AGRICULTURAL AND
FOOD ENGINEERING
WORKING DOCUMENT
3

Agro-industrial parks
Experience from India

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by

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The Agricultural and Food Engineering Working Document disseminates findings of work in progress to encourage the exchange of ideas and experiences related to agricultural and food engineering within agri-food systems. The series aims to bring the findings to the public domain as quickly as possible, even if the presentations are less than fully polished. The papers carry the name of authors and should be used and cited accordingly. The findings, interpretations and conclusions are the author's own.

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The text draws mostly upon Indian experience, and particularly that of agro-industrial development in Karnataka State in the south of the country. I have been involved in a number of studies and projects concerning agro-industrial planning and park development for the Karnataka State Government and elsewhere in India over the years, and gratefully acknowledge the use of this information in the preparation of the text. I remain particularly indebted to the Commissioner of Industrial Development Sri Aravind Jadav of the Karnataka State Government and to his colleagues in Bangalore for permission to use this information. I had the benefit of many periods of discussion with the Commissioner and his colleagues from 1997 on, and access to files and libraries belonging to the state government. It has been my privilege to discuss the requirements of this report with many ex-colleagues in the Department of Industries and Commerce of the Karnataka State Government – too many to name - and their contribution is gratefully acknowledged.

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The interpretation of the information and the conclusions and recommendations that have been made remain my responsibility. Planning and development is a dynamic process, and much of what has been reported here will become dated as new opportunities evolve and new findings are made and evaluated. The reader is invited to re-interpret the information to suit his/her particular interests (for example, in investment, manufacturing or marketing opportunities) whatever the locality, region or country. I would also be pleased to receive any useful feedback from those involved with

the sector that we may eventually share in the preparation of an updated version of the text. Please share your views with the Chief AGST FAO Rome that we can both be kept informed.

Agro-industries provide the basis for creating wealth within local communities, and help bring socio-economic development to rural people. India is following international trends with urbanization, but people will always require access to food and agro-materials no matter where they choose to live. The farmer, trader, agro-processor and salesman/women will always be an important part of the team. Agro-industrial parks are just one means of enhancing the productivity of the production-processing chain that everyone in society will gain benefit.

Foreword

The key to poverty reduction is accelerated economic growth and employment generation. The establishment of viable agro-processing enterprises in rural areas is crucial to create employment and income opportunities and thereby enhance the demand for farm produce. In rural areas, economic growth will, in most instances, be led by the growth of commercial agrifood systems which are efficiently run and responsive to evolving market demands. The efficiency of post-harvest handling, processing and marketing operations is a major determinant of the prices paid by urban and rural poor and is an important factor in ensuring household food security. Improvements in the performance of the agro-processing and distribution sectors also contribute to the safety and quality of food for all households. Agro-enterprise development has the potential to provide employment for the rural poor in off-farm activities such as handling, packaging, processing, transporting, and marketing of food and agricultural produce. Similarly, input suppliers have an important role to ensure that the farm sector has access to inputs and materials at competitive prices.

Globalization and market liberalization create opportunities for countries to trade agricultural and food products; however, they also produce challenges and carry risks. For agro-industries to be competitive the enterprises must understand consumer needs and wants, employ skills and technologies to gain efficiencies, deliver quality goods in the quantities and timing schedules required, and forge reliable and mutually-supportive relationships up and down the supply chain. The Agro-industries programme of FAO seeks to document analyse and share agribusiness and agro-processing know-how in the development of agro-industries and in the optimization of their management and operation. It specifically seeks to assist member countries to create linkages with the private sector such that profitable agro-industries emerge and expand to respond efficiently to market demands and contribute to growth of farm- and non-farm rural economies by creating jobs and enhancing income for the rural population, but especially for those who have limited economic prospects in farming alone.

This publication reports on the role of agro-industrial parks in the development of agro-processing industries in India. It provides guidance based on this experience which should be of value to other countries considering the establishment of agro-industrial parks.

Gavin Wall
Chief
Agricultural and Food Engineering Technologies Service
FAO

Preface

Processing agricultural materials at source of production has many advantages. Processing adds value, reduces bulk *(by reducing levels of moisture and other unwanted materials)*, removes any spoiled or sub-standard materials and helps with grading and packing according to the manufacturing processes involved. Better quality materials are prepared for the market, and lower quality materials and wastes remain at point of production. This makes handling, storing and transporting more efficient and cost effective. While retaining the characteristics of the original materials processing should, where possible, also improve shelf life. This can extend the area of distribution and sales. In addition, processing and packaging should enable the product to better withstand the demands of transportation and distribution.

In spite of the abundant and varied production base of *farmers* in developing countries, and the substantial international demand that exists for many fresh and processed foods, the export performance of *traders* and *processors* in many of these countries remains poor. On world-scale, the proportion of international trade from developing countries is of the order 1-2 percent by value, and most of this is raw materials trading, with much of the value addition taking place in the importing countries. Further, increased export trade has sometimes been inhibited for a variety of reasons much of it linked to inadequate management, limited investment and lack of competitiveness on the part of the producer/trader/processor.

In addition to challenges of increasing yields and diversifying production to feed ever-growing populations in many developing countries, these same countries face the challenge of conserving sufficient quantities of raw materials post-harvest to provide for food security. Facilities in most countries are woefully inadequate and this results in high losses of food – during the production cycle and once harvested. Further, the use of inadequate or outdated technologies, poorly maintained plant and a labour force with limited technical skills frequently results in contaminated or substandard goods offered for sale. Rejection may follow, with high levels of waste produced and loss of confidence in the supplier.

The consumer is wary of foods and brands that have performed badly in the marketplace. During 1989, for example, more than 13 500 consignments of food imported from 66 countries and worth >US$1 150 million were detained for violating FDA regulations at port of entry into the United States. Among an estimated 2 450 consignments that did not conform to specifications, >7.5 percent were from India. Most violations can be attributable to poor post-harvest management, poor manufacturing, inadequate facilities and weak inspection. These include, for example, the presence of pathogenic bacteria, animal faeces, live and/or dead insects, moulds and mycotoxins, decomposing foods, the presence of poisonous substances and unfilled low-acid canned foods. This is a tragic track record from a country that is rapidly industrializing, and striving to meet international standards for export of processed foods.

The high cost of modern technologies, equipment and infrastructure makes it difficult (sometimes almost impossible) for most small-scale manufacturers in developing countries working in isolation to keep pace with change. Old methods of working remain, and the manufacturer is unable to meet the standards required for producing high quality products under hygienic conditions. Shared facilities are a means of meeting this challenge, and may provide both the critical mass and the catalyst that will enable the small-scale processor to compete.

Many governments have been pursuing the idea of creating facilities that can be shared within the framework of what has come to be called the ‘Industrial Park’. The advantages of shared investment, access to technical information and tax incentives, scale of operation and the provision of services (such as power, water and wastes disposal) are obvious, particularly when seen in retrospect and from a distance. The situation may be different in the village, provincial town or capital city of the developing country, however, where resources taken for granted in the industrial countries may rarely be available. Herein public services have a role. It may be convenient for the government to provide subsidies to encourage newcomers or simply to provide the framework and legislation in which the private sector can flourish. This may include the provision of land,

subsidies for the provision of the infrastructure needed (e.g. roads, buildings, power-lines, etc.) and exemptions for park management and/or park tenants from selected taxation - at least during a period of start-up. Government is also obliged to consider the wider implications of international business arrangements at this time. The domestic manufacturer should not face undue financial difficulties when seeking access to equipment or supplies, or additional hikes in purchasing price as the result of duties and levies when buying from foreign suppliers.

There is a considerable learning curve involved for newcomers when introducing commercial production systems of this kind, and the early experience of some industrial parks in India, for example, has not been successful. One reason for failure (or only partial success) has been the composition of the industrial units within the industrial estate and the provision of services on-site. If the mix of industrial units is too heterogeneous there may not be sufficient linkage across the network of associated units to enable neighboring companies to gain benefit from the synergy of working one-with-the-other. Environmental issues are also relevant. If there are insufficient waste disposal facilities on site, for example, the industrial park may contaminate the land it occupies and the surrounding countryside. This is particularly serious where issues of air, water or land contamination may be dangerous or unhygienic to local communities. Leather manufacturing is a case in point with, for example, the uncontrolled discharge of untreated chromium salts in solution. In some areas in some countries this has resulted in widespread damage to aquifers.

A well designed agro-industrial park with all the requisite facilities has considerable potential for commercial success. By definition an ‘agro-industrial park’ focuses upon the processing required of ‘agricultural products’ (and the mix of ‘non-agricultural’ industries may be low or non-existent). Of prime importance is access to a viable hinterland, where a range of productive agro-horticultural enterprises may exist. Services such as management, information, transport, storage and packaging can be shared across a range of different crop and livestock products. There may be opportunities for recycling wastes and/or using rejected products from the one processing stream as the raw material for the next. Many entrepreneurs and public sector planners have been quick to realize the opportunities involved, and many proposals have been made in a host of countries. A number of agro-industrial parks have been established in recent years, for example, in India with varying degrees of success.

The text assembled herein provides an overview of many of the issues concerned with the planning, introduction and development of agro-industrial parks within a regional community. Much of this is based upon Indian experience but descriptions, findings and recommendations remain relevant to many developing countries and particularly those within Asia. Elsewhere, the information provided should be adapted and re-interpreted to suit local conditions. The text provides some introductory information on agriculture and agro-industries in India – reference to resources is essential for planning purposes - and further explores potential, status and markets, and some of the constraints faced by the different sectors.

Based on current Indian experience, the infrastructural needs of agro-industries have been identified. Agro-industrial parks provide networks of contacts between producers, markets and processors, but also provide the physical infrastructure required for the transforming industries. Herein is the role of the planner, public servant, engineer (in structures, water, power, etc.) and, importantly, the entrepreneur and those within the local finance industries that support them. Joint investment and industrial planning are central to issues of park construction and operation. The text provides a useful guide to government departments and others concerned with framing the policies required with which to encourage developments of this kind. Policies are required to encourage partnership arrangements between the public and private sectors that sufficient services and experienced management will be attracted to the park – to help ensure commercial success.

The first three chapters of the text provide an insight into the background of the work required with early planning. In this case, the agro-horticultural base and the agro-industrial status in the region are explored, with reference to India and Karnataka State (in southern India). Karnataka State represents the most highly developed agro-horticultural area in the country. Chapter 2 describes the importance of the agricultural raw materials base, trends in production and productivity, the use and application of post-harvest technologies, the institutional support available and other factors that may influence agricultural production. Chapter 3 refers to agro-

industries in a global context with particular reference to developing countries. It describes the status of the food processing sector in India including current and modern technologies, the constraints and capacities that apply, and issues of location and geography.

Chapter 4 considers the marketing of processed foods and, importantly, the relevance of this to the promotion required of agro-industrial parks within the domestic community of producer/processor/investors. Access to the separate, sometimes partially-developed plots of land or to the ready-built factories (that will provide the basis of manufacturing in the park) is not always welcome for the changes and/or investment required of well-established processors elsewhere in the locality. These companies will already have facilities and plant, and may be reluctant to abandon or relocate them for unknown and unproven resources elsewhere. They may prefer to remain where they are notwithstanding the incentives and facilities offered. A considerable sales effort on the part of the park promoters may be required, linked to incentives that will encourage a shift of location. Chapter 4 highlights the experience of an industrial area development agency in one of the major oilseed growing districts in Karnataka State. The guidelines required for identifying market-driven agro-industrial projects (and the commercial facilities needed to encourage them) are discussed.

Chapters 5, 6 and 7 provide the conceptual basis for the development of a model agro-industrial park. The constraints faced by agro-industrialists and the choice of options available for the physical facilities required are described in chapter 5. These include facilities to improve the marketing of fresh and processed foods (e.g. inspection, grading, control, etc. required of quality production and sales), use of warehouses and cold stores, access to extension advisors (i.e. links between processors and growers/traders), access to agricultural R&D information (for the preferred varieties of crops and/or breeds of livestock that can be exploited) and, importantly, access to trading information. Close links with service providers in the public sector – agricultural and marketing advisors, R&D institutions, agricultural university, etc. - will enable infrastructure, resources and facilities to be used in support of the park. These resources will further help support the producer network within which the park will flourish. Herein is the inter-dependency of the producer-processor chain.

Chapter 6 refers to the support required from government, and exemplifies the impact of the policies introduced by the Government of India for the agro-food industries sector from 1991 on. Further, the plans of the Federal Ministry of Food Processing Industries are explored for the objectives therein that provide the basis for encouraging change – that will enable the agro-industrial sector to grow.

Chapter 7 describes the practicalities of developing a model concept for an agro-industrial park. An example is given for establishing a park for processing mainly horticultural crops. The infrastructural facilities required are identified. This includes those that are commercially viable, those that can be shared and managed by the users themselves and common facilities that may have to be subsidized – and the means by which a measure of subsidization can be supported. The needs for cross subsidizing or for grant-aided funding from the public sector are discussed. Reference is briefly made to the socio-economic impact of establishing agro-industrial parks.

Chapter 8 provides a summary of the main text. The chapter can quickly be reviewed for a better understanding of the key issues involved. For those with limited time chapter 8 provides an overview of the opportunities and issues involved with park development.

A Bibliography containing a list of reference material has been provided, most of which have been used in the preparation of the text. The interested reader is advised to continue to explore many of these sources for the re-interpretation of information that may come from further reading. A number of Annexes provide supporting information to the report. This includes a Glossary of the terminology used, and further insight into the case study of the agro-industrial park in Karnataka State referred to in the main text. Details of selected food parks in SE Asia are provided with particular reference to the present status of the KINFRO Techno-Industrial Park in Kerala State India.

List of abbreviations

ADFPIK	Agency for Development of Food Processing Industries in Kerala
AEZ	Agric-export zone
AFST	Association Food Scientists and Technologists
AIBP	Accelerated irrigation benefit programme
APCTT	Asia Pacific Center for Technology Transfer
APFEDA	Agriculture and Processed Food Exports Development Authority
APT	Appropriate technology
BDA	Bangalore Development Authority
BOD	Biological oxygen demand
CACP	Commission for Agriculture Costs and Prices
CAD	Command area development (programme)
CB	Commodity board
CBO	Community based organization
CCI	Cotton Corporation of India
CETP	Common effluent treatment plant
CFTRI	Central Food Technological Research Institute, Mysore
CI&TCC	Chhattisgarh Industrial and Technical Consultancy Centre
CIFTI	Confederation of Indian Food Trade and Industry
COD	Chemical oxygen demand
CSIR	Council for Industrial and Scientific Research
CWC	Central Warehousing Corporation
DCSSI	Development Commissioner Small-Scale Industries
DFRL	Defence Food Research Laboratory
DRDO	Defense Research and Development Organization
DSIR	Department of Scientific and Industrial Research
DST	Department of Science and Technology
EDP	Entrepreneurship development programme
EIA	Environmental impact assessment
EMP	Environmental management plan
EOU	Export Orientated Unit
ERM	Extension, renovation and modernization (projects)
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FAR	Floor area ratio
FCI	Food Corporation of India
FDA	Food and Drug Administration (of the United States)
FICCI	Federation of Indian Chamber of Commerce and Industry
FMCG	Fast moving consumer goods
FPO	Fruit products order
FPTC	Food Processing Training Centre
GDP	Gross domestic product
GHP	Good hygiene practice
GIDC	Gujarat Industrial Development Corporation Ltd
GMP	Good manufacturing practice
GOI	Government of India
GOK	Government of Karnataka
GOSL	Government of Sri Lanka
HACCP	Hazard analysis and critical control point
HLL	Hindustani Lever (Company) Ltd

HPC	High Power Committee (Commiserate Agric. Karnataka State)
IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
IEM	Industrial entrepreneur memoranda
IID	Integrated infrastructure development
IIM	Indian Institute of Management
IMRB	Indian Market Research Bureau
IQF	Individually quick-frozen
ISHRAE	Indian Society of Heating, Refrigeration and Air-Conditioning Engineers
ISI	Indian Standards Institution
ISO	International Standards Organization
JCI	Jute Corporation of India
JTC	Jurong Town Corporation
KIADB	Karnataka Industrial Areas Development Board
KINFRA	Kerala Industrial Infrastructure Development Corpn Ltd
KITCO	Kerala Industrial and Technical Consultancy Organization
KSII&DC	Karnataka State Industrial Investment & Development Corpn Ltd
KVIC	Khadi and Village Industries Commission
L/S	Large and small
MFPI	Ministry of Food Processing Industries
MFPO	Meat food products order
MIA	Mahalbagayat Industrial Area
MLD	Millions of litres per day
MMPO	Milk and milk food products order
MNC	Multinational companies
MPCE	Monthly per capita expenditure
NABARD	National Bank for Agriculture and Rural Development
NAFED	National Agricultural Cooperative Marketing Federation of India
NCCF	National Consumers Cooperative Federation
NCDC	National Cooperative Development Corporation of India
NCE	Not classified elsewhere
NH	National highway
NHB	National Horticulture Board, New Delhi
NID	No industry district
NIT	National Institute of Technology, Calicut
NSSO	National Sample Survey Organization
OASIS	Operation and administrative system for import support
ORG	Operation research group
PFA	Prevention of food adulteration
PPP	Purchasing power parity
PRI	Panchayati Raj Institution
R&D	Research and development
RBF	Ready built factory
REC	Regional Engineering College *(now National Institute of Technology – NIT)*
RIDF	Rural Infrastructure Development Fund (-I, -II, III, etc.).
RRL	Regional Research Laboratory, Trivandrum
SC/ST/OBC	Scheduled casts/scheduled tribes/other backward classes
SEAI	Solvent Extractors Association of India
SHG	Self-help group
SME	Small and medium enterprise
SP	Self paced
SSI	Small-scale industry

STD/ISTD	Subscriber trunk dialing/international subscriber trunk dialing
SWMM	Storm water management module
TECSOK	Technical Consultancy Services Organization of Karnataka
TIFAK	Technology Information, Forecasting and Assessment Council
TQM	Total quality management
TRIFED	Tribal Co-op Marketing Federation of India Limited
TSS	Total soluble solids
UNTPDC	United Nations Trade Point Development Centre
USA	United States of America
WHO	World Health Organization of the United Nations
WMP	Water management programme
WTO	World Trade Organization of the United Nations

g	gram
ha	hectare
kg	kilogram
km	kilometre
KVA	kilovoltampere
l	litre
m, m^2, m^3	metre, square metres, metres cubed.
mg	milligram
Mha	million hectares
MJ	megajoules
Mkm^2	million square kilometres
ml	millilitre
Mt	million tonnes
MW	megawatt
t	tonne (1 000 kg)

>	more than
<	less than

Million	1 000 000 (10^6)
Billion	1 000 000 000 (10^9)
1 lakh	100 000 (10^5)

IND Rs	India rupee
SRL Rs	Sri Lanka rupee
US$	United States dollar

US$1.00 = SRL Rs 69 (November 1999); = Rs 102 (December 2005)
US$1.00 = IND Rs 45 (June 2000); = Rs 45 (December 2005)

Chapter 1
Background

FOOD SECURITY FOR EXPANDING POPULATIONS

The food needs of a country depend upon the growth of the population and the changing socio-economic development of local communities that may bring changed lifestyles. This normally raises demand for more food and for alternative foods. The population of the world is increasing rapidly, and particularly in most developing countries where annual growth rates may typically be 2–3 percent. This suggests that the food needs of these countries may double or triple during the next 20-30 years. During the same period, *per capita* land available for food production is expected to decline to less than half that of current levels. It follows that self-sufficiency and food security will come increasingly to depend upon systems of food production that will be more intensive. The continuity of many subsistence and unproductive systems will no longer be tenable, and higher levels of food production will become essential for survival. In order to feed populations growing at >2 percent per year, a minimum target growth of 4 percent or more must be set for food production during the same period – and attained.

As incomes increase the demand for foods changes. This is a trend already seen in most newly industrializing countries, where demands have shifted towards animal proteins and imported cereals and other foods that are not always grown locally. There is frequently a shift away from many traditional foods as people become more affluent. For example, the extra income in the household results in higher consumption of vegetable oils and temperate fruits – whether fresh or processed – the substitution of wheat for rice, and meat for cereals. There is a demand for more convenience foods and poultry meat, in particular, has become a popular urban food in many countries. Novel foods, for example, may find a ready market (see Plates 1.1 and 1.2).

Wherever the country, however, efforts are in hand in most places to increase food production to meet rising expectations and expanding populations. This is featured in the national policies of most countries. Priorities are mainly grouped under:

- General agricultural development.
- Development of sectors in support of agriculture.

These measures are normally sufficient to encourage farmers, and to provide for food security in an increasingly urbanizing society. Measures taken in support of general agricultural development include:

- Improved use and service delivery of important agricultural inputs.
- Investment in agricultural research and development (R&D).
- Restoring, protecting and developing arable land and making it more productive.
- Promoting agriculture mechanization.
- Re-directing agricultural education and training needs to respond to the changing requirements of the agriculture sector.
- Promoting the development of indigenous technologies (particularly biotechnologies).
- Measures to protect the environment and to conserve natural resources.

The success of these efforts can be seen in the growth in productivity of the agriculture sector in many countries. Attaining food security depends upon a number of parallel developments including:

- An understanding of the use of appropriate post-harvest practices (including the introduction or expansion of commercial agro-industries).
- Development of adequate physical and institutional infrastructure.
- Improved macro-economic management and agricultural capacity building.

Gherkin processing in Bangalore Rural District

K. LAXMINARAYANA RAO

Plate 1.1
Washing machine for cucumbers.

K. LAXMINARAYANA RAO

Plate 1.2
Sorting and grading belt for vegetables.

ADDING VALUE AND CREATING WEALTH

If agricultural production continues to expand as expected and fiscal policies are not in place to manage the growth of the downstream processing and trading industries, the result will be reduced prices at the farm and in the primary market. Thus the initial growth will not be sustainable and the confidence of farmers will be lost. Growth and expansion, therefore, has to be managed to comply with prevailing industrial opportunities, and this requires competent planning by governments. The issues are complex and demanding, and involve an understanding of the way in which industries can be introduced and encouraged to grow. Much depends on the availability of markets, and the way in which these can be exploited for a range of fresh or processed goods.

Further, the post-harvest practices that traditionally exist in an area largely determine the efficiency of post-production systems – the way in which foods/materials are collected, handled and transported into store or factory. Distribution mechanisms have to be improved in order to reduce the high levels of loss that typify much of production. If the infrastructure is poor – limited roads, non-specialized transport, limited care when handling, inadequate packaging, etc. - then fresh produce will deteriorate at a rate proportional to the distance, time and handling involved. The prevailing climate is also an issue. Losses of the order 50 percent, for example, are found for soft fruits when shipped in an open truck from farm to town during the heat of the day. Losses, by comparison, are negligible for cut flowers shipped overnight by air from East Africa to the Netherlands. The differences are those of value and packaging, and access to experienced management and dedicated transport equipment and facilities. Good handling and marketing facilities are essential to minimize the losses (Plates 1.3 and 1.4).

It is not sufficient to encourage the growth of processing separate from, and independent of, the service industries that provide the support, facilities and resources that are essential for commercial success. Production, in many cases, remains a relatively easy, well-understood and low-cost part of the food chain. Thereafter, the issues become more challenging, with equal opportunity for both success and failure. Mistakes and failures are inevitable, but this experience also provides the information required to ensure that the next venture has a greater chance of success. Whatever the technical levels of production that typify production in the country, post-production as exemplified by agro-processing is a logical development to provide for food security and to help create wealth (for the family and for the nation).

Plate 1.3
Shandy Village near Bijapur. Traditional market.

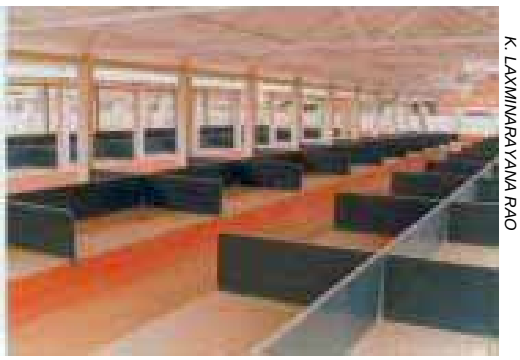


Plate 1.4
New farmer's market at Yelahanaka near Bangalore. Ready for occupation.

AGRO-INDUSTRIES IN INDIA

Agro-industries in India, for example, account for about 20 percent of value addition manufacturing – in a country that is rapidly industrializing across all sectors. In Africa, by contrast, agro-industries account for about 60 percent of value addition manufacturing. The socio-economic issues herein are complex, however, and far beyond those of food industries development. Notwithstanding some regional differences, African industrial development exemplifies the difficulties of attracting domestic and/or foreign investment. There are issues of good governance herein *(with all that this implies for planning, policy-making and security that may attract the investor)* in addition to limited infrastructure, inadequate services, fragmented and low-quality production and lack of domestic markets for processed goods. The considerable differences between India and Africa reflect different priorities, investment levels and stages of development. In Africa most of the staple foodstuffs (i.e. grains, oilseeds and tubers) are processed in the home. In India, by contrast, foods have always undergone minimum primary processing before being used (Ali–Dinar, 1995).

Farmer's market on the outskirts of Bangalore. Yelahanka then and now

In India, commodities that are traded locally such as fruits and vegetables, spices, coffee, tea, cocoa, rubber and cotton are processed to a limited extent on the farm to boost quality and to prepare them for processing in the factory. Processing of agricultural commodities increases their availability, boosts local incomes and, on a national scale, helps to reduce imports. This is particularly important for crops that are seasonal or highly perishable. Further, processing can help to maintain or reverse declining self-sufficiency, it provides for better market opportunities and stimulates increased food production in local communities. Advantages of this kind have not been lost on governments and many resolutions of the United Nations General Assembly, for example, have been passed to give special emphasis to processing raw materials in the countries of origin (Ali–Dinar, 1995). Nevertheless, in most developing countries (but also in some industrializing countries) few commodities are processed before exporting. Selected crops such as food grains, fruits and vegetables, spices and raw milk sometimes undergo minimum industrial processing at point of production. Value addition, however, is mainly undertaken in the importing countries prior to sale – and goods are sometimes sent back to the exporting country at cost per unit that are considerably higher than those of the original purchase.

In the newly industrializing countries exemplified by India, most food grains undergo limited primary processing – cleaning, grading, storing, etc. Secondary processing is also becoming increasingly more common for some foods, for example, cereals are converted into extruded snacks, breakfast cereals and other convenience or novel foods. The technologies required are well proven and locally available. Foods of this kind are now widely sold on local markets *(mainly to service an expanding middle class sector).* Insufficient primary processing comes from lack of vision on the part of local entrepreneurs, from limited information *(of the technologies and equipment required)*, from entrenched views that consider imported foods to be superior, and

from a lack of understanding of the finer requirements of a national palate. National palates are, however, dynamic and change with time. There is little point, however, in introducing a new food (and the processes required) if people will not eat the goods produced. In India, for example, there remains a firm preference for fresh fruits and vegetable, particularly where people live in rural areas or have access to a garden. Traditional cuisine often demands that foods be prepared in the home kitchen with the use of familiar methods, equipment and tools just before being eaten. This remains normal practice for the majority of families, i.e. most people collect/purchase, prepare, cook and eat their meal as a logical sequence of activities.

Whatever the proportion of fruits and vegetables that are processed into juices, sauces, jams, jellies or canned foods, most fresh produce is shipped away from point of production and a large proportion is exported. The majority of people cannot afford the additional costs of processing when purchasing foods but, given trends in urbanization, this is now changing. Cities, for example, demand specialized transport and marketing services to enable fresh foods to be sold daily, and these services are frequently insufficient to cover the entire city. In addition, working people in cities do not always have the time to shop each day. India typifies the changing trends found in many industrializing countries, where people are slowly beginning to eat many of the processed foods found elsewhere. Change is coming, however, and primary processing of food grains and oilseeds everywhere in India, for example, has largely shifted from home-based methods to mechanized industrial processing.

In a large country such as India increasing efficiency of production is essential to provide for the daily needs of everyone. This is because perishable foods such as fruits and vegetables make up nearly 50 percent of total foods required of a typical daily diet, and the country has a finite area of land available with which to produce the food required to feed an expanding population *(estimated >1.2 billion people mid-2004).* In the absence of reliable preservation techniques or modern processing facilities within producer areas, a large proportion of the perishable foods are spoiled before they reach the consumer. While the problems of food availability are more often related to the money (and other resources) normally available to a family or village community (i.e. to their level of economic development), other factors may compromise and over-ride food supply. These include a reduction in food available due to deterioration or to the higher unit cost (i.e. value) of processed foods, which place them beyond the purchasing power of the majority people.

People normally have no alternative to fresh produce for their daily foods, because of the high cost of value addition. Many people have an income that simply cannot meet the additional costs required of processing. There are issues of economic values herein, for even fresh markets add value to produce with well-designed grading, packing, pre-cooling, storage and distribution systems that may help enhance presentation and prevent loss due to deterioration or damage between farm and market. For poor communities living in the city, access to fresh produce can be difficult. Rising income levels match the rises in food costs and these filters down the supply chain thereby making fresh foods more valuable at point of production. This sometimes places additional economic constraints on people living in the country. Poor people in towns or rural areas are becoming increasingly marginalized, and lack the means of keeping pace with rising prices. Adding value to fresh foods – for whatever reason – may place these foods beyond the economic reach of the poor.

Providing the infrastructure to help establish processing facilities within producing regions results in value addition to local goods, and also improves storage or shelf life when shipping into the cities. Adding value to that fraction of the crop or material that can sustain it economically enriches everyone dependent upon (and working within) the supply chain. The additional income involved filters into local economies. Grading, for example, provides for the selection of the best produce for fresh markets with the least valuable produce remaining at point of production. It follows that produce of appropriate quantities and lower grades can then be sent for processing. Here it is that processing facilities will be required – and preferably close to point of production.

AGRO-INDUSTRIAL PARKS

The establishment of dedicated industrial estates started in the southern states of India during the 1980s. An exclusive industrial estate for pharmaceutical industries was established in Tamil Nadu State and included the construction of sheds, a common effluent plant, power plant and other facilities normally required of industrial production. The estate complied with the provisions of the Drugs Control Act of the time. A food industrial estate was set up at Mysore in Karnataka State in 1980, and attracted a number of food processing enterprises. This included:

1. Peptic enzyme plant - 2 units.
2. Mushroom cultivation and canning plant - 1 unit.
3. Soft drinks plant (based on fruit pulps and juice) - 1 unit.
4. Instant food mixes plant - 1 unit.
5. Spice powders and masala powders plant - 1 unit.
6. Dehydrated green pepper and pickled green pepper plant - 1 unit.
7. Energy foods plant (based on cereals and pulses) - 1 unit.

The Central Food Technological Research Institute (CFTRI) at Mysore provided technical support services for the estate, and the Technical Consultancy Services Organization of Karnataka (TECSOK) provided project management services. The CFTRI is the leading R&D institution of its kind in southern India and is located 3 km from the estate. The estate provided the separate industrial units on site with water and power services. Notwithstanding considerable effort on the part of the state administration, however, the estate was not an immediate success. The areas allocated proved to be too small for the activities required of the separate enterprises, infrastructural support was strictly limited and, importantly, there were insufficient number of local food industries immediately interested in becoming involved. This led to the allocation of production units on site to *non*-food and *non*-agro-enterprises with the result that the critical mass of food producers was never reached on site. Incompatibilities within the mix of enterprises resulted.

There are a number of discrete advantages with establishing a dedicated agro-industrial park that will attract similar or complementary enterprises. Working in close proximity provides for rationalization of management, of supervision, of services and, with a measure of goodwill on the part of the *'Association of Food Producers'* on the estate, of shared market exploitation. The different enterprises are able to share and/or exploit the complementarity of raw materials, utilities, information resources, transport, import/export arrangements and similar co-ventures that comes from a cooperative and well-coordinated industrial estate supported by both local government and private industries. A model estate may include a number of complementary plants, for example:

1. Decorticating units for groundnuts.
2. Dehulling units for sunflower seeds.
3. Cotton ginning and pressing units.
4. Delinting/dehulling units for cottonseed.
5. Mills for processing paddy rice.
6. Oil expelling units.
7. Vegetable oil refining and packing plants - for refining expeller/solvent-extracted oils.
8. Solvent extraction plants for processing oilseed cake and rice bran.
9. Plants for the manufacture of fuel briquettes from agro-wastes.
10. Plants for the manufacture of furfural from agro-wastes.
11. Plastic blown film plants for suppling oil packaging film.
12. Carton box manufacturing units.
13. Common boiler house - for the supply of steam for processing.

14. Power plant for generating power (using agro-wastes/steam and/or grid electricity).
15. Common effluent treatment facilities as a service unit.

An agro-industrial park may include, for example, the processing of oil crops such as groundnuts, cottonseed, sunflower seed and rice bran; it may re-direct oils to a common packaging plant or to some other food producers, and re-direct wastes and spent crop to an animal feed plant or to an agro-wastes energy producer on site. In the model example cited (#1-15 above) the oil expelling, decorticating and dehulling units in the park should be able to combine purchasing and sales to enable them to buy raw materials and sell finished products from a position of economic strength. This will improve their competitive position in local markets. Issues of scale are involved, and size brings a measure of power with which to negotiate the best deals. There is also complementarity with the shared use of materials. Some materials may require decortication before oil expelling, for example, with processes that may require two industrial units in the park. Once expelled, the oil can be refined and packed within other units in the park. Purchasing and sales can take place at each point in the chain. Cake produced by the expeller can then be re-directed to a different unit. Similarly, cottonseed from the cotton gin can be used for oil extraction and manufacture of animal feed.

Expelling units, refineries and solvent plants require steam for power and heat. The waste generated by the decorticating unit and cottonseed dehulling unit can be used as fuel for raising steam in the boiler. High-pressure steam can be used for generating power in an appropriate turbine plant, and the costs of production can be shared by all units in the park. A common effluent treatment plant for wastewater from the solvent plant and refineries in the park can be used in similar manner, with cost recovery linked directly to the extent of the demand that may apply. Common services (such as wastewater treatment, energy, computing, information and others) can be charged separately depending on level of use, over and above a *base* charge levied for the convenience of having these services available on site.

Units for briquetting solid waste from the decorticating units and rice mills can be established, and the briquettes produced can be used as fuel for the boiler. Paddy husk can also be used for the manufacture of furfural, and spent husk can be used as fuel for the boiler. Manufacturing units for plastic-blown film and carton boxes can be established to meet the demands of the refineries (and other users). Backward and forward integration of oil expelling units, for example, can be highly successful in some agro-industrial parks. If due consideration is given to planning during the time before the park is established, it follows that the majority of the industrial units attracted to the park should be complimentary one-to-the-other and linked in some form of economic network.

Having accepted the importance of the agro-food processing sector as a means of stimulating socio-economic development within rural communities, the Government of India established a separate Federal Ministry of Food Processing Industries (MFPI) in 1987 to exploit the opportunities involved and to take responsibility for national guidance. At state level, agro-food development authorities or nodal agencies were established to catalyze regional developments. The Federal MFPI devised plans for several schemes (*see Annex 3)* with a budgetary provision of Rs220 million for the period of the 8th Plan. During the terminal year of this plan (i.e. in 1996/97) Rs450 million was provided under various schemes. The sectors and schemes funded were (a) grain processing, (b) fruits and vegetables processing, (c) meat and poultry processing, (d) fisheries, (e) consumer industries, and (f) secretarial/economic services.

In addition, the federal government initiated action to strengthen infrastructure development in rural areas of the country through a separate scheme entitled *'Integrated Infrastructure Development (IID) Scheme'*. Under the IID scheme, grants were provided for infrastructural development up to a value of Rs20 million per industrial park. *(This grant has subsequently been raised to Rs40 million).* State governments were encouraged to seek funding with which to become implementing agencies within their respective regions.

A feasibility study prepared for the industrial park described in Annex 2 provided an indication of economic performance, with 73 percent of grant funds (without interest) and 100 percent of the term loan funds (with interest) expected to be recovered during a 7-10 year period. Full recovery of costs was not expected. This became clear from the high costs at which plots of

land in the park were originally expected to be sold and the reluctance, in many cases, of industrial companies to shift from existing locations and buildings that were cheaper, more familiar, sufficient for current needs, etc. Providing for the economic performance of common facilities is a major constraint during the early years of park development; that these facilities will eventually become economically self-sustaining. Experience shows that this is difficult (if not impossible) unless the park facilities are heavily subsidized by the public sector. Real costs cannot always be charged at the outset if the state wishes to attract both newcomers and existing local companies into the park.

It is essential to study the resources and requirements of the region, and design the park with facilities based on the needs of the types of agro-processing industries that are likely to be introduced on site. Scientific and technical studies of this kind are best funded by the state. There are, however, considerable *indirect* benefits to the state with the establishment of viable agro-industrial parks. These include enhanced productivity of the agricultural sector, more money circulating in local communities, increased tax revenues (*based on increased production and added value)* and, where social welfare may be concerned, more food and materials available to local people. There is also less in the way of wasted resources and materials within local production systems. Although not always easy to define in strictly monetary terms, these benefits normally far outweigh the initial expenses of promoting, establishing and nurturing the park into being.

TECHNICAL INFORMATION - KARNATAKA STATE INITIATIVE

The information collated herein and the preparation of a technical bulletin to cover the potential of agro-industrial parks is based on an idea first proposed between FAO and the Government of Karnataka in 1996. Discussions covered support for a number of initiatives that were raised, and came from the opportunity presented by a shared agro-industries/apiculture project in Karnataka State during the latter part of the 1990s. During this time the Commissioner for Industrial Development and Director of Industries of the Government of Karnataka expressed the interest and intention of the state government to build an agro-industrial park 40 km to the north of Bangalore – the state capital. Part of the early planning involved the establishment of a food processing division within the state government. The park was expected to extend over 10 ha and to specialize in food processing, provide modern buildings, waste recycling, effluent disposal, storage, packing facilities and other services to local industries. This development, which is currently underway, will be market-led *(i.e. encouraging the manufacture of products that can be sold profitably).* The state government also intends to take full advantage of crop surpluses that are a feature of annual production and to process the large quantities of fresh potatoes, onions, grapes, tomatoes and mangoes that are normally wasted. The directorate requested the technical assistance of FAO to help with planning, and suggested a bulletin as an appropriate output with which to explore some of the many issues involved when establishing and managing parks of this kind.

FOOD INDIA

During July 2004, addressing an interactive meeting jointly organized by the FICCI and CIFTI in New Delhi, the federal minister of state for the MFPI outlined plans to establish a projected 500 food processing centres in different part of the country. These will form a vanguard for India to achieve higher growth in the food processing sector. Describing the existing 45 food parks in the country as a preliminary learning experience, the minister confirmed that the government is committed to do everything possible to help make the Indian food processing sector a globally competitive one. The minister assured industry that there would be just the one regulatory authority for the food processing sector. He described efforts at the MFPI to produce an integrated food law under the chairmanship of the federal agriculture minister. Further, efforts will be made to ensure that this integrated food law will comprise a single package of logical and easy-to-apply regulations that will encourage both domestic and foreign entrepreneurs to become involved with the Indian food sector.

Issues of food adulteration and the loss of global markets for suspect Indian foods may arise. The minister confirmed that an estimated 35 per cent of domestic processed food products entering markets are currently suspected of being adulterated. Unless a strict code of conduct for quality and safety is developed, adopted and, importantly, enforced the Indian food processing industry will remain at a disadvantage in international markets. Ultimately, there can be no compromise on quality. Among existing constraints facing food processors are those of inadequate, out-dated and poorly maintained infrastructure. Without a massive investment in the sector during the next period, Indian food industries will come under severe threat from what the WTO describes as the *'integrated environment'*. Ultimately, India will require modern facilities that will link factories, laboratories, R&D centres, training institutions, etc. into a single service facility that will strive to provide the services required of food processing manufacturers nationwide. Building these facilities, investing and re-investing to keep pace with technical developments and market requirements will take time and some millions of US$/INDRs investments. Reputations for excellence are built over many years of market development and India (like many newly industrializing countries) is starting well back from competitors in the industrialized countries.

BECOMING INVOLVED

This bulletin draws heavily upon Indian experience – describing requirements, context and advantages, and encouraging both producers and processors to consider domestic and export opportunities for food products. Reporting is based largely upon the outcome of the initiatives undertaken by the Industries Department of the Government of Karnataka. Needs assessments are considered, and lead to the development of a framework for conceptualizing design, the approaches required and the many other options that arise when exploring the constraints and advantages of becoming involved with investments of this kind. It is important to explore what others have done and to take advantage of their experience. Planning and investment is dynamic and rapidly changing, and there is much to be learned for the development of new parks. Herein are issues of resources, markets and government policies, all of which form part of the planning required of a typical model agro-industrial park. The bulletin makes reference to several case studies as the basis for considering action.

Networking with others involved with park development is of value to everyone notwithstanding the difficulties that may arise from the commercial nature of much of the work involved. The Industries Department of the Government of Karnataka and FAO/AGST remain available for further assistance to prospective park developers – in India or elsewhere. These agencies would be pleased to share and exchange further information. Feedback will benefit future editions of the bulletin. Within a viable information network everyone ultimately benefits.

Chapter 2
Raw material resources

IMPORTANCE OF RAW MATERIAL RESOURCES

The advantages of processing agricultural goods at point of production or source are well established *(i.e. higher quality goods, lower cost transport, improved handling, improved market performance, etc.).* Processing improves the value addition of raw materials. Depending on the methods, techniques, etc. involved processing may also reduce bulk *(e.g. by lowering moisture content, grading for quality, etc.),* separate out unwanted material or contaminants such as fibre or soil, provide uniformity and remove spoiled or sub-standard factions. Processing may also result in repackaging the product into marketable portions or easy-to-handle and/or sell packages according to Agrawal (1994), and Linden and Lorient (1999).

While much primary processing is concerned with retaining the original characteristics of the produce, transformation also improves shelf life and assists with distribution, transport and storage between field and shop. This is particularly important when the produce is distributed over a wide area. In summary then, processing:

1. Preserves or improves the shelf life of the produce.
2. Provides conversion from raw form to processed form such that the consumer is able to use it readily - including convenience and/or ready-to-use products.
3. Reduces bulk and/or weigh that may make transportation more cost effective.
4. Removes unwanted fibre, soil and stones, moisture and spoiled factions.
5. Adds consumer appeal and packaging. This assists marketing and, importantly, provides for security of transportation and storage. (It may also help prevent theft, for more valuable products are normally packaged and kept under secure lock).
6. Helps to mitigate the present levels of waste that typify many low-technology production systems. Processing enables waste streams to be used to the full such that the waste (or by-product) of the one process becomes an input to the next. This is frequently the case with animal feed or agro-fuel industries.

Despite shortages of food and materials, various studies conducted during recent years have emphasised the logic of investing in post-harvest handling and processing of agricultural produce to add value and to prevent loss from spoilage. Losses are typically of the order 25-30 percent of the original harvest (and sometimes much higher). Further, processing adds value to raw agricultural materials and this generates employment, increases income earnings and has a flow-on effect to other socio-economic activities in the community. It follows that the scope for agro-processing that can be introduced into a particular region is dependent largely upon the raw materials available. If the full benefits of value addition are to accrue to the farmer-producer or trader, in particular, and flow-on to the community/region as a whole planning and investment has to be cost-effective and, ultimately, profitable at all points in the supply-distribution chain. Whilst subsidises may initially be available as an incentive to investors *(for providing infrastructure, processing, services, power, etc.),* it is the market that will determine financial security long-term. This is particularly so where investment is focused upon a single entity such as an agro-industrial park.

The concept of the agro-industrial park, with the provision of common infrastructure and services that may be used by similar processing enterprises on site, offers potential to minimize expenditure *(and thus reduce both borrowings and risks to investors and industrialists).* There are also issues of scale involved, for example, with the provision of services and of plant for treatment and/or disposal or recycling of wastes. These may require a minimum throughput that could not be provided economically by the many separate enterprises involved. An agro-industrial

park may have a greater chance of becoming self-sustaining from the outset, with costs *(for services, information, technologies, etc.)* shared across the many enterprises involved.

In many countries with large areas of land in agricultural production, people often prefer fresh foods to the processed alternative. India is a prime example. Fresh foods can be produced for much of the year in India, with seasonality a feature of a particular climate or region. It is here that processed foods may have a role (and compete with fresh foods shipped in from distant regions). Simple processing techniques, such as pickling or milling, are frequently used to improve shelf life and to provide for longer periods of storage and food security (for example, for use before the next harvest). Crop that is surplus to domestic consumption in the area will generally be available for industrial processing and for shipping out of the producer zone. Processing can provide an important option for preventing wastes when crop surpluses are available. Processing can help producers take advantage of existing markets or help develop new ones *(for the processed version of the food can be different from the original version, for example, snack potato chips).*

Each agro-climatic zone will normally produce a range of crops typical of the zone and for which it may be well known; where there is a measure of regional expertise and knowledge (and thus reputation). Here, farmers are able to concentrate upon the selection of crops and varieties and develop skills, experience and knowledge to enhance both productivity and the quality of output. Typical examples include chilli from Byadagi in Karnataka State and from Guntoor and Warangal in Andhra Pradesh State, selected varieties of mangoes from Kolar District in Karnataka State and Ratnagiri in Maharastra State, oilseed from the major growing districts of Karnataka State, and basmati rice from Punjab State. In some cases this may result in large surpluses of one or two crops being produced in a region, and subsequent dependency upon other regions for different foods.

While food grains and oilseeds undergo some minimal but essential processing before consumption in the typical Indian cuisine, fruits and vegetables are either eaten fresh as salads or cooked in the home. When planning for an agro-industrial park in a district or region it is essential to take account of local or traditional food preferences, and the preparation methods normally used. This will enable choices to be made for the best selection of enterprises that should be encouraged to establish in the park.

The catchment area for an agro-industrial park should be determined on the basis of the road and transportation network available. Herein are the economic transportation costs, supporting services, the likely numbers and mix of industrial units required and the combined processing capacity for each of the main commodities entering the park that will help determine the design of the park. The importance of the raw material base can best be illustrated by the example of the park proposed for Bijapur District of Karnataka State and described in Annex 2.

AGRICULTURAL PRODUCTION INDIA

India has made impressive strides with agricultural development during the last three decades. Much of the credit for this success is due to the work and diligence of the many millions of small-scale farming families that make up Indian agriculture and create the wealth upon which the economy is based. Policy support, production strategies, public investment in infrastructure, R&D and extension for crop, livestock and fisheries have significantly helped to increase food production and availability. During the last 30 years, food grain production has doubled in India from 102 million tonnes (Mt) in the triennium ending 1973 to >200 Mt in the triennium ending 1999. With few exceptions, this increase has resulted from yield gains rather than from an expansion of cultivated area. The availability of food grains increased from 450 g/capita/day to >475 g/capita/day during this period yet, at the same time, the national population all but doubled (from 548 million to nearly 1 000 million).

Increased agricultural productivity and rapid industrial growth in recent years have contributed to a significant reduction in levels of poverty - from 55 percent in 1973 to 26 percent in 1998. Despite this impressive growth and development record, India is still home to the largest number of poor people of the world. With an estimated 250 million people living below the poverty line, Indian accounts for about 20 percent of the world’s poor. The indicators are many. Critically,

women and children are the most vulnerable with an estimated 25 percent of children seriously malnourished and >50 percent of pre-school children and pregnant women anaemic.

India faces high population pressure on a fixed land area to meet its food and development needs. The natural resource base of land, water and bio-diversity remains under severe constraints. Massive increase in population *(despite a slow down in the rate of growth)* and substantial growth in income, demand an extra 2.5 Mt of food grains annually *(and significant increases in the supply of livestock, fish and horticultural products)* simply to keep pace with population growth.

Given an assumed 3.5 percent growth per capita GDP (i.e. low income growth scenario), demand for food grains (including feed, seed, wastage and export) is estimated >250 Mt for 2020. This will comprise 112 Mt rice, 82 Mt wheat, 39 Mt coarse grains and 22 Mt pulses. For the same year the demand for sugar, fruits, vegetables and milk is estimated to grow, respectively, to 33 Mt, 77 Mt, 136 Mt and 116 Mt. The demand for meat is projected at 9 Mt, fish 11 Mt and eggs 77.5 billion (IARI, 2003).

Future increases in the production of cereals and non-cereal agricultural commodities will have to be achieved through increased productivity, as the prospects of expanding areas of crop and populations of livestock are minimal. According to the Agriculture Policy Vision developed by IARI (2003), to meet projected food demands for 2020 the country must attain production levels of 2.7 t/ha rice, 3.1 t/ha wheat, 2.1 t/ha maize, 1.3 t/ha coarse cereals, 2.4 t/ha cereals, 1.3 t/ha pulses, 22.3 t/ha potato, 25.7 t/ha vegetables and 24.1 t/ha fruits. The production of livestock and poultry products must improve by estimated 60 percent milk, 75 percent meat, 90 percent fish, and 170 percent eggs by the year 2020 (over the base year 1999). Yields of most crops in India, however, continue to remain low (IARI, 2003).

Trends in production of agricultural goods in a region in the recent past are a useful pointer to the availability of raw materials that are likely to be available for processing into the near and middle future. An analysis of agricultural production performance in India provides one example. The economic survey of India 2003/04 showed the performance of the country during the past eight years (Ministry Finance, 1997). This is summarised below.

PRODUCTION TRENDS AND GROWTH RATES

Food grains account for about 63 percent of all agricultural output in India and, hence, even a marginal decline in production has a severe flow-on effect for the rest of the economy. The food grains output of 192.3 Mt in 1996/97 was 7 Mt less when compared to the year before when output reached 199.4 Mt. This was mainly due to a decrease in production of wheat, course cereals and pulses. Favourable monsoon rains helped in attaining a substantial increase in food grains production from 174.2 Mt in 2002/03 to 210.8 Mt in 2003/04, with increases in the production of cereals and pulses dominating. Table 2.1 shows annual growth rates of the major foods during these periods.

TABLE 2.1
Annual production of food grains (%)

Year	Rice	Wheat	Pulses	Food grains
Compound growth rate				
1967/68 to 1979/80	2.90	4.72	0.93	2.67
1980/81 to 1989/90	3.35	3.62	1.21	2.86
1990/91 to 1996/97	1.52	3.62	1.07	1.70
1996/97 to 2003/04	0.81	0.67	0.70	0.80
Annual				
1997/98	0.98	-0.4	-8.45	-3.56
1998/99	4.36	7.38	14.62	5.88
1999/00	4.18	7.15	-10.07	3.05
2000/01	-5.24	-8.77	-17.16	-6.20
2001/02	9.76	4.45	20.72	8.18
2002/03	-22.08	-10.21	-17.16	-18.18
2003/04	18.84	11.67	34.23	21.01

Source: Ministry Finance (1997) and Ministry Finance (2004).

TABLE 2.2
Growth rates GDP and agricultural production (%)

Year	GDP	GDP of agriculture and allied sector	Physical production of agriculture
1992/93	5.1	5.8	4.2
1993/94	5.9	4.1	3.8
1994/95	7.3	5.0	5.0
1995/96	7.3	-0.9	-2.7
1996/97	7.8	9.6	9.3
1997/98	4.8	-2.4	-5.9
1998/99	6.5	6.2	7.6
1999/00	6.1	0.3	-0.6
2000/01	4.4	-0.1	-6.3
2001/02	5.8	6.5	7.6
2002/03	4.0	-5.2	-15.6

Source: Ministry Finance (2004).

There was a significant increase in the production of oilseeds and cotton from 15.1 Mt in 2002/03 to 25 Mt 2003/04. There was fluctuation in the production of oilseeds, and the compound average annual growth rate between 1996/97 and 2003/04 was less than half of one percent. Production increased from 24.4 Mt in 1996/97 to 25 Mt in 2003/04 (Ministry Finance, 2004).

The value of the agriculture and allied sector registered a growth rate of >9 percent in 2003/04 reflecting growth in physical production and also higher remunerative prices for agricultural goods. Growth rates of the sector for 2003/04 were one of the highest in recent years, and only marginally lower than the previous high of >9.5 percent achieved in 1996/97. (See Table 2.2.)

Trends in productivity of major food crops

Yields of rice and wheat rose significantly in India during the 1970s and 1980s. Consequently, both grains registered >3 percent annual growth rates in production in the 15 year period from 1980/81 to the mid-1990s. This was significantly higher than the average population growth of 2.14 percent per annum typical of the 1980s. However, low annual growth rates of 1.2 per cent for the production of pulses during the same period resulted in an average fall of food production of the order 2.85 percent annually. During the first seven years of the 1990s, the annual rate of growth of food grains was 1.7 percent, which is lower than current population growth. This will give rise for concern should the trend continue (see Table 2.3). There is marginal improvement in yields of the major food grains (i.e. wheat and rice) and oilseeds (particularly groundnuts), i.e. demonstrating greater efficiency of land use. A decline in the productivity of minor cereals such as millets was noted.

Production of agricultural crops in India

Cereals and pulses dominate the traditional Indian cuisine. The production of the main crops has remained fairly static during the six year period 1998-2004 as described in Table 2.4, notwithstanding a population increase of the order 10% during this time. The country has become largely self-sufficient in food grains as the result of extraordinary progress made during the period of the 1960-1970s and the implementation in Southern Asia of a package of food production technologies that have become generically known as the *'green revolution'*. Production of the main crops is shown in Table 2.4.

TABLE 2.3
Yields of major crops (kg/ha)

Group/commodity	1990/91	2000/01	2001/02	2002/03*
Food grains	1 380	1 626	1 732	1 562
Kharif	*1 231*	*1 357*	*1 507*	*1 309*
Rabi	*1 635*	*2 067*	*2 079*	*1 944*
Cereals	1 571	1 844	1 974	1 783
Pulses	578	544	615	556
Rice	1 740	1 901	2 077	1 804
Wheat	2 281	2 708	2 761	2 618
Jowar	814	764	761	769
Maize	1 518	1 822	1 963	1 638
Bajra	658	688	869	610
Gram	712	744	853	728
Tur	673	618	681	553
Oil seeds**	771	810	912	710
Groundnuts	904	977	1 128	733
Rape seed and mustard	904	935	1 001	866
Sugar (t/ha)	65	69	67	65
Cotton	225	190	186	193
Jute & mesta	1 634	1 867	2 006	1 968
Potatoes (t/ha)	16	18	20	17

Source: Ministry Finance (2004).
*Provisional estimates.
**Includes groundnut, rapeseed, mustard, sesame, linseed, castor seed, nigeseed, safflower, sunflower and soybean.

TABLE 2.4
Production of food grains (Mt)

Crops	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04*
Food grains						
Kharif	102.9	105.5	102.1	112.1	87.8	110.5
Rabi	100.7	104.3	94.7	100.8	86.4	100.3
Total food grains	**203.6**	**209.8**	**196.8**	**212.9**	**174.2**	**210.8**
Rice	86.1	89.7	85.0	93.3	72.7	86.4
Wheat	71.3	76.4	69.7	72.8	65.1	72.7
Coarse cereals	31.3	30.3	31.1	33.4	25.3	36.8
Pulses	14.9	13.4	11.1	13.4	11.1	14.9

Source: Ministry Finance (2004).
* Third advance estimates.

(1.) Rice

Rice is the cereal of choice of Indian cuisine and is eaten for preference by more people than other grains. Production of rice reached a record level of 93 Mt in 2000/02, but was down to 72.7 Mt the following year (2002/03 provisional estimates). Production in 2003/04 was expected to be of the order 86.4 Mt, i.e. almost 20 percent more than the year before. There are challenges for the future of rice production given changing preferences for other foods and, importantly, constraints with the use of land and water resources. Other crops are more cost effective and bring higher earnings.

(2.) Wheat

Wheat is becoming an important food everywhere in India including the traditional rice consuming areas where it is increasingly replacing the coarse cereals. This follows trends in urbanization and rising incomes. The ratio of wheat production to rice production has steadily

increased from 1:3, respectively, during the 1950s to about 1:2 by the end of the 1960s. By the mid-1990s this ratio was of the order 4:5 with parity expected during the next few years. Wheat output of 65.1 Mt in 2002/03 was 7.7 Mt lower than that of the previous year (72.8 Mt). As the result of unfavourable conditions during the grain swelling stage, there was a decline in productivity for all major wheat growing states. The estimated production of wheat for 2003/04 was 72.7 Mt.

(3.) Coarse cereals

The area under coarse cereals (i.e. bajra, maize, jowar, ragi, small millets and barley) continued to show production stagnation at around 30 Mt through to 2001/02. However, estimates for the year 2003/04 were considerably higher at >36 Mt. Coarse grains are mostly grown by small-scale and marginal farmers in areas that are characterized by low or erratic rainfall in the states of Maharashtra, Rajasthan, Madhya Pradesh, Uttar Pradesh, Andhra Pradesh, Tamil Nadu and Bihar.

(4.) Pulses

Annual production of pulses in India has remained at 8-14 Mt for the past 40 years. *Per capita* availability of pulses has fallen from 69 g in 1961 to 30-42 g during the 10 year period prior to 2004. Production fluctuates from year to year depending on the performance of the monsoon. Farming practices such as inter-cropping and mixed cropping are more common with pulses, which are normally grown as a secondary crop. Production of pulses generally fluctuates annually between 13-14 Mt except during the two year period 2000/01 and 2002/03 when production was lower at 11 Mt. This was due to a substantial fall in the production of gram for the two year period, respectively, to 3.9 Mt and 4.1 Mt from average production of >6 Mt/year earlier.

(5.) Commercial crops

The production of commercial crops such as sugar cane, oilseed, etc. reached almost 300 Mt during 1999/2000, but has shown a decline thereafter. Production of 245 Mt was estimated for 2003/04. Oilseeds, however, are expected to reach a record level of 25 Mt during 2003/04 notwithstanding a decline in cotton production since 1996/97. Production fell from 14.2 million bales to 8.7 million bales in 2002/03, and was estimated at 13.5 million bales for 2003/04. Rising domestic and international demand has stimulated production and prices have improved accordingly. The flow-on effect will be increased plantings in subsequent years.

(6.) Oilseed

Of the nine popular oilseed crops grown in the country groundnut, rapeseed and mustard account for 55-60 percent of total production. Soybean and sunflower have, more recently, emerged as preferred oilseed crops with significant economic potential. Other oilseed crops include sesame, castor seed, niger seed, safflower and linseed. Oilseed production was 18.61 Mt in 1990/91 and reached a high of 20.7 Mt in 2001/02 before declining to 15.1 Mt in the following year. Production for 2003/04 is expected to be of the order 25 Mt (Table 2.5).

TABLE 2.5
Production of oilseeds in India (Mt)

Oilseeds	2000/01	2001/02	2002/03	2003/04*
Groundnut	6.4	7.0	4.4	8.5
Rapeseed & mustard	4.2	5.1	3.9	5.9
Soyabean	5.3	6.0	4.6	7.6
Other Oil seeds	2.5	2.6	2.2	3.0
Totals	**18.4**	**20.7**	**15.1**	**25.0**
Kharif	11.9	13.2	9.1	-
Rabi	6.5	7.5	6.0	-

Source: Ministry Finance (2004).
* Third advanced estimates.

(7.) Cotton

India is a traditional cotton grower with much of production consumed domestically. Prices are dependent largely upon international markets, with areas rising and falling as prices change. Cotton production is estimated at 8.7 million bales (each of 170 kg) for 2002/03, a decrease of >10 per cent over production during 2001/02 (10 million bales). Due to a reduction in the area sown and to weak productivity, the production of cotton is expected to decrease further for 2003/04.

(8.) Plantation crops

Large commercial areas of tea, coffee and rubber dominate Indian production, with smallholder farmers, out-growers and others linked to the estate sector for access to the information, technologies, equipment and processing required. The sector is dependent upon international market prices but, again, much of production is consumed within the country.

(9.) Tea

Tea is the best known of the traditional export crops from India, and the country is rightly famous for the quality of the teas grown and marketed. Tea remains the preferred social drink for most Indians and many other people worldwide. Domestic demand for tea has been rising faster than production, and this has placed considerable pressure on exports. Tea is a major foreign exchange earner with negligible import content, and thus an important source of revenue for the country. The crop also has great socio-economic importance, with more than one million workers employment in the industry. Tea production has been fluctuating between 835 000–855 000 tonnes (t) during the eight year period to 2004. Exports of tea rose to 163 650 t in 1995/96 and were valued at Rs110 912 million in 1995/96 from 152 160 t and earnings of Rs98 641 million in 1994/95. However, exports have declined from a high of 211 206 t in 1997/98 to an estimated 180 400 t during 2003/04.

(10.) Coffee

Karnataka State dominates Indian coffee production with >50 percent of the national crop. Arabica and Robusta are the two main varieties grown and account for 49 percent and 51 percent of the area planted, respectively. In 1995/96 coffee output was 223 000 t, the bulk of which (76 percent) was exported. Coffee production reached a record high of 301 000 t during the two year period 2000/01 and 2001/02, but declined to 275 000 t in following years. Coffee has been identified as a crop with considerable export potential. Coffee exported during 1995/96 was 170 000 t and valued at Rs15 240 million. In September 1996 trade in coffee was deregulated and growers are now free to sell their production in domestic or export markets without quantitative restrictions or compulsory routing through the Coffee Board of India. Current (2003/04) exports of coffee are estimated at 232 000 t with a value of Rs11 560 million.

(11.) Natural rubber

The demand for natural rubber in India is largely met by domestic production with only a small proportion (<5 percent) imported. Production of natural rubber has increased from a modest 15 830 t in 1950/51, to 330 000 t in 1990/91 and to 711 000 t in 2003/04. The area under rubber has also increased from 475 000 ha in 1990/91 to an estimated 522 000 ha in 1995/96. The country currently has 446 600 ha of rubber plantations.

Kerala State is the major domestic rubber producer and, together with Tamil Nadu State, accounts for 86 percent of the area under rubber in the country. The two states produce >75 percent of domestic rubber. The remaining areas are found in Karnataka, Maharashtra, Tripura, Meghalaya, Mizoram, Manipur, Assam and Nagaland, Goa and Orissa States, and on Andaman Islands and the Nicobar Islands. Most rubber plantations are small with an average area of <0.5 ha.

Production and consumption patterns have remained largely static over the years. In the two year period 2002-2003 this was 695 000 t and 649 000 t, respectively. Estimates for 2003-2004 are 718 000 t and 711 000 t, respectively. Imports of natural rubber are required from time to time to bridge the gap between supply and demand. Yields have increased significantly over the years from 284 kg/ha in 1950/51, to 1 130 kg/ha in 1991/92 and to 1 592 kg in 2002/03.

TABLE 2.6
Production of principle horticultural crops (Mt)

Crops	1999-00	2000-01	2002-03	2003-04
Fruits	45.50	43.14	43.00	47.68
Vegetables	90.83	94.00	88.62	97.50
Spices	3.02	3.02	3.77	--
Cashew nut	0.52	0.45	0.46	0.47
Areca nut	0.33	0.33	0.33	--
Coconut*	12.23	12.68	12.82	--
Flowers	0.52	0.56	0.54	0.70

Source: Ministry Finance (2004).
* Million nuts.

(12.) Horticulture

A diversity of agro-climates enables India to grow a variety of horticultural crops. This includes fruits, vegetables, flowers, spices and various plantation crops. Horticultural production is everywhere, from the well-organized upland tea and coffee plantations to the extensive smallholder systems of food production along the densely populated coastal strips where coconuts, roots and tubers pre-dominate. Horticulture has expanded on the basis of the markets and the networks of transport available, and the country holds a prime position in global production of bananas, mangoes, coconut and cashew. It is a leading grower and exporter of citrus, pineapples and apples. India holds first position in global production of cauliflower and is amongst the top ten producers of potatoes, tomatoes, onions and green peas. Horticultural products such as fruits, vegetables, flowers, cashew, spices and similar crops account for nearly 25 per cent of total agricultural exports. Production of the principal horticultural crops is shown in Table 2.6 (Ministry Finance 2004, Ministry Finance 2002 and GOI 2000).

(13.) Floriculture

The production of flowers has been recognised as a promising area of growth in recent years and particularly for the export of cut flowers. In 1994/95 exports of flowers earned more than Rs300 million. More than 200 producers/exporters were estimated to be involved in what is a rapidly expanding sector.

Horticulture has long been recognised as an important avenue for diversification in agriculture. It provides for an eco-friendly approach to more efficient land use, optimum utilization of natural resources and the creation of employment opportunities, particularly for young people and women. The sector was given a boost with increased funding of Rs10 000 million during the 8th plan period, to Rs14 540 million for the 9th plan period, and to Rs21 050 million for the 10th plan period. As a result, the horticulture sector has grown significantly over the years. India has maintained leadership in the production of many commodities such as mango, banana, cashew nut, coconut, areca nut, ginger, black pepper and turmeric.

Post-harvest technologies

As the result of inappropriate technologies, to limited institutional support and to inadequate facilities for handling, packing, processing and the preservation of goods and materials, substantial losses of fruits and vegetables continue to characterize the post-harvest sector. Traditional methods of marketing fruits and vegetables currently result in annual losses estimated at Rs30 000 million. The National Horticulture Board (NHB) was allocated Rs2 000 million within the 8th plan (1992-1997) to implement a number of schemes for providing better infrastructural support. The budgetary provision for 1996/97 was Rs410 million. During 2003/04 new initiatives were undertaken by the Indian Government, which have included:

- A national horticulture mission has been created with the objective of doubling horticulture production.
- The technology mission for integrated development of horticulture was extended to cover Himachal Pradesh, Jammu and Kashmir, and Uttaranchal States.
- Under the NHB cold storage scheme an additional 3 Mt of storage capacity was created.

- A budget provision of Rs500 million was allocated for the year 2003/04 for schemes in support of high technology horticulture and precision farming.

Institutional support and inputs influencing agricultural production

Agricultural production depends upon the optimum and timely use of seeds, fertilisers, pesticides, water and other inputs (that will promote growth). It also depends on the institutional support provided by both the private and public sectors. This includes agricultural marketing, pricing policies, and the availability of (and access to) credit, agricultural research and development (R&D), extension services and a host of other services.

(1.) Seeds

The use of high quality seeds is essential for high yields. Hence the multiplication, distribution and sales of high quality seeds (for a range of crops and varieties) provides the farmer with choices that will best suit his/her growing conditions. Improved seeds and seeds production technologies provided the basis for the green revolution in South Asia from the 1960s on. Thirty years later, however, much of the evolutionary development that followed has lost momentum. (*India, notwithstanding, has become largely self-sufficient in grains during this time, and has developed a small but viable export trade as the result of these developments).* In recent times there has been no significant technical progress within domestic seeds industries - particularly linked to demand for new varieties and new crops. Notwithstanding this, small gains continue to be made with existing programmes for cereals, pulses and selected fruits and vegetables. Slow growth in food grains production during the 1990s has given rise for concern where food security issues are involved, and efforts are being made to take a fresh approach to the sector. For example, ICAR has R&D programmes underway to explore some of the many issues concerning the production of socially sensitive agricultural commodities (DST, 1996).

Seed programmes in India follow conventional practices of selecting across a limited number of seeds generations and then multiplying up. The system recognises three generations namely *breeder*, *foundation* and *certified* seed, and provides adequate safeguards for quality assurance in the multiplication chain in order to maintain the purity of the variety as it enters the trade and is sold to farmers.

Since 1969, >2 385 varieties of agricultural and horticultural crops have been notified, of which 220 varieties were notified during 1995/96. Seed Control Order 1983 seeks to regulate the distribution, supply and trade in seeds. Production and distribution of seeds, particularly for food crops and cereals, remains predominantly a state controlled service in India, although this is changing as the private sector is being encouraged to become involved (Ministry Finance, 1997).

(2.) Irrigation

Food security in India depends largely on the efficient use of water for crop production and, in particular on the performance, delivery and expansion of the irrigation sector. Since an estimated 64 percent of the working population is engaged in agricultural work, irrigation enhances employment opportunities in rural areas *(with a shift from seasonal to stable employment year round).* A buoyant agricultural sector also helps to reduce migration to urban areas. Irrigation provides a measure of security for food grains production by augmenting the vagaries of the monsoon rains. It increases the intensity of cropping on the same area of land with, for example, two or three crops a year where previously only the one rain-fed crop was possible. Irrigation provides food security, employment and income and helps reduce poverty and social tension in rural areas. It helps slow rural-urban migration (Ministry Finance, 1997).

Exploitation of the potential for irrigation and optimum use of water continues to receive high priority in government planning. The potential for irrigated land available in 1995/96 was estimated at 89.5 million hectares (Mha), comprising 33 Mha under major- and medium-scale irrigation projects and 56.5 Mha under minor-scale irrigation schemes. The target for the creation and use, respectively, of the additional potential for 1995/96 was 2.36 Mha and 2.08 Mha across all irrigation schemes. Of this, the targets for creation and use of irrigation from minor irrigation projects during 1995/96 were, respectively, 1.59 Mha and 1.29 Mha. As the result of shorter gestation periods and relatively lower investment costs, a preference exists for minor irrigation

schemes with the use of surface and groundwater resources. Because of comparatively advantageous high water table levels, the eastern sector of the country was given special attention for irrigation development during the 8th five year plan (1992-1997).

Strengthening the irrigation infrastructure available was one of the main objectives of irrigation supply management within the 8th plan. There were 158 major, 226 medium and 95 extension, renovation and modernization (ERM) projects carried forward at the start of 8th plan in 1992. Under the Rural Infrastructure Development Fund (RIDF)-I, 2 623 projects with loans of the order Rs19 910 million were sanctioned for speedy completion by the National Bank for Agriculture and Rural Development (NABARD) in 22 states. These projects are expected to create additional irrigation potential of 2.25 Mha. Under RIDF-II (i.e. the second tranche) with a phase-in period of three years, Rs229 312 million has been allocated for 4 951 irrigation projects in 16 states.

The RIDF received an increased allocation of Rs35 000 million towards RIDF-V during 1999-2000. The Union budget for 2000-01 announced a further allocation of Rs.45 000 million for the RIDF-VI tranche, thus taking aggregate allocations during 10 years to Rs180 000 million. Financing rural infrastructure projects through Panchayati Raj Institutions (PRI), SHGs and NGOs from the RIDF was a major policy shift introduced during 1999-2000. Previously, only state governments were able to implement projects financed by the RIDF.

With a view to ensuring the early completion of projects that provide irrigation benefits to farmers, the Government of India has launched the *Accelerated Irrigation Benefit Programme (AIBP).* Since the beginning of the programme, 28 major and medium projects have been completed, and an irrigation potential of 2 195 000 ha have been created. An additional 26.78 Mha have been developed under the *Command Area Development (CAD)* programme and *Water Management Programme (WMP).* This has resulted in increased paddy and wheat production in command areas and improved farm income (Ministry Finance, 1998 and Ministry Finance, 2003).

(3.) Controlling institutions

Some of the official organizations and institutions currently involved with agricultural products, and with the many issues involved with industrial development of these sectors include the Commission for Agricultural Costs and Prices (CACP), Food Corporation of India (FCI), Cotton Corporation of India (CCI), Jute Corporation of India (JCI) and the Commodity Boards (CBs). Individual organizations have varying degrees of control over production, pricing and marketing.

(4.) Infrastructure support for marketing

The Federal Government of India has provided assistance for the creation of infrastructure and facilities for marketing, which also includes the construction of warehouses. A network of co-operatives at national, state and producer levels operates to help farmers and traders by providing access to inputs and services, and assistance with the sale of produce.

The National Cooperative Development Corporation (NCDC) is an apex institution, which formulates policies for marketing, storage and production, and for the export and import of agricultural produce through cooperative societies. The NCDC had provided Rs799.7 million for setting up 248 cold stores with an installed capacity of 739 000 t by the beginning of 1996.

The National Agricultural Cooperative Marketing Federation of India Ltd (NAFED) is an apex cooperative organization dealing in the distribution, procurement, and export and import of selected agricultural commodities. NAFED is a central nodal agency tasked with providing price support for pulses and oilseeds. It also provides market intervention in support of horticultural products such as potatoes, onions, grapes, kino/malta, black pepper, red chilli and others. The turnover of NAFED for 1996/97 was Rs9 360 million. The marketing of agriculture produce through cooperatives has seen remarkable growth from a value of Rs19 500 million in 1980/81 to Rs95 040 million in 1994/95 (i.e. >4-fold). Other organizations in the cooperative sector are the National Cooperative Tobacco Growers Federation Ltd, the National Consumers Cooperative Federation (NCCF) and the Tribal Cooperative Marketing Development Federation of India Ltd (TRIFED). TRIFED caters specifically to the marketing requirements of people in the tribal areas.

In order to ensure smooth delivery of raw materials to agro-processors and to allow direct and free marketing, a model act for state agriculture produce marketing has been formulated by the Department of Agriculture and Cooperation (Ministry Finance, 2003).

AGRICULTURAL PRODUCTION IN KARNATAKA

The area of Karnataka State is 5.8 percent of the total geographical area of the country, but the state produces 37 percent of ragi, 17 percent of jowar, 12 percent of tur, 43 percent of sunflower, 12 percent of sugarcane and groundnuts, and 11 percent of fruits comprising national production. Average production of agricultural and horticultural crops during the last five years is shown in Table 2.7 for the five year period 1991/92 to 1996/97. Figure 2.1 shows trends in production.

There has been steady growth in the production of food grains in Karnataka. This rose from 3.32 Mt in 1956/57 to >8.97 Mt in 2001/02. However, estimates for 2001/02 and anticipated production yields for 2003/04 are substantially lower, respectively, at 6.73 Mt and 6.72 Mt. Shortfall in production is mainly due to severe setbacks during the kharif and rabi seasons. However, oilseed production estimates are expected to improve from 1.02 Mt in 2001/02 to 1.12 Mt and 1.24 Mt, respectively, for 2002/03 and 2003/04. There is ample milling and crushing capacity available within existing plant, except where regional imbalance occurs with significant cross-border trading (GOK, 2004)a.

Production of pulses and oilseeds at present (2003/04) is as follows: pulses are grown on approximately 1.85 Mha *(i.e. 1.05 Mha in the kharif season, 760 000 ha in the rabi season and 40 000 ha in the summer season).* Oilseeds are grown on approximately 2.29 Mha *(i.e. 1.26 Mha in kharif, 790 000 ha in rabi and 240 000 ha during summer season)* in Karnataka. Coverage during 2003/04 was slightly lower than typical for pulses (1.98 Mha) and oilseeds (2.75 Mha).

Groundnuts and sunflower are the two major oilseeds and comprise 85 percent of the area under oilseed crops in the state. There have been consistent changes in the type of oilseed crops grown in the nine major oilseed growing districts of northern Karnataka during the 1990s. This reflects a shift from groundnuts to cottonseed to sunflower within the decade. Changes in the cropping pattern have resulted in changes in requirements for the type of oil milling equipment used**.**

While groundnuts require relatively simple decortication as a primary processing step, cottonseed requires dehulling, delinting and defibering in preparation for oil extraction, and alkali refining as a post-milling step. Sunflower requires only dehulling as a primary processing step. Frequent changes in cropping patterns in the oilseed sector have raised issues within the milling industry, with mixed messages for the extent of the milling capacity required and loss of investment in plant and equipment that has sometimes resulted. This has led to disharmony between producers and processors.

TABLE 2.7
Agricultural and horticultural production in Karnataka State (Mt)

Sl. No.	Crops	Production in Karnataka	All India production	Share (%)
1.	Rice	4.85	80.50	6.03
2.	Jowar	2.00	11.50	17.40
3.	Ragi	1.58	4.35	36.36
4.	Maize	0.94	9.10	7.02
5.	Tur	0.28	2.40	12.00
6.	Other pulses	0.56	13.15	4.25
7.	Cotton*	0.80	10.70	7.47
8.	Sugarcane	27.60	230.00	12.00
9.	Groundnuts	1.20	8.50	14.10
10.	Sunflower	0.47	0.99	47.47
11.	Vegetables	4.68	74.00	6.32
12.	Fruits	3.56	34.00	10.47

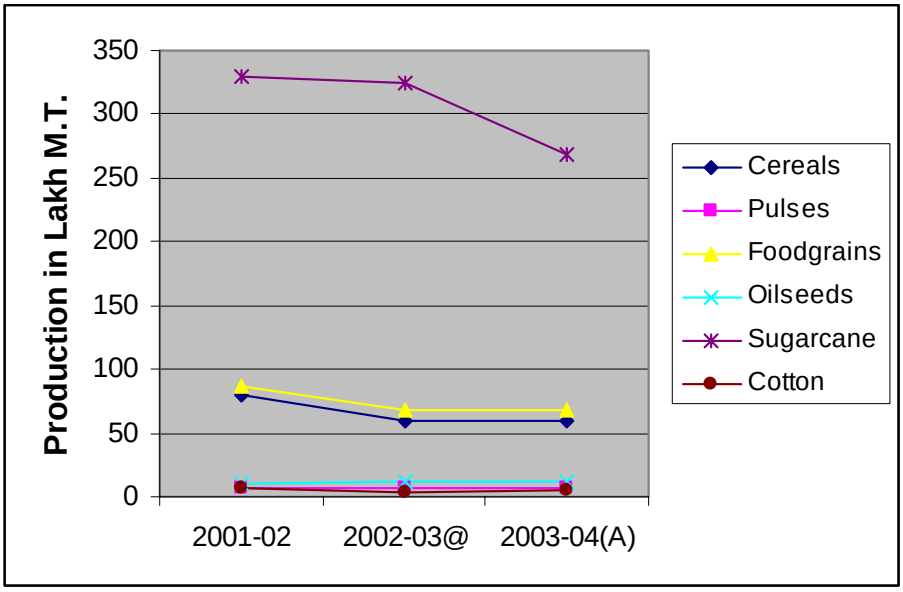
Sources: GOK (1999)a and Ministry Finance (1997).
* In million bales of 170 kg.

Horticultural crops in Karnataka

Of an estimated 11 Mha of cultivated land in the state, >12 percent is given over to horticultural crops. In 1996, this comprised approximately 1.44 Mha. The land planted to the different horticultural crops is shown in Figure 2.2. The state produces >10 Mt of horticultural crops (excluding coconuts, betal vine and nutmeg). Mango, pineapples, grapes, bananas, guavas, sapotas and coconut are the major horticultural crops grown. See Figure 2.3.

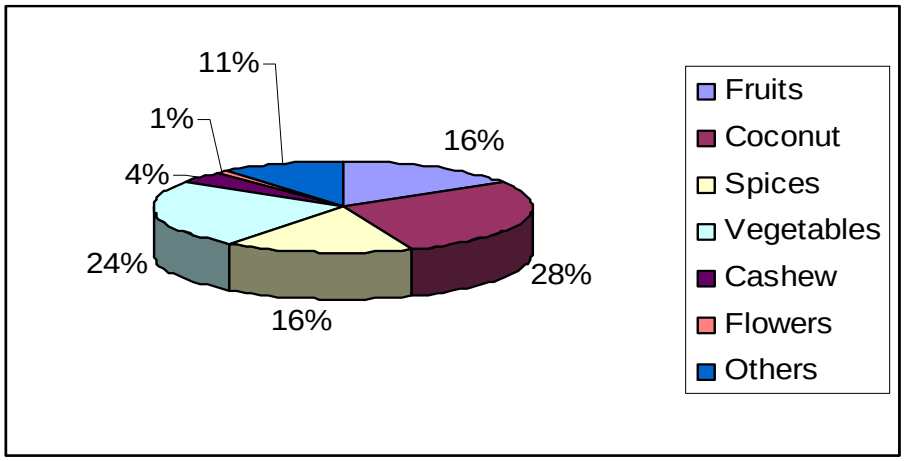
The major horticultural districts in the state are Dharwad, Tumkur, Hasan, Chitradurga and Kolar with each growing >100 000 ha of crop. Bangalore, Belgaum, Shimoga, Chikamagalore and Mysore Districts are also significant producers, each growing of the order 75 000 ha of crop.

FIGURE 2.1
Agricultural production trends Karnataka State (2001/02 to 2003/04)



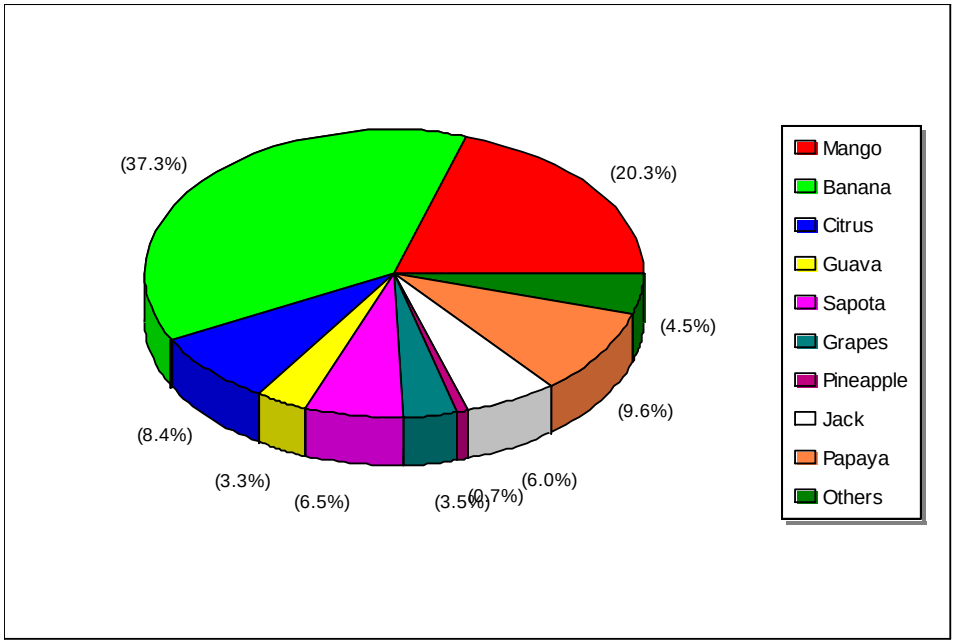
Source: GOK (2002), GOK (2003)a and GOK (2004)b. Estimates provided by the High Power Committee (HPC) of the Commissionerate of Agriculture.
Notes: Cotton production in 100 000 bale units of 170 kg in lint form (l lakh is 100 000).
A: Anticipated.

FIGURE 2.2
Distribution of land under horticultural crops in Karnataka



Source: GOK (2005).
Note: Total area 1 585 Mha.

FIGURE 2.3
Share of production: major fruit crops in Karnataka



Source: GOK (1999)b.
Note: Total Production 1995/96 was 4.73 Mt.

Production and consumption balance

To determine the quantity of surplus crop available for processing, a production and consumption balance sheet should be prepared. This, unfortunately, is not as easy as it may first appear, for consumption patterns can vary widely. For example, traditional culinary preferences differ from region to region, from season to season and on the basis of the income available to a family typical of the area or region under review. The survey required has to be conducted over a period of time to determine the food requirements needed to feed the population of the area or region. Similarly, results attributable to seasonality may vary widely from year to year.

Trends in production should also be considered. While some crops may have increased in production in recent times, others may be stable or declining. For food grains, oilseeds and selected commercial crops (such as sugar) it is essential to cater for increased processing capacity to match production. These crops normally require a measure of preliminary processing *before* transport, store or sale. In the case of fruits and vegetables, only the surplus available after fresh requirements have been met will generally be available for processing. If a food processing industry is to be economically viable, it is essential to plan the product mix and plant capacity to match the expected throughput of raw materials. Over- or under-investment will create problems for the financial and physical management of an agro-industrial park once established and operational. That said, a measure of over-capacity is normally contained in plant design, particularly for delivery of services, for access to space and for the choice and replacement of equipment. Increasingly, modern plant is of modular design and can be quickly and cheaply modified to boost capacity.

Multi-product ventures, of which an agro-industrial park is one example, always have the advantage of being able to use labour available in the most cost-effective manner. Skilled labour is normally the most expensive item on the production balance sheet. Whereas financial planning for land, buildings and plant can be made with some confidence and projected ahead to cover production over the short- to medium-term, the same is not always true with the workforce required. Organized labour and plant management are crucial to the well being of a park, and due attention is required during planning to ensure that local communities (from where labour will be drawn) are kept fully informed of what is taking place.

Recent experience in many newly industrializing countries has shown that crop-specific industries dependent on a relatively narrow range of raw *materials (which, for agro-industries,*

will normally be seasonal in nature) nearly always face constraints of supply and demand *(no matter the planning undertaken and the contingencies made*). Further, they face issues of management, purchase of materials, services and similar when compared to the flexibility that is sometimes available to other multi-product ventures. Additional issues of supply, sales, access to space, working capital and skilled labour and the inadequacy of technologies, information and markets can be countered when the industrial mix available will enable different options *(e.g. products, processes, markets and similar)* to be considered. There is a degree or resilience when a plant is able to source from many suppliers, when alternative products can be produced and when management always has a number of production options available.

The success of the agro-industrial park as a production entity depends upon the success of the separate industrial units that make up the park. Only those industries that have a strong raw materials base and reliable suppliers are likely to remain successful long-term. These are industries that will have been established with a capacity that meets production needs, and for which a realistic production/consumption balance sheet has been prepared during the preliminary planning stage.

While some raw materials such as food grains, oilseeds and sugar are generally available throughout the year due to long production seasons and the ease with which these materials can be stored out-of-season (typical, for example, of Karnataka State), the same is not true of more succulent or fresh materials such as vegetables and fruits. These products may require complex or expensive stores and pre-processing infrastructure to provide for a secure supply out-of-season, for example, ripening facilities and cold or controlled atmosphere storage. Post-processing the same products may require packing and grading centres, quarantine facilities, testing facilities, export infrastructure, effluent treatment facilities, secure lock-up stores and similar.

Whatever the raw materials intake and the end products made, the production-processing chain will require access to adequate transport, to stores and other buildings, to telecommunication networks (to enable people to maintain contact), and to large areas of land. Establishing an agro-industrial park within an area or region requires considerably more than the designation of a block of land on which to locate the separate industrial units and services. These industries, in reality, will encompass the entire area or region, and become involved in the production-processing chain from farm to factory to market to point of consumption.

Single unit industrial complexes for processing oilseeds or sugarcane are typical of existing industrial ventures. A captive land/crop, adequate capacity and a well established bulk commodity market normally ensure success. Where mechanization of production on-farm can cheaply and easily replace labour, such industries continue to thrive. The introduction of mixed production and processing on industrial-scale, however, requires more demanding levels of planning, investment and management. Grouping the industrial plants into a single entity can be successful, but the dynamic nature of production and markets may necessitate that a more long-term view be taken and, for this, high quality market information is essential. There is no room for complacency where access to either raw materials or to markets is concerned.

The economic security of the park comes with a measure of integration from one industrial process to the next. For example, when grouping all processing activities related to oilseeds production this should logically include decortication and/or dehulling. Oil extracted can be refined on site. Decorticated wastes can be reprocessed as a constituent of animal feed and shipped to a neighbouring plant. Refined wastes and/or low quality oils can also become ingredients for animal feed or for other industrial products such as paints, adhesives or chemicals. Agro-wastes that cannot be fed can be pelletized on site for use as a fuel or for sale. Where large quantities of fresh materials are produced, for example from canning fruits or vegetables, these can be re-directed/processed into silage, fed direct to feedlot animals or zero-grazed animals or composted. They can also be digested or decomposed under controlled conditions, respectively, for energy extraction or organic manures. A well-placed agro-industrial park may have several satellite areas close by for the consumption of by-products or the sustainable handling and disposal of wastes.

Chapter 3
Agro-processing industries in developing countries

Food processing industries can be considered within three categories, viz. *primary* - those that involve the basic processing of natural produce, for example, cleaning, grading and dehusking; *secondary* – those that include simple or elementary modification of natural produce, for example, hydrogenation of edible oils; and *tertiary* – those that include some form of advanced modification to the natural produce, for example, to make it ready to eat (tomatoes into ketchup and/or dairy products into ice cream are two familiar examples).

A crucial and rather basic constraint facing many food-processing industries in developing countries is the difficulty of creating local markets for products that may come within secondary and tertiary categories. Most people may simply not be able to afford to pay the costs of the additional added value involved. The concept of purchasing power parity (PPP) is important when planning for industrial development. For example, a country with a *per capita* income of US$1 000/annum (on a PPP basis) may only be able to support a pre-primary food processing industry. A second country with a *per capita* income in the range US$1 000-5 000/annum may be able to support a primary processing industry. Whereas those countries with a *per capita* income of US$5 000-10 000/annum can be expected to support secondary and tertiary food processing industries. Considering that only a small part of the population in most developing countries may have an income in excess of US$5 000/annum, secondary and tertiary food processing industries will have access at best to *small* markets (and, in some cases, only to *niche* markets). These may not be sufficient to enable an industrial unit to remain profitable.

Per capita income in India is about US$1 200/annum. The population of India is more than one billion, of which about 220 million people can be considered ‘middle class’. *Per capita* income, however, is strictly limited and does exceed US$5 000/annum. Thus the food industry in a large country such as India is likely to remain essentially with primary processing (such as milling grain and packaging flour, or producing edible oils), with imports providing for those foods that have been subjected to more advanced processing. The issues involved are rather more complex than this, however, and most countries (India included) have industrial development planning underway to provide for a range of foods that may best serve urban communities, notwithstanding low profitability.

AGRO-FOOD PROCESSING INDUSTRIES IN INDIA

Although the contribution that agriculture makes to domestic GDP in India has fallen (from 40 percent in 1980-1981 to <30 percent in 1995/96), agriculture continues to provide direct employment for an estimated 70 percent of the population. More than 75 percent of Indian people continue to live in rural areas. The Indian Government is committed to supporting the socio-economic development of rural areas, to provide for stability within the country and to reduce (or to slow down as best they can) the ever-increasing migration of people to urban centres in search of improved economic welfare for their families. Much of this commitment is directed to providing better living conditions for rural people and, importantly, to providing more opportunities for rural people to earn higher incomes. Herein food processing and other agro-based industries have a key role. Adding value to raw materials creates employment for trading, services, manufacturing and sales. Much of this can be undertaken at point of production. The additional income is characterized by higher prices to farmers/producers, and filters into the wider community of people who remain in rural areas. These are people who may have limited or no access to land. India is typical of many developing countries where, for example, up to 75 percent of the people may be landless (and thus have only their labour to sell). Investments in rural development help foster agro-industrialization. There are few losers in developments of this kind,

particularly if due consideration is given to environmental sensitivity, that issues of sustainability are recognised and followed from the outset.

Industrialization brings responsibilities on the part of the public sector and the entrepreneurs involved, for example, to ensure that people are not exploited, that commitments made are long-term and that waste materials are either recycled or disposed of in an acceptable manner. The agro-industrial sector is recognised as having an important role with improving agriculture productivity, for reducing waste at point of production *(particularly of fruits, vegetables and other perishable foods)*, of providing a measure of food security with more food provided to domestic markets, and of boosting earnings that may come from exports.

Food processing industry profile

A dedicated Ministry of Food Processing Industries (MFPI) was established in India in July 1988 to help promote the development of the sector. Although in an early stage of development the domestic food processing sector makes up 14 percent of total GDP manufacturing and has a products value of the order Rs2 800 billion. It employs an estimated 13 million people, with opportunities to employ >30 million with more focus upon added value. During the past 10 years the sector has grown by >7 percent annually. This is a considerably higher rate of growth than that of agricultural production, and is one indication of the increased availability of surpluses, higher disposable incomes and changing life styles and tastes in the country. Growth rates are projected to further increase during the next period (MFPI, 2000). Estimates of growth are significantly higher than those provided in 2000 by CIFTI (2001).

As part of the strategy to provide improved food processing infrastructure, the MFPI has been pursuing the task of setting up of food parks in different parts of the country. Reasoning suggests that small- and medium-scale entrepreneurs find it difficult to invest in capital intensive facilities such as cold stores, warehouses, quality control laboratories, effluent treatment plants, etc. and benefit from external assistance. Assistance of this kind can make a cluster of food processing units in food parks more cost effective, and provide for better market exploitation. As of 2003, the MFPI has sanctioned 36 food parks for construction. The MFPI has also approved 41 agro-export zones (AEZ) in the country, which will enable industry to centre investment upon a particular product located in a contiguous area. Focus of this kind has provided an incentive for developing and sourcing raw materials, and helped to establish the processing and packaging facilities required to meet the needs of exporters. The MFPI *(together with the Agriculture and Processed Food Exports Development Authority -APEDA)* is coordinating efforts to capture the synergies that may develop between food parks and the AEZs. (See TECSOK, 1998a).

The food processing industry in India is made up of three groups, viz. (a) primary food processors, (b) informal and/or cottage-scale industries, and (c) formal and/or large-scale processing food industries. Industry can be cross categorized into a number of sectors such as grain processing, meat and poultry processing, milk and milk products, fish processing and consumer food industries. The present status of grain milling, fruit and vegetable processing and oil seed processing sectors is as follows.

(1.) Grain processing

Primary grain processing has substantial capacity in the country (i.e. 185 Mt rice and 17 Mt wheat). In addition there are a number of pulse milling and oil expelling units. Grain processing is the largest component of the food sector and comprises > 40 percent of the sector by total value. One basic feature is the predominance of the primary processing sector (96 percent by value) when compared to the value of secondary and tertiary sectors (4 percent). The rice mill sector contains more than 90 000 traditional hullers *(all of which require modernisation)*, 8 385 huller-shellers and 35 088 modern mills as shown in Table 3.1 (MFPI, 2004)a.

TABLE 3.1
Growth of modern rice mills

Year	1993	1995	1996	1997	1998	1999	2001	2002	2003
No.	32 969	34 113	34 688	34 688	34 688	35 088	35 088	35 088	35 088

Sources: MOA (2001) and MFPI (2004)a.

In the wheat milling sector the number of modern roller mills had decreased from 800 in 1995 to 516 six years later. Combined capacity of roller mills is currently 19.5 Mt and production is 12.5 Mt, with utilization of the order 60 percent. Overall capacity utilization in the grain-milling sector was <55 percent during 2002/03 was <55 percent. India has an estimated 10 000 pulse mills with a combined capacity of 14 Mt.

(2.) Vegetable oils

The sector comprises oil seed crushing, solvent extraction, oil refineries and vanaspathi units. Sufficient capacity is available to meet current needs given the low levels of utilization (see Table 3.2). During 2001/02 India produced 21.16 Mt of oil seeds from which 6.3 Mt of edible oil was produced. Domestic demand for edible oil was augmented by imports.

(3.) Fruits and vegetables

The installed capacity of the fruits and vegetables processing industry has increased in recent years. The capacity of the industry, excluding sun dried and fried fruits and vegetables, increased from 710 000 tonnes in 1990 to 2.33 Mt in 2003/04. Installed capacity has tripled in the last 13 years and production has increased four times. (See Table 3.3.)

(4.) Milk and milk products

India is currently the largest milk producer in the world with production estimated at 75 Mt. Consumption of liquid milk accounts for 46 percent of production with the remaining 54 percent used for manufacturing. The formal sector has an estimated 10 percent of domestic production. Production of milk products is increasing by 5 percent annually to meet demand. Manufactured products include ghee, butter, cheese, ice cream, milk powder, malted milk foods, condensed milk, infant food, etc. Ghee dominates the sector comprising 85 percent of all processed milk foods (MFPI, 2003).

(5.) Consumer products

These include manufacturers of products such as confectionery, chocolates, cocoa products, soya products, ready-to-eat foods, mineral water, soft drinks, high protein foods, etc. Among the consumer industries, soft drinks enjoy the largest share. Aerated soft drinks industries have a portfolio of >100 plants in India. The production of soft drinks increased from 5 670 million bottles in 1998/99 to >6 600 million bottles in 2001/02. (MFPI, 2004)b.

TABLE 3.2
Capacity and utilization of oil mills

Vegetable oil industry	No. of Units	Installed capacity (Mt/year)	Capacity utilisation (%)
Oilseed crushing units.	150 000	42.5 (in terms of seed).	10–30
Solvent extraction units.	742	35.6 (in terms of oil bearing material).	46
Refineries attached to vanaspathi units.	100	1.8 (in terms of oil).	30
Refineries attached to solvent extraction plants.	300	2.5 (in terms of oil).	35
Vanaspathi units.	230	5.9 (in terms of vegetable oil production).	41

Source: SEAI (2004).

TABLE 3.3
Capacity of fruits and vegetables processing sector (Mt)

Detail	1990	1997	1998	1999	2000	2001	2002	2003
No. of units	-	4 932	5 112	5 198	-	-	-	-
Capacity	0.71	1.91	2.04	2.08	2.10	2.11	2.20	2.33
Production	0.25	0.96	0.91	0.94	0.98	0.99	1.03	n/a
Capacity/use	34.50	50.26	44.60	45.20	46.67	46.92	46.82	-

Sources: MFPI (2003) and CIFTI (2003).

Status small-scale food processing industries and prospects for processed foods

The small-scale food processor dominates the sector, and is obliged to work within a severely restricted resource base and to keep pace with the changing demand of domestic and export markets.

(1.) Resource base

The largest number of food processing units in the country is found in the small-scale sector. Small-scale manufacturers contribute substantially to the economy with the rice milling industry leading domestic markets and textiles, garments and clothing providing strong exports. According to the third all-India census of small-scale industries (SSI) conducted in 2001/02, the sector comprised 2 262 401 registered SSIs and 9 146 216 informal SSIs. Of the total registered SSIs, 61 percent were operational at the time of the census (DCSSI, 2004).

Most commercial food processing is undertaken in the informal sector. Traditionally the choice of foods differs from region to region, and most informal units cater to local needs. The 2001/02 census described minimum 19 different segments of food processing, viz. flour mills, rice mills, atta processing, vegetable oil processing, oil crushing, bakery, bread, rice raw (atap), biscuit and cookies, cereal preparations, coconut processing, dhall (pulses) milling, rice preparation, ayurvedic and unani medicines, groundnut oil processing, maida (refined wheat flour) preparation, parboiled rice, spices and rice powder preparation. The census noted that of the total number of SSIs, flour milling ranked 5th, rice milling 8th, atta preparation 12th and mustard oil processing 15th (DCSSI, 2004).

Total output of registered SSI units in 2001/02 was estimated at Rs7 086.173 million, while that of the total sector consisting of both registered and informal units was correspondingly higher. Rice milling dominated the sector with an annual gross output of Rs540.173 million. Mustard oil processing ranked third with a gross output of Rs192.019 million, dhall (pulses) mills ranked eighth (Rs165.28 million), parboiled rice preparation ranked ninth (Rs155.593 million), biri units ranked 12th (Rs143.016 million) and atta 15th (Rs132.753 million) (DCSSI, 2004).

The SSI sector employed 24 932 763 people at the time of the 2002/02 census. More than 95 percent of SSI units had proprietary ownership. Entrepreneurs from socially disadvantaged groups owned/worked in 56 percent of SSI units. The number of SSI enterprises managed by women was 995 141, representing <10 percent. The total number of women employees in the SSI sector was estimated at 3 317 496. About 58 percent of women employees were from units located in Tamil Nadu, Kerala, Karnataka, West Bengal and Andhra Pradesh States. Rice mills ranked fourth for providing employment with 117 250 workers at the time of the census. Flour mills ranked 12th and employed 69 479 people. Atta units ranked 21st with 34 222 workers (DCSSI, 2004).

The census showed that 50 606 SSI units exported goods with a value of Rs14 199.560 million. The value of exports, however, was only five percent of gross output. Registered SSI units accounted for 87 percent of exports. Prawn production ranked 6th with exports valued at Rs368.170 million. Cashew nuts ranked 7th with export value of Rs285.460 million, frozen fish units ranked 14th with an export value of Rs171.730 million and food units ranked 16th with export value of Rs157.580 million.

A large part of the Indian food processing industry is small-scale and cottage-based. Government has encouraged the development of cooperatives in sectors such as processing and marketing of fruits and vegetables, dairy products and fisheries, in an effort to provide assistance

to small processors. This – it is hoped - will enable them to reach some measure of critical mass. A significant number of large-scale Indian and multinational groups also have a strong presence in these sectors, and make a significant contribution to national development. Competition for the small-scale processor can sometimes be severe.

Major constraints to the development of food processing industries remain:

1. High costs of raw materials (due to low yields) and wide variation in the quality of raw materials produced by smallholders.
2. Inadequate and/or expensive refrigeration facilities required for storage.
3. Inadequate transport and distribution systems.
4. Lack of proper infrastructure.
5. Limited availability and high cost of good quality packaging equipment.
6. Outdated processing technologies - and an inability to keep pace with technical change.
7. Access to information – of all kinds.

The situation *is* changing, however, and it *is* possible for the determined entrepreneur to overcome many of these constraints in the current industrial environment. For example, constraints of low yield and variations in quality of raw materials have been successfully challenged through the introduction and development of contract farming (i.e. *managed* and *organised* smallholder farming). Similarly, the importation of capital goods (such as packaging equipment) into the country is now freely encouraged. Earlier restrictions have been lifted and support for domestic manufacturers has changed to enable them to keep abreast of new innovation. Technological developments (including foreign purchasing and imports) have been liberalized. Foreign investment is widely encouraged. Changes of this kind have opened the way for more rapid growth in the sector.

While primary processing normally involves the use of traditional skills and simple technologies, different levels of sophistication have been introduced and used for secondary and tertiary processing. It is significant to note, however, that about 80 percent of value addition with most products normally occurs at the primary processing stage. Considerable scope exists for expanding value addition within secondary and tertiary processing stages. Following consumption trends in the industrial countries, it seems likely that greater quantities of processed foods will be required in *all* developing countries in the foreseeable future, as similar socio-economic changes take place in the way people live and work.

(2.) Domestic tastes

In spite of the somewhat rigid nature of the culinary habits of the traditional Indian family, changes in patterns of consumption of convenience foods have occured in recent years. Indian families have always been fastidious with demand for fresh foods. These presented difficult socio-cultural barriers when introducing processed foods during the 1950s and 1960s. Tourism, better access to information, the introduction of fast-food industries and migration from rural centres to the main towns brought many changes from the 1970s on. Notwithstanding initial consumer resistance (and limited incomes), a variety of new foods have been widely adopted. Much of this development has been linked to the liberation of young people from the sometimes entrenched traditional attitudes of their parents. Indian society is no longer constrained by the past, and attitudes to food simply reflect changing norms in society as the country keeps pace with the rest of the world – much to the delight of the consumer.

The average Indian currently spends 53 percent of his/her income on food. Prior to the 1980s most of the food processed in the formal sector was based on the western palate, i.e. bread, biscuits, squash beverages, jams, canned food, breakfast cereals and similar products. But the 1980s have seen a quantum change in direction for the domestic food processing industry. New technologies and better methods of packaging have been introduced. There is greater understanding of the way in which foods can be prepared to cater for the local palate, and this has resulted in widespread processing of traditional Indian foods to meet domestic requirements. Markets have expanded and now include demand for foods such as pasta products, extruded

foods, ready-to-serve beverages in disposable packs, juices and milk products in aseptic packs, instant mixes, varieties of ready-to-eat products, frozen foods and many more.

Demand patterns for processed foods have changed in India and most other developing countries in recent times – and continue to change. The reasons are many:

- Rapid urbanisation and growth of cities have brought new demands on the food industry. Changing life styles have contributed to a virtual boom in certain types of processed foods. With improved communications and transport into cities, rural populations have become better informed and more adaptable (*susceptible?)* to urban patterns of consumption.
- Increased literacy has lead to more people becoming conscious of good nutrition and the importance of a balanced diet – particularly for children. This is resulting in increased demand for special foods for infants, growing children, convalescing patients, invalids, the elderly and others with special dietary needs (such as diabetics).
- An increase in working women outside the home has resulted in high demand for convenience foods, and those that can be prepared with minimum time and effort in the family home at the end of the day.
- Advertising is having its own impact on the consumption pattern of many people and remains responsible for changing food habits, particularly amongst the young.

(3.) Exports

Given the huge potential for manufacturing processed food products and limited domestic markets, efforts to boost exports are essential. Exports have been limited in recent years, however, as shown in Table 3.4 with a rise of only eight percent during the five year period from 1998. The reasons are many, but lower unit value is one reason for slow growth for sales of pulses, animal products, spirits, beverages, dairy products, processed fruits and fruit juices.

Technology profile of agro-food industries in developing countries

Current status of technologies in food industries

There is a huge market for processed foods waiting to be recognized and developed in most societies – and India is no exception. Traditional practices and choices with foods have always been dynamic and have changed with access to new crops, to new technologies and to increased household income. In this respect, people in developing countries are no different from those in the industrial countries. However, the types of processed foods found on the market frequently come with the introduction of new technologies *(and access to the plant and equipment with which to produce these foods)*. High quality production is essential to meet the demands of middle-income people. In Africa, for example, few agricultural commodities are processed. This includes food and non-food products such as cotton (52 percent processed), oilseeds (40 percent), fish (20 percent), and fruits and vegetables (15 percent). Other crops such as millet, tubers, fruits and milk *are* also processed, but to a limited extent. (Ali-Dinar, Ali B., 1995). *(There are generalisations herein that belie the wider variation between the more industrialized African countries and those that remain poor, and this brings a measure of context into consideration).*

Until recently, trends in food processing in the rapidly industrializing countries such as India were much the same. A major issue has been the availability of appropriate technologies and access to reasonably priced plant and equipment. These require substantial investment. Expenditure on research and development (R&D) for the food sector is a key indicator of the status of technological development in a country. In India, for example, expenditure on R&D in support of the food sector is estimated at just one percent of total domestic R&D expenditure for *all* industrial sectors in the country. This, notwithstanding increased expenditure in R&D, has increased of the order 20-fold since independence in 1947. Much, however, remains to be done to match investment levels with the requirements of R&D for the food industries of modern India.

TABLE 3.4
Export of processed foods from India (Rs million)

Item	1998/99	1999/00	2000/01	2001/02	2002/03
Processed fruits and vegetables	7 056	9 936	13 455	11 006	14 000
Animal products	8 517	9 050	16 371	15 009	17 500
Other processed foods	11 345	14 944	17 980	17 801	16 000
Rice	62 794	31 258	29 433	31 730	37 500
Walnuts	689	605	1 099	1 180	1 000
Marine products	46 268	51 166	64 438	59 571	60 000
Totals	136 669	116 959	142 776	136 297	146 000

Source: MFPI (2004)a.

The technological and R&D needs of the agro-food processing sector in India are mainly undertaken by one of a number of public sector institutions including the CSIR, ICAR, DRDO and KVIC. The CFTRI, Mysore in Karnataka State (part of the CSIR) is the premier research institution of its kind in the country. The services offered by these institutions vary and include indigenous technologies development, technology transfer, technology assessment, technology selection, information exchange and a host of others. There are also a few privately funded institutions recognised by the Department of Scientific and Industrial Research (DSIR). These are primarily in-house facilities created by the respective industries themselves and servicing their own specific industrial requirements. Much of this work remains confidential to the industry or company concerned.

Indian food industries can be categorized into five types on the basis of technological dependence:

1. Industries based on imported plant and machinery, where indigenization may be limited to product formulation.
2. Industries based on imported technologies, where plants based on a mix of imported and indigenous technologies are working satisfactorily.
3. Similar units, but with plants based on the use of indigenous technologies that are working successfully.
4. Industries that rely wholly on domestic technologies and locally made plant and equipment.
5. Indigenous technologies developed, but with a downstream industry that is not well established.
6. Traditional cottage-scale/home-scale industries with limited technological demand and typical low productivity.

Foods such as pastry products, paneer-like textured meat products, freeze-dried coffee, freeze-dried shrimps, and individually quick frozen (IQF) fish, fruits and vegetables are completely dependent on imported technologies, plant and equipment. This contrasts with other products such as dry-salted fish, pickles, butter, ghee, spice powders, curry powders and deep-fried potato chips, which are largely based on indigenous technologies, plant and equipment. Much of this equipment is manufactured locally to cater for a range of production scales.

Selection of appropriate technologies for food processing

The selection of an appropriate technology for a specific food processing industry ultimately depends upon the product manufactured, access to the technology required, quality requirements, market constraints and similar. (See Figures 3.1, 3.2, 3.3.) Once the market into which the final product will be sold has been identified, most of the other parameters that will govern choice quickly become apparent. Much will also depend upon the nature of the new food and its similarity with what may already be available. For example, trying to introduce a new product that is completely different from existing foods may involve high commercial risk. Take breakfast cereals, for example. The manufacture of poha (flaked rice) is a typical cottage-scale industry in

many parts of India. The processes involved are relatively simple and low-cost and the food is popular.

Compare this with the introduction of more sophisticated breakfast cereals such as those with different fruits, spicy flavours and tastes, and based on maize, wheat or rice as the main raw material. Markets herein can be successful only if these foods are sold mainly to the middle classes and/or the urban dweller *(and usually those with an income >US$5 000/year).* Alternatively, the food should be manufactured mainly for export. Export markets are important – targeting the expatriate Indian or emigrant, and others. Even products such as canned fruits and vegetables manufactured in the newly industrializing countries (such as India) are normally market-specific. They are meant primarily for export or for sale to high value niche domestic markets such as tourist or business hotels and flight kitchens. However, for a large country with significant growth potential in these sectors niche markets of this kind are an important means of exploring new products.

The manufacturing technologies involved have to be cost effective, particularly if the product is destined for the local market. Where possible, the technologies should also reduce the waste of existing methods of production (currently >30 percent with fruits and vegetables, for example). Increasing purchasing power and health consciousness on the part of many people in developing countries have followed trends from overseas, with demands for processed foods that have a fresh-like or dietary-beneficial quality. Suppliers of processed foods are required to adapt to changing markets. Some of the food processing technologies that are being introduced into India are primarily meant for products that are exportable, but domestic potential is worth exploring from the outset *(and exploiting as the opportunity may arise)*. Table 3.5 contains some examples.

There are a number of important factors involved with the successful adoption of new technologies for food processing. These include access to sufficient quantities of high quality raw materials, the compatibility of these technologies with local conditions, product profile and consumer acceptability, inter-related socio-economic factors (e.g. concerned with income and traditions), markets available and costs of production and pricing. It is essential that these many factors are prioritised and integrated into decision-making, and an holistic approach then taken when introducing and developing appropriate food-processing industries in the local community.

Appropriate technologies for agro-processing in rural areas

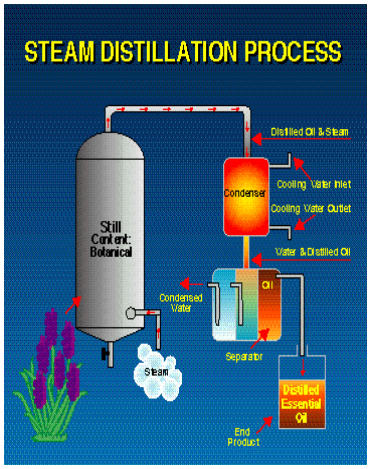
FIGURE 3.1
Mini dhall mill. Popularised by the MFPI. (CFTRI, Mysore)

K. LAXMINARAYANA RAO

FIGURE 3.2
Compact mini rice mill. (Taiwan)

K. LAXMINARAYANA RAO

FIGURE 3.3
Steam distillation process for aromatic herbs. (CIMAP, Lucknow)



. LAXMINARAYANA RAO

TABLE 3.5
New technologies for food processing industries in India

Process/technology/equipment	Application
Cryo-mill processing of freeze ground spices using liquid nitrogen as a direct contact refrigerant.	Used for grinding spices. Helps with the retention of natural colour and flavour in the final product.
Irradiation of foods to replace fumigation and added preservatives.	Helps with the removal of insects and similar pests at different stages of growth. Eliminates fungal growth or decontamination from all types of microbes and insects depending on the level of radiation used.
Super critical fluid extraction. *(Versatile separation technology).*	Useful in the extraction of natural essential oils, food colours, spice extracts, etc.
Vacuum freeze-drying.	For drying shrimps, vegetables and meats. Yet to be used for instant coffee and tea in India.
Aseptic packaging.	Used for fruit juices and pulps. Other applications include high and low acid food products with particulates.
Quick freezing. *(Involves rapid freezing for preservation so that the ice crystal formation does not disrupt the cellular structure of foods).*	Used for shrimps, fruits and vegetables.
Modified atmosphere storage.	Used for fresh and semi-processed foods.
Curing of cereals.	Used for freshly milled rice to impart better cooking quality; equivalent to that of old rice.

Source: Kurade (1994).

Constraints with developing agro-food industries

A major social change that continues to affect people in developing countries in recent times is urbanization – and the growth of cities. Urban populations benefit from stored foods, processed foods, easy-to-prepare foods or convenience foods in some form or other. The more integrated people become with an urban way-of-life, the less time there is available for preparing traditional foods in the home. Apart from cereals, fruits and vegetables are the major foods consumed (in cities and in the countryside) and these are highly perishable. The problems involved are varied and mainly time-dependent. Generally, the production of fruits and vegetables in a region is highly seasonal. In India, for example, there is large variation in the production of fruits and vegetables in the different states as the result of climate, altitude, distance from the coast and latitude from north to south of the country. There are for example, >1 000 varieties of mangos, 40 varieties of banana, 200 varieties of grapes and 50 varieties of guavas grown and marketed in India. Similar variability exists for the choice of temperate and tropical vegetables grown.

Production variations of this kind do not always favour large-scale processing industries since the volume of a particular variety of fruit, for example, required for the market may be strictly limited. The processing plant required for small-scale capacity may not meet the minimum economies of scale, and/or the plant may require constant modification to accommodate the different mix of varieties offered by producers.

The costs of production of raw materials on the farm may be high (for various reasons but usually due to low productivity). This may lead to harvesting over a wider catchment areas, higher transport distances, more producers involved and similar, and the result is higher delivery costs at the factory gate. In addition, the growth of a food processing industry may be hampered by (a) inadequate infrastructure such as stores, power and water services, communications and similar; (b) limited government support; (c) poor location for the industry; and (d) lack of appropriate technologies. Creating sufficient facilities in an agro-industrial park can help solve some of these many problems, giving an ability to spread costs and constraints across a number of industrial sectors. Some of these issues will be re-considered further in Chapter 5.

Need for creating new processing capacity

The polices of some developing countries for providing more capacity than needed for processing the quantities of domestic crops available has, in some cases, led to increased industrial malady. The intension of policies that will create more capacity than required may result in ‘survival of the fittest’ *(i.e. competition will improve quality and indirectly improve agricultural production)*, but this has not always proven to be true - at least not thus far for India. Take the example of the

vegetable oil processing and rice milling sectors. Indian milling capacity is 2-3 times the capacity required in terms of production, but most of the available capacity is characterized by old or out-dated equipment. Mills have closed for lack of parts or similar, and mills have continued to operate inefficiently. In an effort to redress this situation, the government is obliged to provide some kind of modernization programme that may offer incentives to the private sector. Government may also be required to demonstrate the benefits of modernization through appropriate R&D and extension programmes. Notwithstanding this effort, however, it seems likely that a large number of rice mills will continue to use inappropriate technologies and out-dated equipment. In many cases, mill owners or managers will *not* be informed of the investment opportunities available, and will continue to miss opportunities.

The need for creating additional capacity arises as a result of changes in cropping patterns, bumper harvests (when available), a regional imbalance in the capacity available from district to district, insufficient capacity and the replacement of obsolete plant with up-to-date equipment that may reflect modern technologies (and market demands). According to a study conducted by the author during 1997 in the nine districts of Karnataka State, a typical rice mills was using only 37 percent of the installed capacity during any one period of 24 hours. This is because downtime in the rice mills was frequently as high as 47 percent *(due to various reasons, most of which were linked to mechanical breakdowns, inadequate maintenance, and lack of replacement parts and similar).* Further, the average throughput of the mills was estimated at 70 percent of installed capacity. Of the nine districts surveyed, eight were considered to require additional capacity *(in addition to issues of inefficiency and breakdown)* (Laxminarayana Rao and Chandramouli, 1987). See Table 3.6.

In addition to the improved capacity available in more modern or recently modernized mills, the survey showed that there were large numbers of old huller-mills in the districts that were no longer able to cope with demand. Recommendations from the survey suggested that the additional capacity required provided ample opportunity for modernizing the inventory of mills in these districts. Access to funding from the public sector was an additional incentive.

Fruits and vegetable products in India are governed by the Fruit Products Order (FPO) of 1995 and there were, at the time of ratification of the FPO, 4 270 licensed processing units with a combined installed capacity of about 1.4 Mt. In terms of raw materials this capacity is sufficient to process about 3.5 Mt of fruits and vegetables. The bulk of this capacity is used for fruits. This compares with a national production output of about 45 Mt of fruits and 70 Mt of vegetables each year. Thus, the capacity available for processing is grossly inadequate, and considerable potential exists for expanding the industry. Further, the cold storage capacity required for surplus produce that is not processed or absorbed by the fresh market is wholly inadequate. The country has 230 cold stores in the cooperative sector with a combined capacity of just 620 000 tonnes. The combined capacity of cold stores in 1997 was 10-fold at 6.5 Mt.

TABLE 3.6
Requirements for rice milling industries in Karnataka

District	Milling capacity available. (t/month)*	Paddy available for milling. (t/month)	Additional mill capacity needed. (t/month)	No. huller-mills to be modernized.
Belgaum	13 790	84 870	71 080	634
Bellary	66 417	47 120	-	0
Chickmagalore	76 122	104 690	28 568	255
Chitradurga	92 140	107 900	15 760	141
Dharwar	45 822	121 290	75 468	674
Mysore	134 891	158 500	23 609	211
Raichur	92 233	126 640	34 407	307
Shimoga	200 215	262 920	62 705	560
Tumkur	40 323	43 640	3 317	30
Totals	761 953	1 057 570	314 914	2 812

Source: Laxminarayana Rao and Chandramouli (1987). * Capacity of modern/modernized mills in respective districts.

Inadequate post-harvest facilities lead to waste

K. LAXMINARAYANA RAO

Plate 3.1
Drying chilli in rural areas.

K. LAXMINARAYANA RAO

Plate 3.2
Sorting vegetables in villages.

TABLE 3.7
Recommended foods that meet basic nutritional standards

Sl. No.	Food item	Requirements for India		
		g/person/day	Mt/year	Percent
A. Perishable foods				
1.	Cereals	370	112.77	36.78
2.	Pulses and nuts	70	21.33	6.96
3.	Fats and oils	38	11.58	3.78
4.	Sugar and jaggery	40	12.19	3.98
Totals A			157.87	51.50
B. Perishable foods				
5.	Milk and milk products	180	54.86	17.88
6.	Meat, eggs and fish	35	10.67	3.48
7.	Vegetables	235	71.62	23.36
8.	Fruits	38	11.58	3.78
Totals B			148.73	48.50
Totals A+B			306.60	100

Source: Mokshapathi & Potty (1988).

The lack of post-harvest facilities for drying, sorting, grading and packing at point of production adds to the problems of industrialization, and results in a loss of raw materials, as illustrated in Plates 3.1 and 3.2.

LOCATING FOOD PROCESSING INDUSTRIES

Primary processing of all foods and processing of perishable foods should be undertaken in, or adjacent to, point of production. There is little economic value in shifting large quantities of raw materials from farm to factory when the distances involved may be high. Processing close by reduces waste and cuts back on transport and handling costs. Disposal of by-products and wastes at point of production is normally more cost-effective. In a country with the geographic size and population of India, about 310 Mt of foods are required each year to meet basic nutritional needs. Table 3.7 lists the various food items recommended to meet these minimum standards, and shows that about 150 Mt of foods (about 50 percent of total) are perishable.

India has reached self-sufficiency for non-perishable foods and, in recent years, also for milk and dairy products among perishable food items. However, the country has yet to attain a measure of reliable self-sufficiency with most other perishable foods such as fruits and vegetables, meats, eggs and fish products. Much waste occurs between point of production and consumption, and this exacerbates supplies of perishable foods. Consider the socio-economic challenges facing

India with more than one billion people living at an average density of 265/km^2. The country produces nearly 115 Mt of fruits and vegetables, and has an annual requirement of about 95 Mt. Fruits and vegetables available have to be transported, stored and distributed over an area of 3.2 Mkm^2. This means that the fruits and vegetables produced from an area of only 7 500 km^2 have to be distributed over an area that is >400 times the area of production.

While the problems of availability may be due to a culmination of constraints concerned with access to food and money and to the numbers of people sharing these resources, there are additional compromising factors that may dominate supply and demand. These are:

- Reduction in available foods due to deterioration and spoilage as the result of inadequate handling.
- Higher unit value of foods (that have been handled/processed) that place them beyond the reach of people living on a basic income.

A well designed storage, preservation, processing and transportation system originating from the point of production can help mitigate losses caused by deterioration, dehydration and/or bad handling. Moreover, this can be achieved without reducing the freshness or wholesomeness of most food items. However, to keep the unit value of the food within the purchasing power of the consumer presents a challenge. This may involve careful scrutiny of the production-processing chain to identify cost centres, the use of appropriate harvesting methods *(to maximise the production of high quality materials),* market-specific targeting to obtain the best possible prices *(that high production costs can be absorbed)* and the use of government subsidies that may be available to encourage industrial investment. Subsidies can be passed on to the consumer in the form of reduced prices. Subsidies are a mixed advantage, however, and in the long-term should generally be considered as counter-productive. Subsidies should be offered and accepted with a firm measure of care for the long-term well being of the industry for which financial support is being provided.

Locating processing units within the producing regions helps to lower costs. It does this by reducing the bulk transportation required of unprocessed materials, and enables unwanted materials to remain at point of production. These, for example, can be re-directed into organized agro-waste manufacture, which may augment rural fuel supplies or provide for organic fertilisers *(and thus make further savings on bought-in fertilisers).* Savings thus achieved, together with the additional income earned from adding value to raw materials at point of production, help to boost the rural economy in many developing countries.

India produces an estimated 32 Mt of fruits and 71 Mt vegetables annually. Losses of the order >20 percent are due to poor post harvesting practices. (Biswas, *et al,* 2000). This means an average >6 Mt fruits and 15 Mt of vegetables are lost each year - valued at Rs66 billion *(assuming average farm gate prices of Rs5/kg fruits and Rs2/kg vegetables).* Accordingly, the MFPI (2004) has established set values, goals and objectives for:

- Minimum waste acceptable at all stages of the food production-processing chain.
- Development of infrastructure for storage, transportation and processing of agro-food produce.

An agro-industrial park can cater for the infrastructural needs of a variety of agro-horticultural produce grown in a region. Existing processing activities in the region can be encouraged to relocate to the park and to become and integrated part of the new units available. This brings experience and knowledge with which others in the park may benefit. Industrial units scattered across a region can pose environmental issues. Relocation to a park brings a measure of control and security, but this has to be undertaken with the cooperation of the entrepreneurs involved, that production levels remain firm and with similar (or lower) production costs. There is little point in encouraging (*forcing?)* successful enterprises to relocate for the benefit of other industrial units and for environmental well being, only to penalise what had previously been a successful enterprise. In reality, few enterprises are willing to relocate simply to provide for a better organized private sector. The advantages in the medium- to long-term must reflect in the balance sheet of the enterprise involved, with higher potential earnings as a priority.

Chapter 4
Markets

MARKETS FOR INDUSTRIAL PLOTS OR UNITS

The market for industrial plots or for ready-made factory units at an agro-industrial park depends upon several factors, all of which will eventually influence the success of the enterprises that may relocate or start-up business in the park. The demand for plots, units and other buildings will come from:

a) Requirements for additional capacity for primary processing of grains and oilseeds.
b) Requirements for factories that need to relocate to the park.
c) Need for access to packing and grading facilities for fruits and vegetables.
d) Requirements for fruits and vegetables processing/preservation industries.
e) Requirements for secondary and tertiary processing food industries in the region.
f) Need for establishing exports industries.
g) Requirements for stores and warehouse facilities; to service the needs of the separate units in the park.
h) Requirements for other commercial and common facilities on site.
i) Requirements for access to agencies offering services to the separate businesses in the park.
j) Requirements for government agencies and other statuary bodies concerned with the regulation and development of agro-food processing industries in the state/country.

A viable market for the products and services available in the park is the single most important issue for the successful establishment of the separate enterprises, and thus for the long-term commercial viability of the park. If services are lacking or not offered, then the park will face difficulties with attracting investors and with retaining those that may establish there. Issues of this kind are covered later, but suffice to note at this point that confidence in management and the viability of the park is *essential* from the outset. Without this the park may fail commercially. The costs involved with development of the park by promoters (whether private or public sector) and cost carry-over into purchasing or rental on the part of the entrepreneurs are crucial factors. These will influence buyers and renters of units. Levels of costs will depend on the location of the park, the type of facilities being offered and the efforts made by the promoters to attract entrepreneurs to fill industrial units in the park.

The park and the region where the park is located should offer a competitive edge over land and buildings outside the park, in addition to providing a range of essential facilities on site. The availability of skilled labour at reasonable cost is essential. It follows that the socio-economic infrastructure of the area should be sufficient to encourage stability of the work force. This is not always easy to achieve, for skilled labour may be in demand elsewhere and people will normally seek the best possible earnings and living conditions available. There are many socio-economic issues involved, for example, such as land tenure. People require access to land and the right to use it for approved purposes. Rural people will normally remain in place if they have ownership of the land, and perhaps augment work in the park/factory with work on the home farm. Landless people are always more mobile. Further, policies need to be established in support of the park that will not change with the whim of government (as governments may change).

There has to be a reliable supply of raw materials available to the park, and at prices that remain stable; thus markets and the contracting required between producer and processor has to be firm and well understood by both parties. In reality, there should be competition for the plots and ready-made factory units in the park, which will encourage high investment in processing and a filter-down effect to suppliers/producers. In this way, a strong agro-industrial presence can be established across the region.

The concept of an agro-industrial park is not new, and comes from earlier industrial efforts with which to promote manufacturing within or adjacent to urban centres – to provide for employment and to encourage stable communities. The park, however, takes planning further and provides for a more organized and environmentally sensitive industrially designated area in which to manufacture a range of products. It provides the backup required for processing, and ensures the best possible facilities and competitive services available for those on site. With good park design, there will be few advantages (physical or financial) for existing industries to remain *outside* of the park, and everything to be gained by re-locating *into* the park.

Size of park is important for herein are issues of service support, of impact upon the region, of the numbers of viable units that can be accommodated and of the potential that may be considered for medium- to long-term economic opportunities. The industrial size of the separate units will be linked firmly to the resource base, to demand for products and to the services provided. A good example for size relating to the catchment area is that of the Mahalbagayat Industrial Area (MIA) in Bijapur District Karnataka State, and the areas adjoining it. The MIA was recently established as a park for agro-food industries**.** (See Annex 2.)

In the MIA, 136 industrial plots of different sizes were developed following a period of planning, implementation and sales that started in 1985. More than 50 percent of the industries attracted at the beginning were core agro-based and were dependent upon raw materials such as food grains, oilseeds and fruits and vegetables that were produced locally. Eight percent of the units were established in support of agro-based industries providing services such as packaging, printing and cold storage. Almost 40 percent of the units provided additional resources for agro-processing and demand-based industries such as granite processing, building materials and light engineering. In addition, a cold store and a training centre were established in an effort to train a new generation of entrepreneurs, and the skilled and unskilled workers required of agro-processing industries. Notwithstanding this apparent initial success, by 1995 <2 percent of those enterprises allotted land or units had begun activities. A period of 10 years had passed.

The total area developed by the MIA Park was 86 ha. The plot size varied from 607 m^2 to 3 600 m^2 of which the most popular size was 2 400 m^2. A study undertaken in 1997 showed that the demand for agro-based industries was on the increase at the time - notwithstanding the slow start made (TECSOK, 1998)b. This led directly to renewed interest in existing plots and encouraged the Karnataka Industrial Areas Development Board (KIADB) to develop an additional 33.4 ha of land exclusively for agro-industries. The study identified 39 agro-based industries with potential for further development. The study suggested that in addition to providing plots with sealed roads, drainage, water, power and telecommunication facilities, other services could be introduced that would be of advantage to residents. These are described in Table 4.1. The proposed new facilities are expected to alleviate existing constraints and, further, to boost uptake of industrial plots in the park.

MARKETS FOR AGRO-INDUSTRIAL PRODUCTS

Agro-industrial base

The scope for establishing agro-industries in any region depends on several factors. This includes the existing agro-industrial base in the region, the existing plant inventory, the capacity to cater for processing requirements of agro-horticultural materials produced in the region/area, and on the distance to markets for the products made and the services provided. Industrial needs can be categorized on the basis of the culinary traditions of the region, on processing normally undertaken on-farm or in the home and on the opportunities that may exist for exploiting existing

TABLE 4
Layout Mahalbagayat Industrial Area Bijapur District

Land acquired, developed and allotted May 2002					
Extent		Allotted		Extent vacant area (ha)	Price/ha Rs x10^5 (2004)
Acquired (ha)	Developed (ha)	Number Units	Extent (ha)		
87	87	119	73	14	8.20

Source: TECSOK (1998)b.

or new markets. For this, some kind of market survey will be required. The survey should cover the existing industrial base and cover all primary, secondary and tertiary processing facilities. An example of a survey of this kind is the small-scale industry (SSI) survey conducted periodically by the Development Commissioner Small-Scale Industries (DCSSI). *(Extracts from the survey related to food industries are shown in Table 4.2 and 4.3).* The survey of SSIs conducted by the DCSSI during 2002/03 revealed that there were 1 374 974 registered SSIs and 4 233 805 informal small units in the country. The survey of registered units showed that 64 percent located in rural area were working and 36 percent were not working. In urban areas, 58 percent were working and 42 percent were closed (DCSSI, 2004).

Five food items were placed in the top 100 SSI products. These were mustard and groundnut oils (other than solvent extracted), bread, tapioca sago and pickles. These five items in total had 16.12 percent share of the gross output of the best 100 SSI units. (See Table 4.2.)

Among the top 200 SSI products exported from India during 2002/03, 22 were food items (see Table 4.3). The 22 food items earned Rs15 065 million and the percentage share of food items exported among the top 200 products manufactured by the SSI sector was 13.87 percent. This confirmed food processing industries as a major contributor to export industries in the country.

TABLE 4.1
Common facilities proposed Bijapur Agro-Industrial Estate

Common facilities proposed	Purpose
Institutions and commercial centre with a built up area of 500 m^2.	For housing, banks, post office, business centre, restaurants, shops, etc.
Technology support centre with a built up area of 250 m^2.	For testing and research laboratories for oilseeds and oils.
Warehouse buildings with a built up area of 500 m^2	For storage of oilseeds and similar products during transit.
Mini convention centre with guest rooms.	For holding buyer/seller meetings and rest rooms for farmers and traders.
Common effluent treatment plant.	For the treatment of effluent from industries on a cost sharing basis.
Green cover.	For the protection of the environment and to provide greenery in the area.

Source: TECSOK (1998b).

TABLE 4.2
Food items reserved for manufacture by SSIs and value of output during 2002

Sl. no.	Product name	Gross output (Rs $x10^5$)
1.	Oil, mustard (except solvent extracted)	192 019
2.	Oil, groundnut (except solvent extracted)	80 841
3.	Bread	46 358
4.	Tapioca sago	8 869
5.	Pickles	7 058
Total for five food products		335 145
Total output by 100 top products reserved for manufacture by SSIs		2 079 463
Share of food products in top 100 SSI products (%)		16.12

Source: DCSSI (2004).

TABLE 4.3
Major food items contributing to exports SSI sector (2002)

Sl. no.	Product name	Value of exports (Rs x10^5)
1.	Prawns, processed	36 817
2.	Cashew kernels	28 546
3.	Frozen fish	17 173
4.	Food products NEC	15 758
5.	Fish, dried/processed NEC	9 053
6.	Rice milling	7 668
7.	Soya preparations excluding oil	8 000
8.	Cashew nuts, roasted	4 430
9.	Flour milling	3 684
10.	Arhar, milled (dhall)	3 663
11.	Rice, raw (atap and excluding basmati)	2 749
12.	Medicines, ayurvedic and unani	1 554
13.	Fruits, pulp and juice NEC	1 498
14.	Dhall milling	1 490
15.	Pickles and sauces (vegetables)*	1 321
16.	Cattle fish, processed	1 304
17.	Methanol	1 213
18.	Spices, mixed	1 175
19.	Pickles	1 054
20.	Rice, other preparations	894
21.	Papad	814
22.	Guardal	791
Total for 22 food items among 200 top SSI products exported.		150 649
Total for 200 major SSI export items.		1 085 894
Share of food items exported among 200 top SSI products (%).		13.87

Source: DCSSI (2004).
* Not classified elsewhere.

TABLE 4.4
Major food processing clusters*

Product	Number clusters	Number states	States	Number units	Gross Output (Rs)
Flour milling	86	15	HIMACHAL PRADESH, PUNJAB, UTTARANCHAL, HARYANA, RAJASTHAN, UTTAR PRADESH, BIHAR, WEST BENGAL, CHHATTISGARH, MADHYA PRADESH, GUJARAT, ANDHRA PRADESH, KARNATAKA, KERALA, TAMIL NADU	18 912	3 844 941 028
Atta	46	12	JAMMU & KASHMIR, HIMACHAL PRADESH, PUNJAB, UTTARANCHAL, HARYANA, RAJASTHAN, UTTAR PRADESH, BIHAR, WEST BENGAL, JHARKHAND, MADHYA PRADESH, KARNATAKA	10 279	2 618 513 023
Rice milling	43	13	PUNJAB, HARYANA, UTTAR PRADESH, ASSAM, WEST BENGAL, ORISSA, CHHATTISGARH, MADHYA PRADESH, GUJARAT, ANDHRA PRADESH, KARNATAKA, KERALA, TAMIL NADU	9 223	30 720 549 799
Oil, mustard	27	5	JAMMU & KASHMIR, RAJASTHAN, UTTAR PRADESH, BIHAR, WEST BENGAL	5 783	4 995 086 170
Bakery products NEC	9	1	KERALA	2 611	466 263 555
Rice, raw (atap)	9	6	UTTARANCHAL, UTTAR PRADESH, MANIPUR, ASSAM, ORISSA, ANDHRA PRADESH	1 728	5 368 524 746
Coconut oil	6	1	KERALA	1 223	1 342 789 098
Oil crushing & expressing	4	2	UTTAR PRADESH, WEST BENGAL	846	97 201 316
Rice, parboiled	5	5	PUNJAB, UTTAR PRADESH, WEST BENGAL, ANDHRA PRADESH, KERALA	724	5 852 674 430
Flours, cereals and others	4	4	UTTARANCHAL, UTTAR PRADESH, ANDHRA PRADESH, KARNATAKA	660	1 665 888 267
Rice powder	2	1	KERALA	565	112 285 703
Soda water	4	2	GUJARAT, KERALA	560	51 905 917
Wheat flour, refined maida	4	4	HIMACHAL PRADESH, RAJASTHAN, BIHAR, MADHYA PRADESH	555	196 759 863
Rice, basmati	2	2	ANDHRA PRADESH, KERALA	547	1 639 887 328
Bread	3	2	KARNATAKA, KERALA	442	193 749 767
Papad	3	3	RAJASTHAN, MAHARASHTRA, TAMILNADU	439	673 233 531
Food products NEC	2	2	MAHARASTRA, KERALA	324	193 606 323
Menthol	2	1	UTTARA PRADESH	294	494 891 720
Solvent extracted mustard oil	2	2	UTTARA PRADES, BIHAR	293	31 724 580
Ragi, unmilled	1	1	KARNATAKA	224	10 211 227
Oil, groundnut	2	2	KARNATAKA, TAMILNADU	220	2 043 319 220
Milling industries (excl. rice)	1	1	TAMILNADU	190	108 623 215
Sago	1	1	TAMILNADU	163	465 944 462
Sesame oil	1	1	RAJASTAN	141	707 507 343
Gur pam	1	1	UTTARA PRADESH	134	8 539 978
Tapioca sago	1	1	TAMILNADU	116	786 869 563
Leaf plates	1	1	JARKHAND	104	1 121 244
Totals	272			57 300	64 692 612 416

Source: DCSSI (2004a).
*Products for which >100 working units exist in a district.
Total output for registered SSI sector Rs2 032 546 241 305.
Total for registered SSI clusters Rs328 620 093 191.
Total units of registered SSI in clusters 285 150.
Share of food units in clusters >20 percent.
Share of gross output of registered SSI food units in clusters 3.18 percent.

Most of the registered primary food processing plants were located near to raw materials production centres. These were clustered in production districts. Processing units included grain milling for the production of flour or atta, rice mills with or without parboiling facilities, oilseed crushing for expelling oils from mustard and groundnut seed, grain cleaning facilities for ragi and other minor seeds, pam gur units and sago units for use of tapioca and other starches. In addition, there was demand in the clusters for post-primary processing that required more advanced and sometimes more sophisticated equipment for the manufacture of products from rice (e.g. rice flour and poha), starch (sago), wheat flour (bread), soda water, papad, solvent extracted oils from expeller cake, and leaf plates.

The survey conducted by the DCSSI in 2004 identified 272 clusters containing 57 300 SSI food processing units. The clusters had a gross output >Rs64 692 million during 2002/03. The share of food processing clusters in the SSI was 3.18 percent of gross output and >20 percent by number of units available. (See Table 4.4.)

India currently has a milling capability of the order 570 million tonnes (Mt) for rice, 90 Mt dhall and 200 Mt oilseed. This compares with production estimated at 80 Mt rice, 14 Mt pulses and 22 Mt oilseed. Thus the surplus capacity available is huge. According to a study undertaken by Laxminarayana Rao and Chandramouli (1987) available capacity could not be fully used for a variety of reasons. This included 1. power failures, 2. plant breakdowns, 3. lack of raw materials out-of-season, 4. labour problems, 5. lack of working finance, and similar. At the time of the survey, working capacity was of the order 54 percent rice mills, 48 percent oilmills and 62 percent dhall mills. The situation has not changed since then according to the 2003 annual report of the Ministry of Food Processing Industries (MFPI, 2004a). Capacity utilization during 2002/03 is shown in Table 4.5.

Changing socio-economic scenarios provide a useful guide as to what kind of foods will be required in the future. Economic survey reports indicate trends in improved literacy levels, higher economic status, higher growth in urban populations and greater sensitivity to gender issues. Reports describing the expansion of the media and/or the rise in tourism help to indicate the potential for processed foods. For example, in India literacy rates had improved from <45 percent during the 1981 census to >65 percent 20 years later. At the same time *per capita* income has improved, urbanization continues and the numbers of women in the workforce has grown. This has led to increased purchasing power and a demand for more convenience foods. The media helps with educating people on the value of nutrition, food safety issues and marketing, and provides manufacturers with more publicity for their products (Table 4.6).

TABLE 4.5
Utilisation of primary processing food industries (2002/03)

Food processing sector	Capacity utilization (%)
Grain processing (rice mills)	54-55
Roller flour mills	60-64
Pulse milling (dhall mills)	60-62
Fruits and vegetables processing	46-86
Edible oil sector	
Oilseed crushing units	10-30
Solvent extraction units	46
Refineries attached with vanaspathi units	30
Refineries attached with solvent extraction plants	35
Vanaspathi units	41

Source: MFPI (2004)a.

TABLE 4.6
Changing socio-economic environment in India (1981-2001)

Sl. no.	Socio-economic parameters	Units	Census year		
			1981	1991	2001
1.	Urban populations	Millions	192	230	285.36
2.	Working women	Millions	76	105	123.94
3.	*Per capita* income	Rs	1 627	4 242.52	1 0254+
4.	Literacy rate	Percent	43.56	52.21	65.38
5.	Tourism				
	Domestic rail passengers	Millions	3 600	3 800	4 368*
	Domestic air passengers	Millions	5.560	10.083	12.230*
	International air passengers	Millions	1.94	2.35	3.17*
6.	Hotel rooms	Numbers	31 000	38 000	95 772
7.	Motor vehicles	Millions	2.54	5.40	>30.00
8.	Media expansion				
	Newspapers	$x10^5$ copies	46	54	720**
	Television Sets	$x10^5$ copies	160	293	790**

Source: GOI (2001). Information derived from population census 1991 and 2001. Additional reporting from the Dept Tourism, Federation of Hotel & Restaurant Assoc. of India, press information from the Bureau of Govt of India and private communications.
* Domestic rail and air passenger figures under census 2001 are from 1999.
+ *Per capita* income under census year 2001 is at 1993-94 values.
** Newspapers and television set figures under 2001 are from 2003.

FOOD PROCESSING INDUSTRIES IN KARNATAKA

Given a firm agricultural base, a relatively well-educated workforce, excellent communications with the rest of the country and a growing middle class *(based upon the economic development of Bangalore City),* Karnataka State provides an excellent model from which to explore opportunities for investment in agro-industrial parks.

Support for food industries in Karnataka State has centred on primary processing. The potential for this sector continues to grow with increases in raw materials production, with changes in cropping patterns and with technological advances for reducing losses post-harvest/processing. However, the primary processing sector countrywide has largely failed to modernize and to keep pace with changing cropping patterns. This was exemplified with the failure of industry to follow the shift from groundnut and cottonseed to sunflower cultivation for oil production during the 1990s. Behind this lack of market insight is the failure of many oil mills in the country to keep pace with technical change (Laxminarayana Rao and Chandramouli, 1987 and TECSOK, 1993).

Food processing industries remain central to the industrial policies established by the Government of Karnataka. Policies for promoting agro-food processing industries have provided many incentives including:

1. Sales tax exemption for 10-12 years based on the location of the industry.
2. Exemption from payment of all taxes on capital equipment.
3. One hundred percent exemption from stamp duty and registration charges in respect of lease cum sale/sale of land and buildings.

During 2002/03 634 industrial units were registered of which 82 were for food processing. This compares favourably with 549 established during 2001/02 of which 26 were for food products. Most of the food processing units in the medium- and large-scale sectors were sugar mills, solvent extraction plants and flour mills. Of these <10 percent produced food that required a measure of modern processing such as fruit juicing and pulping, packaging concentrates in aseptic bags, refined oils, ice creams and frozen foods. The majority of small-scale units focussed upon primary processing. (GOK, 2004)b.

TABLE 4.7
Monthly *per capita* expenditure on foods and non-food items in rural and urban areas of India

MPCE year	Rural			Urban		
	Food	Non-food	Totals	Food	Non- food	Totals
1987/88	100.82 (72.15)	57.28 (51.99)	158.10 (63.26)	139.73	110.18	249.91
1993/94	177.80 (71.03)	103.60 (34.80)	281.40 (61.44)	250.30	297.70	458.00
2000/01	278.57 (69.54)	216.34 (42.09)	494.91 (54.11)	400.57	514.01	914.58

Source: GOI (2001).

Domestic markets for processed foods

According to the National Sample Survey Organization (NSSO) the average monthly *per capita* expenditure (MPCE) in rural India during 2000/01 was Rs494, i.e. about 54 per cent of the MPCE of Rs915 for a typical urban dweller. The MPCE is considered a fair indicator of living standards since it aggregates the monetary value of goods actually consumed during a particular reference period. This includes consumption of outright purchases as well as those that are home produced. The latter are normally valued ex-farm or ex-factory (GOI, 2002a).

What is striking about MPCE data is the gap that exists between the typical urban and rural dweller. This has widened by more than eight percent between 1987/88 and 2000/01 as shown in Table 4.7. Considering that 1987/88 was a drought year when rural incomes would logically have been depressed, the increase in disparity levels is all the more significant.

Using expenditure as a proxy for measuring actual consumption has its limitations especially when it comes to food items, which are usually cheaper in rural areas (from where they are primarily sourced). The average monthly *per capita* quantity of cereals consumed in rural India during 2000/01, for example, was 12.43 kg when compared to 10.08 kg for urban India. At the same time, the corresponding value of cereal consumption was marginally lower in rural India (Rs99.12) compared to that for urban India (Rs100.67).

The urban-rural gap is much more pronounced for non-food items vis-à-vis food items. As Table 4.7 shows, the average monthly expenditure for a city dweller for food items during 1987/88 was Rs139.73. This was higher than the corresponding non-food spending of Rs110.18. But in 2000/01 this situation had reversed with average non-food expenditure Rs514.01 exceeding that of food Rs400.57. No similar diversification of the commodity basket has been noted for rural India.

About 93 per cent of the rural population during 2000-2001 had an MPCE below Rs915 - the average MPCE for urban India. Thus, the so-called ‘rural rich’ who enjoy consumption standards comparable to the ‘average’ urban Indian, comprise just 5 per cent of the rural population. The NSSO data also shows that while almost 75 per cent of the country's population in 2000-2001 lived in rural areas, they accounted for less than 62 per cent of total consumption expenditure (GOI, 2002a).

In recent years, however, rural markets for processed foods have expanded mainly because of the efforts of the food processing companies. (See, for example, Mori 2000). In a bid to extend their market base, companies are actively exploring the rural hinterland. Hindustan Lever Ltd (HLL), for example, has continued to strengthen its marketing network in the villages, and is currently producing goods to suit the taste and budgets of rural consumers. Companies such as ITC, Pepsi Foods, Tata Kisan Sansar, EID Parry, etc. - the list is expanding everyday - are taking the rural route to expand their market base. This also provides a measure of security for sourcing raw materials for their respective agro-industrial ventures. Noting that larger number of rural Indians living in villages may appear to be a stating the obvious, but what is significant is that these villages have undergone drastic change during the post-reform era (during the 1990s). While the trickling-down effects of higher GDP growth and lower inflation rates have improved

the economic conditions of villagers, exposure to new products has clearly changed their consumption patterns.

The number of people living below the poverty line has been falling steadily - from 44 percent in 1983 to 36 percent in 1993/94 and down further to 26 percent in 2000/01, according to the 55th Round of the Household Consumer Expenditure Survey of the National Sample Survey Organization. What is startling is that poverty levels have fallen at a sharper rate in rural areas than in the towns during the post-reform years. The percentage of people living below the poverty line has declined by 10 percent in rural areas from 37 percent in 1993/94 to 27 percent in 2000/01. This compares to a fall of 9 percent in the urban sector (32 to 23 percent) during the same period (GOI, 2002b).

In absolute terms, the number of people living below the poverty line is, of course, still high. At present about 260 million people live in poverty – estimated 193 million in rural areas and 67 million in cities and towns. But the number of people rising above the poverty threshold during the same period has been significant (Ministry Finance, 1999).

The change in consumption patterns, of course, has been dynamic during the last 20 years and the share of food in the MPCE has been steadily declining. This share has fallen from 59 percent in 1997 to 55 percent in 2002. Much of the surplus income generated from these changes has been used to upgrade living standards. The share of non-food items for the typical rural household during the same period has increased from 41 to 45 percent. In actual terms, the expenditure on non-food items has grown by about 47 percent between 1997 and 2002, against a rise of only 26 percent for food items. Indian villages have become more health conscious and are now spending more on medicines. The share of medical expenses in monthly consumption expenditure increased from 5.7 percent in 1997 to 6.8 percent in 2002.

The most dramatic change, however, has been seen in the consumer goods sector. Higher expenditure on healthcare will keep people fit, but Indian households are no longer prepared to ignore access to worldly comforts. There has been dramatically demonstrated as the result of the exposure of the domestic economy to global competition from the 1990s on. Household expenditure on consumer goods, services and consumer durables has increased sharply during this period. More than 12 percent of a typical rural household monthly budget was spent on consumer goods and services in 2002, against 9.5 percent for the same sector just five years earlier.

There is a network of estimated 850 000 retailers in the country including the supermarkets and more than 500 000 traders, wholesalers and others who stock processed consumer goods. This network of distribution is mainly responsible for popularizing consumer packed processed foods as part of normal commercial activities of promotion and advertising.

The promotion of goods has resulted in changing consumer preferences. This has helped to create a number of popular brand images. Indian agro-processors have been quick to adopt the methods of selling typical of the industrial countries. For example, when traditional markets for vermicelli could not be expanded further *(or replaced by more easy-to-prepare noodles)*, advertising was able to expand markets and, at the same time, create specialised niche markets for what was essentially the same product packaged in different styles and sold under different labels.

The MFPI has increased advertising and publicity budgets with which to provide subsidies to small-scale food processors from Rs600 000 in 1990-91 to Rs4 million in 1999-2000. This is strictly limited when compared to budgets available to the large-scale and/or multinational companies (MNCs). Spending has risen from 5 percent to 12 percent of revenues on brand building and advertising. Hikes in spending by leading MNCs and the groups of larger-scale Indian food manufacturing companies (FMCs) have ranged from 4 percent to 200 percent of sales revenue. Annual spending of the top ten consumer product companies (including processed food companies) on advertising and publicity was 12 364 million during 2000 (Modi, 2000; MFPI, 2002; and Sachdeva, 1988).

Organoleptic perceptions (and, in particular, taste) are a driving force behind the demand of new food products in the Indian marketplace. Only those products that are palatable to local populations are likely to be commercially successful in the short- and medium-term. That said, the changing food preferences of recent years have increased the consumption of bakery products and ready-to-eat snacks, many of which are wheat-based. Advertising is playing an important role

in popularizing these products. While the increase in *per capita* consumption of selected processed consumer packed foods in recent times cannot simply be attributable to advertising, it should be noted that the consumption of processed foods has grown phenomenally in recent years. The trend has been one that closely follows increased advertising by branded product manufacturers. A survey in 1994, for example, to determine the penetration of various food products in urban India showed the impact of well targeted marketing efforts (Potty, 1995). Note the performance of bakery and potato products shown in Table 4.8.

Export markets for agricultural products and processed food products

The leading exporters of food products in global markets are the United States, France, the Netherlands, Germany, United Kingdom, Canada, Belgium, Italy, Denmark, Spain, Australia, Ireland and China. India features among the top 10 exporters of food from the developing countries, and is positioned sixth after Malaysia amongst the industrializing countries. Other major exporters include Brazil, Argentina, Cuba, Thailand, Malaysia, Columbia, Mexico, Singapore and the Ivory Coast.

India exports more than 300 food items and large volumes of agricultural raw materials. Agricultural and allied product exports from India increased from US$2 467 million in 1985/86 to US$6 700 million in 2002/03. World exports of agricultural and allied products were US$262 114 million during 1994. Indian exports during the same year were US$4 667 million or 1.78 percent of world volume by value. The proportional shares of Indian exports in world agricultural markets are shown in Table 4.9.

The wide selection of agricultural commodities grown in developing countries offers enormous scope for increasing exports. India is no exception. It is essential, however, to increase productivity throughout the production chain to enable producers/processors to meet the needs of both domestic and export markets. Competition from other countries with similar agricultural production facilities, expertise, climate and stage of development can be severe. Table 4.10, for example, compares the range of items currently being exported from India and Sri Lanka. It shows the similarity of products manufactured and sold by both countries, and this exemplifies the issues involved when competing in the same international markets.

TABLE 4.8
Penetration of processed foods in urban areas

Processed food products	Penetration (%)
Biscuits and other bakery products	88
Cheese	5
Jam	20
Ketchup and sauces	23
Milk food drinks	28
Wafers (potato-based)	64
Noodles	21
Corn flakes/porridge	3
Packaged meat	2

Source: IMRB (1993). Based on a survey of 8 500 housewives in 32 towns across 14 states in India.
Note: National food survey (I) was undertaken in 1991/92 and represented 11% of households. NFS(II) is in planning and will represent 65% of national households. It will cover >18,000 people and >60 products.

TABLE 4.9
Indian share of world agricultural export markets

Items for export	1990 Share (%)	1994 Share (%)	2001		
			World (US$ million)	India (US$ million)	Share (%)
Meat and meat preparations	0.20	0.30	46 656	312	0.7
Fish, crustaceans, molluscs and preparations.	1.60	2.70	49 654	1 340	2.7
Cereals and cereal preparations.	0.60	0.90	55 393	755	1.4
Rice	6.40	6.60	7 530	631	8.4
Vegetables and fruits.	0.80	1.70	71 126	825	1.2
Sugar, sugar preparations and honey.	0.10	0.20	15 946	0	0
Coffee, tea, cocoa and products.	4.00	2.70	26 956	922	3.4
Coffee and coffee substitutes.	1.70	2.40	9 945	255	2.6
Tea and mate.	22.10	13.60	2 978	415	13.9
Spices	7.70	9.10	2 440	152	10.3
Animal feeds	2.20	3.10	21 574	451	2.1
Oilseeds and oleaginous fruits.	0.80	0.70	15 296	226	1.5
Total exports (all items)	**0.50**	**0.80**	**325 494**	**6 284**	**1.9**

Source: Ministry Finance (1997), Ministry Finance (1999) and Ministry Finance (2004).
Note: Annual economic surveys from 1996-97 on are published on the Internet.

TABLE 4.10
Major agro-food exports from India and Sri Lanka

Sri Lanka		India	
Agricultural produce	**Processed foods**	**Agricultural produce**	**Processed foods**
Fresh coconut	Desiccated coconut	Basmati rice	Fruit juices/pulp
Vegetables	Dried spices	Fresh vegetables	Canned fruits
Areca nuts	Vegetables in brine	Onions/potatoes	Canned vegetables
Cashew nuts	Frozen vegetables	Mushrooms	Dehydrated vegetables
Pineapples	Frozen fruits	Mangoes	Frozen meat
Bananas	Dried tamarind	Cereals	Canned meat
Citrus	Dried vegetables	Other fruits	Pickles/chutney
Mangoes	Natural essential oils	Spices	Bakery products
Mushrooms	Dried fruits	Cut flowers/foliage	Confectionery
Onions/potatoes/garlic		Other varieties of rice	Milk foods
Cut flowers/foliage		Cashew kernels	Cocoa products
Dates			Condiments
Spice seeds			

Source: GOSL (1999) and AFST (1999).

MARKET DRIVEN AGRO-INDUSTRIAL PROJECTS

The types of projects that can be accommodated within, or attracted to, an agro-industrial park depend upon the location of the park. Location may also determine the area of the park, the numbers and sizes of the many separate units on site, and the particular needs of the catchment area. This may include: 1. requirements for *primary* processing units; 2. facilities for cleaning/grading/packing/storing fresh produce for marketing, and 3. *secondary* and *tertiary* processing units for processing surplus produce after fresh market requirements have been met. Whether fresh or processed, it is the market that ultimately determines the extent of demand and, ultimately, the choice of projects that should be considered.

TABLE 4.11
Determining requirements for processing units in Kolar District

Processing requirements	Quantity available for milling (t)	Additional capacity required for milling (t)[1]	No. units that can be started per district[2]
Paddy milling	76 200	12 800	8
Oilseed crushing	142 000	63 800	13

Source: Laxminarayana Rao, K. and Chandramouli, B.R. (1987) and TECSOK (1993).
Notes: 1. Additional capacity required is based on the assumption that practical capacity use is 52 percent.
2. Minimum capacity is estimated 1 t/h for rice mill and 30 t/day for oil mill.

Requirements for primary processing units

Requirements for primary processing units will be based upon:

- Production of food grains and oilseeds from the catchment area of the park.
- Existing processing capacity currently available to producers.
- Proposals/investments underway for expanding the use of existing plant.
- Enhanced efficiency possible with existing plant.
- Modelling to provide feedback for minimum economic capacity required for park units.
- Relocation opportunities for shifting from existing factory sites to the park.
- Capacity of defunct units (i.e. those no longer operational) and similar resources.

Requirements can be exemplified with a review of agro-industrial development in Kolar District in Karnataka State. This is shown in Table 4.11. Industrial units can be established if sufficient raw material is economically available within the catchment area, and if transport costs are shown to be commercially viable.

Requirements for secondary and tertiary processing units

A similar approach to industrial need is essential for determining requirements for post-primary processing. Ultimately, it is the *market* that will determine the numbers and choice of units that should be encouraged and established for those products manufactured in the park. The demand for products depends upon the extent of urbanization of the area, socio-economic levels (including literacy and wealth), working and culinary traditions, changing patterns of demography, and similar. The situation is frequently dynamic, and decisions are taken with little long-term feel for the stability of markets. Unlike the animal feed sector, for example, where costs and nutritional requirements may be guided simply by product design *(for poultry feed, for example, this will be a choice of chick, growers, broilers and/or layers mash),* the development of food products for people is constrained by a constantly changing preference on the part of the consumer.

There are a number of reasons for changes of this kind including increased income, shifts to a more varied and interesting diet, social pressures, advertising, cultural factors, migration and similar. People in India, like those in many other rapidly industrializing countries, have been quick to adopt and modify the social and culinary customs of others, and many previously unknown foods have become commonplace. This has included demand for a range of foods including bakery goods (breads, biscuits, etc.), dairy foods (cheeses, milk, ice-creams and yoghurts) and meat and processed meat products. The same holds true for beverages. Tea remains the most popular Indian social drink, but people are increasingly demanding beers, wines and spirits (brandy, whisky, etc.), popular soft drinks (from the international branded manufacturers) and other beverages such as soyamilk, milk drinks, cocoa and coffee. Snack foods have also become popular. These are mainly sugar or savoury-based, and have led to a dynamic domestic confectionary industry linked to recreation, pastimes and eating-for-pleasure typical of the urban middle class. Equally of interest has been the development of modified and varied traditional Indian foods (i.e. curry pastes and powders, pastas, noodles, roti and chapatti) and the introduction of foreign foods such as pastas, pizza, breakfast cereals, fast-foods and similar.

Food industries and their products have crossed the ethnic barriers and are known to, and eaten by, people from all walks-of-life in most countries. India is no exception. Trends are normally

evident, and can be tracked by investors. The skill comes with projecting the magnitude of change and the speed with which demand may grow (and, in some cases, decline). The most critical influencing factor is the economic strength of the consumer, and this is linked invariably to the wealth of the community. Again, markets predominate, and the entrepreneur or industrial planner is obliged to keep abreast of market dynamics to protect investments.

Surplus raw materials available within a region can be converted into value added products for export. Again, such opportunities can only be realised with some knowledge of the markets that may already exist. Commercial processing should *never* be production-led. In countries such as India there are regions and areas in which the agro-climate is best suited for specific crops. For Karnataka, for example, this includes coffee, cocoa and tea in the Western Ghat Region, mangoes around Kolar and Belgaum, vegetables adjacent to the cities of Bangalore, Kolar, Dharwad and Belgaum, and oilseeds in the rural districts of central Karnataka.

Bumper harvests in some years will inevitably result in a fall in demand and a subsequent slump in prices. This is harmful to farmers and traders alike. During the 1997-1998 seasons, for example, potatoes, tomatoes and mangoes in Bangalore and Kolar Districts faced over-production. Lack of storage or processing facilities resulted in high crop waste, which resulted in protests by farmers across the region. Farmers dumped unsaleable produce on national highways in an effort to draw the attention of the state government to their plight.

Herein, there may be opportunities for shifting surpluses into store (for use between harvests), for adding value, for innovation to develop new or different foods, and for sale of these foods into either urban or export markets. Ventures of this kind, however, demand significant support for planning, technical, financial and managerial services. Some opportunities for agro-processing in Kolar District are shown in Table 4.12. Further, Table 4.12 highlights the potential that exists for industrial exploitation of raw materials available, and demands for processed foods in neighbouring Bangalore City – the state capital and the largest urban area in Karnataka State.

Commercial infrastructure facilities

An agro-industrial park will have sufficient throughput to support the location of common infrastructure for use on site. Whatever the eventual resources contained in this facility, it is expected to be commercial from the start and to eventually become profitable. It follows that the responsibilities for operation, management, replacement, etc. are vested in the joint ownership of the enterprises located in the park. In this respect, the park becomes fully self-contained. Much, however, will depend upon local government policies put into place during the start-up phase, and those that may come on-stream later (as demand grows). Other factors will also apply and include incentives available from the public sector, payment based on volumetric use, payment based on the toxicity of wastes produced, off-park use of facilities, and complementary or competitive

TABLE 4.12
Processing enterprises with potential in Kolar District

Products for domestic markets	Products for export
Refined vegetable oils in consumer packs.	Fruit juices and pulps.
Fruit squashes, syrups, jams and jellies.	Canned fruit slices and canned vegetables.
Tomato ketchup and sauces.	Dehydrated vegetables
Pickles and chutney.	Dehydrated Onions
Ice cream and milk products.	Tamarind paste and powder.
Confectionery and sweets.	Tomato paste and puree.
Tamarind starch	Pickles and chutney.
Bakery products	Pickled gherkins and other vegetables.
Potato wafers and dried finger chips.	Baby corn in brine.
Potato starch and alcohol.	Essential oils
Extruded snack foods	Natural food colours.
Animal feeds	Cut flowers
Essential oils	IQF fruits and vegetables.

Source: TECSOK (1999) and Food Karnataka Ltd (2003).

supporting services available from either the state or the neighbourhood. Facilities with potential for location on-site are shown in Table 4.13, and examples illustrated in Plate 4.2.

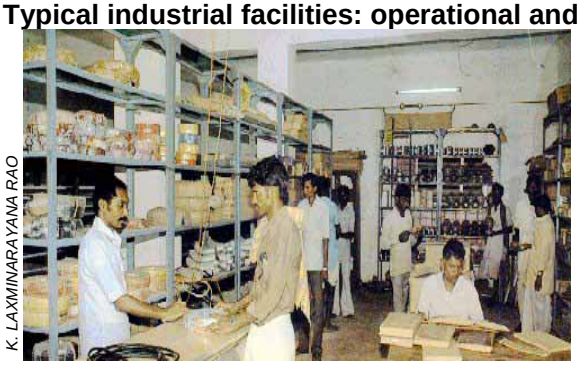
For the success of agro-industries in the medium- and small-scale sector, the one-stop industrial park concept providing all essential facilities and services is recommended. A typical example of a successful industrial park of this kind is Batam Industrial Park in Indonesia.

TABLE 4.13
Industries, supporting services and facilities for an agro-industrial park

Types of industrial activity	Supporting commercial infrastructure
Food grain milling.	Warehouse facilities, drying units, testing laboratories, waste utilisation and power utility.
Oilseed processing units including solvent extraction plants, refining and packing.	Warehouse facilities, drying units, testing laboratories, common effluent treatment plant, power supply and solid waste conversion.
Fruits and vegetable processing.	Packing and grading houses, cold stores, testing laboratories, common effluent treatment plants and solid wet waste composting plant.
Tissue culture laboratory and green/poly houses for flowers and vegetables.	Cold stores, laboratories and container terminals (e.g. airports, shipments, etc.).
Fruit and vegetable dehydration.	Laboratories, cold stores and fumigation facilities.
Essential oils	Laboratories.

Source: Laxminarayana Rao, K. & Chandramouli, B.R. (1987), TECSOK (1993) and Laxminaraya Rao, K. (2002)a.

Typical industrial facilities: operational and under construction



K. LAXMINARAYANA RAO

Plate 4.1
Hardware store in Peenya Industrial Estate Bangalore. Stores of this kind and scale are managed by small industrial cooperative societies.

K. LAXMINARAYANA RAO

Plate 4.2
Warehouse under construction. The need for dry storage facilities is essential to protect oil seeds, food grains and vegetables from damage by inclement weather.

Chapter 5
Challenges for agro-industries

Establishing productive and competitive agro-processing industries requires considerable effort on the part of those involved in the production, processing, transporting, marketing and sales chain. A well organised and well located agro-industrial park has the potential to provide the facilities for processing a range of materials to produce a variety of products, and to provide common services. Herein there is a scope for cost effectiveness and wise investment that will enhance the performance of each entrepreneur within the collective group. Links between producers and processors are symbiotic, but also competitive and the park should remain with a separate identity focussed primarily upon the post-production sector; at least at time of establishment and during the early years of trading. Given the importance of pricing between materials sold off-farm and purchases at the factory gate, a competitive edge is essential to ensure that the best producers and processors remain commercially viable. Herein there is scope for contractual farming and processing agreements.

CONSTRAINTS AFFECTING THE GROWTH OF AGRO-FOOD INDUSTRIES

There are many constraints with the promotion and implementation of agro-industries in developing countries. Some of these may be specific to a particular country, but many are commonplace and include:

a) Insufficient volume of crop and/or crop varieties in available for processing.
b) Costs of production high because of low productivity; making processed foods and other products uncompetitive.
c) Inadequate infrastructure.
d) Poor quality raw materials available - particularly lack of hygiene, pesticide residues, inadequate selection and grading, improper packing and poor storage.
e) Procedural hindrances and delays within the appropriate public departments, for example, when issuing phytosanitary certificates from dedicated plant quarantine agencies in the producer country; procedures may be inadequate, cumbersome or technically poor.
f) Investment and modernization of the food processing sector may be hampered by high costs of imported plant, equipment and materials.
g) Low yields and high levels of waste adversely affect the availability and prices of raw materials.
h) Technological deficiencies in selected areas of production and/or processing, particularly with inadequate R&D and limited dissemination of new information. (For example, traditional varieties of alphanso mango, basmati rice and others command a premium on international markets, but these crops remain under-developed and poorly exploited - low production, poor disease control and inadequate processing facilities).
i) Inadequate structures for taxes and levies that do not encourage more innovation and R&D for new crops, crop varieties and/or processing practices.
j) Lack of quality control facilities results in the rejection of foods by consumers. Improper controls for quality result in the production of poor quality or contaminated foods for markets, and this can lead to health problems or outbreaks of diseases. National reputations suffer where exported products are down graded or rejected at point of importation. This can have considerable repercussions for other exporters from the same country (some of whom may be following strict quality control guidelines).

The role of agro-food processing industries needs to be fully recognized as one means of increasing and improving food supplies to local communities, and for reducing levels of poverty in producer areas. The development of rural agro-industries can accelerate the pace of socio-

economic progress for local people. In India prior to the 1980s, for example, the agro-food processing industry was stagnating; development had virtually stopped because the industry had been considered a luxury sector. Industrialists were burdened with numerous taxes, which were beyond their ability to absorb and, at the same time, remain profitable.

In developing countries, farming communities are sometimes characterized by small numbers of producers dispersed over large areas. The intensity of crop production may be low; with the need to transport goods and materials over long distances to reach markets. A central processing unit has to be located with care and has to consider the many contingencies involved for collection, storage and use of raw materials and, eventually, the disposal of wastes. A review of resources within the target area may enable industrial planners to take account of the likely changes that may follow from crop diversification in that area. The issues facing planners are many. How to consider new crops that may come on-stream? How to dispose of unwanted materials? What services can be provided? Are there sufficient communities available from which to provide workers for the processing centres? What training facilities may be required for workers?

Commercial issues such as access to transport may dominate decision-making that minimum costs will be incurred when hauling unprocessed materials from farm to factory. Post-factory *(when high value goods are transported)* the costs of distribution are more easily assimilated into the financial trading arrangements that may apply to the processing chain. Traditionally, a few processing industries will already be located in producing areas including rice mills, sugar mills and oil mills. Horticultural crops are normally grown adjacent to the main markets *(frequently for fresh consumption),* and this makes semi-urban areas logical places in which to construct processing units. Notwithstanding the concentration of processing units in peri-urban areas, the collection and processing of agro-wastes are normally given low priority. One key factor is profitability. Waste enterprises are rarely profitable *(apart from selected industrial waste streams that can be used for the production of animal feeds or agro-fuels).*

REASONS FOR POOR EXPORT PERFORMANCE

In spite of an abundant and varied production base in many developing countries and the substantial international demand that exists for many fresh and processed foods, the export performance of these countries (and their industries) is marginal. Collectively, the developing countries contribute of the order 1-2 percent of total international export trade. Globally, these countries remain on the fringe of markets that exist. Limited export trade is due to a variety of reasons, the most common of which include:

a) Inadequate post harvest management practices.
b) Lack of sophisticated equipment for ensuring uniform high quality products for export.
c) Lack of cold storage facilities, which make the grower increasingly dependent upon external market traders (and thus market forces over which others have control).
d) Constraints of air cargo space, high air freight rates and lack of facilities at ports of exit.
e) Over-dependence on a few selected export products (for example from India - onions, okra and mangoes; and from Sri Lanka - coir, desiccated coconut and spices).
f) Over-dependence on a limited number of conventional markets in West Asia, Western Europe or North America catering mainly to ethnic populations; making these exports vulnerable to fluctuations in international trade.
g) Absence of clear policies with which to ensure a sustained presence in the main export markets over a reasonable period of time.
h) Lack of adequate quality control facilities either on-site at point of production or as common facilities within a district or an industrial estate.
i) Inadequate information about potential markets and the competitiveness of the raw materials or manufactured goods involved.

These constraints will have continuing and adverse effects upon the trade of both domestic and exports goods, and hence on the development of an agro-food processing industry in the territory. A further scrutiny of some of these issues will help to highlight the principles involved, which, collectively, apply wherever raw materials are processed for sale. Herein there is information that can be scrutinized with which to enhance the design of an agro-industrial park.

NEED FOR QUALITY CONTROL FACILITIES

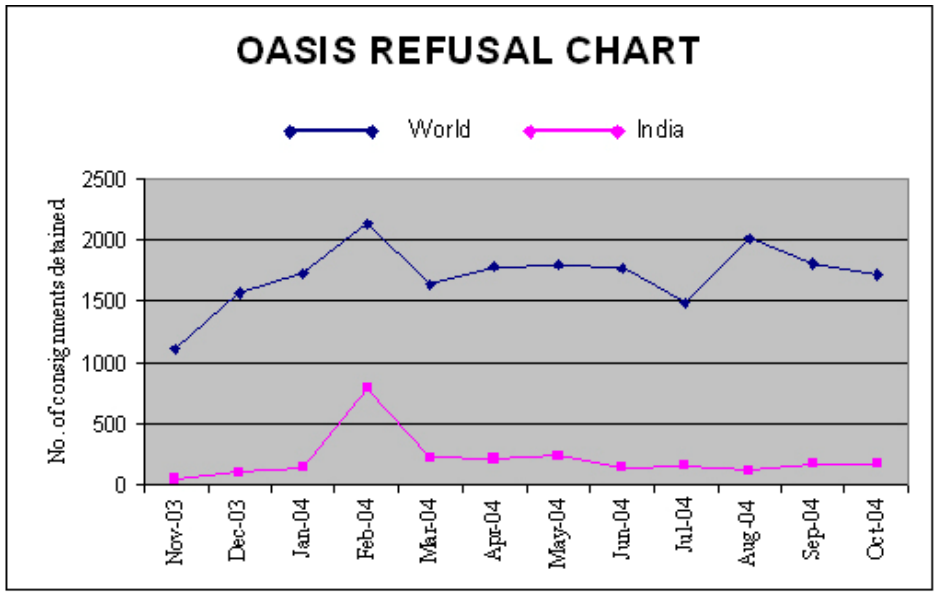
Detention of food shipments at ports of entry

Maintaining the quality of food is essential to ensure food safety and to prevent food-borne diseases affecting consumers. There are also aesthetic and good trading aspects to consider. It makes economic sense to ensure that the food shipped is always of the highest standards, particularly for export. This ensures repeat orders and helps to promote reputations. The converse is also true where poor quality or spoilt goods are shipped. The industrial countries of the European Union, United States, Russia, Japan and others maintain strict quality control at ports of entry and detain or reject all food consignments, which do not meet the standards required of local food codes.

There is normally variation between the different national codes, but they contain a measure of similarity that ensures rejection by one country will usually mean rejection by all. But this is not always the case. Many standards and regulations come from good trading practices and have been devised, developed and re-developed over the years. Many national standards for foods are linked to the regulations of the Codex Alimentarius Commission of FAO/WHO, with each country modifying these codes to suit local conditions.

In order to ensure quality control among the exporting producers, export inspection agencies have been established in most developing countries. These agencies have introduced compulsory inspection of produce before export. This ensures that producers follow what are termed '*Good Manufacturing Practices'* (GMPs). Notwithstanding procedures of this kind, food products from developing countries continue to be detained at ports of entry in the industrial countries or are rejected (for return shipment or disposal). This emphasizes the need to strengthen the quality control infrastructure and procedures of the exporting countries, by establishing proper quality control facilities at all points in the production/processing chain (and particularly before despatch of goods from the country).

FIGURE 5.1
Consignments detained at US entry ports: India vs World



Source: FDA (2004).

During the period November 2003 to October 2004, for example, 20 595 consignments from 83 countries were detained at United States ports. Of these 2 553 consignments were from India. This compared with 13 547 consignments of food imported from 66 other countries (see Table 5.1 and Figure 5.1). Food worth more than US$1 150 million imported under OASIS assistance was detained for violating FDA regulations at point of entry into the United States in 1989 (FDA, 2004; Rajesh and George, 2003).

Among 2 465 consignments which did not confirm to specifications from the many exporting countries in 1989, 186 consignments (or 7.55 percent) of all violations were of Indian origin (Table 5.2). Much of this was due to the presence of contaminants with the largest number of rejections due to *salmonella* in shrimps and lobsters, *animal faeces* in basmati rice, rice products and papad and *microbiological* contaminants and *Ethylene dibromide* residues in peppers. Other contaminants included *cyclamates* in preserved foods and high levels of natural ingredients like *tannin* and *alkaloids* in betel nuts (FDA, 2004).

During a two-month period in 1990, 297 shrimp consignments were rejected at United States ports. Of these, 79 (or 26.4 percent) were from India. In the 12 month period November 2003 to October 2004 detention of consignments as the result of low quality was reduced. The presence of pesticide residues, animal wastes, salmonella, unsafe additives and insufficient processing continued to affect food exports. Most detentions were due to non-declaration of selected nutrients in food such as colour, preservatives, sulphites and materials used for the manufacture of labels. Proper quality control, improved supervision of manufacturing and the introducing of GMPs and ISO 9000 practices will eventually help to solve most of these issues.

TABLE 5.1
US food imports detained during 2003/04

Month	World		India	
	Number consignments detained	Number exporting countries	Number consignments detained	Indian Share (%)
November 2003	1 120	79	57	5.09
December 2003	1 567	84	101	6.44
January 2004	1 730	91	147	8.49
February 2004	2 136	80	797	37.31
March 2004	1 641	81	230	14.01
April 2004	1 782	92	216	12.12
May 2004	1 806	82	236	13.06
June 2004	1 768	94	151	8.54
July 2004	1 490	94	157	10.53
August 2004	2 015	85	121	6.00
September2004	1 815	84	170	9.37
October 2004	1 725	83	170	9.86
Totals	**20 595**	**-**	**2 553**	**12.4**

Source FDA (2004).

TABLE 5.2
US food imports detained during May and June 1990

Types of violations	Worldwide	India	Indian share (%)
Pathogenic bacteria	297	79	26.60
Animal faeces/insects	835	61	7.31
Unfilled low acid canned food product	320	23	7.19
Pesticide residues	456	11	2.41
Heavy metals	156	0	0
Moulds and mycotoxins	-	1	-
Non-permitted food additives	159	2	1.26
Poisonous substances	134	2	1.49
Decomposed state	108	7	6.48
Totals	**2 465**	**186**	**7.55**

Source: Bhat, R.V. (1991).

Need for quality control of raw materials

Most of the quality related problems in the final product identified by the OASIS report (FDA, 2004) and listed in Table 5.3 can be eradicated/controlled at time of procurement. Issues such as pesticide residues, product colour and the presence of extraneous materials should not continue through into sales. The challenge remains that of providing feedback to the many small-scale producers/processors involved, and providing the technical assistance that will enable them to eradicate issues of contamination, etc.

TABLE 5.3
Reasons for detention of food products at US ports during 2003/04

Sl. No.	Reason	Products detained	
		India	World
1.	Pesticides	• Chick peas • Channa dal • Chawli dal	• Long beans, fresh long beans • Fresh green and white long beans • Fresh snow peas • Frozen soyabeans with pods • Fresh string beans • String beans • Romano beans • Fresh eggplant • Indian/Chinese eggplant • Fresh and frozen okra • Peppers (fresh yellow, orange and fresh hot peppers, yellow bell pepper) • Peppers (small, hot and red peppers) • Cucumbers • Yellow squash • Serrano chilli • Pasilla peppers • Jalapeno peppers • Tree cucumbers • Dry chilli puya peppers • Negro peppers • Baby mustard green • Fresh Mexican greens (Mexican tea) • Dried red pepper • Peppers

			• Mini seedless cucumbers
2.	No Process	• Sweet delicacy made with green gram. • Chick peas • Dessert made with bottle gourd. • Pickled green chilli • Vegetable cut in brine • Curried mustard leaves with spices & oil.	• Coloured beans • Fried beans • Pre-cooked beans • Beans • Peas • Corn • Canned red beans • Canned beans • Antioquias beans • Canned giant beans • Laroco fernaldia SP • Squash in syrup • Chiltepe (pickled peppers) • Hot peppers in brine • Hot peppers pickled • Cucumber pickles • Piccalilli pickles • Eggplant speciality • Stuffed pepper • Greek golden pepperoni/peloponesse in brine • Pickles • Peppers • Canned peppers • Pumpkin in syrup • Pumpkin paste • Eggplant • Roasted red pepper • Tomatoes/zelen • Red peppers • Chipilin • Cabbage, pickled • Stuffed cabbage • Artichoke hearts • Cabbage, cut in brine • Stuffed vine leaves • Canned artichoke • Refrigerated bamboo shoots • Bamboo shoots • Slender bamboo shoots • Yanang leave squash • Refrigerated broad beans with pickled mustard leaves • Dried bamboo shoots • Golden country spinach puree • Asparagus juice • Semolina
3.	Needs FCE	• Pickled green chilli	• Coloured beans • Fried beans • Canned red beans • Canned beans • Antioquias beans • Laroco fernaldia SP

			• Squash in syrup • Chiltepe • Hot peppers in brine • Hot peppers, pickled • Cucumber, pickles • Greek golden pepperoni/peloponesse in brine • Pickles • Peppers • Pumpkin in syrup • Pumpkin paste • Eggplant • Roasted red peppers • Tomatoes/zelen • Chipilin • Cabbage, pickled • Artichoke hearts • Cabbage, cut in brine • Bamboo shoots • Dried bamboo shoots • Golden country spinach puree • Asparagus juice
4.	List of ingredients not furnished.	• Toor dhall oily beans	• Kidney beans • Beans, NCE as vegetable • Slender bamboo shoots
5.	Nutrition label not provided.	• Toor dhall oily beans	• Kidney beans • Beans, NCE as vegetable • Piccalilli pickles • Golden country spinach puree • Low protein powder
6.	Presence of wastes.	• Basmati rice (packaged)	• Frozen bean curd • Dried maize ear • Dried pasilla peppers • Dried guajillo peppers • 734 boxes with dried guajillo peppers • Dried cascabel peppers • Dried ancho peppers • Dried puya peppers • Dry whole habanero peppers • Colouring dried chilli • Mirasol dried chilli • Dried chilli • Dried hot peppers • Dried chilli peppers • Chilli peppers • Dry chilli guajillo peppers • Dry ancho peppers • Dried mulato peppers • Dry chipotle chilli peppers • Dry chilli cascabel pepper • Dried morita peppers • Sun dried tomatoes • Frozen banana leaves • Low protein powder

			• Cassava flour • Cassava
7.	Flavour ingredient label not provided.	Fruit juices	
8.	Colour ingredient label not provided.	Fruit juices	
9.	Usual name		• Laroco fernaldia SP • Low protein powder
10.	No English language.		• Golden country spinach puree • Dried laver (mingled with green laver) • Dried wide rock laver • Seasoned laver (L/S size)
11.	Sulphite content not provided on label.		• Piccalilli pickles • Slender bamboo shoots
12.	Lacks N/C (Misbranding)		• Piccalilli pickles • Slender bamboo shoots
13.	Yellow #5		• Piccalilli pickles
14.	Health C (Misbranding)		• Refrigerated bamboo shoots
15.	Salmonella		• Dried taro leaves
16.	False declaration		• Slender bamboo shoots
17.	Lacks firmness		• Slender bamboo shoots • Refrigerated broad beans with pickle • Mustard leaves
18.	Unsafe additive used.		• Slender bamboo shoots • Dried bamboo shoot
19.	Labelling		• Golden country spinach puree • Low protein powder

Source: FDA (2004).

High quality raw materials are essential to enable a good quality product to be made. In most cases, prices for raw materials are based on grading for quality. The potential output of a product may also be linked to the yields of the original crop. Table 5.4 provides some examples of quality parameters that apply to raw material selection that may guide or determine original pricing. For example, in many countries the dairy industry has long determined the price of milk supplied by the farmer on the basis of fat and non-fat solids content. It follows therefore that the price of milk sold to the consumer is based on total solids and milk fat content. The sugar industry buys from the farmer according to total sugar of the cane supplied, and sugar recovery in the mill. Similarly, solvent extraction plants determine the price paid for rice bran on the basis of oil content, free fatty acid content and sand silica content of the bran supplied by the rice mills.

TABLE 5.4
Quality parameters and prices of raw materials

Raw materials	Quality parameter determining price
Milk	Fat content
Rice bran for solvent extraction of oil.	Oil/free fatty acid/sand silica contents.
Groundnuts for oil expelling.	Moisture/oil content
Essential oils	Active principles
Sugar cane	Sugar content in cane/mill sugar recovery.
Wheat for bakery flour production.	Gluten content and quality.
Paddy	Variety and milling quality.

Source: Laxminarayana Rao & Chandramouli (1987) and TECSOK (1993).

Food quality control

High quality is an essential requirement for processed foods. The overall quality of a food depends on nutritional (and other hidden) attributes and on the sensory qualities assessed by appearance, taste, texture, smell and other characteristics that come from the perceptions of people. The absence of nutritional qualities and the possible presence of hazardous microbes, environmental contaminants, food toxins and chemical additives cannot normally be judged by consumers in the home. In most countries governments protect the interest of consumers by implementing stringent controls to ensure good food quality and enact food laws regarding inspection, grading, packaging and labelling of foods. Colour, texture and appearance are characteristics of foods that are important for successful marketing and sales.

Facilities in which foods are processed and handled must have the highest possible hygiene. In India, factories processing foods are directed by law to work within strict codes of hygiene with respect to plant layout, materials handling and storage. Factory management is obliged to provide training to people that come into contact with the food. This will ensure, for example, that workers understand, adopt and follow strict habits of personal hygiene. A certification-marking scheme exists within which qualified manufacturers are licensed to use a certification mark (for example ISI, FPO, Agmark or MFPO). This provides for a measure of conformity with the relevant standards *(and provides consumers with a measure of confidence in the products).*

Agro-industrial parks have a contributing role to play herein. Apart from providing ready-made factory sheds built according to prevailing standards (from ISI, FPO, MFPO, Agmark, etc.) parks may have the capacity to set up a central testing and standards laboratory. This unit can provide the certification required. This then becomes recognized by local public inspection agencies as a 'mark of excellence', and this benefits the many small-scale industries based in the park. Services in the laboratory can recover costs on the basis of fixed payments or sliding scales linked to throughput and/or the level of technical sophistication required by the different factories.

Common facilities for quality control

Agro-food processing industries in developing countries are mainly cottage- and small-scale. The volume of production and the turnover of the many individual units are so small that they cannot justify separate in-house quality control facilities. By contrast, an agro-industrial park has the critical mass of units, products, people and investment to provide shared facilities of this kind. There may be large numbers of units outside the park within the region where the park is located that also require quality control facilities. There may be scope herein for an area or regional facility to be developed and based on the food processing units established in the park (for example, complementing those already available elsewhere in the region). Common facilities of this kind will have economies of scale and enable sensible levels of investment to be made by groups of local producers or processors. The common facilities building for Kakkncheri Park is shown in Plate 5.1.

Plate 5.1
Common facility building at agro-industrial park Kakkncheri, Malappuram District, Kerala State

K. LAXMINARAYANA RAO

Note: park developed by Kerala Industrial Infrastructure Development Corporation (KINFRA). The facility contains laboratories, library, cyber centre, users' offices, convention hall, guest house, government offices, restaurant and a medical centre. A further description of the park is contained in Annex 5.

NEED FOR WAREHOUSES AND COLD STORAGE

Storage requirements are normally of two types, viz. 1. Food grains and oilseed storage facilities, and 2. Cold stores or controlled atmosphere storage. Further, for fresh fruits, controlled ripening facilities will be advantageous (for example, with bananas). Products of this kind are normally seasonal, and it may be sensible to provide for storage over a period of at least three months post-harvest to prolong fresh market sales or to supply stock to processors. Stores for food grains need to be equipped with adequate facilities for materials handling, fumigation and aeration.

Different crops will have different requirements, for example, oilseed are normally delivered to store with high moisture content and has to be dried before storing. This reduces the risk of aflotoxins developing in the seed and the chances of over-heating or insect or mould attack. Individual small-scale food processors will not normally be in a position to invest in storage facilities of this kind, and a common storage facility will be of value. Products such as tamarind, fruit juices and pulps, pastes and purees, and fresh fruits will benefit from cold storage. This will increase the levels of investment required by industry; investments that can normally only be recouped with added value processing. The total installed capacity of cold stores in India, for example, is of the order of six million tonnes (Mt). This compares with sector production of >80 Mt fruits and vegetables nationally, and exemplifies the high levels of investment that will be required to enable industry to shift significantly into post-production processing.

The location of cold stores has to be considered by industrial planners. Most cold stores have traditionally been constructed in producing areas, and they are thus not always within easy reach of the processing industries *(which are usually in urban/consuming areas)*. The viability of cold stores as common facilities depends upon links to, and the economic opportunities for, transport of goods into and out of the agro-industrial park. The minimum economically viability of a cold store in India under present conditions is estimated at 4 000 tonnes for long-term storage, 1 000 tonnes for park storage and 500 tonnes for market/transit storage according to the NCDC (1996 and 2003).

It follows that there should be sufficient flow (in terms of materials handling) into and out of the cold store to enable it to maintain a minimum capacity. Unless there are sufficient numbers of users, these facilities will not become a viable proposition. In the case of market and/or transit storage, occupancy rate should normally be 150+ percent. The park storage occupancy rate will depend upon the number of users and activities present on site.

NEED TO PROPAGATE CROP VARIETIES REQUIRED FOR PROCESSING

Whilst most primary processes based on food grains and oilseeds can survive economically on the basis of quantity *(since whatever is produced needs to be processed and oilseeds and cereals are relatively easy to store)*, crops such as fruits, vegetables, spices and flowers require considerably more management effort and investment to provide for adequate handling and storage. Quality thus becomes the dominant factor for profitability. Fruits, vegetables and similar products will deteriorate quickly with poor handling and inadequate climate control. Processing may be limited to washing, grading and packaging or it may comprise more sophisticated extraction, cooking or preservation. The edible proportion of fruits, vegetables and spices that will eventually be processed may be strictly limited, and this will determine the best approach to take, the most suitable choice of processing required and the economic performance of the system selected. It follows that large quantities of waste or spoiled materials will be discarded, and may require sanitizing and discharge off-site.

Matching supply with demand is essential, and decisions of this kind frequently challenge even the most experienced of companies. For example, during the 1990s Messrs Pepsi Foods of India attempted to integrate processing with production, but met with limited success. Despite more than five years of strenuous extension effort with farmers in Punjab State, the company was unable to provide for a regular supply of tomatoes to their tomato paste plant at Moga. The plant was eventually sold to Messrs Hindustan Lever.

A second company, Messrs Ready Foods, established a state-of-the-art plant in Chitoor District Andhra Pradesh for processing diced vegetables for export using IQF techniques.

Although located in the heart of a vegetable growing area, the company were unable to reach 40 percent capacity utilization, and the plant faces closure (Anon., 1994a and Anon., 1994b).

There are some basic lessons herein. For example, the problems were two-fold for Messrs Pepsi Cola, viz. (1) tomato varieties grown traditionally had a low TSS, which resulted in poor yields of paste, and (2) yields in-field needed to improve from an average of 20-25 t/ha to at least 40-50 t/ha to ensure both a good return to the farmer and reasonable throughput at the factory. Similar varietial constraints were found for other crops including cucumbers grown for pickling and grapes required for both raisin production and for high quality wines. In some cases new crops and/or processing opportunities were recognized, for example for baby corn, but neither the producer nor the processor was willing to invest in the range of crops and varieties required with which to exploit the markets available. Herein there may be need to encourage a suitable R&D programme to determine recommended varieties and crop production practices that may be required for a particular area. Programmes of this kind can be public or private sector led (Anon., 1994a and Anon., 1994b).

In an effort to galvanize support for the agro-industrial sector, the MFPI introduced a scheme for strengthening backward linkages (from factory to farm) and to provide support for the many thousands of small-scale producers involved in the sector. The challenge was one of providing a reliable supply of farm inputs, which would then lead to a reliable supply of materials at the factory gate (MFPI, 2003). The main approach was to encourage contract farming. The scheme primarily helped the industrialist with the establishment of horticulture extension services, but also provided for the reimbursement of a portion of the costs of raw materials procured from farmers. Financial incentives were introduced. The basis for extension support required a minimum 25 farmers in an area to become involved. Under the scheme, farmers were provided with seeds and planting materials and encouraged to adopt good agricultural practices. However, in the absence of production facilities for quality seeds and planting materials within the region, many of the agro-industries in the main crop producing areas were not in a position to take advantage of the scheme, and opportunities to make a difference were lost.

There is scope for extending the concept of agro-industrial parks to encompass improved support for producers of raw materials. Here it is that the production of high quality planting materials or hybrid seeds required for the production of fruits and vegetables will eventually led to improved processed goods for export. Given the considerable effort required for establishing a successful park, however *(and notwithstanding the needs for a reliable supply of raw materials)*, extending the mandate of the park in support of producers brings a measure of risk. Facilities such as those required for the production of tissue culture, quarantine, provision of farm inputs, plant protection and similar remain important, but they are of little *direct* relevance to the processor. The processor is normally more concerned with factory gate delivery and prices, costs of production for the goods produced, and market access (and prices) for these goods. Parks may provide an easily recognized centre for the production of processed agro-industrial goods, but there are sound economic reasons for establishing separate parts of the production and processing chain (rather than integration) independent of the park. This will enable pricing to remain more competitive between the two main sectors. In this way, separate contracting between the many entrepreneurs (on-farm and in-factory) will be possible, and the individual skills, experience and knowledge of the people concerned can be used, with the more capable people gaining the highest rewards.

Chapter 6
Government support policies

NEED FOR POLICY SUPPORT

Firm and progressive support from the public sector in the newly industrializing countries is essential for the establishment of a commercially viable agro-industrial sector. Here it is that well reasoned policies are required. The question becomes one of: *'To what extent the sector should be supported given the considerable number of alternative demands there will always be on the public purse'*. Notwithstanding public sector support, however, herein it is the private sector has responsibilities for taking a leading role with fostering development. It follows that public support should attract the entrepreneur and be just sufficiently viable to enable him/her to establish. From hereon the businessman/woman should remain as the key risk taker and, equally, keep the rewards that may accrue. Issues of subsidization may arise if the incentives offered are too attractive. Factors of time will also apply, and public sector support should be phased out once the private sector is firmly in control.

In many cases policies already in place to provide support for industrialization and/or agriculture may be modified to include the agro-industrial sector, thereby linking the producer to the processor or trader. External investment has to be encouraged to enable facilities such as roads, stores, markets, collecting points and factories to be constructed. Investment in production may also be required, with the confidence that comes from producer groups working in harmony with buyers. This leads to increased yields, improved quality of crop and, eventually, a trickle down enriching effect for the remainder of the community; more employment, more income and more development. Neither the agro-food industrial sector nor farmers/producers can develop if producers and processors are working out-of-harmony one-with-the-other or under stress or under conditions of unfair competition.

Stress comes from lack of information, unfair competition *(between the different parts of the food/materials chain)* and insecurity. Competition for prices between producer and processor inevitable brings a measure of disharmony but, once contractual prices and quantities have been agreed (usually pre-season), then supplies should flow from farm to factory. In the industrial countries the infrastructure (including essential laws) is normally in place to ensure delivery once contracts are firm. This, unfortunately, is not always the case in developing countries. Here the processor may never really have a firm measure of control over production, and the farmer may never really be certain that he/she will be able to sell at costs that will cover production (and then make a reasonable profit). Traders proliferate, and sometimes to the detriment of the supply chain. The many small producers working outside of organized supply groups have alliances that can sometimes be easy to shift, particularly with money on-hand at times of crop delivery.

Food preservation and processing industries hold a key position in the agro-industrial development plans of many developing countries. These industries can have many advantages, as follows:

a) They stimulate the cultivation of high quality crops with yields 2-3 times more than traditional crops; they may be able to utilize land considered comparatively poor and, with the right farm inputs, obtain better economic returns.

b) They generate employment in production, preservation and processing and help improve community incomes particularly in rural areas.

c) They generate employment in rural (agriculture) and semi-urban (processing) areas, which can help reduce migration to cities. Overburdened cities already face serious problems of habitat, health, environmental protection and social tension.

d) They provide adequate supplies of nutritious and hygienic foods to overcome dietary deficiencies of vitamins, minerals, etc. *(some of which may be serious)* that are responsible for diseases such as night blindness, goitre and rickets.

e) They increase exports of freshly packaged, processed and value added products, which can earn 3-4 times more foreign exchange *(when compared to the sale of the original unprocessed raw materials).* This helps to overcome trade deficits and improves the debt service ratio.

f) They increase demand for products from other complementary industries such as sugar, chemicals, containers, freighting, packaging materials, machinery, etc. and also demand for services that may provide information, finance, transport and communications to food industries. The net effect is one of stimulating local industries and local economies.

g) They make savings in energy. Centralized food processing consumes less energy, which is always expensive and in limited supply in the newly industrializing countries.

h) They reduce wastes. Wastes from agro-processing industries may be a valuable raw material for a number of allied industries, and processing wastes will contribute to GDP. Further, a reduction in waste reduces the environmental impact of waste disposal. Pollution may be reduced and better living conditions will result.

The high cost of food production makes it important to minimise losses. Success with waste reduction will increase the amount of food available. It is estimated that India has food losses of 200-300 Mt each year. A reduction of the order 50 percent will boost food security and make more materials available for processing.

POLICIES AFFECTING THE DEVELOPMENT OF FOOD PROCESSING INDUSTRIES

Herein a number of key policies apply concerning the land available, how it may be used, and the licensing, controls and monitoring that will govern the establishment and use of facilities. There is risk in establishing new ventures for which the public sector will frequently provide incentives within a raft of financial policies. These are designed to attract the investor and, once established, proved a window of financial support whilst the enterprise develops. Crucial to long-term success will be on-going support from the public sector for the R&D policies that are developed – new products, higher efficiency, etc. – and encouragement to compete with the best of the imports entering the country, and competition when selling overseas. Here again, there are firm incentives that can be developed within suitable policies.

LAND POLICIES

As the result of the Land Ceiling Acts of the 1960s and later, the size of individual plots of cropland has gradually become smaller in India. This has led to fragmentation of land holdings, which has adversely affected productivity. Smaller plots are not always suitable for intensive agriculture given the high levels of investment that may be required for irrigation, mechanization, land preparation and so on. Small plots suggest labour-intensive production techniques, and this is not always applicable where people cannot be found to work land within cost structures that are acceptable to producers. Increasingly, levels of scale apply to the investment needed in machines and equipment with which to work the land and to harvest the crops. Fragmentation can mean taking large areas of land out of cropping, as people seek off-farm employment and the land reverts to kitchen-garden practice in support of the family. High risk is also involved with putting more land under cultivation particularly if the land is not suited topographically, for example, if it is flood-prone or, increasingly, if it is near urban centres. The transfer of land to non-agricultural use is accelerating worldwide and, given the proximity to towns of high value market-garden lands, it is often the most valuable and productive land that is eventually sold for urban development**.**

In many countries agro-industrialists have not always been encouraged (or been allowed) to own agricultural land. Some exceptions have always existed where industrial estates for sugar, oil, tea, etc. have been established since the earliest times of industrial cropping. Times are changing, however, and the more productive states in India (such as Karnataka and Maharastra) have enacted legislation to enable industries to purchase land for development. There are, however, issues of ownership involved with moves of this kind. In many societies ownership has been vested in the community and *not* in the individual, and industrial ownership frequently leads

to the shift of people away from the land – people who may have traditionally lived and farmed in the area for many generations. In Karnataka State, for example, a registered agro-industry can now legally own 50 ha of land. Mapping land on the basis of fertility is a well known technique in the industrial countries, but rarely followed in developing countries. Resource mapping, however, is essential to provide for sustainable macro-development and land use over the long-term.

Agricultural policies

Most countries have a national agricultural policy of one kind or another, and India is no exception. This is essential given the size of the country, the diversity of production and manufacturing and the large population involved. India, in fact, has always applied a dynamic approach to policy-making and followed a number of innovative approaches. Divestment of public ownership introduced during the 1980s and the liberalization policies adopted in the 1990s have catalyzed change. Each state has been encouraged to plan for self-sufficiency in staple foods as a platform for agricultural production and development. Food security issues have predominated for more than 50 years - since the time of Independence – but change in this approach is underway; not least because the country is industrializing and shifting out of what has largely been subsistence production.

It would be false to see change of this kind as rapid, however (notwithstanding economic opportunities), for the pace of current agricultural growth in India is slow. Annual growth of food grain production between 1991 and 1997 was just 1.7 percent and lower than that of population growth (*1.9 percent during the same period).* This creates issues of pricing instability as stocks are drawn down. Even a marginal fall of 3-4 percent in food grain production can cause prices of other primary products (of all kinds) to escalate sharply. This necessitates further government intervention and draw down on reserve stocks of food grains. In some cases, there is also recourse to imports, as exemplified in India in 1993 and again in 1996 (Ministry Finance, 1997 and Sharma, 2005).

There are opportunities for stimulating production and supplies of raw materials. Land belonging to the state and not in use, for example, can be leased or rented to commercial farmers or agro-producers on favourable terms with contractual conditions of productivity and timing that will apply. Similarly, inland waterways and areas can be leased for aquaculture production, and coastal lands and swamps can be managed for fish and crustacean food industries. Government is thus largely bypassing the individual small-scale farmer in favour of the commercial materials supplier; the basis for a viable agro-industrial sector.

Most food industries depend on a reliable supply of agricultural raw materials, and this requires a stable economic base for production. Stable production encourages stability within producer groups (and their communities), with the reliability of markets and prices that follow. This normally forms part of government policy in support of the agricultural sector. Industrial production can come, however, from *organised* smallholders, from contract farming and from estates. The industrial support scheme started by the Government of India during the time of the 8th plan (1992-1997) and implemented by the Ministry of Food Processing Industries (MFPI) was highly successful. Models can be scrutinized and introduced into other countries with similar levels of development planning (MFPI, 2003).

Licensing, monitoring and controls

Delays and loss of time are detrimental to commercial development, and investment opportunities may be lost. Inordinate delays with granting permission for a particular action or project, for example, are best avoided to ensure that investors and entrepreneurs remain encouraged. There is always an element of competition from place to place where industrial investment is involved, and time wasted at one site can quickly shift investments elsewhere. Issues of investment are often complicated by the availability of funding over short periods and, once normal planning applications and environmental impact assessments (EIAs) are completed, it behoves the municipality or regional planners to move quickly to secure the plant, factory or park (or whatever the infrastructure planned). Firm guidelines should be on hand to enable the public sector to provide services that will continue to promote and encourage the project. One way of achieving this is to devolve decision-making to decentralized or regional authorities. This may

enable construction and/or processing and/or planting to begin *without* a formal licence – and sometimes on the basis that authorization has been accepted and remains in the 'pipeline'.

In many developing countries a multiplicity of food laws have been introduced. The agencies implementing these laws have sometimes been considered a hindrance to agro-industrial development. A Food Safety and Standards Bill (2005) is currently proposed for India (SAI, 2005). Regulations and host agencies for this kind of control in India include:

- Prevention of Food Adulteration Act (PFA) administered by the Ministry of Health.
- Number of quality control orders issued under the Essential Commodities Act and including Fruit Products Order (FPO) and Meat Food Products Order (MFPO) administered by the Ministry of Food Processing Industries.
- Laws regulating hygienic conditions in manufacturing facilities; to prevent the adulteration or the production of substandard foods for sale. Administered by the Food Preservation Branch of the Ministry of Agriculture.

Agencies such as these are an important partner within the processing chain, but they frequently need to adopt a more facilitating role and shift away from that of 'guardian' or 'policing'. A more pragmatic and modern approach is essential.

Financial policies

Financial security is the basis for all commercial success. Without an assured income following a period of investment, few entrepreneurs will continue to remain with the risks involved. New investors will stay away. Herein there are opportunities for the public sector to make concessions, particularly during a period of establishment. This may come from access to favourable loans, a 'honeymoon' payback period *(in which interest rates may be low or lower than normal commercial rates*) and the availability of grant funds, relocation expenses and similar. Depending on domestic fiscal policies within the country or state, most governments will provide for a window of opportunity for agro-food industrial development within the domestic economy.

Most of the raw materials used by agro-processors are seasonal and highly perishable. This may necessitate a different system of loan dispensation, to ensure working finance is available in the right amount and at the right time. Considering the long gestation period required for food-based projects to come to fruition, it is normally practice to provide a package of investment incentives in order attract investments into the sector. Where pioneering is required, significant levels of grant funding may be available from the public sector.

There may be need to rationalize the structure of taxes and duties to avoid unnecessary competition between regions within a country. This is nearly always unproductive. Herein public sector planners at national level have a role with priorities and choices. Processed food products depend on markets that are consumer biased, and this requires considerable promotion and marketing. Urban centres with large numbers of people are preferred, that customer numbers will be higher. Funding available to cover the promotional costs required of any new venture will be attractive to the entrepreneur when launching new products. The possibility for exempting new ventures (or new companies or whole regions) from the payment of income/production taxes can be explored. In India, for example, there are contingencies for tax exemption for income generated from agricultural production.

Import-export policies

Protectionism policies put into place from earlier governments in India imposed high levels of import duty on foreign products, and this led to skewed local production costs. It further encouraged mediocrity and indifferent quality with industrial performance, and with the products and goods produced. Liberalization of trading during the past 15 years has enabled these regulations to be relaxed, but rationalization of import duties remains a requirement for improved industrial performance in the country *(for agro-industries and other sectors).* Abnormally high duties on equipment and other inputs not manufactured locally will contribute to increased product costs. Appropriate import policies should help counter indiscriminate spending of foreign exchange for non-essential imports but, at the same time, provide local manufacturers with incentives to perform and to produce domestic goods that will match the wide variety of imported

goods available. Competition is essential, that domestic manufacturers are constantly aware of the need to remain abreast of innovation that can be adopted or copied. This will help them to remain economically viable.

Public authorities responsible for the development of exports should increase efforts to promote opportunities for domestic companies. Long-term food export policies are required to provide for a measure of confidence in the market. Exporting is expensive. Export incentives or credits may be needed to provide a safety net should there be a significant difference between ex-factory prices and the international prices that are reflected in imported goods. This should eventually be an automatic and on-going process on the part of government. The self-certification of products by the manufacturers concerned *(those with adequate quality control facilities)* should be encouraged, to avoid delays in clearing consignments for export.

Science and technology policies

There is urgent need to increase investment levels for science, technology and information systems that apply to post-harvest aspects of agro-industries. The development and application of indigenous innovation in the production of foods should be encouraged. Firming linkages between food industries, R&D institutions and the agricultural universities can enhance productivity, upgrade technologies exchange, and improve production, manufacturing and processing industry-wide. Herein is an opportunity for contracted research. However, the gulf between the universities, domestic industry and the public sector is frequently wide and not easily bridged in many countries (whether developing or industrial).

IMPACT OF INDUSTRIAL POLICIES ON THE DEVELOPMENT OF FOOD PROCESSING INDUSTRIES IN INDIA

In 1991 the Government of India made some major changes to domestic industrial policies. These sent signals to both domestic and foreign investors alike that the government would encourage investment in industry and, moreover, would not interfere thereafter with normal day-to-day commercial activities. Apart from the framework that was established to provide for the social security of the workers and the environmental security of the resources involved, companies would be free to plan, market and exploit new ventures.

Under the new policies, industrial licensing was abolished across the food sector *(except for products containing alcohol).* Foreign investment up to 51 percent was initially allowed, with 100 percent foreign equity permitted in selected areas with appropriate export commitments. Permission was automatically given for foreign technology agreements in selected high priority areas, where investments of up to Rs10 million were expected. Repatriation of earnings was introduced, viz. five percent of recurring royalties on domestic sales and eight percent royalties on exports.

The role of the public sector was restricted to essential infrastructure, goods and services, the exploitation of oil and minerals, defence-related projects and other areas involving technology developments and support for indigenous manufacturing capabilities. In order to provide the much-needed management and market expertise required of small-scale industries, larger companies and MNCs were allowed to participate in the equity base of small companies; up to a level of 24 percent. As far as food industries were concerned no product was to be reserved exclusively for the public sector, while compulsory licensing remained restricted to alcoholic beverages, sugar, animal fats and oils. The impact of these new policies on the development of the food processing industries sector as a whole has been profound, as summarised in Table 6.1.

TABLE 6.1
Impact policies on the food processing sector

Component	Impact of industrial policies
Raw materials	- Greater production, lower cost and better quality.
Process technologies	- State of the art, energy efficient and better process control.
Equipment and machinery	- State of the art, high cost and spare parts inventories.
Personnel requirement	- Fewer workers/unit, re-training and better remuneration.
Product quality	- Uniform, consumer oriented and enhanced quality culture.
Product cost	- Increased overheads and higher market promotion costs.
Packaging	- Better functionality, reliability and presentation.
Technical services	- Project and training services, and trouble-shooting.

Source: Potty (1992) and Parpia (1993).

TABLE 6.2
Investment in the processed food sector (Rs billion)

Sl. No.	Sector	Industrial entrepreneur memoranda		Industrial licences/ 100% EOU*		Totals		Foreign investment*
1.	Grain milling and grain based products	422	60.08	107	12.59	529	72.67	12.07
2.	Fruits & vegetables	1745	34.38	422	51.80	2167	86.18	10.90
3.	Meat and poultry products	96	4.56	59	13.94	155	18.50	2.67
4.	Fish processing and aquaculture	116	4.63	192	22.28	308	26.91	5.49
5.	Fermentation industry	672	93.01	211	20.73	883	113.74	10.94
6.	Consumer industry (soft drinks, water and confectionary)	869	75.23	79	58.36	948	133.59	44.32
7.	Milk and milk products	1 119	138.23	27	11.82	1 146	150.05	9.06
8.	Others including food additives, flavours, etc.	-	-	75	9.45	75	9.45	9.06
9.	Edible oil/oilseeds	1 675	134.16	-	-	1675	134.16	-

Source: MFPI (2004)a. Note: * EOU - Export Orientated Unit. Data provided against * refers to period 7/1991 to 11/2002. Remainder of table covers data from 7/1991 to 12/2002.

The new policies introduced by the Government of India have had a positive impact on the agro-food sector in that a number of internationally respected companies have subsequently taken an interest in the domestic market. This has led to a significant number of investments and joint ventures in processing for both domestic and foreign sales. Examples include tomato processing in Punjab State by Pepsi Foods Ltd, grape processing in Maharastra State by Champagne India and gherkin processing in Karnataka State by a number of other companies (MFPI, 2003).

From mid-1991 through to the end of 2002, 6 714 industrial entrepreneur memoranda (IEMs) proposing investment of Rs544 280 million were received by the MFPI from the various sectors of industry. Of total IEMs filed, 5 825 (87 percent) were for non-urban areas. The government also approved 1 172 proposals for industrial licences and 100 percent export oriented units. However, only 712 IEMs and 281 industrial licenses and 100 percent export orientated units (EOUs) have been implemented as shown in Table 6.2. These represent 11 percent and 24 percent, respectively**.** (MFPI, 2004a).

Because profit margins have traditionally remained low in the primary processing sector, small-scale manufacturing continues to dominate, notwithstanding the involvement of some larger companies. However, access to land for industrial cropping has remained an issue and, wherever it has been possible to bring large areas of land under a single crop, large-scale processors have entered the field. Herein are prospects for integrating the many steps between production and sales. This enables producers and manufacturers to take advantages of smaller

profit margins at each stage of the chain. Vertical integration between production, processing and sales brings control. It also brings opportunities for use of by-products and for the use of materials previously considered as wastes. The agro-complexes developed by the Oswal Group of Industries in Punjab State are one example of developments of this kind, according to the Punjab Agro-Industries Corporation (PAIC) (PAIC, 2003 & 2004).

Further reforms were introduced in India for industrial development during the period 1996-1997, which boosted investments for small-scale processing to Rs30 million. Further, export obligations on the manufacturing of reserved items by non-SSI companies were reduced from 75 percent to 50 percent. Licensing procedures for the sugar industry were liberalized, and incentive schemes for both new and expanded production units were introduced (MFPI, 1998).

DEVELOPMENT SCHEMES OF THE MINISTRY OF FOOD PROCESSING INDUSTRIES IN INDIA

The Indian MPFI has devised and implemented several developmental schemes for encouraging agro-processing, beginning with the 8th plan of 1992-97. Financial assistance extended to different projects during the period of the 9th plan (1997-2002) was Rs1458.44 million as shown in Table 6.3 (MFPI, 2003). Annex 3 provides additional information to describe the extent of the 10th plan scheduled for 2002-2007. The sectors targeted have included food grains processing, fruits and vegetables processing, meat and poultry processing, fisheries processing and consumer industries. In addition, funds were made available to many of the public sector service agencies that supported the development of agro-food industries. This has helped to provide better infrastructure, more information, access to advanced/modern equipment and technologies, and it has led to greater confidence on the part of those involved. More people have been prepared to consider investing in the sector and to accept the risks involved.

There was no increase in the planned outlay for the development support schemes of the MFPI during the three years following 1997. An analysis of the schemes showed that nearly 25 percent of the funds available were used for training, extension and strengthening research facilities.

Raw materials development was given a major impetus with nearly 46 percent of the budget provision shared by the two major schemes. A backward linkage scheme targeting the horticulture sector and received of the order Rs79.50 million budgetary support. A second scheme for fisheries was of the order Rs116 million and used for promoting fishing activities. This included a number of fishery resource surveys to determine resources as shown in Table 6.4 (MFPI, 2003).

Tamil Nadu State heads the list in terms of assistance received from the Ministry of Food Processing Industries followed by Kerala, Maharastra, Uttara Pradesh, Karnataka Assam, Andhra Pradesh, and Manipur States in that order as illustrated in Figure 6.1.

TABLE 6.3
Financial assistance to projects during 9th plan period

Year	Amount (Rs Million)			
	Total budget outlay	Total expenditure	Assistance to projects	Project assistance as share of total expenditure (%)
1997-98	390.90	228.70	142.31	62.23
1998-99	300.00	300.00	221.48	73.83
1999-00	400.00	377.80	269.13	71.24
2000-01	500.00	500.00	381.87	76.37
2001-02	550.00	550.00	443.65	80.66
Totals 9th plan	2 140.90	1 956.50	1 458.44	74.54

Source: MFPI (2003). Note: 9th plan period 1997-2002.

The impact of these schemes on the development of the agro-food sector remains to be determined in the medium-term. There is also uncertainty for what support may follow from the public purse. The agro-food processing industry in India ranks fifth in size *(when compared to other industrial sectors)* but employs 19 percent of the industrial labour force. Together with production, the agricultural sector dominates employment in India, and is likely to continue to do so well into the foreseeable future. Agro-processing accounts for 14 percent of industrial output with a turnover of US$36 billion, and enjoys a share of GDP of the order 18 percent. The introduction of progressive and far-sighted agro-food industrial policies has considerable potential long-term. Policies of this kind can encourage the participation of other industrial sectors (e.g. construction, heavy industries, transport, etc.), each of which can play a complementary role in national economic well being. The establishment of agro-industrial parks in rural areas is one means of promoting synergy of this kind. It helps to bring social benefits to rural people with better access to public services (e.g. schools, health clinics, roads, etc.) and, at the same time, helps boost agricultural production and provides security for rural communities.

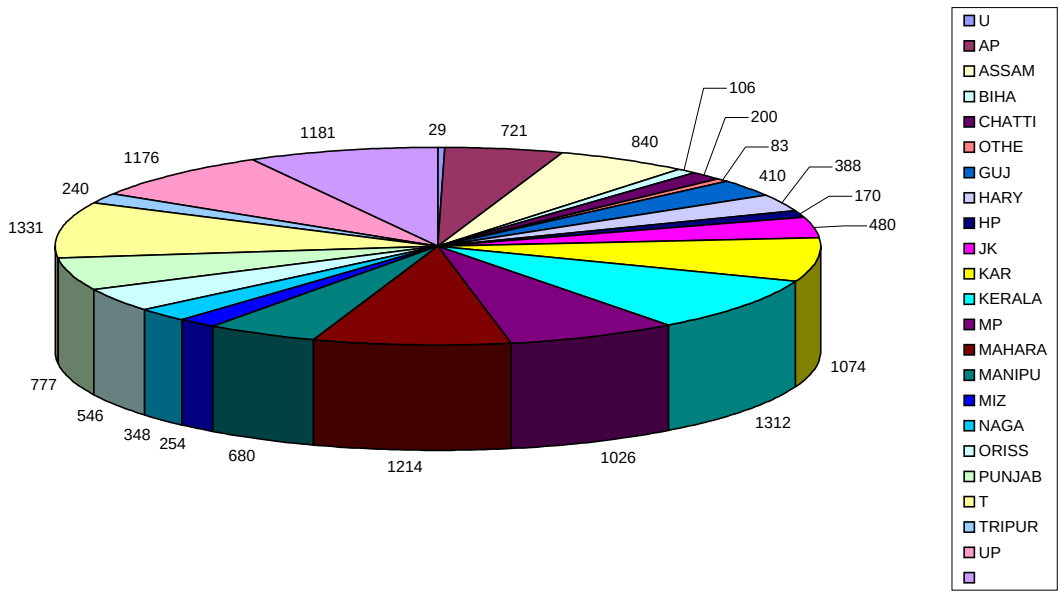
As part of the strategy to develop domestic food processing infrastructure, the MFPI has encouraged the establishment of food parks in different parts of the country. The aim has been one of encouraging small- and medium-scale entrepreneurs who normally find it difficult to invest independently in capital intensive facilities such as cold stores, warehouses, quality control facilities, effluent treatment plants and similar infrastructure. Assistance for development of these as '*common facilities'* for a cluster of SMEs located in an industrial area can make the individual enterprises more cost competitive. The MFPI has, thus far, helped to establish 45 food parks (MFPI, 2004a) and approved 48 agro-export zones (APEDA, 2003). The MFPI and APEDA continue to work together that synergies and convergence between food parks and agro-export zones can be further realized. These are models that may apply in other developing countries seeking to follow similar paths of development.

TABLE 6.4
Support provided by MFPI India 1997-2002 (Rs Million)

Category of scheme	Food grains	Vegetable& fruits	Poultry & meats	Fisheries	Milk based	Consumer industries
Processing and demonstration centre.	6.80	3.50	-	-	-	-
Research, training and extension.	16.60	-	-	0.50	277.70	-
New units modernization programme.	-	287.10	113.70	0.70	-	-
Infrastructure	-	-	-	707	-	-
Market development	-	42.10	1.00	-	-	-
Manpower development	-	75.60	-	-	-	-
Raw materials development	-	23.50	-	-	-	-
Subsidies	-	-	-	-	-	-
Investment in the public sector.	-	-	-	-	-	67.40
Totals	**23.40**	**431.8**	**114.70**	**708.2**	**277.70**	**67.40**

Source: MFPI (2004).
Note: Based on actual expenditure.

FIGURE 6.1
MFPI assistance to state projects in 9th plan (1997-2002) (Rsx10^5)



Source: MFPI (2003).

Chapter 7
Framework for model agro-industrial park

CRITERIA FOR LOCATING AN AGRO-INDUSTRIAL PARK

The framework required for pre-investment decision-making and for following through to establish the design of the park and encouraging the participation of commercial people requires investigation of a number of sectors. This includes the park within its proposed catchment area, the institutional support required for promotion and development and, importantly, the engineering choices of design that will enable the park to function as required. Success comes from exploiting market opportunities and, equally, matching the expectations of the people involved within local communities. The park has to (and has to be seen to) be creating improved socio-economic conditions for all concerned. For best, local authorities should help foster a sense of mutual ownership of the park by both investors and workers – to encourage 'community ownership'.

Primary considerations

Buoyant demand for industrial plots or ready-built industrial sheds (or factories) in a location is crucial for the successful establishment of an industrial park in a particular area. Demand is crucial. Environmental issues will also need to be properly considered once location has been decided but, again, this should follow from demand. The costs involved in adopting measures to protect the environment in the vicinity of the proposed park must be considered, and then included in the selling (or renting) prices required of park facilities.

Notwithstanding the proposed costs of plots or sheds *(which will be largely fixed at time of sale by market prices offset by supporting public sector funds – if any),* it is essential to keep all costs associated with development and with the mandatory environment management plan (EMP) as low as possible. This has to be done without compromising on quality of construction or on the quality of the facilities that will be established. When the demand for industrial plots in a particular location is known, the findings of the EMP will form the basis for the actual choice of land *(from a number of competing locations in the area).* A '*no project'* alternative is not normally considered for the purpose of the environmental impact assessment (EIA), and priority choices will normally be made for the site with the lowest indicated EMP costs available.

If planning for the industrial park is undertaken with a full EIA and an EMP already available, there is no need for the many independent industrial units planned on-site to seek separate approval for environmental suitability. Substantial savings in costs can be made by adopting an approach of this kind. In India, the Environment Protection Act of 1986 already provides for these measures, and the provisions of this act have been widely used in practice.

The EMP for the park should be based on the expected size of the agro-industrial park and the type, scope and size of the industries that can be expected to establish on-site. It follows that this will depend largely upon the agro-industrial potential of the region that will eventually serve as a catchment for the materials required for processing.

Agro-industrial development potential of an area

The agro-industrial development potential of an area follows from feasibility studies required of park design and establishment, which will include a review and consideration of a number of key factors. Feasibility studies are multi-faceted and cover all physical, financial and trading requirements that will help to determine commercial potential. The following list of issues provides a useful guide for the investment and development agencies involved. Consider:

a) Raw materials available and production trends; price movements and price trends; fresh market requirements and surpluses available for processing.
b) Existing industrial base, distribution, numbers and capacities; regional imbalance between production, processing and market capacities.
c) Need for promoting additional capacity based for agriculture production and available processing capacity; efforts made to correct any regional imbalance with capacity.
d) Population of the area; their food traditions, requirements and types of foods currently grown and used in domestic cuisines. Trends and changes. Current availability of foods. Market surveys to identify the foods and materials requirements of the region.
e) Trends in urbanization in the region, and needs for convenience foods; changing food traditions; potential impact of these trends on food processing industrial requirements.
f) Household incomes; the purchasing power of the population and average spending on foods by individual families from different socio-economic groups.
g) Export possibilities. Exports of fresh produce and the infrastructure required. Export potential of processed foods.

An analysis of each parameter helps to identifying the number of resource based and demand based industries that can reasonably be established in a particular area. Development agencies engaged in the promotion of industrial parks may also conduct demand surveys that will help target different aspects of industrial development, including those of interest to the entrepreneur. This can be done by placing announcements in the local media for the possibility of developing an agro-industrial park in the locality, and inviting response from those interested. In Karnataka State in India, for example, an exercise of this kind was undertaken when establishing a pharmaceutical industrial park at Brahmavar in Daksina Kannada District. After an initial show of interest was received from would-be entrepreneurs, further data for the design of the park was collected from the same sources by means of a questionnaire. The data thus collected helped confirm the design of the park and facilities.

There are, however, limitations with demand surveys. A study of the industrial potential of a region with the use of a demand survey may not always be the best indicator of the agro-industrial potential available. However, a demand survey *will* help development agencies to quickly plan their best-option strategies, and this will help confirm the most suitable design of the park. Demand surveys are time dependent and results may be slow to evolve relying, as they are, on feedback from others. The chance of enthusiastic entrepreneurs, for example, responding to exercises of this kind can be improved by first making a number of quick studies of the area, prior to developing the questionnaire that will form the basis of the demand survey. In this way, some reasonable guidelines can be established, and the questionnaire then designed to keep potential applicants interested.

In this way, the time required for conducting an in-depth pre-appraisal feasibility study and the costs involved with this kind of exercise can be minimized. This approach proved successful with the horticulture-based industrial park proposed for Malur in Kolar District in Karnataka Sate. It is useful when considering the development steps required of local authorities, particularly where the institutional experience of this kind of investment is strictly limited. This approach will be of value to others. Background, findings and applications typical of design are described in the following section.

AGRO-INDUSTRIAL PARK FOR MALUR IN KOLAR DISTRICT: CASE STUDY OF AGRO- INDUSTRIAL DEVELOPMENT POTENTIAL

Resource potential comes from an appraisal of raw materials production and availability within the catchment proposed for the park. This includes an appraisal of the agro-horticultural base, potential for new crops and trends in production. The experience of Karnataka State is relevant (KIADB, 2002).

TABLE 7.1
Horticultural crops in Kolar District

Crop	Area (ha)	Production (tonnes)	Production in state	Rank in district
Fruits	36 387	631 502	4 510 728	1 (14.0%)
Mangos	27 930	265 335	915 268	1 (29.0%)
Guava	1 176	14 700	149 313	1 (9.8%)
Sapota	1 048	18 340	291 519	7 (6.3%)
Grapes	732	21 960	157 140	3 (14.0%)
Other fruits	5 501	311 167	2 997 488	(10.4%)
Vegetables	28 524	585 659	4 921 505	3 (11.9%)
Potatoes	4 933	88 794	850 536	3 (10.4%)
Tomatoes	9 682	242 050	980 175	1 (24.7%)
Cole crops	1 582	37, 968	360 576	3 (10.5%)
French beans	2 526	56 835	393 840	3 (14.4%)
Other vegetables	9 801	160 012	2 336 378	(12.0%)
Spices	23 262	41 655	1 542 769	9 (2.7%)
Flowers	1 106	6 428	94 533	7 (6.8%)
Chrysanthemum	441	4 410	31 340	2 (14.1%)
Marigold	210	1 890	19 500	3 (9.7%)

Source: GOK (1998).

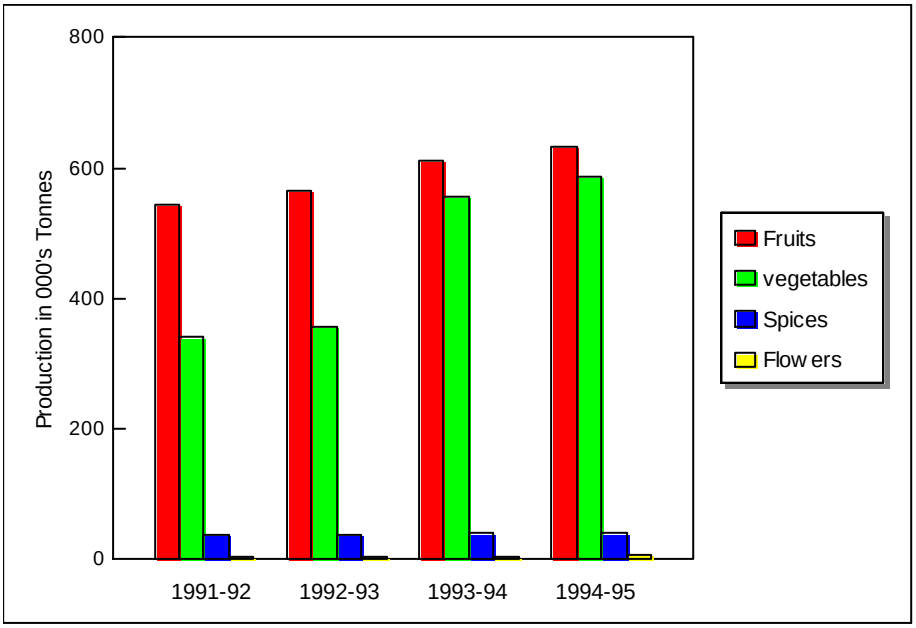
(1.) Horticultural resources of Kolar District

The major horticulture crops of Kolar District are vegetables (i.e. potatoes, tomatoes, cole crops and French beans) and fruits (such as mangos, guava, sapota and grapes) and, among the flowers, chrysanthemums and marigolds. Kolar District is also known for its aromatic herbs such as davana, vetivert and palmarosa grass. The area and production of the major horticulture crops grown and their importance in the district for the period 1994-1995 is shown in Table 7.1.

Vegetable crops in Kolar District are mainly grown under irrigation, which results in higher yields and better quality. Prices received for irrigated crops are consequently higher. The district faces problems of over-production (i.e. from bumper harvests) on average every second year. The major crops in surplus are mangoes, potatoes, tomatoes and grapes. Processing activities at present are limited mainly to pulping mangoes and pickling vegetables. Farmers in the district are enthusiastic for change. During recent times, gherkin cultivation has expanded in the district and pickling has become a major activity for export crops. Aromatic herbs such as davana, palmarosa, eucalyptus and vetivert are grown for processing as a result of the promotional efforts by a number of local companies.

The population of Karnataka State in the mid-1990s was of the order 50 million, and the population of Kolar District was estimated 2.5 million during the same period (i.e. about five percent of the state population). This compares with production from the district of 14 percent fruits 12 percent vegetables, 9 percent spices and 7 percent flowers. Thus the district has a considerable surplus in the production of horticultural crops over local consumption. This offers scope for processing. Trends in the production of horticultural crop in the district have shown stability over recent years. (See Figure 7.1.)

FIGURE 7.1
Trends in production of horticultural crops Kolar District



Source: GOK (1998).

(2.) Food grain and oilseed production in Kolar District

Kolar District produces 230 000 tonnes of cereals, 200 000 tonnes of pulses and 80 000 tonnes of oilseed annually. The district share in state production is 2.9 percent cereals, 2.85 percent pulses and 6.2 percent oilseed. The state is deficient in the production of food grains. Production of oilseed had fallen from 110 000 tonnes in 1989-90 to 80 000 tonnes in 1994-95, and continues to stagnate.

Paddy production in Kolar District is currently of the order of 76 000 tonnes annually, and grown during the *kharif* and summer seasons. Nearly 80 percent of paddy comes from the kharif crop. Rice mills in the district are generally not receiving sufficient paddy for milling, and they work substantially under capacity for much of the season.

(3.) New crops

Of the new crops introduced into the state, gherkins have been particularly successful in Kolar District. Introduced in the mid-late 1990s, gherkins are now grown on >300 ha. There are currently three factories processing gherkins, with small quantities of baby corn and white onion also pickled for export (see Plates 7.1 and 7.2). Among the aromatic herbs davana, palmarosa, vetivert and eucalyptus are successfully grown and processed for their essential oils; again, this is mainly for export. There is limited local demand.

Gherkin farm and processing unit in Kolar District

K. LAXMINARAYANA RAO

Plate 7.1

K. LAXMINARAYANA RAO

Plate 7.2

(4.) Agro-industries with potential for growth

The raw material base of Kolar District offers considerable scope for a number of agro-horticulture processing industries. This potential can, and should, be realized within the proposed agro-industrial park. Given production conditions in the state and the number of units that could be established at any one particular location *(with a raw material catchment of 50 km radius)* the economic size of industrial facilities is projected as shown in Table 7.2. This suggests of the order 36 units processing 250-300 t/day of fresh crop.

Increased urbanization has resulted in higher demand for processed foods because of the convenience of using foods than can be quickly prepared and eaten. Kolar District is adjacent to Bangalore City and can comfortably cater for increasing demands of processed foods. Foods of this kind can expect to be manufactured in the agro-industrial park. These will include breakfast cereals, vermicelli and noodles, masala and curry powders, papads and condiments, bakery products, confectionery, wheat flour, semolina and others.

SIZE OF THE AGRO-INDUSTRIAL PARK

The size of the industrial park depends upon the number of plots projected, requirements for ready-made factory units and the extent of the common infrastructure and services needed on site. Plot size will depend upon a number of factors, many of which will be linked to local building bylaws. This includes plot coverage and floor space index permitted as per building bylaws, additional open space required by each unit (e.g. for future expansion) and other production requirements such as space for the construction of yards where sun drying, for example, may be required, storage space for coal, fuelwood and similar bulk materials, and additional unallocated storage space (e.g. for defunct equipment, etc).

TABLE 7.2

Resource-based agro-industries with potential in Kolar District

Crop	Industrial activity	Size of unit (tonnes/day)	Number of units (per location)
Mangoes	Controlled ripening	1 000 t/season	4
Mangoes	Grading and packing	10	2
Mangoes	Pulp/juice/canned slices	10	4
Grapes	Grading and packing	10	2
Grapes	Dehydration (raisins)	1	2
All fruits	Juice/jams/squashes	5	1
Gherkins	Vinegar/brine	10	2
All vegetables	Pickles/chutney	2	2
All vegetables	Dehydrated vegetables	2	2
All vegetables	Grading/packing	5	1
Herbs	Essential oils	5	2
Herbs	Fractionated essential oils	10	1
Spices	Spice oils/oleoresin	10	1
Spices	Spice/masala powder	2	1
Marigold flower	Extraction of colour	10	1
Oilseed	Oil expelling	30	1
Groundnuts	Fried nut/candies	0.5	1
Cereals/pulses	Energy foods/ flour	10	1
Potatoes	Deep fat fried chips	5	1
Potatoes	Potato flour	25	1
Potatoes	Dehydrated finger chips	5	1
Tomatoes	Grading/packing	25	1
Tomatoes	Puree/sauce/ketchup	50	1

Source: TECSOK (1997).

The number of plots and ready-built factories that will be required should be estimated on the basis of the development potential of the area, but this will also depend upon the numbers of independent parks that may be established to service the region. There are firm cut-off points for scaling-up when economic or environmental considerations, for example, may determine a choice of two smaller parks in preference to the one *(or three in preference to two).* Here it is that state planners will have a firm role within the practical framework required of the proposed park.

Building bylaws

Building bylaws will vary from place to place, but most are fairly uniform where the larger issues are concerned – access to land, water, space, power and similar; disposal of wastes; and the impact upon local habitations or special areas of the country. Bylaws from state to state in India, for example, owe much to federal laws and herein there are some firm guidelines for local legislators to follow. Thus there will be need for minimum setback space to be included to position buildings from a common allotted boundary, and the plot coverage permitted during periods of construction of the buildings will be stipulated. The permitted floor area ratio (FAR) will be determined mainly on the basis of the size of the plot. Table 7.3 provides some general guidelines on setbacks, plot coverage and FAR.

According to guidelines provided by local bodies such as the Bangalore Development Authority (BDA), the minimum setback for front, rear and sides for industrial plots in Bangalore City range from 1 m (plot area 240 m^2) to 15 m (plot area >4 000 m^2). These are shown in Table 7.3 (BDA, 1998 and KIADB, 2005).

Considering the recommended building setbacks from road frontages and common or allotted boundaries based on local body guidelines, the maximum plot coverage within the individual plots ranges from 35-75 percent. This provides a maximum FAR of only 0.5 for industrial plots of >4 000 m^2. Indian standards for area are stringent when compared to international norms. In the case of Malaysia, for example, the local authorities permit a 60 percent maximum built up area within individual plots and a plot ratio of up to 1.2 of the site area when planning industrial parks. This allows maximum floor space use of two-story buildings in larger plots.

Guidelines for fruits products order

The size of the building required depends upon the type of processing plant and machinery to be installed by each unit, the storage space required for raw materials and finished products, and the space required for offices, laboratories and other facilities on site. In the case of fruit and vegetable processing, a number of compulsory guidelines are provided under a fruits products order (FPO) as described in Table 7.4. For meat food processing industries similar guidelines are provided, and in all other cases the provisions of the local factories acts will apply. In addition to following the guidelines of an FPO, it is essential to provide adequate facilities for workers on site - again as per the requirements of local factories acts. Other factors such as recommended dimensions also apply, for example, the minimum height of a building wall should be 4.25 m floor to eaves. This prevents sub-standard structures from being built.

TABLE 7.3
Setbacks, coverage and floor area ratio for industrial buildings

Plot Area (m^2)	Minimum setback front, rear and side (m)	Maximum plot coverage (%)	Floor area ratio (FAR)
Up to 240	1.0	75	1.00
Over 240 up to 1 000	4.5	50	0.75
Over 1 000 up to 2 000	6.0	50	0.75
Over 2 000 up to 3 000	10.0	40	0.75
Over 3 000 up to 4 000	12.0	40	0.50
Over 4 000	15.0	35	0.50

Source: BDA (1998) and KIADB (2005).

Plot mix

It is not always easy to determine the *demand* for the different plot sizes from prospective buyers *(frequently, they are themselves unable to determined industrial space, etc.).* However, the *sizes* of the different plots offered in a park can easily be determined. This follows from the number and capacity of the different types of industrial activities with potential for development *(as suggested in Table 7.2 for location in Kolar District),* the limitations of local building laws and the guidelines provided under FPO, MFPO or the factories acts of the country/state concerned. Plot sizes can be increased by 100 percent or more, to take into account future expansion opportunities for the separate units. Ready-made factory buildings can be offered in sizes as described in Table 7.4. This can include appurtenant land and 50 percent excess land to provide for future expansion.

In addition, the requirement of space for vehicle parking on individual units has to be included when selecting the individual plot sizes. Industries that involve extensive haulage may require large areas given over to truck and/or trailer parking, and turn-about space. The industrial requirements imposed by local bodies in Karnataka State in India, for example, as reported by TECSOK (1997) are:

(1.) Industrial buildings

One car lot of 3x6 m^2 per 100 m^2 of floor space, plus one truck/trailer lot of 4x8 m^2 per 1 000 m^2 of floor space or part thereof.

(2.) Storage warehouses

One car lot of 3x6 m^2 per 150 m^2 of floor space plus one truck/trailer lot of 4x8 m^2 per 500 m^2 of floor space or part thereof.

Based on these considerations, the plot mix shown in Table 7.5 would be suitable for accommodating a mix of different industrial activities for a park proposed for Karnataka State. The number of plots that can then be developed for the model park under consideration will be of the order 30. In addition, 27 industrial sheds of various sizes, together with appurtenant land, also have to be developed for locating the selection of industries described earlier under section 7.1.

TABLE 7.4
FPO guidelines for building requirements of fruit & vegetable processing

Industrial capacity	M'facturing area (m^2)	Storage space for raw and finished materials & goods (m^2)		Total space (m^2)	Minimum height (m)
Annual production <10 t.	25	10	15	50	3.00
Annual production 10-50 t.	60	20	40	120	3.00
Installed capacity <1 t/day and annual production 50-100 t.	100	40	60	200	4.25
Installed capacity 2 t/day and annual production 100-250 t.	150	50	100	300	4.25
Installed capacity >2 t/day and annual production >250 t.	300	100	200	600	4.25

Source: MFPI (2004)b.

TABLE 7.5
Suggested plot mix for an agro-industrial park

Size of plot (m^2)	Number of plots	Area occupied by plots (m^2)
A. Developed plots		
4 800	17	81 600
2 400	8	19 200
1 200	5	6 000
Totals	**30**	**106 800**
B. Plots with sheds		
532 m^2 plot with 200 m^2 shed	8	4 256
266 m^2 plot with 200 m^2 shed	10	2 660
!33 m^2 plot with 100 m^2 shed	9	1 197
Totals	**27**	**8 113**
Totals (A+B)	**57**	**114 913**

Source: TECSOK (1997).

In addition to the developed plots and ready-made sheds, plots are required for locating shared commercial infrastructure and common facilities in the park. The overall size of the park will be the sum total of land required for developed plots and sheds, and the land required for commercial infrastructure plus land required for common facilities and that occupied by roads, drainage areas, parks and green belt. A provision for meeting future demand for park expansion should also be made from the outset. A read-made stock of developed plots and sheds are generally in great demand in regions where there is growth potential for exploiting the raw material base. The costs of holding a number of developed plots and sheds in hand can be recovered by periodic increases in the selling/allotment prices of these plots/sheds. Enterprises will normally be willing to pay a premium for a ready-make stock of developed land since it saves time, and the industrial enterprise can normally begin commercial activities quickly *(with reduced time required for construction, connecting services, etc.).* This helps lower the pre-operative expenses of the incoming industry/entrepreneur.

COMMON INFRASTRUCTURE FACILITIES

The common infrastructure required of an agro-industrial park depends upon the types of industries that will be established. Some common infrastructure facilities will be commercially viable from the outset (given a buoyant economy locally) and, as such, can be promoted through private sector participation *(or as 100 percent private sector venture).* Some of the essential infrastructure required can be promoted on a cost-sharing basis by the park occupants themselves (is association with off-park users), with or without the participation of local governmental agencies. This is possible even where they may not be viable as separate or stand-alone commercial ventures. The management of these facilities can be sub-contracted to private contractors or to the associations/cooperatives that are normally set-up to cater for the interests of users on site. Facilities, such as power generation and distribution, telecommunications, water, waste handling and similar services are normally provided by state agencies and only recently have efforts been made to privatize them in many developing countries. Some of the many facilities required for agro-based industries within a park are discussed below.

Commercial infrastructure facilities – producer support

The success of agro-industries in the park will depend largely upon a reliable supply of high quality raw materials. This will depend upon the ability of farmers to produce to order, and there is much that the park industrialists can do collectively to support farmer-producers. The establishment of facilities that will help boost crop production is an obvious move, and one that may be supported institutionally and financially by the public sector. Here the focus may be one of providing high quality and high-yielding seeds, seedlings and planting materials as the result of appropriate crop breeding programmes. Support for crop care is also possible, to ensure that only

uncontaminated crops are delivered to the factory gate. Post-harvest and post-delivery, there is value in providing the appropriate stores and handling facilities.

(1.) Tissue culture laboratories and seed production facilities

The availability of good quality raw materials at reasonable prices has always been *(and is likely to remain)* a constraint faced by many food processing industries. In India, for example, the government has been encouraging processors to move into production and to bring a measure of control over the security and quality of supplies. Steps of this kind are typical of the newly industrializing countries, where production is dominated by many small-scale *(sometimes peasant/non-commercial)* production systems. The MFPI in India, for example, introduced a scheme for establishing backward linkages during the 8th plan during the period 1992-1998. Under this scheme, new industries were provided with capital grants up to a ceiling of Rs1 million. Grants were provided to help with start-up extension services that would encourage farmers to supply sufficient raw materials at the factory gate. Incentives were also provided to encourage contract farming if the industry concerned was able to reach agreement with a minimum 25 farmers for supplies of goods. The incentives were in the form of reimbursements of a certain percentage of the purchase price of the raw materials. For schemes of this kind to be successful, however, it is essential to provide high quality planting materials to growers, and then to follow-up with technical advisory services. It is normally not sufficient to work within existing production systems.

Tissue culture laboratories, for example, can produce and supply planting materials to the extension services and/or production development divisions established by the food processing industries concerned. Delivery systems have to be established that the producer/receiver of the improved planting materials takes ownership and thus shares in the risks involved. One simple method is for farmers to purchase the planting materials from suppliers *(for cash or credit against factory delivery schedules).* Similarly, seed processing companies may be encouraged to establish facilities to produce quality seeds, which can then be distributed throughout the region. A sound industry-farmer linkage is essential, and will help avoid over-exploitation of the system by unscrupulous traders and others.

Farmers who bring their produce to the factory gate for processing or for sale can sometimes collect agricultural inputs such as seeds, planting materials, fertilizer or compost *(manufactured, for example, from agro-processing wastes processed on site).* Haulage in both directions makes for economies of transport. Tissue culture laboratories and seed processing units established in the park may be able to export selected products. Such facilities, if successful, can be established as independent commercial ventures separate from, but complementary to, processing on site.

In the example described for Kolar District in section 7.1, a proposed tissue culture laboratory and seed-processing centre may be in a position to produce and supply planting materials, seeds and seedlings as required. This may include seedlings for mangoes, grapes, vetivert and other essential oil bearing plants, and seeds for gherkins, okra, tomatoes, baby corn, marigold, chrysanthemum, davana, potatoes, onions and garlic. At present, most gherkin seeds and a key variety of seed required for marigold flower production are imported. A minimum two plots of 4 800 m^2 each could, with planning, be made available in the park for production activities of this kind.

(2.) Warehouses and cold storage facilities

The supply of agricultural raw materials is seasonal and the processor has to stock adequate quantities by procuring them at the right time – when the quality is good and when prices are reasonable. Food grains and oilseed have to be dried to optimum moisture levels, and then stored and fumigated to improve keeping quality. The small-scale entrepreneur will be obliged to invest in storage facilities if he/she wants to take full advantage of markets. Investment costs have to be determined to ensure that the additional costs of storing and treatment are covered in the incremental income that will come from processing and adding value to these materials. There are issues of forward planning involved herein for those markets that are likely to be available, but there may also be many unknowns involved such as the area planted to the crop annually and the yield expected of the current crop. With a bumper harvest across the region, for example, it may

not be possible to cover the costs of holding crops from one season to the next, particularly if capital has been spent on constructing dedicated stores. In this case, renting space in a general-purpose warehouse (on or off-site) may be a preferred option.

A central warehouse in the region, with mechanized handling and crop treatment (i.e. for fumigation, aeration, cleaning, etc.) may be able to offer economies of scale and serve a number of entrepreneurs more economically than many separate smaller owner-user facilities. Much depends upon volume throughput, and competition for markets within the industry. This same industry in the region, however, should have access to facilities (whether separate or collective) that will provide a measure of security within the region. This will enable regional manufacturers to meet competition from outside.

It is here that the public sector has responsibilities to encourage and support the private sector with planning and investment. In India, for example, institutions such as the Central Warehousing Corporation (CWC) are available to provide support of this kind. Depending upon the facilities available from private enterprise, the CWC will consider the investments and implications required in support of local industries. For the industrial park considered earlier, a warehouse with a secure floor space of 500 m^2 may be suitable. The land area required would be of the order 1 600 m^2.

For fruits, vegetables and flowers cold storage is essential. This may also include post-transport pre-cooling facilities to remove field heat, which will help slow plant metabolism and thus extend shelf life prior to processing or sale. The window of opportunity available may enable the entrepreneur to exploit the different markets that are available. The advantages of cold stores are illustrated for potatoes in Table 7.6. The table lists wholesale prices for potatoes at three markets in Karnataka State during a period of two years. Chikkaballapur Market is located in the heart of the potato-growing region. Bangalore Market is a consumption centre and transit market, and Channapatna Market in Bangalore District caters mainly for local sales. The price of potatoes is always lowest at point of production, when compared to prices in consuming centres. Similarly, prices are lowest during the production season for all markets, and industry has to pay a substantial price for the purchase of potatoes from cold store (for processing, for example) out-of-season. Prices remain uniform or vary only slightly in the potato growing regions, particularly where the crop is grown under irrigation.

The lack of adequate cold storage space in Kolar District has been a major problem facing both farmers and industrialists for many years. The provision of cold stores in an agro-industrial park in the district, for example, would provide a considerable boost to local industry and thus to the local economy. Cold stores could also be used for storage and preparation (i.e. grading, chilling, etc.) of seed potatoes and also of tamarind seed. Access to cold stores would enable producers to take advantage of the seasonal changes in market prices, as exemplified in Table 7.6.

TABLE 7.6
Wholesale price of potatoes at selected markets in Karnataka State (Rs/kg)

Month	Bangalore		Chikkaballapur		Channapatna	
	1987-88	1988-89	1987-88	1988-89	1987-88	1988-89
July	2.20	2.35	1.60	1.50	2.00	2.45
August	2.00	1.70	1.80	1.40	2.10	1.50
September	-	1.80	1.50	1.00	1.80	1.75
October	-	-	-	1.00	2.25	1.90
November	2.10	1.50	1.50	1.40	2.30	1.90
December	1.87	1.80	1.50	1.60	1.80	1.30
January	1.45	1.40	1.50	1.20	2.10	1.90
February	1.27	1.20	1.50	1.20	1.40	1.50
March	1.30	-	1.50	1.20	1.60	1.30
April	1.81	1.45	1.50	1.20	1.90	1.10
May	-	2.10	1.50	1.60	-	1.30
June	2.60	-	-	1.80	-	1.50

Source: Laxminaraya Rao (2003).

Size of cold stores will vary according to local requirements but, for Indian conditions, a minimum capacity of 2 500 tonnes is recommended. The land required for a cold store of this size would be of the order 4,800 m^2 (i.e. about 0.5 ha). (See, for example, Laxminaraya Rao, 2003.)

(3.) Common testing laboratories

Quality control and standardization is important for the preparation of high quality foods by local industries. The development, adoption and use of well-proven technical quality controls help provide:

a) Improved quality of products.
b) Greater consumer confidence and satisfaction.
c) Increased consumption and sales.
d) Avoidance of controversy and litigation when trading.
e) Provision of trading information; a means of comparing prices according to quality or grade. This leads to confidence and continuity of markets.

Quality control for a food processing industry begins in the field. It is essential to have sound physical, chemical and microbiological (sanitary) control at all points in the production-processing chain, for example, for (a) raw materials, (b) processes involved, and (c) finished products. Good manufacturing practices should be adopted from the outset. Most cottage- and small-scale food processing units, however, are unable (or unwilling) to follow recommendations of this kind given the lack of resources and information normally available to them. This frequently results in the purchase of sub-standard raw materials and payment of prices that do not reflect on the real quality of these materials.

Over-pricing results in narrower profit margins post-production, and this may lead to cost-cutting procedures that are detrimental to the industry long-term. Everyone in the production-processing chain is affected. For example for food grains, moisture content is an important determinant of quality, of the treatment required and, importantly, of the prices that should be paid at time of purchase. The moisture content of paddy during harvest is normally of the order 24 percent. Moisture content for milling or store, however, should be 14 percent. Thus the crop has to be dried prior to storing or processing. Too high moisture content at time of storing will result in deterioration and loss, and this effectively reduces crop yields. Further, the purchase of paddy with high moisture content represents a loss of income to the store or mill; with the flow-on effect that this may have for the profitability of that store or mill. Water is both a liability and a constituent of the grain that will *not* return purchase value. Much the same applies to other crops such as oilseed or groundnuts. Moisture in groundnuts, for example, will encourage the growth of moulds during storage, resulting in an increase of afflotoxins in the seed. Thus the effect of moisture on both yield and quality of the product is more important than increased weight. The trader and/or miller is obliged to purchase according to moisture content (and a number of other physical conditions) and, for this, accurate measurement of moisture is essential at time of purchase and at time of delivery.

For grapes, the brix of the fruit (i.e. an indication of sugar content) is important when determining suitability for producing raisins or high quality wines. The size of the berries, brix number and acidity of the fruit is important when trading fresh grapes. Similar constraints or requirements determine prices and quality for other crops. For example for gherkins, the smaller the size - the larger the count - the better market reception and the higher the price. For milk, price is always linked to fat content. The price of rice bran is fixed on the basis of oil, free fatty acid and sand silica content. The concentration of active principal constituents present in essential oils, spice oleoresins and food colours is important and determines market acceptability and pricing.

Pesticide residues can sometimes be a contaminant of foods. Inadequate treatment of crops can result in pesticide residues being carried over as a contaminant from the field to the factory, and through to the finished product. This is unacceptable to consumers. Quality control and testing in the factory should enable the manufacturer to detect contaminants of this kind, to provide a measure of protection to the consumer and to the reputation of the manufacturer. Where faults

may lie with the farmer or contractor, for example with lack of crop care, these faults should be identified and corrected. Contaminated materials should be rejected to waste (or to some alternative *non-food* use) with adequate reimbursement for payments made. None of this is practical, however, without an ability to test for residues in the raw materials entering the processing chain.

Large-scale manufacturers usually have in-house testing facilities for both raw materials and finished products. Small-scale processors cannot always afford testing and product development facilities of this kind. Equally important, the small-scale processor may neither be aware of the need for testing nor of testing facilities that may be available regionally. For example, an essential oils distillation plant can be established in India with an investment of as little as Rs100 000. However, the gas chromatograph equipment required for testing distillate products may cost of the order Rs350 000 (India-made) and Rs650 000 (imported). Investments of this order are normally beyond the means of the small-scale distillate processor, and should logically be shared with others. Herein is a role for shared testing and product development facilities, as exemplified by the services that can be established at an agro-industrial park. Many examples of privately owned laboratories are available in producer-processing areas in India.

The requirements of land and buildings for laboratory facilities of the type suitable for industries proposed for the agro-industrial park described in section 7.1 are, respectively, 2 400 m^2 and 250 m^2.

Shared infrastructure facilities – industrial support

Access to on-site facilities is a key prerequisite for encouraging entrepreneurs to establish industries in the park. Herein are choices for the extent of the facilities that will be developed and of their direct and indirect impact upon the industrial processes involved. Ultimately, these facilities will provide advantages to on-site industries that will help improve manufacturing and/or sales of materials and goods, and help with disposal of unwanted wastes or byproducts in an acceptable and cost-effective manner. Choices, impact and effectiveness will determine the costs of shared infrastructure for those using it.

(1.) Quality inspection and quarantine facilities

All fruits and vegetables to be sold fresh to consumers should be subject to quality inspection. Grading and packing units responsible for the export of fresh fruits and vegetables often face difficulties because of inadequate *(or lack of any)* arrangements with the importing countries for third country inspection. The European Union (EU) has developed quality standards for all major fruits and vegetables that are imported for which firm inspection rules apply. Some of the products covered are:

- Fruits: apricots, cherries, citrus, apples, pears, kiwifruit, peaches, nectarines, plums, strawberries, melons, bananas and table grapes.
- Vegetables: artichokes, asparagus, aubergines, beans, brussel sprouts, cabbages, carrots, cauliflowers, courgettes, cucumbers, garlic, leeks, lettuce, endives, onions, unshelled peas, celery, spinach, sweet peppers, tomatoes and witloof chicory.

Approval to undertake inspection at point of export can be granted to authorities of third countries that so request it. The importing country may apply the relevant EU or *equivalent* standards to produce exported and delivered into EU markets. The authorities responsible for undertaking the inspections required must be officially recognized. This body provides checking that conforms to established and accepted guarantees, and should have at its disposal sufficient technical staff, equipment and facilities to do the work required in a satisfactory and timely manner. The countries that have approval, or have applied, for EU standards of inspection include major (non-EU) exporting countries such as Argentina, Australia, Chile, Israel, Morocco, New Zealand and South Africa. The checks cover:

- Packaging and presentation to determine whether packaging has been carried out properly using clean materials to the correct specification, and that the presentation is correct.
- Marking to ensure that it follows standard rules for the display of information. The packages must show the kind (variety) of the product, the country of origin and the quality class.

- The products themselves - to determine that they conform to set quality standards. The inspectorate decides the size of the samples needed. Only fruits and vegetables classified in one of the following three classes, as defined in the standards, are allowed to circulate in the market, viz. “Extra”, “I” and “II”.

If products that have not passed inspection are subsequently brought in and then upgraded to meet levels of conformity through the appropriate corrective measures, a further inspection is carried out and a certificate is issued (i.e. assuming results are satisfactory).

No product can be exported without a phytosanitary certificate. Exporters are required to determine the standards of the importing country, indicating the commodities to be exported and, if applicable, any anomalies found *(such as active ingredients of any pesticides that may have been applied during production and/or in store)*. Where risk of contamination or use of a banned substance may be involved, the exporter should ensure that suppliers and farmers are informed accordingly. Failure to do so may result in a rejected shipment.

In India, phytosanitary certification can create difficulties. This may arise first when obtaining the certificate and then with qualification of the certificate (i.e. validifying it). Indian plant quarantine authorities are not always properly equipped for inspection, and this has led to unnecessary delays with inspection and certification. Delays with shipping have resulted. Prolonged issues of this kind may lead to importers shunning exports, and turning to countries that are more adept at meeting market requirements. Indian mango varieties, for example, have not penetrated EU and SE Asian countries largely because of difficulties experienced with export qualification and quarantine restriction. This is particularly so in markets in countries such as the United States and Japan where minority populations of Indian origin are small or non-existent, and thus demand for the product may be low.

Quarantine is an issue because of the fruit fly that is typically found on popular varieties of mango. Control at point of export has been shown to be inadequate, and importers do not want fruit to be rejected at port of delivery. Further chemical fumigation treatment may not be possible at port of loading, and facilities for vapor heat treatment may need to be provided. From experience, the quarantine authorities in India have found that it has not always been possible to provide for rapid inspection of large consignments of mangoes and other fruits. Reputations can be severely damaged should the one infested consignment be shipped, with the result that importers in the host country may close markets to the exporters from the producer country – for a range of products. Herein the agro-industrial park may have a role with the provision of facilities to provide for the window of opportunity that may exist for exporting well-inspected and correctly certified products.

Requirements for establishing a quarantine and inspection facility would be of the order 4 800 m^2 of land and 500 m^2 of buildings for the park described in section 7.1. The capital costs involved can be shared by both government and commercial industries. Capital costs can be proportioned and loaded on to the costs involved for developing the separate industrial plots. Recovery of costs may come in part from the sale of plots.

(2.) Environmental protection measures

Apart from greening the areas covered by the park, adequate facilities have to be provided for the disposal of solid and liquid wastes produced in the park. Greening normally comprises planting avenues of trees alongside roadways and providing an open and grassed land area around the industrial units. Whether collected on site for later disposal, or collected and disposed of at time of production, waste-handling facilities will require considerable areas of land (both on- and off-site). The investment required can be high and will normally come with the financial assistance of either local or central government. In India this is certainly the case, and financing for common facilities of this kind may be provided courtesy of agencies such as the Industrial Development Bank of India (Ministry Environment and Forests, 2004).

Depending on the extent of the wastes produced (i.e. volume per type, timing, nature, hazards, etc.) they can be collected, segregated and treated according to a number of well-established methods. Many options apply. Wet wastes from organic materials such as fruits and vegetables can be composted with or without the use of earthworms – a system termed *vermiculture*. Given

the large areas of land that may be required, this is normally off-site and it will probably not be practical within the confines of an agro-industrial park. Vermiculture is widely practiced in India, with the sale of high quality compost *and* earthworms (i.e. *fresh* - for new bioreactors or *treated* – for animal feed). According to case studies undertaken in Maharastra, the use of vermi-compost produced significant yield boosts with sugarcane, grape and vegetable crops (BERI, 2000).

Wet solid wastes from fruits and vegetable processing industries can also be treated in purpose-built anaerobic digesters for the production of biogas. Biogas is 60 percent methane and burns with a light blue flame. It has an energy value of 11-22 MJ/m^3. Sludge from the digester can be sold as manure to farmers, and the biogas used as a source of heat in the park or by other industries close by. The technologies involved are well known and equipment is widely available for both industrial and domestic use (e.g. for lighting or cooking). In India, the Central Food Technological Research Institute at Mysore in Karnataka State is a leading promoter of developments of this kind. System performance of the unit/digester will depend largely upon the quantity of the wastes available. The approximate quantities of wastes produced from processing fruits and vegetables are shown in Table 7.7. These can serve as a guide when making a choice of digester (Nand, 1994 and 2001).

The quantities of wastes available from processing fruits and vegetables is seasonal, with volumes peaking as the result of the choice of crops available, varieties of crops, quantities delivered and proportions discharged to waste, transport distances and topography. A measure of flow has to be determined from the outset, that peak loadings can be accommodated without overwhelming the facilities. Investment levels may be offset by dumping quantities of untreated wastes to landfill during times of peak production. Herein there will be need for planning that transport and/disposal routes are adequate. Wastes cannot remain at point of processing given the issues of hygiene that may arise on site. Drying wastes and partial pre-processing before feeding to biodigesters will add enormously to the costs of the biogas, although there may be opportunity costs involved. These may help offset production costs to some extent.

Ensilaging wastes for use as animal feed or for providing feedstock to a biodigester can be successful with some methods of waste management (Shacklady, 1983). Wastes can thus provide feed for livestock or boost energy supplies in local communities. A long processing season will extend the period during which biogas may be produced and, in some cases, year-round production of gas may be possible.

A biodigester has advantages when handling liquid effluent, for this can be mixed with solid wastes to provide feedstock. Biodigestion may provide a low-cost option, and help to prevent or alleviate contamination of aquifers or surface waters with the discharge of untreated liquid wastes adjacent to the park. There are issues of recycling herein, which may provide for closed circuit treatment works on site or near to the park.

TABLE 7.7
Fruit and vegetable wastes from processing

Fruits & vegetables	Nature of waste	Approximate waste content (%)
Mangoes	Mango peel and stone, spoiled mango, etc.	45
Bananas	Peel	35
Citrus fruits	Peel rag and seeds	50
Pineapples	Skin and core	33
Grapes	Stem, skin and seeds	20
Guava	Peel and core with seeds	10
Peas	Shell	40
Tomatoes	Skin, core and seeds	15
Onions	Outer leaves	5
Apples	Peel, pomace and seeds	10

Source: Mokshapathi and Potty (1998) and Nand (1994).

Gas production is of the order 0.71m^3/kg of volatile matter from an hydraulic retention time of 20 days. The effluent from the digester is neutral and will have a maximum COD of 4 000 mg/l. Digested slurry can normally be used as manure post-digestion. A 100 m^3 capacity digester (e.g. two digesters of 50 m^3 each) can accommodate a throughput of 150 tonnes of mango peel annually and, in India for example, will require investment of the order Rs1 million. A well-managed digester and gas reticulation network can generate income estimated at Rs1 million annually, and provide a reliable supply of gas to industry and organic manure to farmers. The original investment thus becomes little more than a one-year liability according to Babu, *et al* (1994).

Dry solid wastes can be converted into fuel pellets and supplied to industries within the park. Alternately, dry solid agro-wastes can simply be incinerated to provide heat and/or electricity. Developments of this kind are normally municipality-based, for example, in Singapore solid wastes are used to generate power. The Tuas Incineration Plant completed in 1986 at a cost of US$200 million can handle 2 000 tonnes of refuse (Plates 7.3 and 7.4), and generates 35 MW power at 6.6 kVA (Government of Singapore, 2000).

For the treatment of liquid effluent a common effluent treatment plant (CETP) can be built on a cost-sharing basis. Industries that generate large quantities of wastewater from processing will normally be required to pre-treat their effluent to meet acceptable levels of contamination *(as agreed by all users of the CETP)* prior to discharge off-site. This will ensure uniformity of loading to the CETP. Users can then be charged for the services of the CETP according to the volumes of wastewater generated and the treatment given.

Depending upon the nature and quantities of dry and wet solid wastes produced by the industrial units, a number of suitable methods of disposal can be considered For example, there may be possibility of combining wastes - with acidic wastes used to neutralize alkaline wastes (or vice versa) with precipitation and recovery of solids that may result. Much of the wastes produced at an agro-industrial park are organic, together with large quantities of wastewater. This leads to the use of digesters for biogas production, to the need for wastewater treatment prior to *(or in agreement with)* treatment by the local municipality, and to the need for access to land nearby for disposal of organic wastes and water post-treatment. For the park described in section 7.1 combined facilities for waste handling/treatment are likely to require of the order 14 000–15 000 m^2 (i.e. 1.5 ha) of land. Larger areas of productive cropping should be available nearby for disposal of wastewater and solids.

Tuas incineration power generation plant Singapore

K. LAXMINARAYANA RAO

Plate 7.3
Refuse bunker
Source: Government of Singapore (2000).

K. LAXMINARAYANA RAO

Plate 7.4
Turbo generator
Source: Government of Singapore (2000).

Additional common facilities

Sound engineering design will ensure that layout, road network, drainage, power supplies, telecommunications, waste handling systems and others are adequate for current and future activities proposed for the park. Design is, however, more than the sum total of the services required, and includes people working in harmony within their neighbourhood. Thus it is that due diligence has to be given to service providers and living and working space, that people are reasonably happy to work within the park and to live close by.

(1.) Roads

Roads within the industrial park are essential for providing easy access to the separate factory sites. Hard pavements are required that are capable of handling fully loaded trucks throughout the year. Further, the park should be linked to the main highways close by that will provide links to producer areas, to markets and to airports, ports, rail-heads, container terminals, container freight stations and similar. Transport facilities provide the arteries along which materials flow into and out of the park. Constraints with transport will limit the potential of the park to meet production and investment targets.

Road design, layout and facilities are always based on a number of well-established engineering principles. These include:

- Minimum development costs for infrastructure. This will ensure maximum availability of saleable land for industrial use. Roads should be planned and established to meet standards of length, width and carrying capacity, with the minimum number of bridges and circle roads. Free-flow of traffic into, within and out-of-the-site *is* a priority.
- Minimization of the number of intersections - in order to reduce traffic hazards.
- No direct access to the separate industrial plots from the main highways. This will ensure effective and efficient traffic flow off-site, and limit the flow of non-park traffic through the park.
- Introduction of tree planting strips along the main access roads of the park to provide green environment/image and shade within the park, for example, for parking and pedestrians. Greening provides an aesthetically pleasing visual appearance to the park. A green perimeter provides a buffer zone between the park and the surrounding areas.
- Provision of sufficient space to enable road patterns to be re-developed to allow for changes to existing roads/parking arrangements, and to allow for the expansion of the park at some future date.
- Provision of adequate slip roads at main junctions with space to enable heavy industrial traffic to enter and depart the park; to include space for re-developing junctions as may be required for future transport needs.
- Provision of generous road space, reserves and carriageways that will accommodate heavy industrial traffic including any future upgrade of carrying capacity.
- Provision of pedestrian walkways alongside or within the road network with the provision of paved footpaths on either side of the roads linking plots to services, amenities and residential areas. Similarly, there are opportunities for separating bicycle traffic from motorized and pedestrian traffic.

The area occupied by the roads within the park will depend upon the size of the park, the types of amenities required, the numbers and size of plots and the width of the roadways. Herein will be local or state engineering guidelines and standards that should be followed. The expected volumes of traffic will also be a consideration. Typical road specifications may be:

- Main entrance roads into the park should be *50 m wide* with planting strips on both sides of the road. Pavements should comprise a permanent walkway minimum *2 m wide.*
- Service roads within the park should be *30 m wide.*

The area covered by the roads, pavements, drainage channels, etc. in the park will normally comprise 15-20 percent of total area depending on the size of the park, the existing topography and existing infrastructure in the locality.

(2.) Drainage

The entire area comprising the park and surroundings should be provided with storm water drains. These will ensure that peak rainwater falling on to the area of the park can be quickly discharged into existing channels. Areas prone to flooding within or adjacent to the proposed park should be provided with adequate drainage at time of construction. Contractors will be obliged to follow normal municipal or state engineering guidelines with choices of materials, design and discharge levels. All new roads and unit foundations should be adequately protected from standing water or cross flow, with the construction of storm water management module (SWMM) side drains.

(3.) Power

Total power demand in the park will depend upon demand from the individual industrial units, from common service facilities and from street lighting (and other municipal uses on site). Demand can be estimated on the basis of the agro-industrial development potential of the separate industries that can be expected to establish in the park during start-up phase and after a period of park maturity. A measure of planning is required to provide for upgrading of power lines and fixed equipment. In India, for example, the on-site power supply will come from an external 11 kVA power line with step-down transformers and a distribution network. Power will be provided by the local electricity supply authorities. Given that the responsibilities for the supply of power will come from the same public sector authorities that have promoted the park, delivery of power up to the park boundary and into the park will not normally be an issue. The park represents an important market for power and one, moreover, which will provide the power authority with increased earnings.

If the area is in deficit for external power supplies, the park may need to consider augmenting supplies with some form of alternative power generation system. Several options may present themselves. For example, separate industrial units may have a captive electrical power generation capability based on the use of standby diesel engines (normally called a "*genset*" in India) for which investment subsidies and easy-finance may be made available. *(This is normally the case in India).* For an agro-industrial park, power generation may also be possible with the use of heat from incinerating wastes or from biogas generation *(as described in section 7.3.2).* A captive power source based on facilities common to all industrial users on-site can also be considered. It may be that the local power authority may be prepared to install and/or manage a facility of this kind, with eventual links to the local grid *(to which surplus power may then be sold).*

(4.) Water supply

Agro-industrial processing of most crops requires large quantities of water, for example for washing fruits and vegetables, for cooling, for conveying, for steam generation, for cleaning facilities and/or equipment and for the hygiene and sanitation facilities required of workers in the plant. Except for preliminary washing, cleaning and sanitation, all uses require the water to be treated according to strict guidelines required for processing. These will already be established within the norms of local regulations and laws. Most of the water used can be recycled after suitable treatment, and used again. This helps with the conservation of fresh water in the park, saves on the purchase of additional water, and reduces the discharge of wastewater (and potential pollutants) into areas surrounding the park.

Water supply within the park can come from a number of sources, for example from a distribution network comprising underground pipelines, storage tanks and header tanks. The supply can be rain-fed, supplied by the municipality or pumped into the park from nearby rivers or aquifers by dedicated supplies that may be under the control of the park. If groundwater potential is good and costs are reasonable, the separate industrial units can be encouraged to sink wells on site and to pump independently. Water requirements of the park can be estimated on the basis of past experience and the processing and hygiene needs determined, including a measure of additional capacity for plant expansion.

(5.) Telecommunications

Good telecommunication facilities are essential for running a successful business. Depending upon location, each industrial plot should have access to minimum one telephone connection/line. Herein there will need to work closely with the local telecommunications authority that bookings for new landlines or mobile connections can be made from the outset. Industrial units *must* be able to make contact with the world outside the park from the beginning. Facilities may be required in the park for the 'telecom' authorities (or others) to establish the appropriate telephone exchange facilities within the park. Mobile facilities will also be essential given the widespread introduction of satellite and/or cellular telecommunication networks regionally and internationally in recent years. Such systems are rapidly replacing/augmenting land-based systems, given the lower levels of investment required in fixed facilities. Implicit in developments of this kind are those that relate to the introduction and use of the Internet. Internet trading and communication facilities have come to prominence in most commercial sectors of the industrial countries, and there is every indication that trends of this kind will follow in *all* developing countries. Any new industrial centre has to consider these options, and to provide suitable facilities for the commercial companies that are expected to establish there.

It is widely believed that the closer a market can approximate to conditions of perfect competition the better the economic welfare of local communities (Trade Point, 1995 and Swaminathan, 1997). Any deviation from perfect competition results in loss of welfare and income to the consumer. Modern information technologies and the use of the Internet, in particular, provide potential for improving the economic performance of agricultural and food marketing systems. Developments within the telecommunications industries will affect every structural characteristic of these marketing systems. Modern information technologies help improve economic performance primarily by reducing time and transaction costs, and making markets more transparent. Quick access to information is a key factor. Encouraging entrepreneurs to take advantage of the relevant electronic communication methods available can substantially reduce transaction costs within the park, and this helps encourage trends towards improved (if not '*perfect'*) competition.

(6.) Commercial premises

Commercial premises are an essential part of an industrial estate. They provide auxiliary services for the main industrial units based at the park and for the people that work there during the day. The commercial area should provide buildings and office space for a wide variety of activities that will be essential for the success of the park. Typical facilities required are described in Table 7.8.

Facilities required within the park will be based on existing facilities already available in the immediate area of the park, in the local town or neighborhood and in the region served by the park. If the park is located within a reasonable distance of an existing township, then the facilities available there may suffice. People may be prepared to walk 10 minutes or take a bus ride to seek the services or goods required outside. In this way full use is made of local businesses and existing facilities, and there will be better integration between the park and the local business community.

There will also be advantages with more effective use of existing facilities, and funding and investment will not be wasted with duplication. It may be that some of those providing existing facilities may take the opportunity of modernizing and expanding services, and provide for new or improved facilities to take account of the park. Herein there may be an opportunity for service providers to relocate closer to the park.

The facilities to be provided will differ on the basis of utility and need, and on the demands of the people and the industrial units within the park. These will vary. They will be multi-service based and include, for example, facilities such as service shops required of the different park industries *(such as spare parts for plant and equipment, electrical servicing, welding, motor repairs and similar),* those that provide for workers *(such as food and clothing shops, etc.),* those that provide business and communications centres *(such as banks, post office, etc.)* and others such as first aid post/dispensaries, transport, etc. The park designers may prefer to have a

dedicated service area adjacent or central to the park that new facilities can be encouraged and planned. This is preferred to *ad hoc* arrangements that may result in limited, low quality and/or unhygienic facilities being introduced without adequate planning.

Due emphasis has to be given the social infrastructure of the park. This may include housing for key park staff, shops, supermarkets, clubs, hotels, playgrounds, parks, cinemas, bus terminus and similar. Whatever facilities may be required, they should be located well away from the industrial zones that there will be no danger for the general public from hazardous stores or processes. Fencing and well-placed pavements and roads will encourage people to move about the park between work units and service facilities that security is always maintained. This will help deter theft and/or trespass.

TABLE 7.8
Commercial facilities in agro-industrial parks

Category of facility	Facility to be provided
Industry related: commercial	• Spare part agencies and shops • Farm inputs suppliers • Motor rewinding shop • Business centre • Restaurants & fast food shops • Supermarkets • Hospital & nursing homes • First aid & emergency services • Banks • Convention centre • Transport operator's office • Container terminals, if required. • Petrol stations • Fuel depot (coal, oil, diesel, etc.)
Industry related: social	• Schools • Housing areas • Playgrounds • Clubs • Hotels & guest houses • Bus terminus & car parks • Parks • Religious centres • Residential areas for key staff
Government and other offices	• Pollution control board office • District industries centre • Inspection & certification agencies • Industrial associations • Local authority offices • Electricity board • Police station • Post office & telephone exchange • Training centre • Fire fighting services • Single window agency • Weather monitoring station • Agro-industrial park office

Source: Laxminaraya Rao, K. (2000a).

Facilities may also be required for housing the various government agencies that may be required for development and control of the separate industrial activities within the park. A dedicated building complex may be located in between the separate industrial zones and housing and/or social infrastructure and/or services zones. Providing facilities for government agencies may encourage industries to re-locate to the park. The park may offer better access to government officials and services including, for example, access to incentives and payments that may be available for re-location, new investments and similar. Better exchange of information will result, and this will ensure that entrepreneurs on site are kept abreast of changing fiscal or taxation developments.

Where the industrial park is large, areas of land can be set aside for road transport terminals, fuel depots, railway sidings, container freight stations *(with facilities for stacking and storing containers)* and also, for example, for research, quarantine, training and agri-horticultural units. Undeveloped land (or land with low priority use) can be allotted to the various agencies engaged in these activities. In India, for example, this may include the India Railway Authority, the Container Corporation of India, the Institute of Horticultural Research or the Department of Agriculture/Horticulture. The success of an agro-industrial park will be enhanced with agencies such as these available on site or nearby.

PARK ZONING

It is always an advantage for the park to have different zones for different types of industrial and non-industrial activities. Zoning helps by encouraging economies of scale, for example, when providing services for the collection and treatment of wastes, recycling wastewater, transport networks, public amenities and similar. It is sound practice to segregate polluting and non-polluting industrial processes, heavy and light industries, wet processing and dry processing industries and similar. Table 7.9 provides examples of the different types of industries that may be involved.

All units producing wet solid wastes should be located together so that these wastes can be collected and treated in a single plant comprising, for example, digester and pre- and post-treatment utilities. The biogas produced can be used by industries located close by, for example, for the generation of steam or heat energy. Similarly, industrial units producing dry solid wastes can be grouped together. This will enable, for example, all solid wastes to be incinerated for generating power or pelletized for the production of easily transportable fuels. Fuels of this kind can be sold in the park for industrial use or sold into the local community as domestic fuel.

Supporting industrial units such as those involved with ancillary activities for printing, plastics, packaging and similar can be located together in one part of the park. Separate enclosures may be provided for common facilities that cater to the needs of individual groups within a particular zone. Commercial services can also be located separately, but should be within a convenient distance from each zone. Long travel distances and/or inadequate transport links will result in these services being under-used, and may encourage *ad hoc* alternatives (such as street food vendors) establishing in non-zoned areas.

MANAGEMENT OF THE PARK AND COMMON FACILITIES

Park management

The period required of planning and establishing the park will normally be minimum five years. Development has to be taken up in a series of phases on the basis of the financial and physical planning and investment required, and the economic well being of the park at time of start-up. During this early period, many of the systems required for the *modus operandi* of the park will be determined and established. The allotment/sale of developed plots or sheds will normally begin when the first blocks of land have been identified, and when services are available on site. This follows macroplanning and comprises the first *phase* of development.

TABLE 7.9
Industrial zones and industries in the park

Classification of industry	Industrial activities
High water consumption and wet solid wastes.	• Fruit juice/pulp/slice canning industry. • Fruit juice extraction and concentration. • Tomato past and puree. • Tamarind juice and paste. • Starch from corn, potato and tapioca. • Sugar milling • Soluble coffee and tea.
Medium water consumption and wet solid wastes.	• Vegetable pickling • Gherkin/baby corn in vinegar & brine. • Fruits and vegetables dehydration. • Potato wafers and finger chips. • Spice oils and oleoresin. • Essential oils from herbs. • Floral concentrates
Medium water consumption and chemical wastes.	• Vegetable oil refining • Cotton seed oil expelling • Vanaspathi and margarine manufacture. • Distillery
Low water consumption and dry solid wastes.	• Oil seed decorticating and dehulling. • Coffee curing • Rice milling • Dhall milling • Cashew nut processing
Zero waste or minimum waste and effluents.	• Bakery • Confectionery • Energy foods • Spice powder and masala powder. • Flour milling • Grading and packing pure spices.

Source: Laxminarayana Rao, K. (2000)a.

Management of the park during the first phase involves the coordination of those activities that relate to planning, initiation, promotion, etc. and the introduction of the concept of the park and its implications to regional and local communities. This is a complex and demanding period for senior planners and managers. Activities will include the identification and choice of park location, feasibility studies of different proposals, the preparation of concept plans, location of finance, detailed engineering planning, decision-making, land acquisition, etc. Planning shifts to action on-the-ground with the implementation of concept plans *(according to the engineering designs selected, contractors chosen, etc.),* coordination with public utilities for procedures, services and information available, coordination and management of construction and development activities, marketing/promotion of the park and similar.

Many local government development and service agencies can be expected to take part in these activities and to provide support. When the initial period of development has been completed and the majority of the plots and sheds have been allotted, the industrial entrepreneurs will become involved with park management. In Gujarat India, for example, management of the industrial areas has been delegated to an elected body of industrialists from within the park. The property tax collected by this elected body is used for the maintenance and upkeep of the industrial areas (GIDC, 2000).

Management of common facilities

Common facilities located at the park should come within the control of the management administration office of the agro-industrial park. There are several ways of achieving this including sub-contracting, direct employment of professional staff and/or secondment of people from within the community of experts and industrialists available. There are advantages for employing specialists for the many technical areas of management involved with administrating the park. These specialists should be responsible to line management and to the committee of representatives from the industries established in the park. Part-time management or employment is not as reliable long-term, and sometimes limits access to those employed by the separate commercial enterprises. There are also elements of vested interest to consider, with decision-making from contracted management/technical experts that will be seen as neutral or separate from the individual industrial units. That said, the park management office should, in some way, be ultimately responsible to the many factory owners or occupiers that make up the park. This will enable short lines of communication to be established, and ensure that decision-making is made with the well being of park residents and/or users as priority.

An association of companies or users should be formed to represent the interests of the park tenants/factory-owners. These will relate directly to management with representation also coming from the utilities, from facilities on site, from workers' unions and from services such as waste plants and power plants. There may also be representatives from associations of people living adjacent to the park to enable communities, for example, affected by waste discharge, movement of traffic or noise levels to have a say in management of the park.

A common effluent treatment plant (CETP) will cater for the needs of those industries discharging significant quantities of liquid or soluble wastes. This will vary from industry to industry depending upon manufacturing processes, products, capacity, utilization, throughput and similar. Discharge of effluent will vary with the seasonal demands of processing. Pollution levels will also change, and this will help determine the extent of the treatment required. Thus firm technical guidelines and working methods will need to evolve - that each user is required to pay according to the extent of use. For example, management of the CETP may encourage fair and equitable sharing of costs by appropriate planning. Some simple-to-understand guidelines should apply:

a) All participating industries should pre-treat effluent to provide for uniform loading at point of entry to the CETP.
b) Quantities of effluent entering the CETP should be metered at point of factory discharge; to determine discharge levels from the individual enterprises before the discharge enters the common mains delivery system.
c) Samples of effluent discharged should be collected at the respective metering points and analyzed for biological and chemical oxygen demand (BOD and COD), suspended solids and other constituents (such as metals).
d) Each industrial participant should be required to purchase a share in the capital structures required of the CETP works and pipe network, according to the quantities of effluent discharged.
e) Operating costs should be shared by participants in proportion to the quantities of effluent discharged, and in proportion to a predetermined (and agreed) loading concentration.
f) Additional charges should be levied in the event of any unit being unable to reduce BOD and/or COD levels to meet agreed standards *(as fixed by CETP management)* before discharging to the CETP.
g) Willful defaulting by participants to (or an inability to remain within) agreed standards should attract penalties. These will be determined by management in well-publicized listings. Penalty rates should be sliding, with higher penalties for repeat offenders.

Management of the CETP may comprise a separate committee with a dedicated line management to ensure full responsibility at different levels. A typical structure may be:

a) Two elected representatives from among participating industries in the park or one representative for every block (or zone) of 20 participating units.
b) One additional elected representatives from among those industries that have high water use and/or high discharge rates of liquid wastes.
c) One representative from the pollution control board (or equivalent) in the municipality.
d) One representative from among local residents living near to the park; to be nominated by the same local body.
e) One representative of the agency managing the agro-industrial park.

Day-to-day administration and maintenance of the CETP should be undertaken by well-qualified and experienced environmental engineers, technicians and chemists. Management of the CETP may also be extended to include responsibilities for environmental management functions elsewhere in the park.

ECONOMICS OF MODEL AGRO-INDUSTRIAL PARK

Project costs

Project costs will depend upon many factors and not least those included in the costs of establishing the capital works and funding required of the park. All costs change with time and geography, and the examples listed in Table 7.10 applicable to Karnataka State India should be taken as a guide to costs that may apply elsewhere. Ultimately, project cost depends upon the type of facilities that will be provided and the size of the park.

Project costs will include the purchase and development of land, together with costs of all essential infrastructure. These costs will reflect in the prices asked for the plots and ready-built sheds on sale. Costs may include:

a) Site development costs such as removal of vegetation and/or existing structures, earthworks for levelling and terracing - depending upon the original form of the land.
b) Paved roads, storm water drains, main drainage system, landscaping and planting trees.
c) Water supply systems including piped networks for supplies to individual plots and sites of ready-build sheds, and to services and facilities.
d) Fire fighting systems such as storage tanks, hydrants and pipe networks.
e) Telecom infrastructural networks, structures, cables, lines and/or manholes for access below ground.
f) Power supply infrastructure including sub-stations, transformers and distribution lines.
g) Sewage systems for domestic effluent, but excluding networks for flow of effluents to the CETP.
h) Contingencies and overheads.
i) Consultancy fees for consultants, architects, technicians, engineers and other service experts.
j) Financial costs.

Costs of additional infrastructure that may be developed will be paid for on a cost-share basis according to the extent of intended use. Infrastructure costs should be treated as separate cost centres. Planning, design and construction has to be started simultaneously with other park developments. Pre-construction planning and feasibility studies will ensure that adequate attention is given to the timeline involved with construction and servicing. Whilst some on-site services for industrial units can be left until the particular site is occupied, common services should be in place by the time the first occupant is ready to establish in the park. Individual unit costs can be recovered from the tenant/occupier. Table 7.10 does not include these additional components costs. Total cost can be calculated based on the size of the park and the extent of the services, facilities, etc. that will be constructed. Financial costs will be based on the building and

establishment schedule devised for the park – and described within the number of *phases* required, on the timelines involved and also on the eventual size of the park.

TABLE 7.10
Estimated costs of an agro-industrial park

Item no.	Description	Unit	Quantity*	Rate (Rs)*	Total cost (Rs x 10^6)*	Cost saleable plot area* (m^2)
1.	Site cleaning.	ha		10 000		
2.	Earthworks average 5 m fill.	m^3		60		
3.	Main drain excavation.	m^3		20		
4.	Entrance road 30 m wide.	m^2		1 000		
4.	Internal roads 18 m wide.	m^2		1 000		
4.	Roadside RC drain.	m		1 200		
5.	Water supply 150 m^3/ha/day. Roadside pipes length: 25% network 600 mm. 75% network 300 mm.	 m m		 1 680 1 200		
6.	Fire fighting system. Fire hydrant pipes. Storage tanks.	 m m^3		 800 15 000		
7.	Telecom infrastructure. 25% network 8-way. 75% network 4-way. Inspection holes.	 m m no.		 1 500 1 000 70 000		
8.	Power supply infrastructure. Substation Distribution lines.	 MW m		 40 000 1 800		
9.	Sewerage system pipeline, including inspection holes.	 m		 1 000		
10.	Landscaping	m^2		100		
11.	Contingencies & overheads at 10%.					
12.	Consultancy fees at 5%.					
13.	Financing Cost at 15%*					
14.	Land cost. Land compensation. Land acquisition expenses.	 ha ha		 500,000 100,000		
	Total costs					

Source: Laxminarayana Rao (2000)b.
* The quanities, rates, total costs and unit costs of salable plots in a park will be estimated on actuals. They will be dependent upon the size of the park, location, plot mix and facilities proposed for the park. Rates shown are typical examples. Complete the table when the quantities can be reasonably estimated.

Financing project costs

Flow of funding will determine the rate of construction and establishment, with an implementation period varying from a minimum three years for small parks (<100 ha) to more than five years for larger parks. In regions where there is good potential for growth, the establishment of the park can be expected to be undertaken within minimum three development phases. During a typical project life cycle there are likely to be three different types of plots offered to tenants/owners, viz.

1. Plots allotted to industries, to be developed by the new owners/tenants.
2. Fully developed plots and ready-made buildings for entrepreneurs who wish to start activities immediately.
3. Blocks of undeveloped land for sale, and intended largely for expanding industries or for use for locating service infrastructure (by agencies and others) in the future.

Agencies that may become part of the park include shippers, transport companies, railways, housing development agencies, warehouse corporations and others. These agencies may establish/re-locate when sufficient industries requiring their services have established. Project planners are required to plan well in advance for land expansion and for additional services, to avoid incurring higher acquisition costs later and to reduce speculation on land - for both will be detrimental to the long-term security of the park.

Phased requirements of funds for the project are shown in Table 7.11. These are based on a three-year implementation schedule for the first phase of the project, and estimated 200 percent excess land acquisition (based on land required during the first year) in subsequent years.

The project is likely to generate its own funds beginning Year 2. This comes from receipts from advanced bookings for plots and sheds, and confirmed allotment/sales of completed plots/sheds from the beginning of Year 3. From experience, nearly 25 percent of project costs should be recovered within the implementation period of the project (Years 1-3).

The project may also receive a measure of financial assistance from the government. In India, for example, projects of this kind will receive of the order Rs20 million in grants from the federal government. Much depends, however, on the development agencies involved and their links to the public sector. In India, for example, grants are available under the Integrated Infrastructure Development Scheme, which includes the *'Development of Industrial Estates in Rural Areas'*. State governments may also promote schemes of this kind, and one estimate of public sector support is 15-30 percent of project costs depending upon the size of the project. (See Table 7.12.) (TECSOK, 1997; Food Karnataka, 2003 and CI&TCC, 2003).

TABLE 7.11
Scheduling of funds required

Project activities	Funds required for the project (%) Year 1	Year 2	Year 3	Totals
Payment for land compensation.	75	25	-	100
Acquisition expenses.	80	20	-	100
Development costs phase I.	10	70	20	100
Preliminary expenses phase I, II & III	30	20	!0	60
Contingencies at 10% of project costs	0	40	60	100

Source: TECSOK (2004).

TABLE 7.12
Public sector financial support

Source	Proportion project cost (%)
Grants from government and other agencies.	15-30
Own capital from the implementing agency (minimum contribution).	10
Internal generation of funds from bookings and sale of plots and sheds.	25
Loans from national and international financial institutions.	35-50

Source: TECSOK (2004).

TABLE 7.13
Typical shared costs and investment between private and public sectors

Proposed location of food park	Project costs (Rs million)	GOI/GOK subsidy/equity (Rs million)	Promoter's responsibility (Rs million)
Jevargi, Gulaburga District.	194.79	80	114.79
Hiriyur, Chitradurga District.	173.40	80	93.40
Gejjalgere, Mandya District.	168.10	80	88.10
Halaga, Belgaum District.	191.05	80	111.05
Malur III Phase, Kolar District.	196.11	80	116.11

Source: Food Karnataka Ltd (2003).
Note: GOI/GOK contributions are Rs 40 M each. This is available irrespective of the size of the park and the extent of the investment proposed. Subsidies have continued into the period of the current 10th plan.

Funding for establishing a park depends largely upon the share of federal and state government grants and equity funds that are available. Location, the marketability of the plots and other services, and the time frame required for implementation will also have a bearing on attracting private finance. The MFPI in India, for example, has provided of the order Rs40 million as grants per park (for public and private ventures) in recent years. State governments normally participate with a matching contribution as equity shares. Annex 3 describes assistance provided by the Federal Government of India under the 10th plan.

Promoters have the responsibility of attracting the balance of funds required. Generally the promoters of the park raise loans from financial institutions or banks, with a repayment period spread over a pre-determined implementation period or longer. The periods required for loans form part of the negotiations involved between the project and the financial institutions at time of loans application.

Promoters will normally be able to raise finance during the implementation phase on the basis of the advanced bookings for developed plots and facilities. Companies allocated plots can normally raise loans for the investment proposed, and then pay the park promoters on an installment basis - following progress with park implementation. If the promoters of the park are able to sell the plots quickly, then they should be able to generate the additional funds required through internal generation of funds. Typical cost estimates for a food park project are shown in Table 7.13. These represent five different locations for joint public and private sector funding in Karnataka State.

Marketing facilities

Marketing the industrial plots and ready-built sheds is an important promotional activity undertaken prior to construction. In India, for example, after a project of this kind has been conceived, the nodal agency (and other appropriate development agencies) conducts campaigns in those cities and regions of the country where commercial interest in investments of this kind can be found. The aim is to encourage the best of entrepreneurial talents available to set up business in the new park. Ministerial delegations may also visit other countries to invite non-resident citizens and other commercial leaders in allied fields (such as trading, finance, retail, etc.) to take advantage of the opportunities available. Promotional activities of this kind are typical with considerable effort made at trade shows, international fairs and other industrial venues. Industry-specific targeting is undertaken, particular within newly industrializing countries in the region.

Publicity campaigns may invite industrialists and others to visit the region, to meet the people involved and to gain some idea of the many opportunities available. There may be arrangements for technical and/or financial joint ventures available for the industries proposed, for example, as described in the UNIDO-supported International Investors Forums '*Intechmart'*. (Anon, 1999). A further example is provided by the Global Investors Forums supported in selected countries by the Asia Pacific Centre for Technology Transfer (APCTT, 2002).

On-the-spot bookings and/or allocation of plots and ready-built sheds can be made during promotional campaigns. It follows that there has to be financial and commercial confidence on the part of the promoters/investors that a show of interest will be converted into a firm

commitment on the part of the companies concerned. A survey to determine demand for plots, etc. prior to promotion will enable portfolios of interests to be established, to help identify the most likely entrepreneurs who will eventually establish in the park. Those readily identified can be re-contacted as soon as the plots are ready for allotment to enable them begin on-site development and construction. Allotment procedures followed in India, for example, and the time taken for the disposal of applications for allotment may involve the different steps shown in Table 7.14.

The Karnataka Industrial Area Development Board (KIADB) is the nodal agency for the development of industrial areas in the state. This is undertaken by the subsidiary company Food Karnataka Ltd, which was established in 2003. The KIADB is ratified to meet full ISO 9000 standards for all infrastructure planning and development activities. It follows similar procedures when marketing the plots and allotments, and maintains high professional standards for schedules and applications according to normal business practices in Karnataka State. The KIADB has the full confidence of the State Commissioner for Industries and Commerce of the state government and can access a range of services, expertise and experience to ensure the smooth transition from ideas to commercial reality (KIADB, 2003).

Messrs Udyoga Mitra is a leading agency in Karnataka State for the provision of industrial services to entrepreneurs, particularly where start-up work is required. The agency offers a *'one-stop'* office that will cover the many complex issues concerned with local regulations required of industrial development. Messrs Udyoga Mitra are facilitators, and work in close cooperation with the KIADB and other government organizations in the country (GOK 2003a, 2003b, 2003c).

Selling prices for plots and ready-built sheds

Selling prices for plots or sheds must be reasonable, market-linked, easy-to-understand and transparent. They must reflect prices prevailing in local markets, and take account of actual costs plus margins that will enable future exigencies with production and/or processing to be fully considered. However, prices have to remain competitive and, where necessary, a measure of cost absorption should be included to enable newcomers to establish with confidence in the region/country. Transparency in pricing is essential that everyone in the chain will be aware of the incremental prices and/or costs involved. This is particularly so where the economic development of a region may be involved. Herein local government has a responsibility to encourage investment, and may be obliged to consider opportunities for public sector support to encourage take up of plots or buildings. It may mean that full recover of costs may *not* be possible – at least at time of sale and start-up. *(Later, these additional costs may be recovered within taxation regimes).* This is particularly so where it may be necessary to encourage entrepreneurs to shift into rural areas and away from towns. Incentives can be directly related to start-up costs, for example, as sliding percentages based on the levels of investment required, i.e. the higher the investment, the higher the percentage incentive offered.

Incentives can come in the form of grants or access to loan funds at favourable rates. Grants can also be made to the nodal or implementing agency. This will enable costs of land and buildings to remain fixed for longer periods, with hikes in prices countered by the grants provided. Grants of this kind may also meet a proportion of the development costs for the site and services.

TABLE 7.14
Procedures for allocating plots

Step	Procedure	Period (weeks)
1.	Submission of application for allotment of plot or shed.	4
2.	Application scrutiny and preliminary screening.	4
3.	Allotment of land or ready-built shed.	2
4.	Documentation and possession of plot or shed.	2

Source: KIADB (2004) and KINFRA (2004).

Implementing agencies (as representatives of the public sector) sometimes cross-subsidize the costs of planning and development either within the separate industrial parks or between groups of parks. For example in Karnataka State, when the area identified for sub-division is being marketed by the KIADB, allotment prices of the plots are normally kept below that of the acquisition cost of the bare land. Bidar District in Karnataka State is one of the least developed areas and was declared a '*no-industrial district (NID)'* under a scheme introduced by the Federal Government of India. This released substantial levels of grant funding for the establishment of a park. In addition, to make up for the poor social infrastructure of the region, investment subsidies were provided. In terms of commercial pricing, plots in parks in areas such as this are frequently sold at a loss to the public purse. However, a financial appraisal of the agency (for example, the KIADB) will be undertaken for a number of different activities (including park establishment) and performance ratified on the basis of cross-subsidization from one sector to another. The losses incurred in a single NID project are less relevant when considered in the context of the economic development of the region (TECSOK, 1983).

There are large numbers of isolated and/or under-developed areas in most developing countries that would qualify as an NID *(as determined by Indian experience).* Herein may be considerable development potential in terms of raw material resources and agro-climatic conditions that will enable crops and livestock to be grown and processed. The introduction of well-designed infrastructure in support of post-production activities may help catalyze socio-economic development in the area. The costs of developing agro-industrial parks *(based on the models discussed herein)* may be high, and it may not always be possible to recover the direct investments required of the park. Choices have to be made by both the public sector and those with the ability to exploit local resources commercially, that the economic benefits to those communities within the area will outweigh the immediate investment required of industrial development.

To keep expenditure on development of infrastructure at reasonable levels and to ensure the availability of adequate raw materials long-term, the choice of location of the park is of crucial importance. It helps if the park is located where infrastructure may already exists – roads, housing, commercial services and similar. Investment levels will be lower and this will enable the industrial plots to be sold at lower cost *(or at best limit the levels of subsidization required).* Table 7.15 illustrates some of the many issues involved with choices of this kind within a spatial cost range of A-I (i.e. high to low, respectively).

Decisions for preferred choice of location are not always taken simply on the basis of the economic factors involved, however, but costs always remain a prime consideration. It helps to have the entire country or state mapped for resources, infrastructure, centres of consumption and/or processing and sale to assist with making choices. For most planners in developing countries, however, the information available will be strictly limited and a preferred choice of location may not always be immediately obvious or immediately available.

TABLE 7.15
Matrix for locating an agro-industrial park

	High infrastructure development index	Medium infrastructure development index	Low infrastructure development index
High existing and high future raw materials development potential.	**A**	**B**	**C**
Medium existing and high future raw materials development potential.	**D**	**E**	**F**
Low existing and high future raw materials development potential.	**G**	**H**	**I**

Source: Laxminarayana Rao (2000)a.

The promotion of agro-industrial parks in industrial or newly industrializing countries requires skilled marketing and access to commercial people who have an understanding of the potential available. These networks of people may already know the main players within regional or national industries, and they are able to follow development trends within those industries that may eventually establish within the park. A number of specialized promotional companies are available in most industrial countries or regions with experience of industrial development of this kind. The same is not always true of developing countries, however, where promotional skills and experience may be strictly limited, and where the public sector continues to have a major responsibility.

It follows that the Ministry of Trade and Commerce or the Ministry of Works and Labour may undertake work of this kind. New park developments in the industrial countries are widely advertised in the specialist journals, on television and in the newspapers – from time of conception through to finalization of facilities. A promotional programme of this kind may cover a number of years. In recent times the Internet has become a popular means of promotion, with dedicated websites established that may provide friendly and detailed information – including access to promotional movies or videotape (Laxminarayana Rao, 2000b).

The entrepreneur can thus explore details of the infrastructure available, prices for land or buildings, incentives offered by governments or park management (i.e. grants, loans, tax exemptions, etc.) and a host of other issues that will enable him/her to make decisions from a computer in the home office. Internet information can be easily and cheaply reviewed from just about any location in the world. Desk studies can be undertaken based on the information provided, and the entrepreneur may be able to plan production runs against a timeline that will enable markets to be exploited long before confirming any preliminary decision to become further involved.

IMPACT OF AN AGRO-INDUSTRIAL PARK ON THE REGION

The impact of an agro-industrial park in support of a producer region is always positive; therein is a *'win-win'* situation for the people, communities and governments involved. There is intellectual and financial wealth to be gained in the organization of many small-scale producers to supply the agro-processors in the park. Wealth creation leads to more socially-secure rural communities, and people are better able to feed themselves, educate themselves and plan for a secure future from the additional employment and incomes that result from the investments that a park brings. There are also gains for the environment with improved management and use of natural resources. People become less exploitive and more responsible where there are long-term issues of socio-economic security involved.

More food available

Whatever the production/processing chain involved, losses are a normal part of all commercial practices and particularly so for food industries. Losses represent waste, and it follows that this represents lost income to the companies or people involved. Most commercial enterprises make efforts to minimize wastes, and handle crops and materials with care. Poor quality or damaged materials are discarded long before they enter the production/processing chain. Much more can be done to reduce losses, however, and choices are normally made on the basis of control and handling methods (and the costs thereof) and the value of the materials being handled. It follows that the higher the incremental value of a product post-treatment, the higher the costs that can be sustained with the care required of handling and storing.

Losses represent inefficiency throughout the production/processing chain prior to point of loss. Preventing the loss of 1 kg of materials at entry to the factory, for example, may be equivalent to 2 kg produced on the farm since, apart from capturing the 1 kg that was produced (and not lost), this quantity will continue into the processing chain and may eventually result in an additional kilogram of food. Levels of loss can be high, however, and much can be done with basic 'house-keeping' to minimize losses. For example, according to estimates in India, 15-25 percent of durable foods and 20-50 percent of perishable foods are lost for want of adequate processing/preserving facilities at point of production (Mokshapathi, 1990).

The establishment of a park may help increase food supplies by augmenting facilities available within an area, by enabling producers to take advantage of alternative outlets for their crops or materials and by making use of crop surpluses. Higher outputs may enable pressure on land to be reduced, and this will provide for more effective use of farm inputs and lead to higher incomes for producers. The flow-on effect will be beneficial to the public purse, with augmentation of subsidies and a more equitable distribution of resources within the rural community. Agricultural production thus becomes more efficient from the more effective use of subsidized inputs. Annual government subsidies on fertilizer in India during 1996-1997, for example, were of the order Rs16 480 million for imported fertilizer and Rs45 000 million for domestic fertilizer - in total Rs61 480 million. It is no longer possible to increase these subsidies, and the development of food conservation and processing facilities in selected parts of the country is one means of extending current benefits. The same arguments hold true for use of land, for in an intensely cultivated countries (of which India is a prime example) access to under-utilized or new lands is no longer practical. Forest cover in India, for example, is already reduced to 11 percent *(and continues to decline in quality).* An area this small is already considered by many to place high ecological risk on the country (FAO, 2000).

Creating employment

Agricultural production dominates the livelihoods of more than 80 percent of the people in most developing countries. Notwithstanding urban developments and the migration of young people from the land, agro-industries are likely to continue to provide employment for the majority of populations in these countries well into the foreseeable future. Agro-industries generate significant levels of employment per unit of investment, and this helps to reduce poverty especially in rural areas. *(It does this by providing facilities with which people find work or by returning more money to rural communities from the sale of crops and livestock).* The agro-food industry in India, for example, accounts for 18 percent of the Indian labour force and almost 20 percent of industrial GDP *(and India is generally credited with being the 12th largest industrial economy in the world).* The location of an agro-industrial park in a rural area will help reduce the exodus of people to urban areas and help prevent the growing social tensions created by congested living conditions in cities. Organized employment programmes of this kind enable people to come to terms with changing socio-economic conditions that may affect their community. Investments of this kind help to avoid the harmful social, environmental and ecological problems that may prevail elsewhere.

Improved food production for domestic consumption and exports

The establishment of an agro-industrial park will provide investment opportunities for the domestic private sector. The park will enable local entrepreneurs to link industry with agricultural producers; to upgrade farm output and to provide the high quality raw materials needed for processing. The direct participation of industry in production (by investing in agriculture) will enable advanced technologies to be introduced with the use of equipment, information, farm inputs and new skills that will further enrich and develop local communities. Work effort will become more rewarding with a reduction in manual effort and the greater use of intellect. Higher yields and sales will result. The work involved is more rewarding and attractive to people. There are issues herein of breaking away from cycles of poverty that people, previously under-developed, are provided with the education and social skills that will enable them to improve themselves and their communities. The situation is a *'win-win'* one, with no detrimental effects to the people, communities, region or country.

Byproducts utilization

Production and processing activities always give rise to the production of wastes, losses and byproducts. Where economies of scale are such that large quantities may be produced, scope may exist for the use of these materials, which then become the raw materials of the next production cycle. Processing and/or sale of agro-industrial by-products are only possible when there is sufficient scale and throughput available. This may enable the economics of production to show profit. Thus the issue of markets becomes important; in effect this is the *'who, where, when and*

at what prices' determinants of commercial development. An agro-industrial park may provide facilities for combining wastes from a number of unit industries for conversion to useful by-products such as fuels, feed or fertilizers. Better returns on wastes can bring down or hold prices for the main products from the factory, and help improve the competitiveness of those products in the market.

Economic development

The development of agro-industrial *potential* within a region will help boost the agriculture *productivity* of that region (and the country at large). Increases in production, employment and income will help improve the overall economy of the region and the social well being of the people who live there. Everyone benefits.

Chapter 8
Summary and conclusions

INTRODUCTION

Successful agricultural production and the long-term security of food supplies come from planning that takes account of changing socio-economic and demographic trends in the focus communities. Herein is a role for the post-production sector to add value to agricultural products, to produce the foods and materials required and to provide the basis for economic growth within rural communities. A viable agro-industrial sector will provide employment and economic security for local people. Increasingly in most developing countries, farm income is being augmented by off-farm employment by both landowners and landless people alike. India is no exception and the country has taken advantage of these trends to seek to boost the role of agro-industries within rural development, to add value to raw materials produced locally and to enhance employment and earnings of rural people. This provides the country with a more varied range of products that can be shipped and sold into both domestic and international markets. It offers promise for long-term rural development.

Agro-industries in India account for an estimated 20 percent of manufacturing value addition to agricultural goods. The country is particularly well equipped with processing facilities when compared to many other rapidly industrializing countries. Primary processing of most food crops is off-farm and factory-based with the use of robust technologies and relatively simple machines and equipment – much of locally-made.

The construction of dedicated estates or parks designed specifically for processing agricultural products is a relatively recent innovation in many developing countries, but investments of this kind have featured in most industrialized countries. Efforts to replicate these developments in the *newly* industrializing countries, however, have thus far been mixed. The location of numbers of agro-processing industries adjacent one-to-the-other can provide for a measure of complementarity with the intermediary products, byproducts or waste materials from the one industry providing the raw materials for the next. A cluster of agro-processing industries sharing similar infrastructure and service facilities has a number of advantages over stand-alone enterprises.

Planning and constructing dedicated parks requires considerable support from the public sector for the provision of ideas, land, investment funds, laws, regulations and/or management. Partnership arrangements between the public sector and local entrepreneurs can be encouraged. This has been the case with the introduction of parks in India during the past 20 years.

There is much to be gained by sharing experience of this kind that others elsewhere can learn from agro-industrial ventures in India. But generalizations of this kind raise issues of extrapolation given the considerable differences that may apply to location, to geography, to domestic economies, and when finding the skilled people, resources and finance required. Ultimately, it is the availability of markets that will determine the extent to which an agro-industrial venture of this kind will be viable in a given environment – and the pace at which they can be developed.

Markets dominate all production and processing activities – worldwide. Planners, investors and entrepreneurs are obliged to explore all aspects of the markets that may apply to the goods and services available from the park – before shifting from feasibility to practical application. No matter that the public sector may encourage and support the development of a park, ultimately, it has to survive in the commercial marketplace. Pragmatism at this stage is essential – that the long-term viability of the park can be assured – wherever it may be located.

This section of the text has attempted to summarize some of the many issues raised, and to draw some general conclusions and recommendations that may apply to the many social and commercial investments opportunities involved. The section links the resource base available to

the markets that can be exploited, and to choices that need to be made by planners and investors. Herein are challenges that need to be met and the support sometimes provided by the public sector, which aims to encourage investment. Investors in Asia have been particularly successful with the development of parks .The lessons learned are briefly summarized for the experience that may be of value elsewhere. A number of logical recommendations are shown in italics. The conclusions and recommendations are in no particular order of priority – all are important.

RAW MATERIAL RESOURCES

Concerned with the raw material base that exists in the areas that will supply the park, with the choice of crops and varieties that should be exploited, and with the practical support provided by the public sector to encourage investment.

(1.) Resources

There are firm advantages for processing agricultural produce at place of origin. Issues arise concerning seasonality of raw materials, availability, competition from other markets, the production of crops of known quality and in quantities that will meet factory gate delivery schedules, and the cost effectiveness of the producer. Farmers also have to make profits. The range of raw materials available to a particular region will largely determine the basis for, and the choice of, industries that will establish in the park.

Contractual arrangements between agricultural producer and processor are essential. With processing linked to firm delivery schedules and known manufacturing costs, the entrepreneur will be well placed to target markets.

The park will succeed financially on the basis of the reliability of the supply of raw materials to the different unit enterprises on-site; and to their respective profitability.

Given the sometimes dominant position of the processor within the supply-delivery chain, a measure of transparency will be essential for access to market information that profit centres are accepted at every node in the chain – and that every business is treated fairly.

The processor may be obliged to provide a measure of leadership, technical information, etc. to the many small-scale producers supplying the processing plant. This will help ensure reliability of supply – of known qualities to firm delivery schedules.

(2.) Choice of crop

Trends in the production of agricultural produce are a useful indicator of potential. It is essential to project trends into the foreseeable future and link them to demographic growth to provide some indication of the flow of raw materials that can provide for industrial processing. Information of this kind will help the industry to grow. Logically the processor will focus upon crops that are grown locally; and where local experience of production is available. New crops should *not* initially be considered, but follow from a period of successful trading in the early years.

The seasonality of supply can be extended with the introduction of suitable varieties, cultivars or similar crops (from the same generic family). This will help eliminate peaks in production (and slumps in market prices, etc.).

Market competition for popular foods will apply at times when production is poor – no matter prior agreements that have been made for supply to the processor. Processors will be obliged to stockpile, to buy from other sources or to curtail production. These issues bring risks to markets for the processed goods concerned.

Newly established industries should be aware of demand for industrial crops from existing processors – oilseed, cotton, cereals, etc. – and not try to compete head-on. Shared resource allocation is logical, with external processors re-locating to the park to take advantage of the improved facilities available.

Additional facilities (such as cold stores) may be required to enable a crop to be stored out-of-season; to augment availability and to enable the processor to extend the period of manufacturing.

(3.) Institutional support

This is normally available from the public sector during the period in which the park is established. Public support will encourage investors, provide funding for services, help to supply

infrastructure, etc. Support of this kind is likely to shift as priorities change, once the park has become established and is trading successfully.

Producers and processors should make effort to establish corporate groups that will best serve their respective industrial interests. This will enable them to promote these interests from a position of relative strength.

A strong management team is required for the park; one that can represent the interests of all participants on site. Where practical, representation should also link to those living and working off-park.

AGRO-INDUSTRIAL CHOICES

Concerned with the level and sophistication of processing required, the equipment that should be used and the constraints that may apply.

(1.) Food processing industries

These should be considered at three levels, viz. *primary*, *secondary* and *tertiary*. A basic constraint of food processing industries in many developing countries is the difficulty of establishing domestic markets for products that have undergone secondary and tertiary processing. Either the technologies are not available or the costs involved will raise the selling prices of finished goods out of the reach of local consumers.

Public support is essential for the establishment of an organized agro-processing industry, including the establishment of dedicated parks. The experience of the Ministry of Food Processing Industries in India should be further examined by others seeking to follow Indian experience. Existing ministerial support from 'Agriculture' or 'Trade and Industries' may not suffice.

Choice of processing and/or products manufactured will depend upon the markets available – and this equates to the demand from consumers for these products, and their ability to purchase them (with sometimes low-average incomes). Thus it is that most agro-processing in developing countries remains at a 'primary' level.

(2.) Processing technologies

The processing technologies required will depend largely upon the products to be manufactured, the costs involved, the quality of goods required and the markets to be exploited. In reality, all choices are cost-linked and based on the added value costs that can be recuperated from sales. A sound choice of plant and technologies will assist with reducing crop losses during times of surplus, but this is firmly linked to markets available for goods and services available from the park.

Local technologies, equipment and plant are always cheaper and easier to service than those purchased from outside the region or country. Quality of manufacture will vary and this may affect the quality of finished goods.

Public sector institutions frequently promote the introduction or use of advanced and/or intermediate technologies, whereas existing or 'indigenous' technologies are frequently sufficient for local markets. A more pragmatic approach is sometimes required – with a shift in technology levels as-and-when the market may determine.

It is illogical to purchase and install advanced equipment or plant that will produce goods that are either not required for the target market or too expensive for consumers. Equally, it is unprofitable to continue with out-dated or inappropriate technologies when modern alternatives are more applicable.

Processing capacity should link to factory delivery and to market demand. For best, modular plant should be purchased that can easily (and cheaply) be upgraded for improved manufacturing, for alternative products or for boosting throughput. Management should work existing plant at maximum capacity; this should include back-up options for access to alternative processing routes should plant or equipment fail.

(3.) Manufacturing scale

Typically, agro-processing industries in developing countries are small-scale and informal. Production may not meet appropriate criteria for quantity or quality sufficient to supply domestic markets. A number of processors on site in the park may provide the critical mass required with which to supply markets; meeting requirements for quantity and quality of production and, importantly, timeliness of delivery. Grouping many small-scale producers into a park will provide for economies of scale.

Scale and production levels are linked to the technologies that apply. There is need to explore options for access to power, replacement parts, technical information, skilled people and similar, before investing in high cost equipment and structures - unless high throughput can be assured. This comes, for example, with shared use of resources.

(4.) Constraints of processing

Urbanization has brought greater demand for foods that can be stored and prepared for the table with minimum effort. The demand for convenience foods is a feature of a typical urban family. This contrasts with many traditional cuisines in many countries, where women in the family may spend several hours collecting and preparing food for the table. Convenience foods, however, require post-production infrastructure that is not always available.

Much of existing plant and equipment is used inefficiently. Factories continue with out-dated equipment and processing systems, and fail to move with the technical shifts required.

Waste in the production-processing chain is typical of agro-industries in all developing countries – and can reach levels of >50 percent of production. This represents a considerable loss of potential to all concerned.

Trends in urbanization will continue and people will increasingly shift from foods prepared in traditional manner to convenience foods, because of the limitations of time and effort required. More processed foods will eventually be eaten by everyone.

Investors are required to balance market demand with the costs of establishing processing plant and/or production centres (for the raw materials required). Timing is crucial that investments are always timely and cost effective.

Sufficient processing capacity should be included when planning new ventures that throughput can be boosted when necessary to meet market demands. There is frequently scope for re-evaluating existing plant to make it more cost efficient – before making new investments. This sometimes relates to location – ensuring that new investments, etc. are made where the raw materials are produced. Similarly, waste in the production-processing chain is intolerable. Investments in waste reduction are frequently more cost-effective than establishing new plant, etc.

MARKETS

Market opportunities will always dominate investment and management decision-making. This is concerned with demand for factories on-site, demand for the choice of common services and facilities provided, and of domestic demand for goods processed in the park.

(1.) Markets for industrial plots/factories

Industrial planners are obliged to estimate the proposed size of the park on the basis of the number of plots and built-up units, and the mix of units per area of land that may be practical. A number of dynamic issues apply including demand from processors, an understanding of existing production and potential production of raw materials from the park catchment areas, and the kind of processing that is required. Trends in production should be considered that factory processing can be expanded to meet market demand.

Market demand and thus park size comes from surveys that should be undertaken as part of the planning process. It is sometimes better to take a cautious approach and to construct the park in stages. Thus it is essential to leave an area of under-developed land adjacent to the park for future expansion. If this does not materialize over a period, the land can be re-directed into alternative use.

Existing companies may not relocate to the park without sufficient encouragement and/or financial assistance. Planners are obliged to consider the extent to which re-location, etc. will be essential to the operational efficiency of the park long-term and, it follows, to the extent of the common services that the park will provide.

The park should contain an appropriate mix of primary, secondary and tertiary processors; that will suit short- to medium-term market exploitation.

(2.) Agro-industrial base

The scope for establishing agro-industries in a given region will depend upon the portfolio of existing agro-industries in the region, and their capacity to cater for the processing requirements of an expanding agro-horticultural production base. Here are trends and markets that will dominate decision-making. An understanding of changing socio-economic trends in the region will be essential.

Planning is a dynamic process. It is essential for the long-term security of the park that sufficient public and/or private sector support is provided to park managers that they are able to re-direct investment accordingly. Issues may arise when relocating companies working outside the park into the park.

(3.) Domestic markets for processed foods

Changing market demand for processed foods is dependent upon the income of local communities. This will be dependent upon the mix of urban and rural populations and the changing dynamics of both sectors. The more urban people in the community the greater the demand for processed foods. There are firm models for the choice of food and non-food expenditure in the average household budget, with the former falling as a proportion of total expenditure as incomes rise.

Export markets are less dependent on changes of this kind but, equally, changes in market demand for the main products available need to be tracked. In this way the park will remain more competitive.

Management of the park are required to keep track of demographic changes in the markets in which the products and services of the park are sold; to enable them to maintain the degree of product/service mix required of manufacturers.

(4.) Commercial infrastructure facilities

All service facilities have potential and value, but planners are required to determine these requirements over set periods of time/phase development that facilities are in place when needed. There is little point in establishing facilities before they are required. Construction later will be more expensive, but it may be that provision of facilities can be undertaken within a private sector investment programme. Facilities may include warehouses, cold stores, fumigating services, testing laboratories, effluent treatment plant, solid waste disposal and power generation.

Timely investment in service facilities will come from planning undertaken before construction of the park and, importantly, within periods of phased development once the park is operational.

PROBLEMS FACED BY AGRO-INDUSTRIES

Concerned with the delivery of materials into the park in known quantities and qualities, and the services and support required of producers to meet acceptable standards of production. Similarly, concerned with the ability of manufacturers to produce to standards that meet the requirements of the importing countries.

(1.) Constraints affecting the growth of agro-food processing

There are many constraints facing agro-industries including **v**olume of crops available, costs of production, low productivity, quality and quantity of supplies, access to appropriate technologies and/or plant, access to services, support from the public sector, availability of sufficient investors, etc.

Again, planning can assist by reducing the impact of the more severe issues that will dominate and/or preclude investment. It is here that the public sector as a promoter of the park has responsibilities. Viability comes from pre-investment surveys and findings, which are then shared within the public domain – that everyone is involved and informed.

(2.) Exporting goods

Export opportunities are only tenable after a period of domestic production when manufacturers have sufficient experience to produce goods of the quality required for exporting. Early entry into export markets can be damaging to markets. Inspection and certification of products at point of dispatch and, in the importing country, at point of entry will be required. Services have to be of sufficient high quality to meet the import requirements, in particularly, of the industrial countries. Food laws will be in place to provide for inspection, grading, packaging, labeling and display.

Export markets are best exploited with a knowledge of market demand, competition within the market for the same goods and, importantly, the production of high quality goods that meet the requirements and/or restrictions of the importing country.

Agro-food processing industries in developing countries are mainly small-scale, and have limited resources available with which to focus upon high quality production. Herein is a major advantage of agro-industrial parks that common facilities for quality control and/or testing will be available to all processors. This will include access to dedicated warehouses and/or cold stores.

(3.) Support for producers

A number of opportunities exist for providing the best varieties of crops and crop care required for processing, but the technical assistance required is normally beyond the immediate responsibility of the food processor. Partnership arrangements are possible with the intervention of the public sector.

Given the importance of links between producer and processor, contracting is a valuable means of providing an outlet for sales of fresh crop, and for delivering known quantities and quality materials at the factory gate. Contracting is a means of linking producers and processors, but difficult to apply where alternative markets for food crops, etc. sometimes exist. Industrial materials are easier to contract.

Technical assistance between the producer and processor is a two-way network, but with the processor normally in the dominant position. The provision of planting materials, crop inputs, equipment and technical information, for example, is essential for the production of high quality farm materials. Joint public sector (government) and private sector (park companies) arrangements are required.

GOVERNMENT SUPPORT POLICIES

The support of the public sector is essential. Government has responsibilities for developing, establishing and enforcing the appropriate policies that will promote and manage agro-industrial development – of which the investment in parks will comprise one part.

(1.) Need for policy support

National planning has to consider the key role of agro-processing for security of income and foods in rural communities and, importantly, the additional value to the national exchequer that comes from processing and adding value within domestic industry. The introduction of a raft of appropriate policies that may reduce risk and provide financial assistance will help channel investments and encourage investors.

Support from government comes in the form of materials development, research, training and extension, infrastructure development, market development and subsidies and investment. The focus is usually one of modernization and/or expanding existing industries and establishing new ones.

Again, planning prior to investment is essential to enable laws, legislation and regulations to be developed and introduced that will enable a park to succeed commercially. This should include support for the services required of the park – water, electricity, waste handling, training skilled people, access to investment finance, etc.

(2.) Agricultural policies

The absence of progressive agricultural policies in many countries has resulted in reduced agricultural production in recent years. This is exemplified by the large areas of public lands that sometimes remains idle including coastal lands, mountain lands, swamplands and inland waters.

Land reform to encourage more cost effective production of materials is crucial that processors are able to participate in the supply of raw materials. This provides for the establishment of industrial producers/out-grower schemes. Land reform in some countries can be highly politicized and fraught with difficulties for making changes that will encourage agro-industries.

Without adequate land reform, the industrialization of agricultural production will be less effective. This will reduce the competitiveness of the park and its financial viability.

(3.) Financial policies

No investment funds - no industries; the messages are simple but difficult to put across at times. The private sector demands low-interest loans or grants, and the public sector is not always prepared to lend without collateral. Thus the new investor may find himself/herself without sufficient funds. Risk can be high, but this can be mitigated with well-designed financial policies.

For nascent industrial developments in a region, incentives should be put into place to encourage entrepreneurs. This may include grants, access to loan funds and exemption from selected taxes. Once up-and-running, however, the new industry should be expected to make all normal financial contributions to the state within an equitable taxation system.

(4.) Export policies

Effort is required to explore export opportunities for those industries that are capable of producing to the standards required of foreign markets. Export policies should be long-term and flexible. They should enable markets to be identified for a range of locally made products over an appropriate time-scale. Much will depend upon industrial confidence within the appropriate markets.

Public sector support is required for establishing policies that will enable goods to be produced that can be sold competitively into foreign markets.

(5.) Science and technology policies

More R&D effort is required to explore indigenous technologies and to adapt innovation to meet processing needs. This is particularly so where imported technologies may be either expensive or inappropriate for domestic use.

Public sector support is required for establishing policies that will enable manufacturers and producers to keep abreast of appropriate R&D innovation.

MODEL AGRO-INDUSTRIAL PARK: FRAMEWORK

The public sector normally has the responsibility for planning, developing and introducing the framework required for park development. Herein the private sector can be expected to invest and flourish. Numerous physical and financial issues are involved including where to site the park, choice of area and make-up, choice of facilities required, park sales, management and promotion recommended and, importantly, the likely impact of the park on its locality. Taken together they comprise the framework required of design and operation within which the park will perform. Herein is the basis for commercial success.

(1.) Park location

Demand for industrial plots in a particular area is a major factor for the establishment of an industrial park. Planners should ensure that demand/support is based on the reality of the potential of the area. A successful park elsewhere will frequently exemplify the opportunities available, but there are risks involved with copying. Planners and designers need to take account of the dynamics of geography, including the location of parks at sufficient distance one-to-the-other that the network is able to flourish commercially. The type, number and sizes of the industries on-site will depend ultimately upon the agro-industrial potential of the area serviced by the park.

Park design will be site-specific. Planners take risks with copycat applications and design. Pre-investment studies are essential to enable the location of a park to be determined with confidence.

(2.) Agro-industrial development potential

The potential of an area is dependent largely upon the inventory of materials produced and trends in production. This will include current prices and trends in prices, fresh market requirements, surplus materials available for processing, and the markets that exist or can be developed for processed goods. Demand for processed goods will depend upon the socio-economic and demographic trends in the region, which will part-determine changing patterns of consumption.

Promotion of the sector and the park brings different opportunities for determining potential, and comes from efforts made to target the industrial community interested in re-locating to the park. This may include the need to conduct demand surveys. A survey is simply means of assisting with decision-making. Choice will ultimately depend upon a mix of socio-economic-technical data, and the levels of risk accepted by investors.

Pre-investment surveys are an essential part of the planning required with which to determine the design of the park and the extent of manufacturing, etc. proposed, and should be undertaken. Survey results should be publicized.

(3.) Park size

The area of the park will depend upon the number of developed plots and ready-made factory units required. The range and extent of common infrastructure that will be constructed will also help determine park size. All local building codes, guidelines and bylaws should be rigidly monitored as part of the planning process. Adequate space is required for raw materials and finished products, offices and laboratories and other facilities. Health, sanitation and security measures should take priority.

Pre-investment studies and surveys are essential, and should be undertaken as part of preliminary investigations into the feasibility of the park. Dialogue with producers and processors will be essential, and should be undertaken.

(4.) Plot mix

Plots will vary in size and number according to client demand, but will normally be within the range 0.15-0.50 ha. Factory shell size and design will vary accordingly**.** Planners will be required to sometimes determine vehicle access and parking requirements that will suit the *average* factory owner on the basis of experience. Layout and planning will depend upon the numbers of plots and ready-built sheds that will be constructed, and the land required for common facilities, roadways, service centres, green areas and similar. Costs of plots will vary with size, position and time of purchase.

Flexibility within the design of the park will be essential during early planning phases. Feedback from potential investors will enable the mix of plots to be established with confidence. Dialogue with producers and processors will be essential, and should be undertaken.

(5.) Common infrastructure facilities

Common infrastructure will include laboratories, warehouses, quarantine, power generation plant, telecommunications, effluent waste treatment and other facilities. These will vary depending on the mix of industries attracted to the park but, without exception, all are *essential* for agro-industrial processing. Costs of the separate facilities can be absorbed at time of construction but operational costs, replacement costs, re-investment, expansion, etc. have to be covered by the companies that relocate on-site. These costs should be considered as additional overheads to in-house production costs.

Motorable roads within the industrial park are essential. All plots will require easy access to on-park services, and vehicles should be able to enter and exit the park without road congestion. Unwanted traffic should be kept out of the park. Roads should be kept within a reasonable pattern that may allow for future development/expansion. Standard size roads with recommended road facilities capable of handling normal freight traffic will be required.

Power demand for the park will depend upon the demand of the separate industrial units and common services on-site. Much of this can be planned, for consumption will be known and utility companies will be familiar with the procedures involved. The commercial interests of park management and investors will be best served by providing adequate services from the outset.

Inadequate facilities will curtail development and will bring risk to processors on-site. Planning prior to investment must take account of both start-up and longer-term requirements for services and facilities.

There is little point in locating a park in a region where power supplies are generally insufficient. A stand-alone power plant can be constructed, but this brings additional complexity and costs.

The park should be located were water is plentiful. Costs should be realistic and processors obliged to pay commercial rates for all water used. Water re-use should be encouraged.

Modern electronic information and communication networks can dramatically enhance the ability of processors to react to the demands of the market, and thus remain competitive. These services must be provided on-site and from Day 1.

Planning is required to restrict unwanted economic development such as unofficial street markets, and demolition, reconstruction and recycling industries, where these may detract from the original 'raison d'être' of the park. A core focus is essential. Facilities should not duplicate those that may be available in commercial areas adjacent to the park. The location of selected facilities within the boundaries of the park can enhance industrial performance.

Zoning should separate polluting and non-polluting industrial sectors within a park, and provide for better working conditions, better control of wastes and more effective use of land, space and air around and within the different industrial units on-site.

(6.) Park management

Experienced management is essential. A management team should be assembled with the competence and skills required. This may initially come from within the public sector, and form part of the planning required for developing the park. Management of service facilities can take different forms but, ultimately, should come within the overall management responsibility of the park.

Without competent and experience managers the park may fail. Managers should be recruited to form a dedicated management structure responsible for, and to, those on site. A professional management team should work full-time, and be accountable to shareholders.

An association of user-industries should be formed to ensure representation of park residents within management of the park and management of facilities. Long-term the park should be managed by the users themselves with the interests of users as a priority. Representation from outsiders – the municipality, ministries and producer groups - is encouraged.

(7.) Economic issues

Cost will depend largely upon the prevailing rates for loans and investment funds available within the country at the time the park is established. Cost can be offset by public sector support. Financial incentives may be provided by the public sector. Size, location, infrastructure, facilities and similar will determine levels of investment funding required. Costs are higher where pioneering effort is required – when a new park is to be established. The same holds true for the many people, companies and industries involve. Costs will be lower where experience is already available. Eventually, the park should become self-financing as public sector finance shifts to new projects. Herein are requirements to ensure that industries attracted into the park will be commercially viable in the long-term.

Market economic factors will ultimately determine the commercial viability of the park. It is not sufficient to provide public sector finance in support of start-up costs without some indication of when and how the park can expect to become financially viable on the basis of the companies that establish there. Confidence comes from attracting investors that have proven track records with manufacturing and selling goods for which buoyant markets are available.

(8.) Park finances

Financial performance is linked to the controlled flow of funds within phased investment during the periods of planning and construction. Much will depend upon access to investment funds from both public and private sector sources and, importantly, the performance of the national or regional economy during this time. More investment funding is available when an economy is perceived to be performing well, and this frequently comes as the result of good governance. Interest rates will be lower. Land is a basic cost that can be passed on to the buyer/tenant within the appropriate land policies that government may enact.

The park will succeed or fail on the basis of the financial support available for investment and function. Financial models should reflect a mix of public and private sector support. These models should be established as part of the pre-investment planning required.

(9.) Promoting the park

Marketing industrial plots and ready-built sheds to entrepreneurs may require a number of industrial campaigns. Without uptake and interest from investors, any new park will not succeed. The quicker the uptake of plots, the quicker the park can integrate into the local economy and become commercially viable.

Promotion and advertising will be an intrinsic part of the pre-investment planning required, and extend into the construction and development phases until all units on-site are sold/rented.

(10.) Selling prices of plots and ready-built factories

Government may be the only real source of expertise and funding available when promoting the park. Agencies sometimes cross-subsidize costs either within a particular project or between projects that may come within their control. This enables costs to be maintained within limits that may appear favourable to investors. Providing a competitive package of land, buildings, facilities and, importantly, access to investment funds at attractive rates is essential. This will initially require vision on the part of the local community, municipality or government but, thereafter, it is the entrepreneur who is required to carry risk.

The quicker plots or factories are sold or rented, the more buoyant cash flow within the financial models that will apply and the more certain the promise of commercial success. The agencies responsible for promoting the park will need to give priority to sales efforts.

(11.) Economic impact of an agro-industrial park on the region

The establishment of an agro-industrial park will bring a measure of economic security to a region. Markets for a range of crops will improve, where processing may augment demand for fresh foods and where losses typical of most post-harvest systems can be minimized. The park may become a focal point for development within a region, thereby attracting further investment *(e.g. in information, people, resources, infrastructure, etc.)* and creating additional wealth. This will filter into the communities are large. The construction of a park helps to change attitudes, and brings greater security to both investors and workers alike. Links to producers become stronger and rural communities throughout the region will benefit. With sound planning, there are *few* negatives involved when establishing a commercially viable agro-industrial park in an agriculturally productive region.

Establish firm linkages between the network of producers, processors and service providers economically dependent upon the park with the trust, transparency and inter-dependency required; ensure that the wealth created is shared. Herein is the basis for the long-term success of the park.

Annex 1
Glossary

The glossary includes some of the many words and phrases commonly applied to agriculture, food processing, agro-industries and agro-industrial development. The explanations provided are those relevant to the context of this text and may (in a few cases) deviate from Standard English usage. Where this applies, a specialized technical dictionary should be consulted. The same approach is recommended where a more specific explanation of the terms and phrases used in agro-industries may be required.

Agriculture	Art or practice of farming, especially of growing crops.
Aseptic packing	Packing food under aseptic conditions; that is free from bacteria that may cause the food to become septic.
Bales	Term used to measure the quantity of cotton; and equal to 170 kg.
Basmati rice	Aromatic rice; especially produced in India.
BOD	Biological oxygen demand. A measure of the oxygen utilized by micro-organisms during oxidation of organic chemicals.
Breakfast cereal	Prepared and/or pre-cooked cereal food normally served for breakfast, for example, corn flakes, rice flakes, etc.
Brine	Solution of salt (NaCl) in water.
Brix	Scale of densities used in the sugar industry. A scale used to measure the concentration of sugars in fruit represents the density corresponding to a pure sugar solution.
Cereal	Any kind of cultivated grass-like plant (typically of graminae spp) the seeds of which are used for food; or plants which are grown to produce food grains.
Chakki	Local equipment used in Indian villages for milling wheat to produce flour or for grinding spices.
Chrysanthemum	Typical and decorative garden plant with large showy and brightly coloured flowers in autumn and early winter in India. A popular plant for cut flower production.
Coarse grains	Term used to define food grains other than rice and wheat.
COD	Chemical oxygen demand of industrial wastewater.
Controlled ripening	Process for uniform ripening of fruits.
Cure	To preserve by smoking, salting or drying (e.g. meat, fish, etc.).
Decorticating	Removing the loose outer shell or bark of food grains or oilseeds such as groundnuts.
Dehulling	Removing the outer shell of a grain or seed such as paddy rice or cottonseed.
Desiccated	Dehydrated; especially desiccated coconut.
Diet	Range of foods and drinks usually taken by a person or a group that may follow traditional customs of eating. Also applies to those following sporting, weigh-loss and/or health eating regimes.
EIA	Environmental impact assessment. A study report assessing the impact of a development project on the surrounding environment.
EMP	Environmental management plan. Prepared for the protection of the environment and follows from a positive EIA.
Factory	Building or group of buildings where goods are processed and/or made. Frequently contains a large selection of equipment.
FAR	Floor area ratio. Total built up area permitted to be constructed in a plot including all floors, as per the local building laws that may

	apply to that area.
Food	Anything that can be eaten or drank. Any substance providing nourishment.
Grain	Small hard seed of cereal plants; especially used for food.
Greenhouse	Building with transparent roof and sides (made of glass or plastic) in which plants can be grown. Normally contains equipment to control the internal atmosphere.
Grocer	Shopkeeper who sells dried, preserved foods and similar products.
Herb	Any one of several kinds of plants from which leaves, seeds, bark or roots are used in medicines. Can be added to foods to improve taste. Herbs can be used fresh or dried for use out of season.
Horticultural	Of, or concerning, horticulture.
Horticulture	Science and practice of growing fruits, flowers and vegetables.
Huller	Machine used for removing the outer coat or husk of food grains such as paddy rice.
IQF	Individually quick-frozen. Fruits and vegetables are individually frozen quickly to enhance their keeping quality over long periods.
Industrial	Of an industry and the people who work in it.
Industry	Factories and services involved with processing and transformation of raw materials into finished goods.
Ketchup	Thick red sour liquid used to give a pleasant taste to food; prepared from tomatoes.
Kharif	Agro-climatic season starting in mid-July and finishing in mid-October in India.
Light industry	Industries which may offer services, servicing, manufacture of light equipment, few products, short production runs, etc.
Malting	Controlled germination process.
Minimum economic capacity	Processing capacities of a plant below which the capacity is not viable economically.
Modified atmosphere storage	Storage where the internal atmosphere is changed to suit the commodity being stored, so that it remains fresh for longer periods of time. Alternatively, controlled atmosphere to control rates of ripening.
Papad	Condiment native to Asia especially India, and produced from cereals and pulses.
Pickle	Foods preserved in pickled form, i.e. in vinegar or saline water. Including vegetables, fruits, etc. which have been pickled.
Plant quarantine	Isolation or restrictions placed on commodities suspected of, or inspected for, infection.
Plot coverage	Ground area permitted to be covered by civil structures under local building laws, and expressed as a percentage of the total area of the plot in which the civil structure will be built.
Plot mix	Number of plots of different sizes that will comprise the industrial estate or park. Plots offered for sale, lease or rent.
Poha	Tradition Indian breakfast cereal prepared by flaking rice.
Population	Number of people living in a place, viz. city, state, country, etc.
Primary processing	Sequence of first chemical/physical reactions required of processing, for example, removal of outer husk from paddy rice; or washing and drying to make food ready for cooking in the kitchen. Followed by secondary processing.
Processing	Act, especially in industry, of passing materials through a sequence of activities to produce a finished object, product, etc.
Pulse	Seeds of selected legume plants such as beans, peas and lentils. Used as food.

Rabi	Agro-climatic season starting from October in India.
Refinery	Building, plant and machinery used for the purification of vegetable oils, sugar, etc.
Salmonella	Pathogenic bacteria present in foods.
Service industry	Industry that provides services to primary manufacturers such as transport, insurance, logistics, storage and others that are described as 'secondary'.
Set back	Minimum distance between the boundary of the plot and the main buildings located on the plot. Perimeter boundary zone. Essential part of a building plot.
Shelf life	Amount of time a fresh or processed food item can be safely stored without risk of spoilage.
Smoked	Foods dried and preserved by hanging in the smoke rising from wood fires. Treatment given to meats and fish to impart flavour.
Staple	Main food or product of a country, people, region, etc.
Statutory minimum price	Price fixed by local governments for the purchase of agricultural produce from farmers or traders.
Storm water drains	Open channel constructed on either side of a roadway or across land; normally to carry rainwater discharge to prevent flooding.
Technology	Practical uses of the discoveries of science, especially in industry.
Tissue culture	Technique to produce planting materials using healthy plant cells.
Vermicelli	Pasta made into long slender threads like spaghetti, but much thinner; often added to soup.
Vermiculture bio-technology	Technology for converting agri-food waste into organic materials for use as an organic fertilizer; using earthworms
Wholesome	Of food, good for the body.

Annex 2
Case study: agro-industrial park Karnataka State India

An agro-industrial park is currently being constructed in the Bijapur District of Karnataka State within a scheme implemented by the Government of India. The scheme is entitled "Integrated Infrastructure Development including Technological Backup Services for Small-Scale Industries in Backward/Rural Areas". Information describing the project provides a useful model for others considering similar developments. A brief overview of the Bijapur District Agro-Industrial Park is described in this annex.

LOCATION

The park is located at Aliyabad Village, Bijapur Taluk in Bijapur District. When completed is will extend over an area of 34 ha. The site is 3 km from Bijapur Town and adjacent to the existing Mahalbhagyat Industrial Area. Thus the park will essentially be an extension to an existing industrial estate.

FEATURES OF THE AREA

Bijapur District has considerable industrial culture and a working population that is experienced with industrial development and practices. There are good resources and infrastructure available and a resilient and well focused private sector. Many agro-industries were already established in the town at the time that the park was proposed including oilseed processing, cotton ginning, food processing and agro-horticultural service industries. The district is predominantly agrarian and the major agriculture crops grown are listed in Table A2.1.

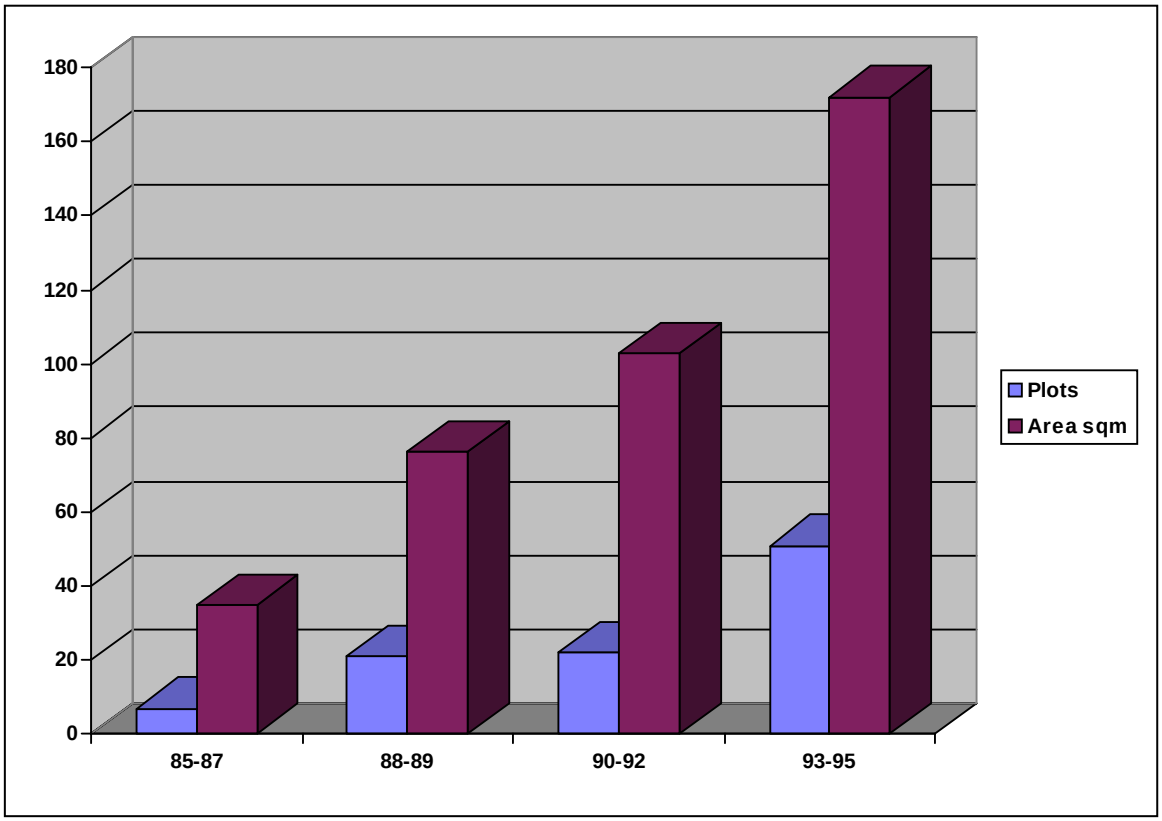
The population of Bijapur urban area was estimated at 200 000 in the mid-1990s with a literacy rate of 65 percent (i.e. higher than the national average). The existing industrial area covered 81 ha and comprised a mix of agro-processing (i.e. oil mills, oil refining, cotton ginning, etc.), light engineering, heavy metal industries and services. There were 101 small-scale and 35 medium- scale industries officially on site (although figures/units are not easily defined given the degree of sub-contracting and different ownership arrangements that have evolved over the years). The estate was developed by the Karnataka Industrial Areas Development Board (KIADB), which was able to sell all the plots available over a period of 10 years beginning 1985. This 10 year period also included the planning required of the proposed agro-industries park. Sales of plots per year are shown in Figure A2. 1 (TECSOK, 1998b).

TABLE A2.1
Production major agricultural crops in Bijapur District

Sl.no.	Crops	Production (t)
	Major crops are shown in brackets	**Average production (1993–1996)**
1.	Cereals and minor millets (rice, jowar, bajra, maize and wheat).	640 990
2.	Pulses (tur, horsegram, greengram and Bengal gram).	50 000
3.	Oilseeds (groundnuts, sunflower, safflower and soyabean).	210 000
4.	Cotton	22 000
5.	Sugarcane	5 000 000
6.	Spices (onions, chilly, garlic and turmeric).	130 000
7.	Fruits and vegetables (banana, grapes, guava, sapota and tomatoes).	88 000

Source: TECSOK (1998)b.

FIGURE A2.1
Sale of plots to small-scale industries in Mahalbhagyat Industrial Area



Demand for plots has been increasing progressively over the years as experience of the estate has grown within the community. Of the estimated 136 industries on site 66 units were for agro-food processing, six units process cotton and 12 units provide supporting services such as packaging and transport.

Bijapur Town has considerable academic and technical resources including an engineering college, medical college, polytechnic institute and a number of schools and other colleges that provide primary and secondary education. The town contains the district administration, and has good infrastructure and reliable trading and banking services. It is well placed within a network of national highways (mainly linked into NH-13), state highways and district roads, which provide fast and reliable transport throughout the state and the country.

INCENTIVES AVAILABLE TO AGRO-INDUSTRIES

Incentives have played an important role with the success of the existing industrial estate and are expected to do the same for the proposed new park. Incentives for the park will be expected to provide 30 percent (Rs2.5 million maximum) as an investment subsidy (limited to promoters' contributions) and 100 percent sales tax exemption over a period of six years. Alternatively, deferred payment of sales tax is likely for a period of eight years (*with a maximum value limited to investment levels of fixed assets*).

LAND USE PATTERN

The agro-industrial park will comprise 117 commercial plots in an area of 27 ha, 3.23 km of roads occupying 6 ha and 1 ha of land reserved for the development of common facilities. The plot mix is expected to be as shown in Table A2.2.

COMMON FACILITIES PROPOSED

These follow the industrial pattern described in chapter 7 and will include an effluent treatment plant, a building of area 470 m^2 (for housing the post office, dispensary, bank, government offices and similar), a commercial centre for shops, agencies, business centre, STD/ISTD telephone booths, etc., two stores containing 232 m^2 covered space and parking, transportation and similar facilities. A separate cold store will be established as a joint commercial venture with co-operative/private sector investors. A convention hall of 232 m^2 (comprising reception, meeting halls and guest facilities) will also be provided to enable local industrial groups to hold meetings, exhibitions, seminars, training programmes and similar activities. A guesthouse/hotel and catering unit may be attached depending upon the interest shown and the success of the convention hall.

POWER, WATER AND TELECOMMUNICATION FACILITIES

A suitable network of transformers and distribution lines will provide the power required on site based on incoming 11 kVA transmission lines. Power demand is estimated at 2 550 kW. Water will be reticulated throughout the park with a number of tube wells sunk and a pipe network capable of providing an estimated 700 m^3/day. On-site storage will comprise 4.5 m^3 subterranean tanks and 4.5 m^3 overhead tanks.

ENVIRONMENTAL PROTECTION MEASURES

Trees will be planted throughout the park. This will include avenues lining the roads in the park, around the main buildings and along perimeter boundaries. A common effluent treatment plant (CETP) is proposed, which will be managed jointly by the nodal agency and the occupants of the sites. The CETP will be landscaped, grassed and screened by trees.

PROJECT COSTS AND SOURCES OF FINANCE

The estimated cost of the agro-industrial park at 1996 prices is shown in Table A2.3 together with proposed sources of finance.

TABLE A2.2

Area of plots proposed for the agro-industrial park

Sl. no.	Plot size (m^2)	Number plots	Total area (m^2)*
1.	1 012	36	36 432 [13.65]
2.	2 024	45	91 080 [34.10]
3.	3 036	7	21 252 [7.95]
4.	4 048	28	113 344 [42.45]
5.	5 061	1	5 061[1.85]

Source: TECSOK (1998)b. * Note: Figures in parenthesis are the percent total area occupied by the 117 plots.

TABLE A2.3

Costs of establishing the agro-industrial park and sources of finance

Costs (Rs million)		
1.	Acquisition cost of land for the project (34 ha).	10.40
2.	Cost of developing land and infrastructure.	45.16
3.	Preliminary and administrative expenses.	3.73
4.	Provision for cost over-runs, etc.	5.56
	Total cost of agro-industrial park	**64.85**

Finance (Rs million)		
1.	Grant from the state government for acquisition of land.	11.45
2.	Grant from the government under IID scheme.	20.00
3.	Internal generation funds during implementation period.	3.40
4.	Term loan from Small Industry Development Bank of India.	30.00
	Total source of finance	**64.85**

Source: KIADB (2002).

ALLOTMENT PRICES OF PLOTS TO INDUSTRIES

Plots are being allotted to industries on a lease-cum-sale basis over a period of 10 years. The allotment price will be Rs168/m^2 when sales begin and will be increased each year to cover financing costs and overheads. The incremental increase will be Rs10/m^2 per year for any unsold plots until all plots are sold. The built-up areas will be rented at a rate of Rs450/m^2 increasing to Rs510/m^2 by the fifth year.

PROJECT COST RECOVERY

Proposals have been made to recover 73 percent of the grants and 100 percent of the loans (with interest) through sale of plots and rentals during a period of seven years.

EXPECTED IMPACT OF THE PROJECT

The new agro-industrial park will augment the facilities of the existing industrial estate at Mahalbhagyat. The creation of more infrastructural facilities in the form of warehouses, cold stores, common effluent treatment plant, testing facilities, convention centre and similar should encourage a buoyant and mixed interest for units. This will come from primary processors through to entrepreneurs responsible for more sophisticated food processing industries. This, it is hoped, will further boost agriculture and horticulture production in the district. The additional facilities should also help to conserve the large quantities of crops produced in the district, and further help to reduce levels of waste that are a feature of post-harvesting locally *(when markets for most surplus crops are strictly limited)*. The district and the services in Bijapur Town will benefit from the value addition that will flow from crop processing with more employment opportunities for working people.

PRESENT STATUS OF THE PROJECT

The park is in advanced stage of development and the industrial plots were ready for allocation during 2000. Two years later as of mid-2002, 73 ha of developed land had been allotted to 119 industries.

Annex 3
Agro-processing industries in developing countries

Food processing industries can be considered within three categories, viz. *primary* - those that involve the basic processing of natural produce, for example, cleaning, grading and dehusking; *secondary* – those that include simple or elementary modification of natural produce, for example, hydrogenation of edible oils; and *tertiary* – those that include some form of advanced modification to the natural produce, for example, to make it ready to eat (tomatoes into ketchup and/or dairy products into ice cream are two familiar examples).

A crucial and rather basic constraint facing many food-processing industries in developing countries is the difficulty of creating local markets for products that may come within secondary and tertiary categories. Most people may simply not be able to afford to pay the costs of the additional added value involved. The concept of purchasing power parity (PPP) is important when planning for industrial development. For example, a country with a *per capita* income of US$1 000/annum (on a PPP basis) may only be able to support a pre-primary food processing industry. A second country with a *per capita* income in the range US$1 000-5 000/annum may be able to support a primary processing industry. Whereas those countries with a *per capita* income of US$5 000-10 000/annum can be expected to support secondary and tertiary food processing industries. Considering that only a small part of the population in most developing countries may have an income in excess of US$5 000/annum, secondary and tertiary food processing industries will have access at best to *small* markets (and, in some cases, only to *niche* markets). These may not be sufficient to enable an industrial unit to remain profitable.

Per capita income in India is about US$1 200/annum. The population of India is more than one billion, of which about 220 million people can be considered 'middle class'. *Per capita* income, however, is strictly limited and does exceed US$5 000/annum. Thus the food industry in a large country such as India is likely to remain essentially with primary processing (such as milling grain and packaging flour, or producing edible oils), with imports providing for those foods that have been subjected to more advanced processing. The issues involved are rather more complex than this, however, and most countries (India included) have industrial development planning underway to provide for a range of foods that may best serve urban communities, notwithstanding low profitability.

AGRO-FOOD PROCESSING INDUSTRIES IN INDIA

Although the contribution that agriculture makes to domestic GDP in India has fallen (from 40 percent in 1980-1981 to <30 percent in 1995/96), agriculture continues to provide direct employment for an estimated 70 percent of the population. More than 75 percent of Indian people continue to live in rural areas. The Indian Government is committed to supporting the socio-economic development of rural areas, to provide for stability within the country and to reduce (or to slow down as best they can) the ever-increasing migration of people to urban centres in search of improved economic welfare for their families. Much of this commitment is directed to providing better living conditions for rural people and, importantly, to providing more opportunities for rural people to earn higher incomes. Herein food processing and other agro-based industries have a key role. Adding value to raw materials creates employment for trading, services, manufacturing and sales. Much of this can be undertaken at point of production. The additional income is characterized by higher prices to farmers/producers, and filters into the wider community of people who remain in rural areas. These are people who may have limited or no access to land. India is typical of many developing countries where, for example, up to 75 percent of the people may be landless (and thus have only their labour to sell). Investments in rural development help foster agro-industrialization. There are few losers in developments of this kind,

particularly if due consideration is given to environmental sensitivity, that issues of sustainability are recognised and followed from the outset.

Industrialization brings responsibilities on the part of the public sector and the entrepreneurs involved, for example, to ensure that people are not exploited, that commitments made are long-term and that waste materials are either recycled or disposed of in an acceptable manner. The agro-industrial sector is recognised as having an important role with improving agriculture productivity, for reducing waste at point of production *(particularly of fruits, vegetables and other perishable foods)*, of providing a measure of food security with more food provided to domestic markets, and of boosting earnings that may come from exports.

Food processing industry profile

A dedicated Ministry of Food Processing Industries (MFPI) was established in India in July 1988 to help promote the development of the sector. Although in an early stage of development the domestic food processing sector makes up 14 percent of total GDP manufacturing and has a products value of the order Rs2 800 billion. It employs an estimated 13 million people, with opportunities to employ >30 million with more focus upon added value. During the past 10 years the sector has grown by >7 percent annually. This is a considerably higher rate of growth than that of agricultural production, and is one indication of the increased availability of surpluses, higher disposable incomes and changing life styles and tastes in the country. Growth rates are projected to further increase during the next period (MFPI, 2000). Estimates of growth are significantly higher than those provided in 2000 by CIFTI (2001).

As part of the strategy to provide improved food processing infrastructure, the MFPI has been pursuing the task of setting up of food parks in different parts of the country. Reasoning suggests that small- and medium-scale entrepreneurs find it difficult to invest in capital intensive facilities such as cold stores, warehouses, quality control laboratories, effluent treatment plants, etc. and benefit from external assistance. Assistance of this kind can make a cluster of food processing units in food parks more cost effective, and provide for better market exploitation. As of 2003, the MFPI has sanctioned 36 food parks for construction. The MFPI has also approved 41 agro-export zones (AEZ) in the country, which will enable industry to centre investment upon a particular product located in a contiguous area. Focus of this kind has provided an incentive for developing and sourcing raw materials, and helped to establish the processing and packaging facilities required to meet the needs of exporters. The MFPI *(together with the Agriculture and Processed Food Exports Development Authority -APEDA)* is coordinating efforts to capture the synergies that may develop between food parks and the AEZs. (See TECSOK, 1998a).

The food processing industry in India is made up of three groups, viz. (a) primary food processors, (b) informal and/or cottage-scale industries, and (c) formal and/or large-scale processing food industries. Industry can be cross categorized into a number of sectors such as grain processing, meat and poultry processing, milk and milk products, fish processing and consumer food industries. The present status of grain milling, fruit and vegetable processing and oil seed processing sectors is as follows.

(1.) Grain processing

Primary grain processing has substantial capacity in the country (i.e. 185 Mt rice and 17 Mt wheat). In addition there are a number of pulse milling and oil expelling units. Grain processing is the largest component of the food sector and comprises > 40 percent of the sector by total value. One basic feature is the predominance of the primary processing sector (96 percent by value) when compared to the value of secondary and tertiary sectors (4 percent). The rice mill sector contains more than 90 000 traditional hullers *(all of which require modernisation)*, 8 385 huller-shellers and 35 088 modern mills as shown in Table 3.1 (MFPI, 2004)a.

TABLE A3.1
Growth of modern rice mills

Year	1993	1995	1996	1997	1998	1999	2001	2002	2003
No.	32 969	34 113	34 688	34 688	34 688	35 088	35 088	35 088	35 088

Sources: MOA (2001) and MFPI (2004)a.

In the wheat milling sector the number of modern roller mills had decreased from 800 in 1995 to 516 six years later. Combined capacity of roller mills is currently 19.5 Mt and production is 12.5 Mt, with utilization of the order 60 percent. Overall capacity utilization in the grain-milling sector was <55 percent during 2002/03 was <55 percent. India has an estimated 10 000 pulse mills with a combined capacity of 14 Mt.

(2.) Vegetable oils

The sector comprises oil seed crushing, solvent extraction, oil refineries and vanaspathi units. Sufficient capacity is available to meet current needs given the low levels of utilization (see Table A3.2). During 2001/02 India produced 21.16 Mt of oil seeds from which 6.3 Mt of edible oil was produced. Domestic demand for edible oil was augmented by imports.

(3.) Fruits and vegetables

The installed capacity of the fruits and vegetables processing industry has increased in recent years. The capacity of the industry, excluding sun dried and fried fruits and vegetables, increased from 710 000 tonnes in 1990 to 2.33 Mt in 2003/04. Installed capacity has tripled in the last 13 years and production has increased four times. (See Table A3.3.)

(4.) Milk and milk products

India is currently the largest milk producer in the world with production estimated at 75 Mt. Consumption of liquid milk accounts for 46 percent of production with the remaining 54 percent used for manufacturing. The formal sector has an estimated 10 percent of domestic production. Production of milk products is increasing by 5 percent annually to meet demand. Manufactured products include ghee, butter, cheese, ice cream, milk powder, malted milk foods, condensed milk, infant food, etc. Ghee dominates the sector comprising 85 percent of all processed milk foods (MFPI, 2003).

(5.) Consumer products

These include manufacturers of products such as confectionery, chocolates, cocoa products, soya products, ready-to-eat foods, mineral water, soft drinks, high protein foods, etc. Among the consumer industries, soft drinks enjoy the largest share. Aerated soft drinks industries have a portfolio of >100 plants in India. The production of soft drinks increased from 5 670 million bottles in 1998/99 to >6 600 million bottles in 2001/02. (MFPI, 2004)b.

TABLE A3.2
Capacity and utilization of oil mills

Vegetable oil industry	No. of Units	Installed capacity (Mt/year)	Capacity utilisation (%)
Oilseed crushing units.	150 000	42.5 (in terms of seed).	10–30
Solvent extraction units.	742	35.6 (in terms of oil bearing material).	46
Refineries attached to vanaspathi units.	100	1.8 (in terms of oil).	30
Refineries attached to solvent extraction plants.	300	2.5 (in terms of oil).	35
Vanaspathi units.	230	5.9 (in terms of vegetable oil production).	41

Source: SEAI (2004).

TABLE A3.3
Capacity of fruits and vegetables processing sector (Mt)

Detail	1990	1997	1998	1999	2000	2001	2002	2003
No. of units	-	4 932	5 112	5 198	-	-	-	-
Capacity	0.71	1.91	2.04	2.08	2.10	2.11	2.20	2.33
Production	0.25	0.96	0.91	0.94	0.98	0.99	1.03	n/a
Capacity/use	34.50	50.26	44.60	45.20	46.67	46.92	46.82	-

Sources: MFPI (2003) and CIFTI (2003).

Status small-scale food processing industries and prospects for processed foods

The small-scale food processor dominates the sector, and is obliged to work within a severely restricted resource base and to keep pace with the changing demand of domestic and export markets.

(1.) Resource base

The largest number of food processing units in the country is found in the small-scale sector. Small-scale manufacturers contribute substantially to the economy with the rice milling industry leading domestic markets and textiles, garments and clothing providing strong exports. According to the third all-India census of small-scale industries (SSI) conducted in 2001/02, the sector comprised 2 262 401 registered SSIs and 9 146 216 informal SSIs. Of the total registered SSIs, 61 percent were operational at the time of the census (DCSSI, 2004).

Most commercial food processing is undertaken in the informal sector. Traditionally the choice of foods differs from region to region, and most informal units cater to local needs. The 2001/02 census described minimum 19 different segments of food processing, viz. flour mills, rice mills, atta processing, vegetable oil processing, oil crushing, bakery, bread, rice raw (atap), biscuit and cookies, cereal preparations, coconut processing, dhall (pulses) milling, rice preparation, ayurvedic and unani medicines, groundnut oil processing, maida (refined wheat flour) preparation, parboiled rice, spices and rice powder preparation. The census noted that of the total number of SSIs, flour milling ranked 5th, rice milling 8th, atta preparation 12th and mustard oil processing 15th (DCSSI, 2004).

Total output of registered SSI units in 2001/02 was estimated at Rs7 086.173 million, while that of the total sector consisting of both registered and informal units was correspondingly higher. Rice milling dominated the sector with an annual gross output of Rs540.173 million. Mustard oil processing ranked third with a gross output of Rs192.019 million, dhall (pulses) mills ranked eighth (Rs165.28 million), parboiled rice preparation ranked ninth (Rs155.593 million), biri units ranked 12th (Rs143.016 million) and atta 15th (Rs132.753 million) (DCSSI, 2004).

The SSI sector employed 24 932 763 people at the time of the 2002/02 census. More than 95 percent of SSI units had proprietary ownership. Entrepreneurs from socially disadvantaged groups owned/worked in 56 percent of SSI units. The number of SSI enterprises managed by women was 995 141, representing <10 percent. The total number of women employees in the SSI sector was estimated at 3 317 496. About 58 percent of women employees were from units located in Tamil Nadu, Kerala, Karnataka, West Bengal and Andhra Pradesh States. Rice mills ranked fourth for providing employment with 117 250 workers at the time of the census. Flour mills ranked 12th and employed 69 479 people. Atta units ranked 21st with 34 222 workers (DCSSI, 2004).

The census showed that 50 606 SSI units exported goods with a value of Rs14 199.560 million. The value of exports, however, was only five percent of gross output. Registered SSI units accounted for 87 percent of exports. Prawn production ranked 6th with exports valued at Rs368.170 million. Cashew nuts ranked 7th with export value of Rs285.460 million, frozen fish units ranked 14th with an export value of Rs171.730 million and food units ranked 16th with export value of Rs157.580 million.

A large part of the Indian food processing industry is small-scale and cottage-based. Government has encouraged the development of cooperatives in sectors such as processing and marketing of fruits and vegetables, dairy products and fisheries, in an effort to provide assistance to small processors. This – it is hoped - will enable them to reach some measure of critical mass.

A significant number of large-scale Indian and multinational groups also have a strong presence in these sectors, and make a significant contribution to national development. Competition for the small-scale processor can sometimes be severe.

Major constraints to the development of food processing industries remain:

1. High costs of raw materials (due to low yields) and wide variation in the quality of raw materials produced by smallholders.
2. Inadequate and/or expensive refrigeration facilities required for storage.
3. Inadequate transport and distribution systems.
4. Lack of proper infrastructure.
5. Limited availability and high cost of good quality packaging equipment.
6. Outdated processing technologies - and an inability to keep pace with technical change.
7. Access to information – of all kinds.

The situation *is* changing, however, and it *is* possible for the determined entrepreneur to overcome many of these constraints in the current industrial environment. For example, constraints of low yield and variations in quality of raw materials have been successfully challenged through the introduction and development of contract farming (i.e. *managed* and *organised* smallholder farming). Similarly, the importation of capital goods (such as packaging equipment) into the country is now freely encouraged. Earlier restrictions have been lifted and support for domestic manufacturers has changed to enable them to keep abreast of new innovation. Technological developments (including foreign purchasing and imports) have been liberalized. Foreign investment is widely encouraged. Changes of this kind have opened the way for more rapid growth in the sector.

While primary processing normally involves the use of traditional skills and simple technologies, different levels of sophistication have been introduced and used for secondary and tertiary processing. It is significant to note, however, that about 80 percent of value addition with most products normally occurs at the primary processing stage. Considerable scope exists for expanding value addition within secondary and tertiary processing stages. Following consumption trends in the industrial countries, it seems likely that greater quantities of processed foods will be required in *all* developing countries in the foreseeable future, as similar socio-economic changes take place in the way people live and work.

(2.) Domestic tastes

In spite of the somewhat rigid nature of the culinary habits of the traditional Indian family, changes in patterns of consumption of convenience foods have occured in recent years. Indian families have always been fastidious with demand for fresh foods. These presented difficult socio-cultural barriers when introducing processed foods during the 1950s and 1960s. Tourism, better access to information, the introduction of fast-food industries and migration from rural centres to the main towns brought many changes from the 1970s on. Notwithstanding initial consumer resistance (and limited incomes), a variety of new foods have been widely adopted. Much of this development has been linked to the liberation of young people from the sometimes entrenched traditional attitudes of their parents. Indian society is no longer constrained by the past, and attitudes to food simply reflect changing norms in society as the country keeps pace with the rest of the world – much to the delight of the consumer.

The average Indian currently spends 53 percent of his/her income on food. Prior to the 1980s most of the food processed in the formal sector was based on the western palate, i.e. bread, biscuits, squash beverages, jams, canned food, breakfast cereals and similar products. But the 1980s have seen a quantum change in direction for the domestic food processing industry. New technologies and better methods of packaging have been introduced. There is greater understanding of the way in which foods can be prepared to cater for the local palate, and this has resulted in widespread processing of traditional Indian foods to meet domestic requirements. Markets have expanded and now include demand for foods such as pasta products, extruded

foods, ready-to-serve beverages in disposable packs, juices and milk products in aseptic packs, instant mixes, varieties of ready-to-eat products, frozen foods and many more.

Demand patterns for processed foods have changed in India and most other developing countries in recent times – and continue to change. The reasons are many:

- Rapid urbanisation and growth of cities have brought new demands on the food industry. Changing life styles have contributed to a virtual boom in certain types of processed foods. With improved communications and transport into cities, rural populations have become better informed and more adaptable (*susceptible?)* to urban patterns of consumption.
- Increased literacy has lead to more people becoming conscious of good nutrition and the importance of a balanced diet – particularly for children. This is resulting in increased demand for special foods for infants, growing children, convalescing patients, invalids, the elderly and others with special dietary needs (such as diabetics).
- An increase in working women outside the home has resulted in high demand for convenience foods, and those that can be prepared with minimum time and effort in the family home at the end of the day.
- Advertising is having its own impact on the consumption pattern of many people and remains responsible for changing food habits, particularly amongst the young.

(3.) Exports

Given the huge potential for manufacturing processed food products and limited domestic markets, efforts to boost exports are essential. Exports have been limited in recent years, however, as shown in Table A3.4 with a rise of only eight percent during the five year period from 1998. The reasons are many, but lower unit value is one reason for slow growth for sales of pulses, animal products, spirits, beverages, dairy products, processed fruits and fruit juices.

TECHNOLOGY PROFILE OF AGRO-FOOD INDUSTRIES IN DEVELOPING COUNTRIES

Current status of technologies in food industries

There is a huge market for processed foods waiting to be recognized and developed in most societies – and India is no exception. Traditional practices and choices with foods have always been dynamic and have changed with access to new crops, to new technologies and to increased household income. In this respect, people in developing countries are no different from those in the industrial countries. However, the types of processed foods found on the market frequently come with the introduction of new technologies *(and access to the plant and equipment with which to produce these foods)*. High quality production is essential to meet the demands of middle-income people. In Africa, for example, few agricultural commodities are processed. This includes food and non-food products such as cotton (52 percent processed), oilseeds (40 percent), fish (20 percent), and fruits and vegetables (15 percent). Other crops such as millet, tubers, fruits and milk *are* also processed, but to a limited extent. (Ali-Dinar, Ali B., 1995). *(There are generalisations herein that belie the wider variation between the more industrialized African countries and those that remain poor, and this brings a measure of context into consideration).*

Until recently, trends in food processing in the rapidly industrializing countries such as India were much the same. A major issue has been the availability of appropriate technologies and access to reasonably priced plant and equipment. These require substantial investment. Expenditure on research and development (R&D) for the food sector is a key indicator of the status of technological development in a country. In India, for example, expenditure on R&D in support of the food sector is estimated at just one percent of total domestic R&D expenditure for *all* industrial sectors in the country. This, notwithstanding increased expenditure in R&D, has increased of the order 20-fold since independence in 1947. Much, however, remains to be done to match investment levels with the requirements of R&D for the food industries of modern India.

TABLE A3.4
Export of processed foods from India (Rs million)

Item	1998/99	1999/00	2000/01	2001/02	2002/03
Processed fruits and vegetables	7 056	9 936	13 455	11 006	14 000
Animal products	8 517	9 050	16 371	15 009	17 500
Other processed foods	11 345	14 944	17 980	17 801	16 000
Rice	62 794	31 258	29 433	31 730	37 500
Walnuts	689	605	1 099	1 180	1 000
Marine products	46 268	51 166	64 438	59 571	60 000
Totals	136 669	116 959	142 776	136 297	146 000

Source: MFPI (2004)a.

The technological and R&D needs of the agro-food processing sector in India are mainly undertaken by one of a number of public sector institutions including the CSIR, ICAR, DRDO and KVIC. The CFTRI, Mysore in Karnataka State (part of the CSIR) is the premier research institution of its kind in the country. The services offered by these institutions vary and include indigenous technologies development, technology transfer, technology assessment, technology selection, information exchange and a host of others. There are also a few privately funded institutions recognised by the Department of Scientific and Industrial Research (DSIR). These are primarily in-house facilities created by the respective industries themselves and servicing their own specific industrial requirements. Much of this work remains confidential to the industry or company concerned.

Indian food industries can be categorized into five types on the basis of technological dependence:

1. Industries based on imported plant and machinery, where indigenization may be limited to product formulation.
2. Industries based on imported technologies, where plants based on a mix of imported and indigenous technologies are working satisfactorily.
3. Similar units, but with plants based on the use of indigenous technologies that are working successfully.
4. Industries that rely wholly on domestic technologies and locally made plant and equipment.
5. Indigenous technologies developed, but with a downstream industry that is not well established.
6. Traditional cottage-scale/home-scale industries with limited technological demand and typical low productivity.

Foods such as pastry products, paneer-like textured meat products, freeze-dried coffee, freeze-dried shrimps, and individually quick frozen (IQF) fish, fruits and vegetables are completely dependent on imported technologies, plant and equipment. This contrasts with other products such as dry-salted fish, pickles, butter, ghee, spice powders, curry powders and deep-fried potato chips, which are largely based on indigenous technologies, plant and equipment. Much of this equipment is manufactured locally to cater for a range of production scales.

Selection of appropriate technologies for food processing

The selection of an appropriate technology for a specific food processing industry ultimately depends upon the product manufactured, access to the technology required, quality requirements, market constraints and similar. (See Figures A3.1, A3.2, A3.3) Once the market into which the final product will be sold has been identified, most of the other parameters that will govern choice quickly become apparent. Much will also depend upon the nature of the new food and its similarity with what may already be available. For example, trying to introduce a new product that is completely different from existing foods may involve high commercial risk. Take breakfast cereals, for example. The manufacture of poha (flaked rice) is a typical cottage-scale industry in

many parts of India. The processes involved are relatively simple and low-cost and the food is popular.

Compare this with the introduction of more sophisticated breakfast cereals such as those with different fruits, spicy flavours and tastes, and based on maize, wheat or rice as the main raw material. Markets herein can be successful only if these foods are sold mainly to the middle classes and/or the urban dweller *(and usually those with an income >US$5 000/year).* Alternatively, the food should be manufactured mainly for export. Export markets are important – targeting the expatriate Indian or emigrant, and others. Even products such as canned fruits and vegetables manufactured in the newly industrializing countries (such as India) are normally market-specific. They are meant primarily for export or for sale to high value niche domestic markets such as tourist or business hotels and flight kitchens. However, for a large country with significant growth potential in these sectors niche markets of this kind are an important means of exploring new products.

The manufacturing technologies involved have to be cost effective, particularly if the product is destined for the local market. Where possible, the technologies should also reduce the waste of existing methods of production (currently >30 percent with fruits and vegetables, for example). Increasing purchasing power and health consciousness on the part of many people in developing countries have followed trends from overseas, with demands for processed foods that have a fresh-like or dietary-beneficial quality. Suppliers of processed foods are required to adapt to changing markets. Some of the food processing technologies that are being introduced into India are primarily meant for products that are exportable, but domestic potential is worth exploring from the outset *(and exploiting as the opportunity may arise)*. Table A3.5 contains some examples.

There are a number of important factors involved with the successful adoption of new technologies for food processing. These include access to sufficient quantities of high quality raw materials, the compatibility of these technologies with local conditions, product profile and consumer acceptability, inter-related socio-economic factors (e.g. concerned with income and traditions), markets available and costs of production and pricing. It is essential that these many factors are prioritised and integrated into decision-making, and an holistic approach then taken when introducing and developing appropriate food-processing industries in the local community.

Appropriate technologies for agro-processing in rural areas

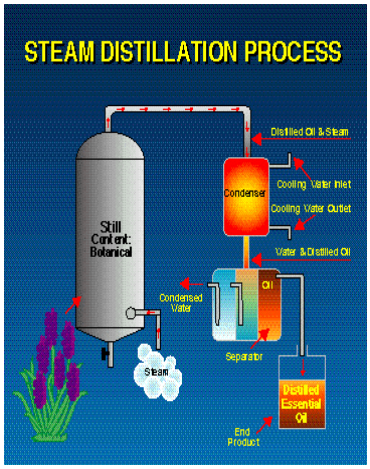
FIGURE A3.1
Mini dhall mill. Popularised by the MFPI. (CFTRI, Mysore)

K. LAXMINARAYANA RAO

FIGURE A3.2
Compact mini rice mill. (Taiwan)

K. LAXMINARAYANA RAO

FIGURE A3.3
Steam distillation process for aromatic herbs. (CIMAP, Lucknow)



K. LAXMINARAYANA RAO

CONSTRAINTS WITH DEVELOPING AGRO-FOOD INDUSTRIES

A major social change that continues to affect people in developing countries in recent times is urbanization – and the growth of cities. Urban populations benefit from stored foods, processed foods, easy-to-prepare foods or convenience foods in some form or other. The more integrated people become with an urban way-of-life, the less time there is available for preparing traditional foods in the home. Apart from cereals, fruits and vegetables are the major foods consumed (in cities and in the countryside) and these are highly perishable. The problems involved are varied and mainly time-dependent. Generally, the production of fruits and vegetables in a region is highly seasonal. In India, for example, there is large variation in the production of fruits and vegetables in the different states as the result of climate, altitude, distance from the coast and latitude from north to south of the country. There are for example, >1 000 varieties of mangos, 40 varieties of banana, 200 varieties of grapes and 50 varieties of guavas grown and marketed in India. Similar variability exists for the choice of temperate and tropical vegetables grown.

Production variations of this kind do not always favour large-scale processing industries since the volume of a particular variety of fruit, for example, required for the market may be strictly limited. The processing plant required for small-scale capacity may not meet the minimum economies of scale, and/or the plant may require constant modification to accommodate the different mix of varieties offered by producers.

The costs of production of raw materials on the farm may be high (for various reasons but usually due to low productivity). This may lead to harvesting over a wider catchment areas, higher transport distances, more producers involved and similar, and the result is higher delivery costs at the factory gate. In addition, the growth of a food processing industry may be hampered by (a) inadequate infrastructure such as stores, power and water services, communications and similar; (b) limited government support; (c) poor location for the industry; and (d) lack of appropriate technologies. Creating sufficient facilities in an agro-industrial park can help solve some of these many problems, giving an ability to spread costs and constraints across a number of industrial sectors. Some of these issues will be re-considered further in Chapter 5.

NEED FOR CREATING NEW PROCESSING CAPACITY

The polices of some developing countries for providing more capacity than needed for processing the quantities of domestic crops available has, in some cases, led to increased industrial malady.

TABLE A3.5
New technologies for food processing industries in India

Process/technology/equipment	Application
Cryo-mill processing of freeze ground spices using liquid nitrogen as a direct contact refrigerant.	Used for grinding spices. Helps with the retention of natural colour and flavour in the final product.
Irradiation of foods to replace fumigation and added preservatives.	Helps with the removal of insects and similar pests at different stages of growth. Eliminates fungal growth or decontamination from all types of microbes and insects depending on the level of radiation used.
Super critical fluid extraction. *(Versatile separation technology).*	Useful in the extraction of natural essential oils, food colours, spice extracts, etc.
Vacuum freeze-drying.	For drying shrimps, vegetables and meats. Yet to be used for instant coffee and tea in India.
Aseptic packaging.	Used for fruit juices and pulps. Other applications include high and low acid food products with particulates.
Quick freezing. *(Involves rapid freezing for preservation so that the ice crystal formation does not disrupt the cellular structure of foods).*	Used for shrimps, fruits and vegetables.
Modified atmosphere storage.	Used for fresh and semi-processed foods.
Curing of cereals.	Used for freshly milled rice to impart better cooking quality; equivalent to that of old rice.

Source: Kurade (1994).

The intension of policies that will create more capacity than required may result in 'survival of the fittest' *(i.e. competition will improve quality and indirectly improve agricultural production)*, but this has not always proven to be true - at least not thus far for India. Take the example of the vegetable oil processing and rice milling sectors. Indian milling capacity is 2-3 times the capacity required in terms of production, but most of the available capacity is characterized by old or out-dated equipment. Mills have closed for lack of parts or similar, and mills have continued to operate inefficiently. In an effort to redress this situation, the government is obliged to provide some kind of modernization programme that may offer incentives to the private sector. Government may also be required to demonstrate the benefits of modernization through appropriate R&D and extension programmes. Notwithstanding this effort, however, it seems likely that a large number of rice mills will continue to use inappropriate technologies and out-dated equipment. In many cases, mill owners or managers will *not* be informed of the investment opportunities available, and will continue to miss opportunities.

The need for creating additional capacity arises as a result of changes in cropping patterns, bumper harvests (when available), a regional imbalance in the capacity available from district to district, insufficient capacity and the replacement of obsolete plant with up-to-date equipment that may reflect modern technologies (and market demands). According to a study conducted by the author during 1997 in the nine districts of Karnataka State, a typical rice mills was using only 37 percent of the installed capacity during any one period of 24 hours. This is because downtime in the rice mills was frequently as high as 47 percent *(due to various reasons, most of which were linked to mechanical breakdowns, inadequate maintenance, and lack of replacement parts and similar)*. Further, the average throughput of the mills was estimated at 70 percent of installed capacity. Of the nine districts surveyed, eight were considered to require additional capacity *(in addition to issues of inefficiency and breakdown)* (Laxminarayana Rao and Chandramouli, 1987). See Table A3.6.

In addition to the improved capacity available in more modern or recently modernized mills, the survey showed that there were large numbers of old huller-mills in the districts that were no longer able to cope with demand. Recommendations from the survey suggested that the additional capacity required provided ample opportunity for modernizing the inventory of mills in these districts. Access to funding from the public sector was an additional incentive.

TABLE A3.6
Requirements for rice milling industries in Karnataka

District	Milling capacity available. (t/month)*	Paddy available for milling. (t/month)	Additional mill capacity needed. (t/month)	No. huller-mills to be modernized.
Belgaum	13 790	84 870	71 080	634
Bellary	66 417	47 120	-	0
Chickmagalore	76 122	104 690	28 568	255
Chitradurga	92 140	107 900	15 760	141
Dharwar	45 822	121 290	75 468	674
Mysore	134 891	158 500	23 609	211
Raichur	92 233	126 640	34 407	307
Shimoga	200 215	262 920	62 705	560
Tumkur	40 323	43 640	3 317	30
Totals	761 953	1 057 570	314 914	2 812

Source: Laxminarayana Rao and Chandramouli (1987).
* Capacity of modern/modernized mills in respective districts.

Inadequate post-harvest facilities lead to waste

Plate A3.1
Drying chilli in rural areas.

Plate A3.2
Sorting vegetables in villages.

The lack of post-harvest facilities for drying, sorting, grading and packing at point of production adds to the problems of industrialization, and results in a loss of raw materials, as illustrated in Plates A3.1 and A3.2

Fruits and vegetable products in India are governed by the Fruit Products Order (FPO) of 1995 and there were, at the time of ratification of the FPO, 4 270 licensed processing units with a combined installed capacity of about 1.4 Mt. In terms of raw materials this capacity is sufficient to process about 3.5 Mt of fruits and vegetables. The bulk of this capacity is used for fruits. This compares with a national production output of about 45 Mt of fruits and 70 Mt of vegetables each year. Thus, the capacity available for processing is grossly inadequate, and considerable potential exists for expanding the industry. Further, the cold storage capacity required for surplus produce that is not processed or absorbed by the fresh market is wholly inadequate. The country has 230 cold stores in the cooperative sector with a combined capacity of just 620 000 tonnes. The combined capacity of cold stores in 1997 was 10-fold at 6.5 Mt.

LOCATING FOOD PROCESSING INDUSTRIES

Primary processing of all foods and processing of perishable foods should be undertaken in, or adjacent to, point of production. There is little economic value in shifting large quantities of raw materials from farm to factory when the distances involved may be high. Processing close by reduces waste and cuts back on transport and handling costs. Disposal of by-products and wastes at point of production is normally more cost-effective. In a country with the geographic size and population of India, about 310 Mt of foods are required each year to meet basic nutritional needs.

TABLE A3.7
Recommended foods that meet basic nutritional standards

Sl. No.	Food item	Requirements for India		
		g/person/day	Mt/year	Percent
A. Perishable foods				
1.	Cereals	370	112.77	36.78
2.	Pulses and nuts	70	21.33	6.96
3.	Fats and oils	38	11.58	3.78
4.	Sugar and jaggery	40	12.19	3.98
Totals A			157.87	51.50
B. Perishable foods				
5.	Milk and milk products	180	54.86	17.88
6.	Meat, eggs and fish	35	10.67	3.48
7.	Vegetables	235	71.62	23.36
8.	Fruits	38	11.58	3.78
Totals B			148.73	48.50
Totals A+B			306.60	100

Source: Mokshapathi & Potty (1988).

Table A3.7 lists the various food items recommended to meet these minimum standards, and shows that about 150 Mt of foods (about 50 percent of total) are perishable.

India has reached self-sufficiency for non-perishable foods and, in recent years, also for milk and dairy products among perishable food items. However, the country has yet to attain a measure of reliable self-sufficiency with most other perishable foods such as fruits and vegetables, meats, eggs and fish products. Much waste occurs between point of production and consumption, and this exacerbates supplies of perishable foods.

Consider the socio-economic challenges facing India with more than one billion people living at an average density of 265/km^2. The country produces nearly 115 Mt of fruits and vegetables, and has an annual requirement of about 95 Mt. Fruits and vegetables available have to be transported, stored and distributed over an area of 3.2 Mkm^2. This means that the fruits and vegetables produced from an area of only 7 500 km^2 have to be distributed over an area that is >400 times the area of production.

While the problems of availability may be due to a culmination of constraints concerned with access to food and money and to the numbers of people sharing these resources, there are additional compromising factors that may dominate supply and demand. These are:

- Reduction in available foods due to deterioration and spoilage as the result of inadequate handling.
- Higher unit value of foods (that have been handled/processed) that place them beyond the reach of people living on a basic income.

A well designed storage, preservation, processing and transportation system originating from the point of production can help mitigate losses caused by deterioration, dehydration and/or bad handling. Moreover, this can be achieved without reducing the freshness or wholesomeness of most food items. However, to keep the unit value of the food within the purchasing power of the consumer presents a challenge. This may involve careful scrutiny of the production-processing chain to identify cost centres, the use of appropriate harvesting methods *(to maximise the production of high quality materials)*, market-specific targeting to obtain the best possible prices *(that high production costs can be absorbed)* and the use of government subsidies that may be available to encourage industrial investment. Subsidies can be passed on to the consumer in the form of reduced prices. Subsidies are a mixed advantage, however, and in the long-term should generally be considered as counter-productive. Subsidies should be offered and accepted with a firm measure of care for the long-term well being of the industry for which financial support is being provided.

Locating processing units within the producing regions helps to lower costs. It does this by reducing the bulk transportation required of unprocessed materials, and enables unwanted materials to remain at point of production. These, for example, can be re-directed into organized agro-waste manufacture, which may augment rural fuel supplies or provide for organic fertilisers *(and thus make further savings on bought-in fertilisers).* Savings thus achieved, together with the additional income earned from adding value to raw materials at point of production, help to boost the rural economy in many developing countries.

India produces an estimated 32 Mt of fruits and 71 Mt vegetables annually. Losses of the order >20 percent are due to poor post harvesting practices. (Biswas, *et al*, 2000). This means an average >6 Mt fruits and 15 Mt of vegetables are lost each year - valued at Rs66 billion *(assuming average farm gate prices of Rs5/kg fruits and Rs2/kg vegetables).* Accordingly, the MFPI (2004) has established set values, goals and objectives for:

- Minimum waste acceptable at all stages of the food production-processing chain.
- Development of infrastructure for storage, transportation and processing of agro-food produce.

An agro-industrial park can cater for the infrastructural needs of a variety of agro-horticultural produce grown in a region. Existing processing activities in the region can be encouraged to relocate to the park and to become and integrated part of the new units available. This brings experience and knowledge with which others in the park may benefit. Industrial units scattered

across a region can pose environmental issues. Relocation to a park brings a measure of control and security, but this has to be undertaken with the cooperation of the entrepreneurs involved, that production levels remain firm and with similar (or lower) production costs. There is little point in encouraging (*forcing?)* successful enterprises to relocate for the benefit of other industrial units and for environmental well being, only to penalise what had previously been a successful enterprise. In reality, few enterprises are willing to relocate simply to provide for a better organized private sector. The advantages in the medium- to long-term must reflect in the balance sheet of the enterprise involved, with higher potential earnings as a priority.

Annex 4
Agro-industrial parks

Walpita Dedicated Economic Centre is located 50 km from Colombo and 5 km from Divulapitiya on the Giriulla Road. The park is in two blocks A and B and covers 34.50 ha. Block A is an export processing zone and houses agro-based manufacturing industries (14 ha) and large-scale agriculture projects (7 ha). Block B contains agro-based manufacturing, light industries and services (7 ha). The common facilities and infrastructure provided in the park are described below.

TABLE A4.2A

Infrastructure and common facilities in the park	
• Bitumen surfaced roads to all plots. • 6 MVA dedicated power supply. • 112 m^3/day ground water source. • 1 125 m^3/day water supply scheme from Maha Oya. • Communication facilities: 25 lines expandable to 125 lines. • Chain link security fence with 24 h security. • Administration centre housing BOI. Administration centre and other offices.	• Wholesale centre • Agriculture facility centre • Trading centre • Management centre • Paddy store • Other stores • Parking • Water treatment plant • Water storage tank • Customs centre • Power supply

Seethawaka Industrial Park is located 47 km from Colombo. The park covers 170 ha of which 78 ha is factory area providing space for 70 manufacturing companies including 10 standard ready-built factories each of 1 433 m^2 floor area. The park incorporates a township built by the Ministry of Housing. Infrastructure and common facilities planned for the park are as follows:

TABLE A4.2B

Infrastructure	Other facilities
• Roads: 8 m wide carriageway with 2.5 m pavement on both sides. • 9 450 m^3/day capacity water treatment plant, tapping water from River Kelani. • 9 900 m^3/day capacity effluent treatment plant. • Power: 132/33 kV grid sub-station and 33 kV distribution lines. • 400 telephone lines.	• Vocational training centre. • Administration building housing BOI office, customs, post office, bank, transport company and immigration. • Container terminal. • Fire brigade. • Industrial township with housing, hospital, school, hotels, commercial areas, etc.

The Park contains the following industries:

- Labour intensive. Garment and apparel, soft toys, electronics and light engineering.
- Agro-based. Rubber processing and products, food processing including fruits and vegetables processing.
- Pharmaceuticals, printing and packaging industries.

Carmelray Industrial Park II at Laguna in the Philippines contains ready-built factories (RBF) that provide companies with low-cost and trouble-free startup facilities. The RBFs offer production space of 1 200 m^2 to 4 000 m^2. Each has been built with separate mezzanine office space, sanitary facilities, guardhouse, bin centre, loading and parking bays, fire protection and adequate power, water and other utilities. Built during 1999/2000 the park houses 19 units over an area of 10 ha with a built up area of 4.60 ha. The total area of the Park is 145 ha. Infrastructure facilities provided include:

- Dedicated power plant.
- Water supply system.
- Effluent treatment plant.
- Telecommunication services.
- Professional estate management with supporting amenities.
- Training centre.

The park contains industries manufacturing electronic components, computer hardware and software, consumer electronics, home appliances, industrial machinery, machine tools, light supporting industries, chemicals, plastics, foods and beverages.

The KA Food Link is located at 171 Kampong AMPAT, Singapore. It was built by the Jurong Town Corporation (JTC) to serve local food industries, and has been managed by JTC since opening**.** It contains six floors and is reputed to be the only multi-storied factory estate of its kind in East Asia. Facilities include:

- Loading and unloading bays with provision for 29 spaces for truck parking and 20 for parking containers.
- Four passenger lifts and 10 cargo lifts.
- Two corridors for out-going cooked foods and one central corridor for incoming raw food materials.
- 160 bay basement car park.
- Dust screw refuse flue.
- Nine dock levellers.

To help with quick start-up operations at the beginning of the day, each unit has its own ventilation fans and gas pipes. High standards of hygiene are encouraged – and are essential. Each unit has dedicated flue ducts, dedicated corridor entry for incoming raw food materials and two corridors for out-going foods, discretely placed disposal facilities for waste, and a common waste treatment plant servicing the entire complex.

Woodland Spectrum Factory was built by Juron Town Corporation (JTC) of Singapore. Described as a *'detached stack-up'* or *'high rise'* factory, the design provides a novel approach to more effective use of land in areas where industrial space is limited. JTC claim that the design has helped increase the supply of industrial space and, at the same time, made it more affordable. Each stack-up factory consists of two floors; and thus the complex comprises three factories stacked one-on-top-of-the-other. The building has six floors, with each factory provided with the equivalent of convenient ground floor access – private loading bays, car parks, etc. Woodland Spectrum factory features three novel designs:

- Detached stack-up factories.
- Terraced stack-up factories.
- Semi-detached stack-up factories.

Annex 5
Malappuram food park, Kerala (India)

INTRODUCTION

The food park constructed at Kakkancherry in Malappuram District was the first of its kind in Kerala State. This annex describes progress from conception during 2000 to inauguration in September 2003 by the President of India A.P.J. Abdul Kalam, and subsequently through to mid-2004. Figures A5.1-A5.5 show three years of development on the 41 ha site constructing the internal roads, power supply, water reticulation, common facility buildings for park users and offices, communications network and other facilities.

PARTNERS IN PROGRESS

The estimated cost of the park has been Rs250 million. The Federal Ministry of Food Processing Industries (MFPI) provided grant funds of Rs40 million for part financing of common infrastructure facilities required at the park. The Ministry of Commerce provided support with technical assistance from the UN Industrial Development Organisation (UNIDO).

TABLE A5.1
Main features of Malappuram Food Park

Location advantage	• Proximity to the Regional Engineering College (REN) and the newly established Indian Institute of Management (IIM) at Kozhikode. • The park is located on NH17, which links Mumbai to South India. • Karipur Airport at Kozhikode is 10 km from the park. • Kozhikode Railway Station is 20 km from the park. • Malappuram is linked by good all-weather roads to Kerala and India.
Infrastructure	• Uninterrupted power supply through a substation and distribution system. (Estimated cost Rs40 million). • 3.5 million litres/day (MLD) treated water supply and distribution system. (Estimated cost Rs20 million). • Communications network.
Common facilities	• Healthcare centre. • Convention facilities. • Hostel for workers and staff. • Bank • Post Office • Telecommunications centre (>400 lines). • Modern cold storage. (Estimated cost Rs40 million). • Fully equipped laboratory. (Estimated cost Rs8 million). • Hygienic waste disposal system for solid wastes and liquid effluent. • Dry warehouses for raw materials and finished goods. • Marketing and exhibition centre. • Common effluent treatment plant. (Estimated cost Rs5 million).
Manufacture sectors	• Yeast manufacturing, soft drinks and mineral water bottling, spirit from cassava, fruits, etc. Fruit juices, fruit pulp and concentrates, pappad, pickles, chutney, jams, jellies, etc. dehydrated/dried vegetables, spices, oleoresins, essential oils, etc. Breakfast cereals, weaning foods, nutritional foods, etc. IQF fruits and vegetables, ready-to-eat snacks/meals, etc. Flour mills, bakeries, noodles, vermicelli, confectionery, tomato sauce, ketchup, powders, pastes, juices, etc.

UNIDO initially helped local authorities by identifying food processing industries that offered promise. UNIDO also helped with the preparation of pre-investment business plans for the projects involved. The agency provided training for hazard analysis and critical control point (HACCP) including the preparation of a manual. Further, they helped select suitable partners for establishing and operating common infrastructure such as cold stores, warehouses and the quality control laboratory. UNIDO helped the state to publicize the park throughout SE Asia. This included help with identifying suitable investors. This was undertaken as part of a study tour to other industrial parks in the region – and to food parks in particular.

A number of agencies, consultants and contractors were involved with the development of the park. This included the Central Food Technological Research Institute (CFTRI) at Mysore, the Regional Research Laboratory (RRL) at Trivandrum, the Defense Food Research Laboratory (DFRL) at Mysore, the Kerala Industrial and Technical Consultancy Organisation (KITCO) and the National Institute of Technology (NIT) Calicut. The development of the park was organized and managed by the Kerala State Industrial Infrastructure Development Corporation (KINFRA). KINFRA provided the resources and base from which consultants appointed by UNIDO and local industrial associations were able to provide assistance.

RECENT DEVELOPMENTS

A second phase of park operations is currently underway. KINFRA signed an agreement with the DFRL in October 2004 for establishing an agro-food business incubation centre in the park. This was expected to become operational for early 2005. The incubation centre will be an integral part of the Agency for Development of Food Processing Industries in Kerala (ADFIK), which is part of KINFA. The incubation centre will provide support to companies that have established in the park. The centre will contain a food technology centre and a food biotechnology centre, which will be equipped with pilot production facilities such as fermenters, canning and bottling lines and an aseptic processing plant to support food industries on site.

Access to R&D on site will provide for both trouble-shooting and technical extension activities in support of park industries. The incubation centre also aims to provide innovation for the manufacture of novel and/or value added foods, to enable companies to expand markets and keep abreast of new commercial opportunities. Herein product development can expect to focus upon alternative and/or ethnic foods such as star fruit juice, low fat sausages, fruit jams, tropical fruit beverages and cordials, and shelf stable coconut milk. Extended shelf life is essential. Access to an irradiation centre will further promote product diversification. The incubation centre will contain facilities with which to explore enzyme applications to novel foods, and feed-related products such as the use of natural colourants. Spray drying and flavour capsulation (i.e. liquid food converted into powder) will also be explored. A sensory evaluation facility will focus upon the interests of the consumer. This will include an evaluation of consumer acceptability, market research, benchmarking, shelf life testing and product analysis. The incubation centre will provide chemical and microbiological analysis and HACCP facilities. Eventually the park can be expected to brand products manufactured in the park as part of a strategic aim for more effective exploitation of domestic markets.

PRESENT STATUS

For the end of 2004, 16 companies had contracted to establish in the park. Of these four had begun work by October 2004. Collectively, these companies were expected to invest an estimated Rs240 million in the park. They included the Parison Group and Rime Rich Foods, respectively, with manufacturing focus upon edible oils and ice cream products. Additional ice cream manufacturing is planned by other companies. The Central Warehousing Corporation has constructed facilities for storing raw materials and finished products. Four hectares have been setaside for the IT Centre. By mid-2004, two IT companies had relocated into the IT Centre.

The Agency for Development of Food Processing Industries in Kerala (ADFIK) provides management to the park. ADFIK is planning to establish a consultancy unit to provided technical consultancy services to food processing industries to encourage them to establish in Kerala State

– in general and, particularly, in the park. ADFIK is currently establishing a network of consultants to provide the technical expertise required.

Plate A5.1

Development of Malappuram Park 2000

The original source of water available to the park was a small open well on site with a capacity of 0.5 MLD. Note the well, land and roads under development, the security gate (and Common Facility Building in the background) and the new water tower. These were the first facilities to be built on the land provided for the park by Calicut University, Kerala.

Plate A5.2

Malappuram Park developments 2001-2004

Entrance to food park

Park security gate at right with the Common Facility Building in the distant right background. The building on the left is the IT Centre.

The main entrance is provided with a security gate. All park users – staff, workers and clients - and light commercial vehicles enter through the main entrance during daylight hours. There is a separate gate for heavy goods vehicles requiring warehousing facilities to one side of the park. This gate remains open 24 h for all traffic.

The modern IT Centre with all facilities. Two specialized e-companies had located to the IT Centre by mid-2004. Other companies located in the park started using the services of the IT companies from the outset.

KINFRA

KINFRA

Water resources

The park has a 0.5 MLD capacity water supply within the park boundaries with an additional 3.0 MLD water available from a local river. Total water supply is estimated at 3.5 MLD. The water supply and distribution system remains adequate.

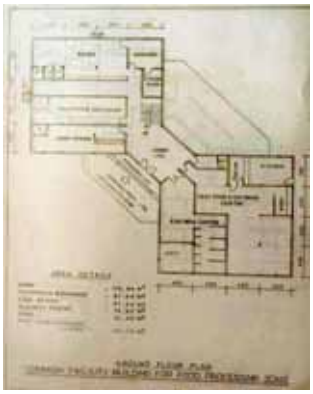
Plate A5.3

Malappuram Park Common Facility Building

KINFRA

Common Facility Building constructed at a cost of Rs16 million. Plan views below show the separate wings and floors, all of which have a discrete area function and focus for the visitor.

Plate A5.4



KINFRA

First floor left wing

This floor contains the main commercial shopping areas in the park. This includes fast food centre, shops, business centre, etc.

First floor right wing

Communications and finance is the main focus with banks, post office, telephone exchange, etc. available.

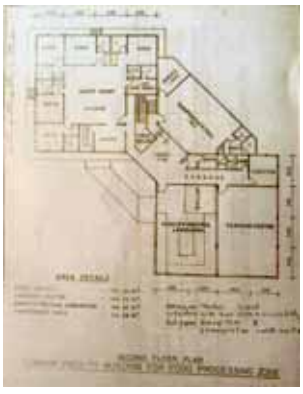
KINFRA

Second floor left wing

The focus is one of finance and business management, that park companies have access to a range of services from both the public and private sectors.

Second floor right wing

The floor houses KINFRA administrative offices and the health centre.



KINFRA

Third floor left wing

The floor houses services in support of quality assurance. This includes laboratories and the offices and training facilities of the Manpower Development Centre.

Third floor right wing

Hospitality is the focus of this wing with a guesthouse and restaurant available.

Plate A5.5

Malappuram Park electrical power facilities

KINFRA

Electrical sub-station and distribution system has been designed to cater for present and future demands for power. The sub-station has a capacity of 30 MW.

Plate A5.6

Commercial companies in Malappuram Park

Parison Foods Ltd

The company manufactures refined vegetable oils and vanaspathi (hydrogenated fats).

KINFRA

KINFRA

Parison Foods was one of the first companies to establish in the park. The company has a state-of-the-art facility for the manufacture of refined oils and related products.

Rime Rich Food Pvt Ltd

Manufacturers of dairy products. Showing factory entrance.

KINFRA

KINFRA

Interior of the factory showing the sweet milk production line.

Merrytime Foods Pvt Ltd

KINFRA

KINFRA

Manufacturer of ice cream foods. Showing the front of the factory and milk storage and chiller room.

Technopack Pvt Ltd

Manufacturer of packaging materials for foods – cartons, cardboard boxes and similar.

KINFRA

References and bibliography

AFST. (1999). *Export and trade information. Report.* Association Food Scientists and Technologists India. CTFRI Campus, Bangalore, India.

Agrawal, C. (1994). (Ed). *Food processing industries – an Indian overview*. Min. Food Proc. Industries. Publ. World Assembly Small & Medium Enterprises, New Delhi, India.

Ali-Dinar, Ali B. (1995). (Ed). *Food security and food self-sufficiency in Africa*. In 'Issues on african economy and telematics'. Economic Commission for Africa, African Study Center, University of Pennsylvania, USA.

Anon. (1994)a. *Broken commitments: the case of Pepsi in India.* Industry news. Indian Food Industry, 13 (2), March-April. 14 pp.

Anon. (1994)b. *Brooke Bond for taking over Ready Food operations.* Industry news. Indian Food Industry, 13 (3), May-June.13 pp.

Anon. (1999). *Step towards new venture*. Report on Intechmart 99. Ganahakti News Magazine. Kolkata, India. Available at: mail@ganahakti.co.in.

APCTT. (2002). *Asian & Pacific Centre for Transfer of Technology*. Brochure. New Delhi, India. Available at: http://www.apctt.org/events_2002.htm.

APEDA. (2003). *Information: investment in agro-export zones.* Update report. Agriculture and Processed Food Export Development Authority, Ministry of Commerce, New Delhi, India.

Babu, S., Krisha, N., Srilatha, H.R., Srinath, K. & Madhukara, K. (1994). *Improvement in biomethanation of mango processing waste by addition of plant derived additives.* Biogas Forum 58. FAO, Bangkok, Thailand. 16-20 pp.

Batamindo Industrial Management. (1999). Technical brochure. Batamindo Industrial Management Pte Ltd, Singapore.

BDA. (1998). *Building bylaws.* Bangalore Development Authority, Bangalore, India. Available at: http://www.bdabangalore.org/.

BERI. (2000). *Annual report 2000.* Bhawalkar Earthworm Research Institute, Pune, India.

Bhat, R.V. (1991). *Pattern of detention of foods of Indian origin at ports of entry into the USA.* Indian Food Industry, March-April. 21-22 pp.

Biswas, S., Chandrasekhar, T., Rajan, Y.S., Singh, D.N. & Amudeswari, A. (2000). *Long-term technology vision 2020: an Indian experience.* Report. Technology Information, Forecasting & Assessment Council (TIFAC), New Delhi, India.

CI&TCC. (2003). *Techno-economic and feasibility study on food park.* Report. Chhattishgarh Industrial & Technical Consultancy Centre, Raipur. Joint venture between Chmoku Agro & Spices Ltd and Chhattishgarh State Industrial Development Corp. Ltd, Raipur, India.

CIFTI. (2001). *Food processing industries in India.* Profile. Confederation of Indian Food Trade and Industry, New Delhi, India. 51 pp.

CIFTI. (2003). *Retail scenario in India – unlimited opportunity*. Background note. Confederation of Indian Food Trade and Industry, New Delhi, India. 21 pp.

DCSSI. (2004). *Third all-India census of small-scale industries 2001-2002.* Report. Development Commissioner Small-Scale Industries, Min. Small-Scale Industries, Agro and Rural Industries, New Delhi, India. Available at: http://smenetwork.net/economy/fcensus.htm.

DST. (1996). *Research and development in India 1997-1998.* Directory. 'R&D in India: extramural research and development projects approved for funding by selected central government agencies/departments'. National Science & Technology Management Information System, Div. Dept Science & Technology, Min. Science & Technology, New Delhi, India. Available at: www.nstmis-dst.org.

FAO. (2000). Global forest resource assessment. Available at: www.fao.org/forestry/site/fra/en.

FDA. (2004). *Imports rejected 1990, 1992, 2003-2004.* Report. OASIS import refusal. US Food & Drug Administration, Washington DC, USA. Available at: http://www.fda.gov/ora/oasis/ora_oasis_ref.html.

Food Karnataka Ltd. (2003). *Agro-food park at Malur III phase, Kolar District, Karnataka.* Project profile. KSII&DC Ltd., Bangalore, India.

GIDC. (2000). *Annual report.* Gujarat Industrial Development Corporation Ltd, Gandhinagar, India. Available at: http://www.gidc.gov.in.

GOI. (2000). *Agro-food processing technology vision 2020: fruits and vegetables – current status and vision.* Report. Technical Forecasting. Dept Science & Technology, Government of India, New Delhi, India.

GOI. (2001). *Population census.* Reports 1991 & 2001.

Available at: http://www/censusindia.net and http://pib.nic.in.

GOI. (2002)a. *Household consumer expenditure and employment: unemployment situation in India.* Report no. 476. National Sample Survey Organisation. Min. Statistics & Programme Implementation, New Delhi, India.

GOI. (2002)b. *Consumer expenditure, employment and unemployment and non-agricultural enterprises in the informal sector in India.* Reports no. 453 & 454. National Sample Survey Organisation. Min. Statistics & Programme Implementation, New Delhi, India.

GOK. (1998). *Annual bulletin.* Dept Horticulture, Government of Karnataka, Bangalore, India. Available at: http://www.horticulture.kar.nic.in/ *(Note: all annual reports, bulletins, etc. are currently being uploaded).*

GOK. (1999)a. *Annual report.* Dept Agriculture, Government of Karnataka, Bangalore, India.

GOK. (1999)b. *Annual report.* Directorate Horticulture, Government of Karnataka, Bangalore, India.

GOK. (2002). *Annual report.* Dept Agriculture, Government of Karnataka, Bangalore, India.

GOK. (2003)a. *Annual report.* Dept Agriculture, Government of Karnataka, Bangalore, India.

GOK. (2003)b. *Economic survey of Karnataka.* Dept Planning & Statistics. Government of Karnataka, Bangalore, India.

Available at: http://nitpu3.nic.in/planning/ecosur0203/ecosur0203.htm.

GOK. (2003)c. *Karnataka Industries (Facilitation) Act 2002.* Secretariat. Government of Karnataka, Bangalore, India.

GOK. (2004)a. *Annual report.* Dept Agriculture, Government of Karnataka, Bangalore, India.

GOK. (2004)b. *Economic survey of Karnataka State 2003-2004.* Survey. Dept Planning, Institutional Finance, Statistics, Science & Technology. Government of Karnataka , Bangalore, India.. Available at: http://www. Nitpu3.kar.in/planning/ecosur0304/ecosur0304.htm.

GOK. (2005). *Annual report.* Directorate Horticulture, Government of Karnataka, Bangalore, India. *(In preparation).*

GOSL. (1999). *Export and trade information.* Report no. 42. Policy & Planning Div., Sri Lanka Export Development Board, Colombo, Sri Lanka. Available at: http://www.tradentsl.lk.

Government of Singapore. (2000). Annual report. Environmental Agency, Government of Singapore. (Available at: http://www.nea.gov.sg/interative).

IARI. (2003). *Agricultural policy vision 2020.* Report. Indian Agriculture Research Institute, New Delhi, India. 19 pp.

IMRB. (1993). *National food survey 1991-92.* Indian Market Research Bureau. Available at: http://www.imrbint.com/syndicate.

KIADB. (2002). *Preparing the ground for Karnataka's growth.* Brochure. Karnataka Industrial Areas Development Board. Bangalore, India.

KIADB. (2003). *Annual report.* Karnataka Industrial Areas Development Board. Bangalore, India. Available at: http://www.kaidb.kar.nic.in.

KIADB. (2004). *Personal communication.* Karnataka Industrial Areas Development Board. Bangalore, India.

KIADB. (2005). *Information floor area ratios.* Karnataka Industrial Areas Development Board. Bangalore, India. Available at: http://kiadb.kar.nic.in/menudown/faq.htm.

KINFRA. *(2004). Personal communication*. Kerala Industrial Infrastructure Development Corporation Ltd, Trivandrum, India.

Kurade, A.S. (1994). *New technologies for the food processing industry.* Chapt. 'Food processing industries: an Indian overview'. Publ. World Assembly Small & Medium Enterprises, New Delhi, India. Sponsored Min Food Processing Industries, New Delhi, India. 174 pp.

Laxminarayana Rao, K. & Chandramouli, B.R. (1987). *Maximizing the production of rice and rice bran oil.* Study report. Industrial Development Bank of India, Mumbia, India. 670 pp.

Laxminarayana Rao, K. (2000)a. *Master plan guidelines for agro-industrial park at Kakkancheri, Mapappuram District, Kerala 1999-2000.* Report. Kerala Industrial Infrastructure Development Corporation Limited, Government of Kerala, Trivandrum. India. *(Unpublished).*

Laxminarayana Rao, K. (2000)b. *Proposed industrial township.* Report. M/s Malaysian Technopolies Pvt Ltd, Bangalore, India. *(Unpublished).*

Laxminarayana Rao, K. (2003). *Economic viability of cold storage.* Paper. Proc. Nat. Seminar Cold Storage. Workshop 15-16 June, Bangalore. Indian Soc. Heating, Refrigeration & Air-Conditioning Engineers, New Delhi, India.

Linden, G. & Lorient, D. (1999). *New ingredients in food processing.* Biochemistry & Agriculture. Woodhead Publishing Ltd, Cambridge, UK. September. 384 pp.

MFPI. (1998). *Annual report 1997.* Min. Food Processing Industries. New Delhi, India. Available at: http://mofpi.nic.in/annualreport/reports.htm.

MFPI. (2002). *Annual reports 1999, 2000, 2001 & 2002.* Min Food Processing Industries. New Delhi, India. Available at: http://mofpi.nic.in/annualreport/reports.htm.

MFPI. (2003). *Outline of assistance under the 8th, 9th and 10th plans 1992-2007.* Min Food Processing Industries. New Delhi, India.

MFPI. (2004)a. *Annual report 2003.* Min. Food Processing Industries. New Delhi, India. Available at: http://mofpi.nic.in/annualreport/reports.htm.

MFPI. (2004)b. *Guidelines food processing industry.* Available at: http://mofpi.nic.in/fpoguide.htm.

MFPI. (2005). *Draft food policy 2005.* Min. Food Processing Industries. New Delhi, India. *(In preparation).*

Ministry Environment & Forests. (2004). *Personal communication.* Ministry of Environment and Forests, New Delhi, India.

Ministry Finance. (1996). *Economic survey of India 1996-1997.*Available at: http://indiabudget.nic.in.

Ministry Finance. (1997). *Economic survey of India 1997-1998.*Available at: www.ieo.org/es_index.html.

Ministry Finance. (1998). *Union budget 1998-1999.* Key features: Agriculture & rural development. Available at: www.indiabudget.nic.in/ub1998-99/high.htm.

Ministry Finance. (1999). *Economic survey of India 1999-2000.* Available at: www.ieo.org/es_index.html.

Ministry Finance. (2000). *Union budget 2000-2001, chapter 88, section 8.30 'Horticulture'.* Available at: www.indiabudget.nic.in/es2001-02/chap88.pdf.

Ministry of Finance. (2002). *Union budget 2002-2003, chapter 87, section 8.24.* Available at: www.indiabudget.nic.in/es2002-03/chap87.pdf.

Ministry of Finance. (2003). *Economic survey of India 2002-2003.* Available at: www.indiabudget.nic.in.

Ministry of Finance. (2004). *Economic survey of India 2003-2004.* Available at: www.indiabudget.nic.in.

MOA. (2001). *Annual report 2000.* Ministry of Agriculture, New Delhi, India.

Mokshapathi, S. & Potty, V.H. (1988). *Complete statistics on processed fruits and vegetables exported from India during 1977-1985.* Handbook. Central Food Technological Research Institute, Mysore, India. 173 pp.

Mokshapathi, S. (1990). *Problems and prospects of processed fruits and vegetables in India with reference to exports.* PhD thesis. University of Mysore, Manasa Gangothri, Mysore, India. *(Unpublished).*

Mori, T. (2000). *How much do they spend on wooing the consumer?* Available at: www.indiainfoline.com.

Nand, K. (1994). *Biogas from food wastes*. Indian Food Industry, 13. 33-35 pp.

Nand, K. (2001). *Industrial potential of enzymes in waste effluent treatment of food industries.* Bio Energy News, 5 (2). June. 7 pp.

NCDC. (1996). *Annual report.* National Cooperative Development Corporation, New Delhi, India.

NCDC. (2003). *Annual report*. National Cooperative Development Corporation, New Delhi, India.

PAIC. (2003). *Annual report 2001/02.* Punjab Agro-Industries Corpn Ltd, Chandigarh, India. Available at: http://punjabgovt.nic.in/PAIC.htm.

PAIC. (2004). *Annual report 200/03*. Punjab Agro-Industries Corpn Ltd, Chandigarh, India. Available at: http://punjabgovt.nic.in/PAIC.htm.

Parpia. H. (1993). *Policy and strategy for integrated development of horticulture ad processing industry*. Report. Govt of Karnataka, Bangalore, India. 48 pp

Potty, V.H. (1992). *Impact of new industrial policy on development of food processing industry*. Indian Food Industry, 11 (4). 20-27 pp.

Potty, V.H. (1995). *Trends in food consumption and food industry development: global prospective*. Indian Food Industry, 14 (4). 36-48 pp.

Rajesh, M. & George, J. (2003). *Research and information system for the non-aligned and other developing countries*. Report. Joint Research Project Research and Information System. India Habitat Centre New Delhi India; Thammasat University Thailand, Australian National University Canberra and University of Melbourne Australia. Meeting sponsored by the Australian Centre for International Agricultural Research. 'Processed food products exports from India: an exploration with SPS regime'. 59 pp.

Sachdeva, S. (1988). *Trends in advertising by the Indian corporate sector*. Report. Institute for Studies in Industrial Development. New Delhi, India. 13 pp. SAI. (2005). Food Safety and Standards Bill 2005. Standards Authority of India, New Delhi, India. Available at: http://mofpi.ni.in/foodsty.htm.

SAI. (2005). *Food Safety and Standards Bill 2005.* Standards Authority of India, New Delhi, India. *Available* at: http://mofpi.ni.in/foodsty.htm.

SEAI. (2004). *Trade estimates of Indian kharif oiilseed crop*. Paper. 42nd All India Convention, Hyderabad 21 Nov. 2004. Solvent Extractors Assoc. India. Mumbai, India. (In preparation). Available at: http://www.seaofindia.com/index.htm .

Shacklady. C.A. (1983). (Ed.) *The use of organic residues in rural communities*. Proc. Workshop Organic Residues in Rural Communities. Held Denpasar, Bali, Indonesia, 11-12 December 1979, under auspices Indonesian Government Institute of Sciences (LIPI), the Government of the Netherlands, and the United Nations University. 183 pp. Available at: http://www.unu.edu/unupressbooks/80362e/80362E00.htm.

Sharma, D. (2005). *Agriculture and food security*. Background paper. Available at: http://www.infochangeindia.org/agricultureIbp.jsp.

Swaminathan, M.S. (1997). *Pathway to rural prosperity: survey of Indian agriculture*. Annual publication. The Hindu, Chennai, India. 9-11 pp.

TECSOK. (1983). *Industrialization of non-industry district of Bidar Karnataka*. Study commissioned by Industrial Bank of India. Technical Consultancy Services Organization of Karnataka, Dept Industries, Government of Karnataka, Bangalore, India. (Unpublished).

TECSOK. (1993). *Potential for solvent extraction plants in Karnataka; study raw material scenarios.* Report. Technical Consultancy Services Organization of Karnataka, Dept Industries, Government of Karnataka, Bangalore, India. (Unpublished).

TECSOK. (1997). *Establishment of food industrial estate in Malur Taluk, Kolar District.* Report. Technical Consultancy Services Organization of Karnataka, Dept Industries, Government of Karnataka, Bangalore, India. (Unpublished).

TECSOK. (1998)a. *Establishment of export processing zones in Karnataka*. Report. Technical Consultancy Services Organization of Karnataka, Dept Industries, Government of Karnataka, Bangalore, India. (Unpublished).

TECSOK. (1998)b. *Establishment of Mahalbagayat Industrial Area in Bijapur District.* Project report. Technical Consultancy Services Organization of Karnataka, Dept Industries, Government of Karnataka, Bangalore, India. (Unpublished).

TECSOK. (1999). *Food industrial estate Malur Kolar District Karnataka*. Report for Karnataka Industrial Areas Development Board. Technical Consultancy Services Organization of Karnataka, Dept Industries, Government of Karnataka, Bangalore, India. (Unpublished).

TECSOK. (2004). *Personal communications.* Technical Consultancy Services Organization of Karnataka, Dept Industries, Government of Karnataka, Bangalore, India.

Trade Point. (1995). *Doing business in India*. UNTPDC Trade Point Server Incubator. Trade Point, New Delhi, India. (Note. UNTPDC is no longer available, and services previously provided are now available through the National Informatics Centre Services – NICSI – New Delhi, India. NICSI is a subscription service and available to paid-up subscribers). Available at: http://trade.nic.in/regform/membership_fortrade.htm.

AGRICULTURAL AND FOOD ENGINEERING WORKING DOCUMENTS

1. Meeting consumers' needs and preferences for fruit and vegetables (E)
2. Food product innovation (E)
3. Agro-industrial parks (E)

Ar	-	Arabic	Multil – Multilingual
C	-	Chinese	
E	-	English	* In preparation
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