and generate massive income and employment opportunities for the rural poor. Details of energy plantation and power plant economics are contained in the Annexures.

B. BIO-FUELS

Figure 4 shows the projected growth of demand for oil during the same period. Even under the best case scenario, oil demand will increase by 250% and total oil imports will rise from 85 million tons to nearly 200 million tons by 2020. This will result in a huge outflow of foreign exchange and make the domestic economy increasingly vulnerable to international oil price fluctuations and shortages.

Figure 4: Projected Demand for Oil



C. JATROPHA

India also has the capacity to generate bio-fuels in massive quantities. Curcas (*jatropha curcas)* is a plant introduced from Africa, which already grows wild in India and is often used as a fence crop. The plant produces large quantities of seeds which contain up to 35% oil that is a substitute for No.2 diesel and kerosene and can be blended in diesel motor fuels up to 15%. The cost of

production is competitive with other fuel oils. Cultivation of 10 million hectares of this crop could produce 12 million tons of bio-fuel annually, while generating year-round employment for 7.5 to 10 million people. The Committeee on Development of Bio-Fuel concluded that it is possible to raise jatropha on 13.4 million hectares of land, including 3 million ha of forest lands, 3 million ha of farm land as a hedge crop, 2 million ha of plantation, and 2.4 million ha of cultivable fallow lands. Details of jatropha cultivation and yields are contained in Annexure 2 and details of oil extraction industries for edible oil are contained in Annexure 4.

D. ETHANOL FROM SUGARCANE

Ethanol, which can be produced from maize, tapioca, sugarcane, sugar beet and other crops, is another bio-fuel with enormous potential. It can be mixed as a pollution-free blend with petrol and diesel. Ethanol-petrol fuel blends are utilized in more than 20 countries, including Brazil, Canada, Sweden and USA. USA consumes 4 billion litres of ethanol as motor fuel per annum. Brazil consumes more than 16 billion litres of ethanol annually and meets 41% of demand for transport fuel from this source. Between 1979 and 1992, an ethanol fuel strategy enabled Brazil to reduce reliance on imported oil by 70 percent.

India presently consumes approximately 40 million tons of diesel fuel and 6 million tons of petrol per annum. Assuming a 10% blend of ethanol with petrol and diesel, the total requirement of ethanol would be 4.6 million tons per annum, equivalent to 4.6 billion litres. With engine modification, much higher ethanol blends can be utilized, creating a potential demand for more than 10 million tons of ethanol per annum.

Currently India produces surplus sugar and is holding stocks equivalent to about 10 months domestic requirement. Export of the sugar is not viable because India's low productivity and the high subsidies for sugar exports by other countries. Utilizing surplus sugarcane and molasses as raw material for ethanol production will also improve the prospects of India's huge population of sugarcane farmers.

E. SUGAR BEET

Tropical varieties of sugar beet are now available that grow well in a wide variety of agro-climatic regions of India. It is a 5½ month crop as compared to 10-13 months for sugarcane and it requires only 40% as much water. Under Indian conditions sugar beet can produce approximately 50% more sugar per acre than sugarcane in half the growing time with half the water consumption. Sugar beet yields can average 30-40 tons per acre with a sugar recovery of 12.5 to 18%, which results in an average sugar yield of 5.25 tons per acre compared to 3.4 tons for sugarcane.

An immense added advantage derives from the fact that year-round cultivation of sugar beet in combination with sweet sorghum generates twice the employment per acre as sugarcane. Substitution of sugar beet for sugarcane will raise farm incomes, generate employment and reduce water consumption.

Sugar mills will have to be modified to process sugar beet at an approximate cost of Rs 20-25 crores each. Initially, efforts can be instituted to promote introduction of sugar beet on 10% of the existing sugarcane area and the surplus sugar can be diverted to ethanol production.

F. SWEET SORGHUM

Sweet sorghum is an excellent source for ethanol production. It is a short duration crop that can be grown in temperate and tropical regions and produces a very high yield of 30 dry tons/ha/year. This crop can be grown in rotation with sugar beet, one sugar beet crop and one or two sweet sorghum crops per year. Generally grain/fodder sorghum is in vogue in many states as Kharif & Rabi season crop. The Kharif season crop in most of the states is rain-fed and the Rabi crop is irrigated. The southern part of India, especially Tamilnadu, Andhra Pradesh, Karnataka, has potential for raising

two crops a year, which can be made available to the factory for a minimum of eight months. In North India, one rain-fed crop and another irrigated crop is possible.

Annexure 5 shows the comparative cost of cultivation and income from sugarcane, sugar beet and sweet sorghum. A combination of sugar beet and sweet sorghum can generate an annual net income to the farmer nearly three times that of sugarcane. The conversion of three million hectares of sugar cane cultivation to sugar beet and sweet sorghum can generate an additional four million employment opportunities. Extension of these crops to an additional three million hectares of land that is presently not cultivated can generate an additional eight million jobs.

A strategy to develop large quantities of ethanol for fuel could include the following elements:

- Utilize surplus sugarcane and molasses to produce ethanol.
- Cultivate sugar beet and sweet sorghum to produce additional ethanol.
- Establish 250 new processing plants to convert surplus sugarcane and other crops into approximately 6 million tons of ethanol per annum.
- Processing units can register these other crop for ethanol production just as sugar mills now do for sugarcane.
- Apply rainwater harvesting & advanced water management technology in all areas covered by the programme to improve water conservation and efficiency of utilization.
- The additional begasse produced by the programme would be sufficient to generate more than 20 billion units of electricity.
- Generation of 6 million additional on-farm and non-farm employment opportunities.

G. EDIBLE OIL FROM PARADISE TREE

India currently produces 18 million tons of edible oil per annum, which represents a shortfall of 3 million tons from current domestic consumption. To fill this deficit, the country imports approximately Rs 9000 crores of edible oil each year, resulting in a heavy outflow of foreign exchange.

Paradise tree (*simaruba glauca)* is a Brazilian oilseed-bearing plant that can become an important source of edible oil for India. The plant is a drought-resistant, high-yielding, perennial ever-green tree ideally suited for dry land areas of India. It grows under rain-fed conditions and requires minimal inputs. It starts bearing seeds from the 3rd or 4th year. The seeds contain 50% oil, which when refined is very similar in characteristics to groundnut oil.

The National Oilseeds & Vegetable Development Board has already identified this crop and recommended its widespread cultivation in India. Cultivation of 5 million hectares of Paradise tree over five years can meet the shortfall in the edible oil production while generating 2 million year-round employment opportunities and Rs 11,000 crores of additional rural income. Due to the relatively long gestation period before the crop comes to full yield, it would be advantageous to cultivate this crop over large tracks of degraded forest lands, where it can provide employment to the indigenous population.

Details of Paradise Tree cultivation and yields are contained in Annexure 3 and details of oil extraction industries for edible oil are contained in Annexure 4.

H. BENEFITS OF BIO-MASS, BIO-FUELS AND EDIBLE OIL STRATEGY

The approach outlined above

- Generates an assured and remunerative market for agricultural produce.
- Creates employment for more than 5 million rural families

- Generates huge rural income
- Reduces dependence on imported fuels
- Create an alternative market for sugarcane to reduce sugar surplus
- Stimulus to rural industrialization
- Reduce pollution from petrol-based motor fuel
- Boost rural electricity generation from begasse & provide local source of power for rural industrialization
- Improve general rural eco system and generate average Rs.20,000 per year for each families covered under the scheme.

The greatest advantage of producing bio-mass power and bio-fuels from tree crops is that they can generate millions of rural jobs and stimulate enormous growth of rural incomes, especially among the weaker sections. Therefore, this approach should not be evaluated solely from the narrow perspective of energy, but from the wider perspective of national development.

5. *Horticulture*

The *Prosperity 2000* strategy was based on the recognition that as educational levels and living standards rise, the aspiration for higher levels of consumption would drive demand for diversification and nutritional improvement of the Indian diet. The report projected a large surge in demand for fruits, vegetables and sugar, which is in line with the actual growth in consumption over the past 14 years. Production of fruits in India rose by 60% from 28 million tons in 1991-2 to 45 million tons in 2002-3, while the area under fruits increased by 52% to 3.9 million hectares. Production of vegetables increased from 58 million tons to 94 million tons during the same period, a growth of 66%, while the area increased 31% to 6.3 million hectares. Since per capita levels of consumption remain far below world averages, this trend is likely to accelerate in future.

A. POTENTIAL

Expanding development of horticulture crops offers enormous benefits.

- *High farm incomes:* While only 8% of the cultivated area is presently under horticulture crops, they contribute 25% of agricultural GDP.

- *High value added:* Processing of fruits and vegetables can multiply their value 50 to 500 times and open up huge export markets.

- *Export earnings:* Fruits and vegetables earn 20-30 times more foreign exchange per unit area than cereals. India is one of the world's major food producers but accounts for less than 1.5 per cent of international food trade. This indicates vast scope for both investors and exporters. Food exports in 1998 stood at US $5.8 billion whereas the world total was US $438 billion.

- *Dehydrated produce:* In 2001 India exported 3200 tons of dehydrated fruits and vegetables. APEDA projects that the export potential will rise to 19,500 tons by 2007. The import of dehydrated produce by Japan alone was 68,000 tons valued at $145 million in 2001. There is vast potential for export of dehydrated fruits such as mango, papaya, pineapple and guava, which can be processed during the peak season when prices fall and unmarketable surpluses are generated. There is also potential for popularizing small sachets of nutritious fruit juice both for Midday Meal Schemes within the country and for export.

- *Employment:* The average labour requirement for horticulture crops is 860 person days per hectare compared to 143 days for cereal crops. This rises to as high as 1000 to 2500 days in

- *Dietary requirement:* Present consumption of fruits in India averages only 100 grams per day compared to a recommended intake of 140 grams. For vegetables the nutritional gap is from 200 to 270 grams. Filling this gap would generate an additional domestic demand of Rs 50,000 crores per annum.

B. CONSTRAINTS

At the same time there are some serious constraints that inhibit development of this sector.

- *Productivity Gap:* Yield levels for most fruits and vegetables remain far below international averages. As cited earlier, the average yield for tomato in India is 14 tons per ha compared with 25 tons in China and Thailand, 32 tons in Mexico, 59 tons in Brazil, and 88 tons in Philippines, a yield six times higher than the Indian average. Productivity improvement remains the single greatest constraint to increasing domestic consumption and export potential for Indian horticulture crops.

- *Quality of Produce:* As yields are low, so is the quality of produce. To a large extent, poor plant nutrition accounts for both. Inadequate intake of micronutrients severely retards growth and diminishes the shelf-life of produce. This results in high rates of spoilage and low levels of acceptance in foreign markets.

- *Processing:* The demand for processed products has risen from 42% of agricultural exports in 1990 to 48% in 2000. Only 2% of India's fruits and vegetables are processed, compared to 30% in Thailand, 70% in Brazil, 78% in the Philipinnes and 80% in Malaysia.

- *Post harvest losses:* Losses average 30-35% due to the lack of processing, transport and cold storage facilities. Farm produce valued at Rs 7000 crores is being wasted every year.

- *Cold chain infrastructure:* Without a strong and dependable cold chain vital sector like food processing industry which is based mostly on perishable products cannot survive and grow. Cold chain facilities are grossly inadequate to meet the increasing production of various perishable products like milk, fruits, vegetables, poultry, fisheries etc.

- *Other constraints:* Crop spoilage is also high due to lack of primary processing facilities in proximity to the growing areas, lack of transport facilities, suitable transport containers, overloading of produce, improper packaging, poor rural roads, heat accumulation due to poor ventilation, lack of refrigerated transport and delays in transport to market.

- *Credit:* The long gestation period for some fruit crops requires long term investment which is often unavailable, especially to small farmers.

C. STRATEGY FOR HORTICULTURE DEVELOPMENT

In recognition of the huge potential of horticulture crops the Government of India has announced the goal of doubling the production of horticulture produce within three years and to accelerate growth of food processing industries and has allocated Rs 10,000 crores for this purpose. Tapping this huge potential can best be done by an integrated strategy that includes the following components:

- *Expand area cultivated:* The area under horticulture crops can be extended by an additional 4 million hectares in order to raise production to meet growing domestic demand and

- *Raise crop yields*: There is scope for doubling of productivity on most horticulture crops by improved cultivation methods, which include appropriate application of the full spectrum of 13 plant nutrients, deep chiselling to increase root structures and enhance drought tolerance, etc. The proposals set forth in this document to disseminate advanced production technology through farm schools can result in a minimum 50% increase in crop yields. Incentives can be provided to improve cultivation methods by improvements in plant nutrition and irrigation systems.

- *Raise crop quality*: Improving plant nutrition and the quality of inputs will also have a marked impact on quality of produce, resulting in longer shelf-life, lower rates of spoilage, better properties for processing, and greater acceptability in the international markets.

- *Cold storage & transport*: The infrastructure of rural of cold chain and cold transport facilities must be significantly enhanced in order to provide adequate facilities for preservation and safe transport of horticulture products.

- *Self-help Groups*: Given the high employment and income potential of horticulture crops, even small areas of land can contribute substantially to raising rural incomes. Special programmes should be developed to promote SHGs for horticulture production.

- *Contract farming*: Horticulture crops will flourish under conditions in which the farmer has access to quality seeds and inputs, adequate credit, advanced technology and assured market. Raising the proportion of these crops that are processed is crucial to expansion of this sector. As farmers are concerned about assured markets, food processors are often hesitant to expand their operations due to lack of assured produce. The proposals for contract farming described in the document can serve as an excellent base for rapid expansion of cultivation and strong linkage to processing industries.

- *Credit:* Since fruit crops require a longer period from planting to harvesting, offering crop loans that include a portion of income to the farmer for the labour he expends in raising the crop will encourage more rapid growth of this sector.

- *Insurance:* The proposals for crop insurance made in this report will provide additional protection to farmers and encourage them to invest more in this high value-added sector.

6. *Other Crops with Strong Agro-industrial linkages*

In addition to the energy and edible oil crops discussed above, there are a range of other crops which when processed can tap a large market potential and form the basis for viable agro-industries. A few examples are mentioned below:

A. COTTON

1) Profile of India's Textile Industry
   - The textile industry accounts for 18% of India's workforce and 8% of the country's GDP, 17% of its manufacturing capacity and 27% of its export earnings.
   - The textile industry directly employs 35 million workers – including those engaged in cotton cultivation, cotton processing, yarn manufacturing, garment production, textile machinery manufacture, making dyes and chemicals, marketing and transport.
   - The 1227 cotton/mad-made fibre mills provide direct employment to over 15 million persons in the mill, powerloom and handloom sector.

2) Cotton Production
   - India is the world's third largest producer of cotton and cotton accounts for 30% of India's total export volume.
   - According to recent FAO data, India produces an average of 750 kg of seed cotton per hectare compared to 2100 in USA, 2800 in Egypt, 2900 in Mexico, 3100 in Brazil, and 3400 in China. China, with half the area under cotton cultivation, produces 1.5 times the amount of cotton, has 1.5 times the world market share and three times the average yield.
   - This year's output is expected to touch a record 18 million bales, of which 1.9 million bales will be an exportable surplus.
   - Rising world production coupled with India's bumper crop and very low yields have resulted in massive import of lower prices foreign cotton by textile manufacturers at a time of record domestic surplus, causing domestic prices to fall dramatically and creating havoc in the local cotton market.
   - The need to ensure that Indian textile exports remain competitive compels the country to permit the low priced imports at the same time that WTO agreements make raising protective barriers increasingly difficult.
   - While India is capable of producing a very high quality of cotton, the vast bulk of what is supplied to mills is mixed with impurities and considered to be of inferiority quality.
   - Methods of cultivation and irrigation presently employed also result in a very high consumption of water in cotton cultivation, which can be reduced by 75% or more.

3) Prospects & Challenges
   - With the lifting of textile import quotas beginning January 2005, India has the opportunity to dramatically increase the export of cotton textiles and garments.
   - Industry projections indicate that as many as 12 million additional jobs can be created in agriculture, processing industries and garment production, 5 million through direct employment in the textile industry and 7 million jobs in allied sectors.
   - To fully tap this potential, concerted efforts are needed to elevate India's current cotton low yields and poor quality.

4) Strategy
   - *Raising Yield & Quality:* Considering India's huge productive base of cotton cultivation coupled with its huge textile industry and surging export potential, concerted efforts are needed to raise the yield and quality of cotton production both for domestic consumption and export.
   - *Farm Schools:* Improved varieties of cotton seed coupled with improved plant nutrition and advanced irrigation practices can dramatically improve the yield and quality of Indian cotton. The farm school programme outlined in this document provides the necessary means to achieve these goals.
   - *SHGs & Contract Farming:* Cotton farmers suffer from a variety of ills typical to small and marginal farmers in India, namely poor cultivation practices, poor quality seeds and inputs, lack of credit and dependence on middlemen. Promotion of SHGs linked by contract to ginning and textile mills as described in Section 0 below can address all these weaknesses in an effective manner. The model evolved by Appachi Foundation, Coimbatore and applied to establish 60 SHGs of cotton farmers in Tamil Nadu can effectively be extended throughout the country.
   - *Crop Insurance:* Since a large portion of cotton cultivation is rainfed, strengthening implementation of crop insurance programmes is vital for reducing threats to cotton farmers.

B. MAIZE PRODUCTS

Maize can be processed into chicken feed and cattle feed, which enjoy a huge market. India is currently importing large quantities of chicken feed to meet domestic demand. Maize can also be processed into corn syrup, which is the largest source of sugar in the USA, corn flour, corn flakes and many other products. The potential for India's maize productivity improvement is three to four times, provided modern techniques are adapted.

C. HERBS & MEDICINAL PLANTS

Herbal and medicinal plants such as amla and neem have both domestic and export potential when processed to extract their active agents and vital nutrients.

7. *Agricultural Credit & Crop Insurance*

Lack of access to farm credit and crop insurance have seriously constrained farmers from adopting new cropping patterns and improved crop production practices. The decision of the Government of India to double credit to farmers is a very important initiative to reverse the gradual decline in support to this crucial sector. However, the translation of that decision into action will face serious obstacles due to the accumulated loan arrears to the agricultural sector coupled with the broader effort to operate the nationalized banks on a more strictly commercial basis. Special policy measures will be required to overcome this tension between commercial and developmental goals.

A viable crop insurance programme can play a vital role in bridging the gap between developmental and commercial objectives. Insurance can provide protection to both the farmers and the banks against uncontrollable risks, thereby lowering default rates and encouraging wider lending to this sector.

A. CREDIT

Lack of sufficient farm credit -- Even if the first two factors are successfully addressed, higher cultivation cost or longer crop duration will still constrain farmers from adopting improved production methods unless assured access to credit is also made available.

The best example of a successful farm credit system is the contract farming system employed by sugar mills all over the country. Farmers register with local sugar mills for growing sugarcane in a certain area and obtain access to farm inputs and crop loans on the basis of these contract. Similar contract farming practices supported by crop loans from commercial and cooperative banks, which are prevalent practices in other countries, can be extended to a wide range of crops, including maize, tapioca, and sugar beet for ethanol production; jatropha and Paradise Tree for oil extraction, and tree crops for biomass power generation.

Combined with greater access to credit, advanced AT applied in a graded approach can raise farm productivity and incomes, so that in each cropping system an incrementally higher investment in cultivation can result in a significantly higher net income to the farmer. Even in instances where farm credit is limited, farmers can gradually and progressively raise their productivity and incomes utilizing this technology. In one project southern Bihar, applying advanced AT enabled maize farmers doubled their yields and incomes from maize in one cropping system and then went on over four years to diversify cropping patterns and multiply farm income. Today these farmers, who started with only an acre or less of land just a few years ago, are now cultivating five acres or more of high income vegetable crops.

Extension of credit to farmers is severely curtailed by the huge backlog of agricultural defaulters and the natural reluctance of banks to extend further credit to those who have not repaid in the past. While wilful default is a common practice that must be discouraged and minimized, often default occurs because of reasons beyond the farmers' control and reflects an temporary inability rather

than an unwillingness to pay. Cutting off credit in these instances only further aggravates the situation by converting that temporary inability into a permanent status.

Mechanisms can and must be adopted to strengthen the capacity of banks to enforce repayment from wilful defaulters while encouraging them to extend additional credit to those who are willing but temporarily unable to pay the full amount of arrears.

B. CROP INSURANCE

Without a strong crop insurance programme, increasing credit to the farm sector will be fraught with difficulty. Existing crop insurance programmes suffer from multiple weaknesses.

- Coverage usually does not include the incidence of drought.
- Even when it does, the lack of adequate rain gauges to monitor actual rainfall within regions results in wrong decisions regarding payment of insurance awards.
- Studies have shown that rainfall may vary significantly within small regions. Therefore a much more precise monitoring system is required to monitor it.
- Reimbursements under crop insurance programmes often occur after a year or more, which is an untenable period for a farmer who needs to immediately reinvest in his next crop.

The following measures are needed to strengthen crop insurance coverage.

1) Expand coverage to include drought as well as other factors.
2) Insurers can stipulate that enrolment in farm school programmes adoption of advanced technologies is a precondition for insurance coverage.
3) The system for monitoring rainfall must be strengthened to provide accurate data on actual rainfall patterns at the village level.
4) An independent public body consisting of agricultural university staff, insurance agents, bank officers, SHG leaders, district level government officials, farmers group leaders and contract farming agents should be established for monitoring insurance claim administration in each district.
5) A time limit of 90 days must be established and enforced for the processing of all crop insurance claims by insurance companies.

8. *Promotion of Sustainable Self-Help Groups & Contract Farming*

While credit is an essential input for the tapping of these potentials, the greatest necessity is to evolve a more viable form of rural organization that provides for all the critical elements needed by farmers and ensures close linkages between small farmers, processors and end-markets.

More than one million SHGs benefiting about 15 million families have been established in India within the past four years. Most of these groups consist of women undertaking subsidiary occupations. The repayment rate on loans extended to the groups has been remarkably high. While most of the SHGs are engaged in non-agricultural activities, recently SHGs of small farmers have been successfully established for cultivating cotton and other crops. The SHG model has shown that it has great potential, provided that strong linkages are created for supply of inputs and credit and for marketing.

India already possesses a proven system for farm to factory linkages that has operated successfully in the country for over 150 years – contract farming in the sugar industry. Through the system of registered crops, farmers obtain credit, inputs, extension services and assured market for their produce. Contract farming as practiced by the sugar industry has enabled India to become the world's largest producer. It has not spread to other crops because there is no way to enforce the contracts for delivery of crops.

Creation of sustainable SHGs can be fostered by combining this organizational model for production with a complementary organizational model for procurement, processing and marketing – contract farming. The contract farming system has proven successful around the world for a wide range of crops. The successful combination of these two complementary systems requires addressing some key practical and policy issues, which are discussed below.

C. KEY ELEMENTS OF A STRATEGY TO MODERNIZE AND ELEVATE INDIAN AGRICULTURE

An organizational strategy is needed that will tie together all the essential elements required for raising production and productivity – training and extension, input supply, farm credit, crop protection and market access.

- Self-help Groups (SHGs) are spreading rapidly, enabling million of small producers to obtain access to credit, but the existing model does not provide for the critical inputs needed to elevate Indian agriculture – quality inputs, credit, access to processing facilities and assured markets.

- Most small and marginal farmers are presently ineligible for bank credit under SHG schemes since they have defaulted on prior bank loans for one reason or another. Tie-ups with contract farmers can provide banks with the confidence that SHG produce will have a ready market and the contractor can take responsibility for repaying bank loans out of the sale proceeds, as is presently done in the sugar industry.

- SHGs will be sustainable only when they are constituted to effectively serve real market needs. Assured marketing can best be achieved by fostering close linkages with processing industries. Processing industries must be developed as the primary market for agricultural produce rather than the direct consumer.

D. BASIC ELEMENTS OF THE CONTRACT FARMING – SHG MODEL

- Contracting Agency (CA) establishes a new processing plant for the produce or negotiates with an existing downstream processing industry or ties up with a domestic or export market for the produce.

- CA adopts an area for contract farming.

- CA approaches farmers to establish SHGs in each village for cultivation of specific crops.

- CA appoints one member of the SHG who is a Consultant-Lead Farmer (CLF) to act as its link agent with the farmers.

- CA acts as intermediary with commercial banks to obtain loans for all members of the SHG against group guarantees.

- CA enters into a contract with each SHG committing to buy the full production of the crop at a fair market price to be determined by an objective and independent mechanism.

- CA ties up with processing units to deliver the crop at harvest time.

- Loans are disbursed mainly in the form of seeds, fertilizer and pesticide during the cropping season through the CA who procures and distributes the materials and obtains payment directly form the bank. Failure of the farmer to proceed with any stage of crop development leads to an automatic and immediate suspension of the credit line.

- CA obtains post-dated checks payable to the bank from the borrowers at the time of loan sanctioning to ensure timely repayment.

- CA acts as intermediary with insurance companies to obtain crop insurance coverage for the SHGs, to monitor and investigate claims, and represent claims to the insurance company and a regulatory monitoring authority.

- CA acts as intermediary with input suppliers to purchase quality inputs in bulk ex factory at discounted prices and delivery them to the farmers at various stages of the cultivation process to ensure that they are applied as specified.

- The CLF is responsible to ensure proper dissemination of the loans to qualified applicants, sale of the crop to the CA, and timely repayment to the bank.

- CA provides training to its CLFs in advanced cultivation practices and each CLF establishes a model farm cum training centre (Farm School) on his own land to demonstrate and disseminate the same knowledge to farmers in the SHG. The CLF is paid an incentive by the CA for demonstration, transfer of knowledge and raising productivity of the SHG. The Farm School is the key to effective technology transfer.

- CA utilizes the power of Information Technology (village kiosks) to deliver cost effective training, technical advice and market information to the SHG members.

E. POLICY FRAMEWORK REQUIRED TO MAKE THE SYSTEM EFFECTIVE IN INDIA

- ***Access to Credit:*** Credit must be made available to all farmers, even previous defaulters, in order to break the cycle of poverty. Regulations can be modified instructing national banks to extend new credit to members of SHGs **who sign group guarantees** and who agree to return the old banking dues over time. The incentive of new credit will motivate many farmers to return at least a portion (25 or 50%) of their arrears as a pre-condition for extension of further credit. It is possible 100% arrears will be collected before the scheme opens if the confidence of the farmer is won.

- ***Powers for Revenue Recovery:*** Banks must be empowered with Revenue Recovery Act summary procedures to seize the assets of wilful defaulters under the SHG scheme, a power now enjoyed by the cooperative banks.

- ***Effective Crop Insurance Cover:*** A viable and effective crop insurance programme, which covers drought as well as other factors, can lead to dramatic improvements in farm productivity. Insurers can stipulate that adoption of advanced technologies is **a precondition for insurance coverage**. Accurate monitoring of local rainfall in each covered area is essential for fair administration of the scheme and adequate staff must be provided to support the system. CAs and CLFs can act as agents for the insurance companies, facilitating access to insurance, and agents for the SHGs to facilitate filing of claims. An independent public body consisting of agricultural university staff, insurance agents, bank officers, SHG leaders, district level government officials and CAs may be established for monitoring claim administration in each district. Crop insurance is a FULL GUARANTEE to the banks for recovery as the farmer will perform to qualify for the insurance. **After a cycle of a few years of successful performance, the LOAN itself can be insured.**

- ***Incentives for Raising Productivity:*** CAs are the best agency for delivery of effective farm extension services. They will be motivated to improve crop yields and quality because it reduces the cost of production and increases the marketability of the produce. Incentives can be introduced for CAs that provide farmer training and achieve measurable improvements in crop productivity.

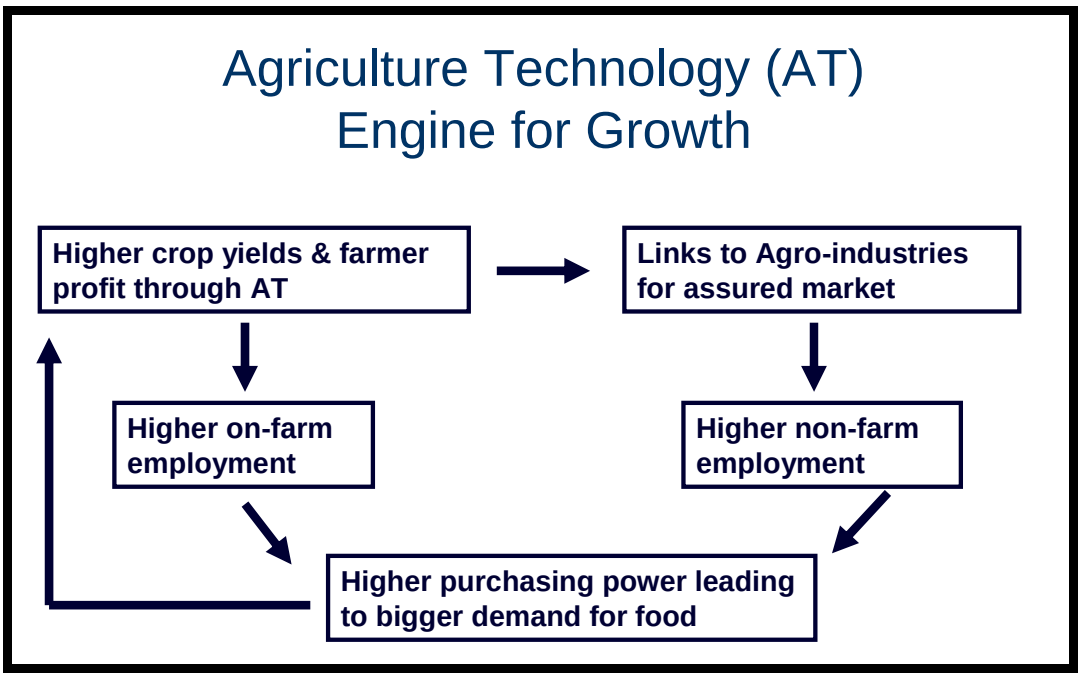
- ***Enforcement of Penalties for Adulteration:*** CAs are the best agency for delivery of quality inputs. Severe penalties may be levied and strictly enforced for supply or sale of adulterated materials.

- ***Harnessing Rural Information System:*** Mission 2007: Every Village a Knowledge Centre – if implemented as conceived, this will provide the essential basis for transfer of information and delivery of timely and cost effective training and extension services to farmers.

9. *Comprehensive National Strategy*

This paper presents a comprehensive strategy for applying this set of solutions as depicted in Figure 5.

Figure 5: AT Strategy



The main elements of the strategy include:

1. Train agricultural entrepreneurs and lead farmers in the advanced and proven agricultural production technologies to increase yields and farm incomes on a wide range of irrigated crops, including rice, maize, sugarcane, cotton, vegetables, banana, tapioca, and others, as well as on a wide range of rain-fed crops that can be grown on manavari and cultivable wastelands, including casuarina, eucalyptus, cashew, neem, jatropha, Paradise Tree, amla, prosopis and others.

2. Promote widespread cultivation of bio-fuel crops such as jatropha, maize, tapioca and sugar beet in conjunction with efforts to foster agro-industrial linkages for the establishment of jatropha oil and ethanol processing plants.

3. Promote widespread cultivation of bio-mass crops such as casuarina and prosopis in conjunction with efforts to foster agro-industrial linkages for the establishment of decentralised biomass power plants.

4. Promote widespread cultivation of edible oil crops such as Paradise Tree in conjunction with efforts to foster agro-industrial linkages for the establishment of edible oil extraction plants.

5. Promote expansion of area under horticulture crops supported by a national network of cold storage, transport and processing units.

6. Demonstrate and promote dissemination of advanced methods for rainwater harvesting and improved water management, including deep soil ploughing and furrow irrigation techniques.

7. Hesitation to take up new crops in place of traditional crops can best be addressed by educating farmers and demonstrating the higher profitability of alternative crops. Farmers are more educated and progressive today and will respond when exposed to proven opportunities.

8. Concerns about marketing can be addressed by fostering agro-industrial linkages and reducing production cost to open up international markets. The tremendous expansion of the sugar industry is the best example of agro-industrial linkages. The success of Maharasthra in grape and mango cultivation is an excellent example of successful international marketing.

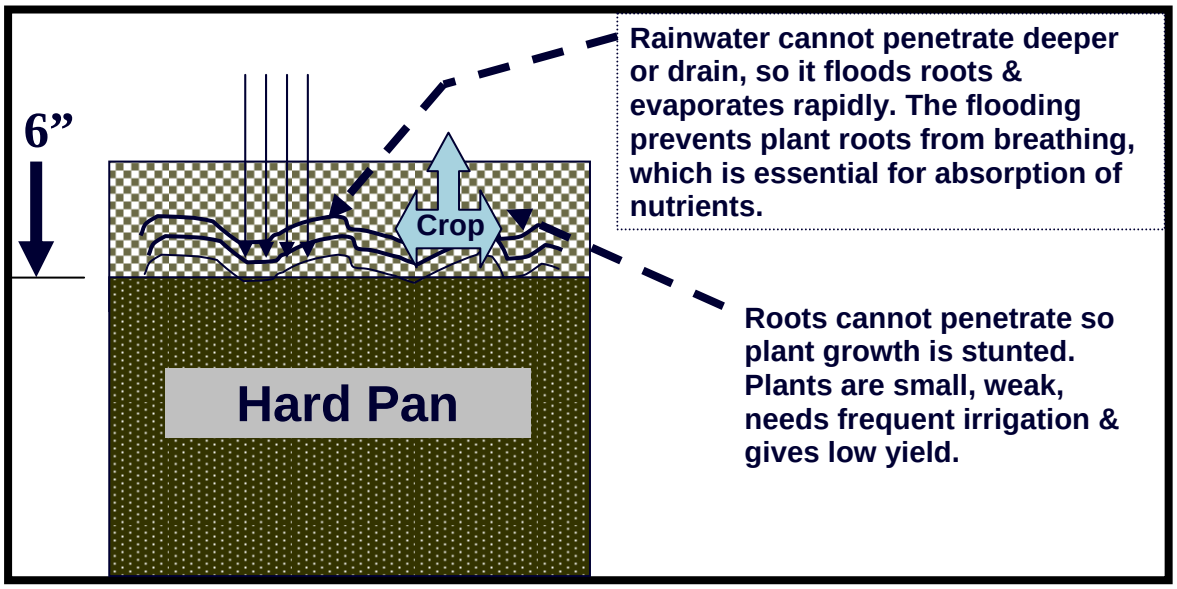
10. *Raising Crop Productivity*

The advanced agricultural technology needs to be inducted, including technology for upgrading soil fertility and improving irrigation to double or triple farm yields and incomes on a wide range of commercial crops. This technology has already been shown to be highly effective under a variety of conditions in India.[‡] The technology involves --

A. Land Preparation for High Productivity and Water Conservation

1) Indian farmers usually plough the soil only 6 to 8 inches deep. This results in dense packing of the earth over time, which prevents rainwater from penetrating deep into the soil where it can be stored and results in run-off of rain water and excessive soil erosion. The hardening of the soil also prevent plants from sending their roots deep into the earth, resulting in horizontal root growth, weak plant structure and stunted plant growth. When these lands are irrigated, the root systems are alternately flooded and starved of water, which prevents them from metabolizing soil nutrients effectively. The problem of shallow ploughing is illustrated in Figure 6.

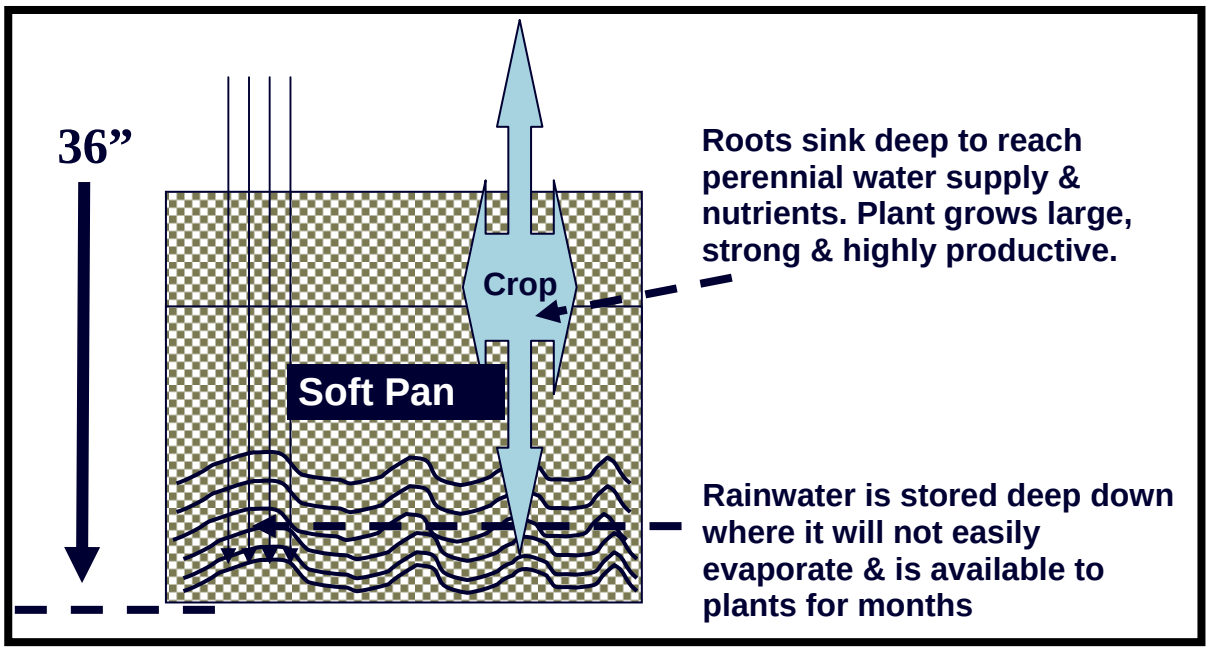
Figure 6: Impact of Shallow Ploughing in India



[‡] Pioneering work has been done by Dr. C. Lakshmanan, Director of California Agricultural Consulting Services, in demonstrating the potential for higher yields and profits on a wide range of crops under Indian conditions.

2) Advanced land preparation techniques utilize special implements to break up the underlying pan to achieve deeper root penetration by crops and improve water retention and utilization. These deep ploughing techniques can penetrate down 36 inches or more into the soil. This enables rain water to penetrate and collect at greater depth where it can be drawn upon by the plant root systems and also stored for long periods of time. Rainwater run-off and soil erosion are greatly reduced. Plants are much healthier and crop productivity is much higher. These methods can reduce the need for irrigation to as low as 20% or on-fifth that normally required in India. That is why California farmers are able to irrigate cotton only once in 40 days compared to once in 6 days in Tamil Nadu under similar climatic conditions. The benefits of deep ploughing are illustrated in Figure 7.

Figure 7: Impact of Deep Soil Ploughing



B. BALANCED SOIL AND PLANT NUTRITION

3) Plants require more than 12 essential nutrients to generate healthy and productive growth. Without these nutrients, the genetic potential of hybrid seeds cannot be tapped. For example, the same hybrid rice seed that yields 2.8 tons per hectare in India, generates 5.4 tons in China and 8 tons in USA because of improved plant nutrition.

4) Soil testing labs in India routinely test for only three macronutrients, nitrogen, phosphorus and potassium. Other crucial nutrients such as iron, copper, manganese, sulfur, magnesium, chlorine, boron, calcium and molybdenum are ignored. As a result, the application of chemical fertilizers does not effectively replenish soil nutrients and the plants raised in that soil lack resistance to pests and suffer from slow and stunted growth. Advanced methods of plant nutrition can triple or even quadruple productivity of the same hybrid seed.

5) In addition, the methods and timing employed for the application of chemical fertilizers in India lead to low absorption by the plants, excessive wastage and high cost. Achieving balanced soil nutrition can generate higher rates of growth with relatively lower levels of fertilizer application.

6) Progressive application of plant nutrients prior to planting can balance and build up the fertility of the soil over successive cropping seasons.

7) Crops grown without proper nutrition are also poorer in quality and more perishable. They deteriorate more rapidly after harvesting, leading to high post-harvest losses. Improved soil nutrition can extend storage time, improve taste and nutritional value, improve appearance

and also achieve more desirable qualities for specific purposes, such as lower moisture and higher solids content from vegetables that are to be processed.

C. CROP SELECTION

8) Crop Rotation is practiced to restore the nutrient value of the soil and to reduce dependence on a single cropping pattern. An example of a typical crop rotation pattern suitable for irrigated lands in Tamil Nadu is given below:
   - Vegetable in fall
   - Maize in spring
   - Pulse in summer

9) Mixed Cropping Patterns are practiced even on small land holdings in order to maximize incomes, reduce dependence and vulnerability from reliance on a single crop and meet the varied nutritional needs of the family. An example of a several mixed cropping pattern for irrigated and dry lands is given below:

   Cropping pattern for irrigated & dry lands
   - 2 acres sugar beet and sweet sorghum for ethanol
   - 1 acre banana
   - 1 acre vegetable
   - 1 acre pulses for edible oil
   - 1 acre mango, neem or amla orchard (irrigated or dry)
   - 1 acre Casuarina (irrigated or dry)
   - 1 acre jatropha (irrigated or dry) for fuel oil
   - 1 acre Paradise tree (dry) for edible oil

D. IRRIGATION & WATER MANAGEMENT

Crops grown in India often suffer from excess of water rather than water deprivation. When plant root systems are submerged under water, the plant cannot absorb the oxygen necessary to metabolise soil nutrients, so it can actually 'starve' in the midst of plenty. Methods commonly employed in India for flood irrigation often deliver too much water at the wrong place and the wrong time for maximum benefit to the plants. Proven methods for extensive irrigation can optimize the utilization of water while maximizing plant growth.

E. ADVANCED METHODS OF PRODUCTION OF TRANSPLANTS AND SEEDING

Advanced methods can ensure a healthy, pest free plant material that has received all the nutrients required during the critically important early stages of growth, so that the genetic material in the seed can fully express its potential.

F. PEST MANAGEMENT

Poor nutrition and poor water management practices also make crops more vulnerable to attack by a wide range of pests. Improving soil nutrition generates higher resistance to pest attacks while improved water management reduces the moisture content in which pests thrive. A comprehensive package of pest management practices can significantly reduce the risks and losses due to pests.

G. TIMING & SCHEDULE MANAGEMENT

Effective application of agricultural technology depends not only doing the right thing in the right way, but also on doing it at the right time. Each stage in the preparation of land, application of soil nutrients, planting, weeding, irrigation, pest management and harvesting

needs to be timed so as to maximize the benefits to the plants and minimize waste and losses. Schedule management is essential for achieving optimal performance from seeds, fertilizers and water.

H. ADVANCED METHODS FOR HARVESTING AND POST-HARVEST HANDLING

Proper handling of crops during and after harvesting can result in a significant reduction in damage and wastage and significantly longer shelf life.

I. STRATEGY FOR IRRIGATED FARM LANDS

- Diversification of crops, including foodgrains, pulses, vegetables, fruits and tree crops, to focus on those that generate the highest profit per acre under current market conditions.
- Application of rainwater harvesting techniques to improve water retention and plant growth and reduce soil erosion.
- Improved soil nutrition to double or triple yield per acre.
- Mixed cropping patterns to reduce vulnerability to saturated markets.
- Linkages with agro-industries such as ethanol to provide assured off-take and remunerative prices

J. STRATEGY FOR NON-IRRIGATED FARM LANDS

- Diversification of crops, including oil bearing and biomass tree crops, fruits and nuts, herbs, medicinal crops such as amla and neem, to focus on those that generate the highest profit per acre with little or no water.
- Application of rainwater harvesting techniques to improve water retention and plant growth and reduce soil erosion.
- Improved soil nutrition to double or triple yield per acre.
- Crop rotation and mixed cropping patterns to reduce vulnerability to saturated markets.
- Linkages with agro-industries such as biomass power, jatropha fuel oil and Paradise Tree edible oil to provide assured off-take and remunerative prices

K. STRATEGY FOR AGRO-INDUSTRIAL LINKAGES

- Educate farmers about commercial potential of each agro-industrial crop.
- Promote contract farming to strengthen linkages between growers and processors.
- Demonstrate methods for high profit cultivation at training centres & on farm schools.
- Canvas farmers in each region to plant sufficient area for one or more agro-industries of each type.
- Conduct business conferences in major cities to promote these agro-industries.
- Identify potential entrepreneurs and investors in each taluq and approach them to establish units.

- Recommend establishment of cold storage and crop processing facilities.

11. *Farm Schools*

Rapid introduction of advanced agricultural production technology can be achieved by establishment of a national system of model farm schools to demonstrate and train progressive farmers on the latest production technology. These Farm Schools should be supported by a network of regional training centres (RTC) providing technical support on a continuing basis, the soil testing labs, and farm equipment hiring services. The characteristics of the farms schools should be as follows:

A. Each farm school will be self-sustaining, profit-making, farm cum training centre owned and managed by a farm school instructor-entrepreneur.

B. The objective of each farm school will be to demonstrate multiple cropping patterns suited to the local soil and climatic conditions that can generate a minimum of Rs 50,000 per acre annual income from irrigated lands and a minimum of Rs 10,000 or more per acre from rain-fed lands.

C. Each farm school should consist of a minimum of ten acres of irrigated and rain-fed farm lands owned by the instructor-entrepreneur or leased from farmers in the village, a computer system with internet connection linked to the regional training centre and a classroom teaching facility.

D. Demonstrations and training will be carried out on lands owned by or leased from farmers, so that they will have maximum impact.

E. Capital expenditure by the farm school entrepreneurs on computers, farm machinery and teaching materials as well as crop cultivation loans will be financed by banks through a special state-sponsored agricultural credit scheme.

F. Certified farm school instructors who enlist a minimum of 30 students per annum will be eligible for continuing technical support from the RTC in the form of:

   1) Access to a high quality, soil testing lab at the RTC capable of accurately analyzing the complete spectrum of plant nutrients.

   2) Access to an expert computer program for analyzing soil types and recommending best practices to achieve maximum yield and profitability.

   3) Access to priority use on a hire basis of the specialized farm machinery required for deep ploughing and soil treatment to be provided by or through the RTC.

   4) Access to Internet and CD-Rom-based training material designed to accelerate transfer of knowledge to lead farmers.

G. All cultivation on the farm schools should be done by student farmers enrolled at the school and drawn from the local population. Students should be charged a fee for enrolment in the programme which entitles them to participate in classes and demonstrations, provides them access to information from the computerized intelligent system and computerized training materials, as well as priority access to specialized farm machinery.

H. Each farm school should achieve a minimum average annual revenue of Rs 50,000 per acre for irrigated crops and Rs 10,000 per acre of rain-fed crops.

I. Training Curriculum
   - Crop economics
   - Crop selection methods
   - Land preparation
   - Deep ploughing & rainwater harvesting techniques

- Soil analysis & plant nutrition techniques
- Pest management practices
- Irrigation scheduling & methods
- Crop maintenance practices
- Harvesting methods
- Post-harvest handling
- Agro-industry & agri-business opportunities
- Marketing
- Teaching and communication skills

12. *Employment Guarantee Scheme*

On November 14th, 2004 the Prime Minister launched the Employment Guarantee Scheme covering 150 of the poorest districts in the country. The programme, which is supported by a budget allocation of Rs 5000 crores, is intended to provide employment for at least one member of each family below the poverty line.

While previous programmes have focused on generating employment on public works projects, which involve high capital investment, the EGS can also be used to create employment opportunities discussed in this report, particularly those related to cultivation of energy plantations for bio-mass and bio-fuels, Paradise Tree for edible oil, and horticulture. Development of large scale plantations of these crops will involve millions of man-years of employment in the form of land preparation and development, raising of nurseries, planting and nurturing of plants, etc. The fact that material inputs for these projects is quite low, will mean that more of the resources will be available for direct wage payments to the programme beneficiaries.

13.*Benefits of these Strategies*

Concerted efforts to apply the solutions listed above can result in dramatic benefits, raising millions of people above the poverty and ushering in a Prosperity Movement in the country. These benefits will include

Higher farm incomes: Incomes from both irrigated and non-irrigated lands can be raised by a minimum of 100%.

Employment: The strategies described in this paper, when fully implemented can generate 40 to 50 million on-farm and non-farm employment opportunities around the country. See Table 2 below. These addition jobs and incomes would generate a multiplier effect that generates as many as 60 million additional jobs in other sectors of the economy.

Poverty Alleviation: Lower food production costs, higher farm incomes and additional on-farm and non-farm employment opportunities can raise millions of families above the poverty line and usher the rural areas into prosperity.

Development of Cultivable Wastelands: Cultivable rain-fed lands in private hands can be made far more productive, resulting in higher incomes to families living below the poverty line, year-round employment opportunities, generation of renewable energy and stimulus to agro-industrial enterprises.

Improved Water Management: Application of advanced techniques for rainwater harvesting and water management will result in substantial increase in crop yields, reduce rainwater run-off and soil erosion, and recharge groundwater.

Renewable energy: Implementation of this approach can lead to establishment of more than 40,000 MW of biomass power plants in the country based on renewable energy over the next five years in addition to production of more than 7 million tons per annum of bio-fuels from ethanol and jatropha.

Rural industrialization: The cultivation of irrigated and non-irrigated crops with assured industrial potential, including maize, tapioca, and sugar beet for ethanol production; Casuarina, bamboo, prosopis and other tree crops for biomass power; Paradise tree for edible oil and jatropha for fuel oil can result in the establishment of around 8000 new rural industries supported by a reliable decentralized network of rural power plants.

- *4000 biomass power plants of 10 MW each*
- *2500 jatropha oil extraction units*
- *1000 Paradise tree oil extraction units*
- *250 ethanol fuel processing plants*

Higher GDP: Higher agricultural productivity combined with agro-industries can generate more than Rs 100,000 crores per annum of additional GDP in the country. The wasteland and energy related programmes alone can generate Rs 70,000 crores per annum.

Table 2: Employment Generation Potential

Project	Additional Area (Ha)	Job Creation
Energy plantations for 40,000 MW		
Prosopis	5 M ha	
Casuarina	5 M ha	5,000,000
Oilseed plantations		
Paradise Tree - Edible oil	4 M ha	2,000,000
Jatropha - Fuel oil	10 M ha	8,000,000
Ethanol plantations from sugar beet & sweet sorghum	3 M ha irrigated	8,000,000
Horticulture	4 M ha	8,000,000
Other High Potentials Areas		
Crop productivity improvements to double farm incomes		5,000,000
Agro-forestry, medicinal plants, dairy, animal husbandry, fisheries		6,000,000
Cotton & Textiles based on industry estimates of higher export potential by 2010		12,000,000
Total in agriculture & agri-business		**54,000,000**
Multiplier effect on economy as a whole – an additional		**46,000,000**
Total employment potential		**100,000,000**

ANNEXURES

Annexure 1: Energy Plantations for Biomass Power Generation

Cultivation of fast-growing trees such as *casuarina equistifolia, bamboo, and eucalyptus* and bush crops such as *prosopis juliflora* can serve as biomass fuel for establishing a national network of decentralized rural power plants. These power plants, ranging in size from 10-25 MW, can generate thousands of megawatts of power from renewable, forest-based fuel sources in a cost-effective manner. This would reduce India's dependence on imported fuel oils, stimulate private investment in the power sector, and generate massive income and employment opportunities for the rural poor.

1. Energy Plantations

Casuarina is a fast growing tree that can be cultivated on marginal waste land and harvested on a rotating basis from the third to fourth year onwards. Casuarina is already commercially cultivated over wide tracks in the southern states, primarily as a rain-fed crop for fuel and construction. It can also be used as pulp for papermaking. It has been found an excellent species for environmental control of erosion, stabilization of soils and reclamation of poor soils. Casuarina has a calorific value of about 3500 k calories and contains less water than most wood species.

One hectare of Casuarina under rain-fed conditions can produce on average 200 tons of fuel in four to five years, an average of 40 to 50 tons per annum under rain-fed conditions. Under irrigated conditions, yields averaging 150 tons per acre per year can be obtained.

It requires 10,000 tons of Casuarina to generate one megawatt for a year.

By harvesting the crop on a rotating basis, a standing plantation of 250 hectares is sufficient to generate one megawatt of power. A 2500 hectare Casuarina energy plantation can support a 10-12 MW power plant.

Assuming a net farm selling price of Rs 700 per ton, one hectare of Casuarina can generate year-round net income of Rs 28,000.

Prosopis is a thorny plant that already grows wild on extensive areas of wasteland and serves as a fence, but is not being harvested or utilized for commercial purposes. It grows rapidly, producing about 10 tons of biomass on dry-weight basis per hectare per annum. The wood is hardy with calorific value of about 4000, as compared with 3000 for coal. It grows well in sandy, loamy, sodic, saline, alkaline and marshy soils with very little input and at very low cost. The biomass is an excellent raw material for power generation. A 1000 hectares of rain-fed prosopis can provide sufficient fuel to generate one MW of electric power.

One hectare of prosopis under rain-fed conditions can produce on average 10 tons of fuel per hectare per year, from the 3rd year onwards.

By harvesting the crop on a rotating basis, a standing plantation of 1000 hectares is sufficient to generate one megawatt of power. A 10,000 hectare prosopis energy plantation can support a 10 MW power plant.

Assuming a net farm selling price of Rs 700 per ton, one hectare of prosopis can generate year-round net income of Rs 7,000.

Each hectare requires 100 man-days per annum of labour input.

2. Economics of Cultivation

Table 3: Economics of Energy Plantation Crops

	Casuarina	**Prosopis**
Initial cost of cultivation 1st year (w/o labour)	Rs 2000	Rs 500
Gestation period	5 years	3 years
Capital cost till harvesting begins/hectare	Rs 6000	Rs 500
Average yield per hectare per year	40 tons	10 tons
Price per ton (net at farm)	Rs 700	Rs 700
Average annual gross income per hectare	Rs 28,000	Rs 7000
Average annual net income per hectare	Rs 27,000 from year 5	Rs 7000 from year 3
Plantation for 10 MW power	2500 hectares	10,000 hectares
Employment generation per plantation	2500 persons	5000 persons
Average annual income per person	Rs 27,000	Rs 14,000

3. Power Plants

Mini-power plants in the size range of 6 to 25 MW utilizing biomass such as Casuarina, prosopis and paddy husk are already operational and commercially viable in several Indian states.

The local power plants will provide an assured market for the energy plantation crops at pre-negotiated prices and reduce the cost of transporting the crop from field to market.

All power generation equipment is indigenously fabricated and readily available.

The power plants will cost approximately Rs. 3 crores per megawatt. The low capital investment in the power projects will make them attractive to Indian entrepreneurs and reduce dependence on large power projects with long gestation periods and foreign investment.

Based on a farm sale price of Rs. 700 per ton for the fuel, the cost of power generation is Rs. 3.00 per unit, compared to Rs 2.50 for coal and Rs. 4.00 for petroleum based power plants utilizing imported fuels. In addition, wood generates far less pollution than either coal or oil.

4. Programme Benefits

These rural plantation and power projects offer a variety of advantages:

- Establishment of 10 million hectares of energy plantation will be sufficient to generate 40,000 MW of power generation
- Cultivation of 10 million hectares of energy plantations alone will generates direct year-round employment for 5 million persons and on-farm income of Rs 1000 crores.
- Purchase of fuel from rural families generates rural jobs and rural prosperity rather than expenditure of foreign exchange.
- Power plants can be located in every district and taluq of the country, providing the essential infrastructure for rural industrialization.

- Local power distribution will also reduce transmission losses from the current 18-13% down to 10%.
- Locally grown bio-fuel will reduce dependence on imported fuels.
- General improvement in water harvest and increases the sub-soil water table.
- Better soil Conservation and fertility improvement.
- The expansion of forest area will increase rainfall, reduce the run-off of rainwater and raise the water table throughout the country.

Annexure 2: Bio-Fuel from Jatropha

Cultivation of oil bearing crops such as jatropha on both irrigated and medium grade cultivable wastelands can serve as an economically attractive alternative to the import of fuel oil. Establishment of local oil extraction units can stimulate rural industrialization. Establishment of 10 million hectares of jatropha oilseeds plantation will be sufficient to provide 5 million employment opportunities.

This plant was introduced from Africa, where it grows in the wild. A wild species already grows in India and is often used as a fence crop. The plant produces large quantities of seeds which contain up to 35% oil. The oil is a bio-fuel and substitute for No.2 diesel and kerosene. It can be blended in diesel motor fuels up to 15%. The cost of production is competitive with other fuel oils. In addition, curcas oil can be utilized in the manufacture of soap, paints and varnishes. The oil cake is highly nutritive as an organic manure which is superior to poultry manure. The crop starts yielding from the 3rd year and continues bearing for 25-30 years.

- Planting pattern – 2500 plants per hectare @ Rs 2 per plant
- Cost of cultivation per hectare – Rs 3000 in 1st year for plants & fertilizer (labour till maturity not included)
- Gestation – yield from 3rd year onwards
- Farm yield per hectare (rain-fed) – ranging from a high of 5kg/tree or 12.5 MT per ha under good conditions to 1.5 MT per ha under rainfed or poor soil conditions.
- Based on 35% oil content and 91% extraction efficiency, it requires 3.125 kg of seed to produce one kg of oil. We assume an average yield per ha of
  - 3750 kg of oil seed containing 1200 kg of oil
  - 1800 kg of oil cake
  - 1250 kg of pulp manure (nitrogen rich manure can be used to extract biogas for power generation and then used as a fertilizer).
- Sale price of farm produce – Rs 5/kg of seed; Rs 3-4 for oil cake, and Rs 1.50-2.00 /kg of manure
- Income of farmer per hectare (rain-fed) – Rs 27,000 per annum from 3rd year onwards
- Value added income of oil industry – Rs 6,000 per hectare per year
- Oil Produced – 1200 kg per hectare valued at Rs 20 per kg = Rs 24,000. Yields from irrigated lands will be 100% higher.
- Employment – average of 150 man-days per hectare per year
- Proposed area for cultivation – 10 million hectares in five years
- Total employment – 7.5 to 10 million permanent jobs depending on conditions
- Total income generated – Rs 30,000 crores

Annexure 3: Edible Oil from Paradise Tree

Cultivation of edible oil bearing crops such as Paradise Tree on both irrigated and medium grade cultivable wastelands can serve as an economically attractive alternative to the import of edible oil. Establishment of local oil extraction units can stimulate rural industrialization. Establishment of 5 million hectares of Paradise Tree oilseeds plantation will be sufficient to provide 2.5 million year-round employment opportunities.

Paradise Tree (*simaruba glauca)* is a Brazilian oilseed bearing, drought-resistant, high-yielding, perennial ever-green tree ideally suited for dry land areas of India. It grows under rain-fed conditions and requires minimal inputs. It starts bearing seeds from the 3rd or 4th year. The seeds contain 50% oil, which when refined is very similar in characteristics to groundnut oil. India currently produces 18 million tons of edible oil per annum, a shortfall of 3 million tons less than current domestic consumption. The National Oilseeds & Vegetable Development Board has already identified this crop and recommended its widespread cultivation in India. Cultivation of 10 lakh hectares of Paradise tree over five years can meet the country's entire shortfall in the edible oil production.

- Planting pattern – 250 plants per hectare @ Rs 10 per plant
- Cost of cultivation per hectare – Rs 3000 in 1st year for plants & fertilizer (labour till maturity not included)
- Gestation – 3-4 years
- Yield per hectare –1500 kg seeds & 750 kg oil for (rain-fed), 3000 kg seeds & 1500 kg oil for (irrigated).
- Sale price of oil – Rs 30/kg (assume Rs 20 to farmer, Rs 10 to expeller)
- Income per hectare (rain-fed) – Rs 15,000 per annum from 4th year onwards
- Edible oil produced per hectare – 750 kg
- Proposed area for cultivation – 5 million hectares in four years
- Employment – 100 man-days per hectare per year
- Total employment from 5 million hectares – 2.5 million permanent jobs
- Total income generated – Rs 10,000 crores

Annexure 4: Oil Extraction Industries

Oil can be extracted from both Paradise seeds and Curcas by means of small oil expeller units suitable for operation in rural areas. Establishment of 550 units to process the oil from these plantation crops will serve as a stimulus to rural entrepreneurship and rural industrialization.

- Investment per 10 ton per day oil expeller unit – Rs 10 lakhs, including
  - Plant & machinery – Rs 5 lakhs
  - Civil works – Rs 5 lakhs
- Capacity – 10 tons of oil per day, equivalent to 4000 hectares per annum
- Number of expeller units –
  - 250 expellers per million hectares
  - 2500 expellers for 10 million hectares

Annexure 5: Economics of Sugarcane, Sugar beet & Sweet Sorghum

	Sugar Cane	**Sugar beet**	**S Sorghum**
Cost of Cultivation		*rupees per acre*	
Land Preparation	1200	1100	500
Sowing / Planting	4200	2450	400
Manures & Manuring	2600	2600	1700
Inter cultural Operations	1500	750	500
Irrigation	1000	500	250
Plant Protection	800	800	250
Harvest & Post harvest	7200	3300	1700
Total cost of cultivation	**18500**	**11500**	**5300**
Income			
Yield in tons	Cane:30-40	Tuber: 40	Stalk: 20 Grain: 0.8
Selling Price	Rs.850/ton	Rs.600/ton	Stalk Rs.400/ton Grain Rs. 5 / kg
Gross Income (Rs per acre)	25500	24000	12000
Net Income (Rs per acre)	7000	12500	6700
Duration of the crop	12 Months	6 Months	4 Months
Av.Net income / day in Rs.	20	65	56
Annual Income	**Cane Rs 7000**	**Sugar beet + S. sorghum 19,200**	

ENDNOTES

[1] Growth of employment in agriculture averaged 2.7% annually during the period 1983-93, declining to an average 1.07% during the following decade.

[2] A detailed proposal for an Advanced Agricultural Training Programme based on farm schools has been prepared by The Mother's Service Society, Pondicherry.

[3] See http://www.indiainfoline.com/fmcg/fopo.html

Prepared by Garry Jacobs, The Mother's Service Society, Pondicherry, e-mail: garryjacobs@vsnl.com