AN INDUSTRIAL PARK FOR AGRICULTURAL INDUSTRIES

by

SHREENIVAS N. MATE

B. Arch., University of Bombay, India, 1961

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF ARCHITECTURE

College of Architecture and Design

KANSAS STATE UNIVERSITY
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Approved by:

Major Professor

India, with one of the richest cultural heritages, is one of the poorest countries in the world today. The roots of poverty have struck deep into complicated social, economic and political structures. Since her independence in 1947 India has launched a struggle against poverty, overpopulation, disease and ignorance. Her people have been very busy with the task of planned progress for the country. Emphasis is on industrialization and 'social justice'. Rapid industrialization is being implemented, but 'social justice' is lagging behind. Thus in spite of industrialization, people are facing a soaring cost of living and food shortage. True, the tremendous population growth inhibits progress, and it must be controlled. But population density is not India's only problem. Too big a percentage of the people is engaged in unefficient agriculture. These people get few returns and their endeavor is inadequate to provide a surplus economy for the nation. Industry is now reducing labor pressure on the land. But it has not done a satisfactory job of replacing the reduced labor force with advanced techniques and resources for agriculture. It is time to stop and see how far this has crippled agriculture and if industry could not remedy the situation. For industry by reorienting some of its efforts can not only repair the damage but it can boost Indian agriculture.

This thesis is an effort to assess the situation and to seek a kind of economic activity that will strike at the very roots of poverty in India. The appraisal reveals that an industry geared to the needs of agricultural production is badly needed in India. This industry - termed in the thesis 'agro-industry' - will have to do a triple job of supplying machinery and other resources to agriculture, of processing agricultural products, and of manufacturing machinery for processing-factories. It is suggested that the industrial policy of India's 'Five Year Development Plans' should also make provision for agro-industrialization, so that this industry will grow in a planned fashion and not as an accident and also that it will not be in conflict with 'social justice'. (Due to its involved nature 'social justice' is not discussed in the thesis.) Three successively larger patterns are recommended: an agro-industrial district made of cellular agro-industrial parks and an agro-industrial region made up of the agro-industrial district and an agricultural district. A detailed study of one region in India is then made to evaluate its agro-industrial needs. This is followed by a discussion of industrial location and location patterns.

To elucidate the above proposal an agro-industrial park is designed for one agro-industrial region in the State of Maharashtra. The design is made as comprehensive as possible, though the difficulty of getting all necessary data from India has tended to make this study more of a schematic nature. It is hoped that the concept can be further developed and applied to the practical problems in India to help achieve a prosperous economy.

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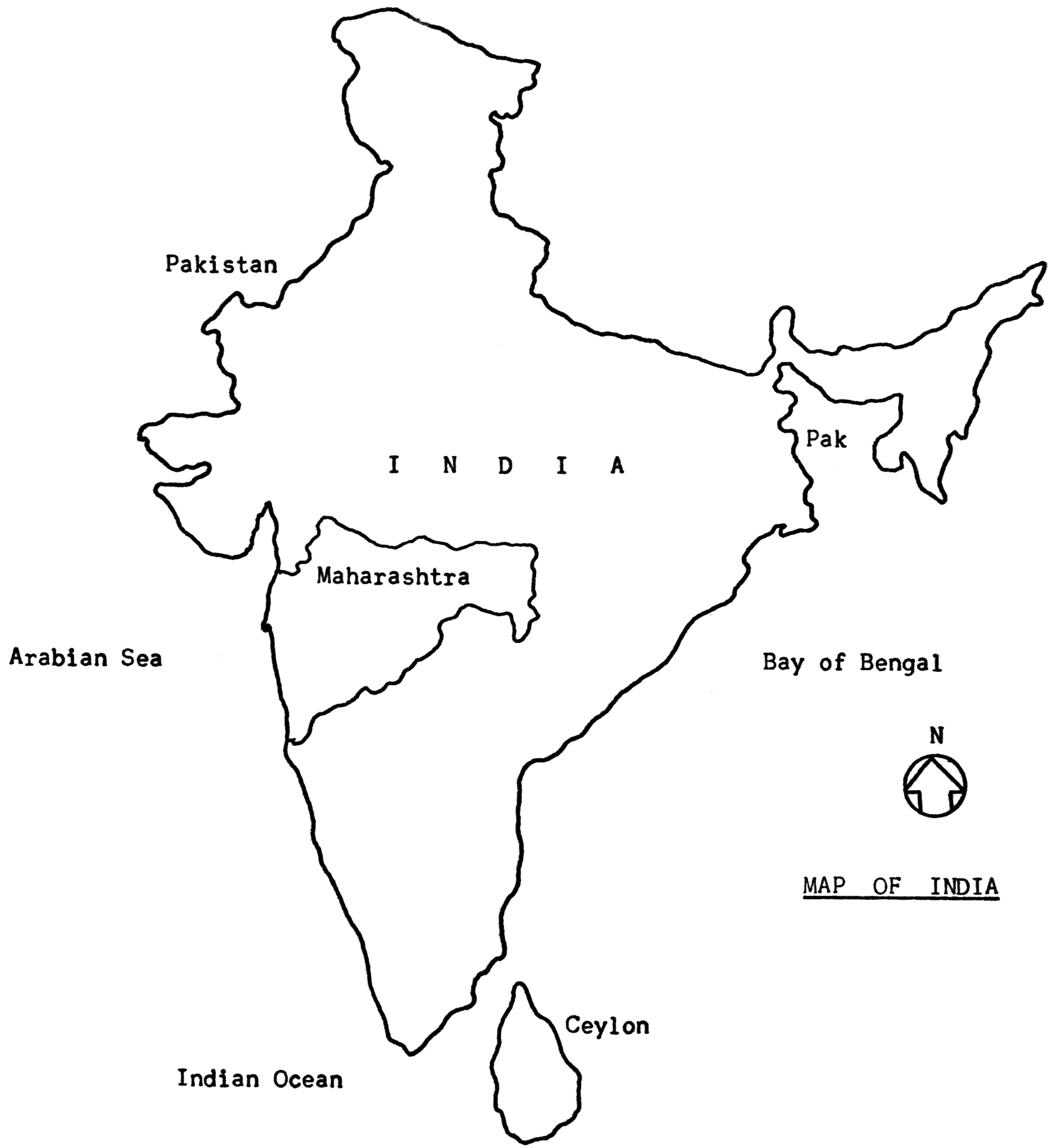
P A R T I

THE PROBLEM AND A CONCEPT OF A SOLUTION


Pakistan
I N D I A
Pak
Maharashtra
Arabian Sea
Bay of Bengal
N
Ceylon
Indian Ocean

MAP OF INDIA

1.1 India: The Socio-economic Problem

Introduction

India lies between latitudes 8° 4' 28" and 37° 17' 53" north and longitudes 68° 7' 33" and 97° 24' 47", measures about 2,000 miles from north to south and about 1,850 miles from east to west and covers an area of 1,261,597 square miles.[11] Bounded by the Himalayas in the north, the country stretches southwards and, at the Tropic of Cancer, tapers off into the Indian Ocean. The Peninsular plateau, marked off from the Indo-Gangetic Plain by the Satpuda Mountins is flanked on either side by Western and Eastern Ghats (Ranges), respectively. The Himalayas have a marine origin, while the Indo-Gangetic Plain is made up of alluvial deposits up to 1,300 ft. thick. The Peninsula consists of highly metamorphosed rocks of the earliest periods. The Himalayan rivers are snow-fed, while the Deccan rivers are generally rain-fed. Gana basin is the largest, Godavari basin in the south is the second largest. The country is in sub-tropical region, but climate varies from humid hot in South India to snowy winters in Kashmir, from dry desert in Rajastham to wet tropical of the rain forests in Assam.

People and Economy

People in India belong to six major religions, and they speak 15 different languages. However there is a unity in the apparent diversity, since all the people belong to the Indo-Aryan culture. India's population in the 1961 census was 439,072,893 or 370 persons per square mile.[11] It has been increasing at 2.15% rate per anum. About 82% of the people live in rural India, and 70% of the population is engaged in agriculture. Literacy is 24%.

The preliminary estimates of 1961 - 62 show per capita per anum income at Rs 293.40* at 1948 - 49 prices.[11] The income index has moved from 100 in

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* One Indian Rupee equals about $0.20.

1952 - 53 to 126.9 in March 1963. In the same period consumer price index increased by 33%. The agricultural laborer earns as little as Rs.100.00 per year. The average standard of living is on the survival margin and half the population is still below subsistance level.

The Crux of the Problem

The vicissitudes of the situation are many. Poverty, illiteracy, over-population, small farm-holdings, inadequate irrigation and uncertain monsoons, evils of caste system, factionalism, indebtedness, undernutrition and low life expectancy (42 years) are all the links of a vicious circle that has created a stultified society, stagnant economy and a nation that is staggering under this weight in its onward march.[15]

Agriculture is the backbone of the economic structure in India where 48% of the national income comes from the 70% population engaged in agriculture.[11] Low agricultural yields, faulty marketing, neglected warehousing and negligible processing of farm products have ultimately resulted in a chronically weak national economy.

Low agricultural yields can be illustrated through the following comparison:[15]

Product	India	U.S.A.
Rice	87 lbs./acre	312 lbs./acre
Wheat	593 lbs./acre	1,079 lbs./acre
Sugar (raw)	3,063 lbs./acre	3,701 lbs./acre
Cotton (ginned)	87 lbs./acre	312 lbs./acre
Milk	400 lbs./cow	5,328 lbs./cow

Lack of transport and warehouses is the first hindrance in marketing. Then there is very little cooperation between farmers, so the farmer has to sell his products at low prices. The long chain of middlemen, malpractices against the farmer, ridiculous and superfluous market charges, non-maintenance of standards and grades have again discouraged better farming. Processing, preservation, and storage are invaribly insufficient, if not absent altogether.[14] Because of the lack of processing the farmer does not get a good price; lack of preservation causes immence losses through spoilage: and absence of storage compels him to sell at any price, depriving him at the same time of the credit he could have had for warehoused goods.

The Necessity of New Economic Activity

Indian economy's heavy reliance on agriculture, the woes of agricultural production discussed above, and excessive rural unemployment call for a country-wide increased economic activity. Such activity-which implies some kind of industry - must be used to give impetus to agriculture to help national capital increase at a perceptible rate. Further this activity has to do away with the ill effects of undisciplined marketing, and almost non-existent warehousing and processing.

The Famine Enquiry Commission had recommended the development of 'agro-industry' and village public works. By 'agro-industry' it meant a type of industrial activity (not a cottage industry) which is specially suited for development in rural areas for processing farm products.[15] The Planning Commission, however, has recommended in June 1955, that further expansion of large scale industry in this sector should not be permitted, except under certain conditions, such as, for instance, the establishment of a unit by the government or by a cooperative organization. Before questioning this policy it will be worthwhile looking at efforts in other countries with similar problems.

In Pureto Rico agricultural and economic bases are almost at the same level as in India. The American policy there is to encourage industry so as to relieve agricultural land of excessive population and to foster competition between the agricultural and industrial labor through income differentials; thus arousing farmers to the need of raising and modernizing their agricultural activities to attract labor through better payment.[19]

Southern Italy, which suffers from illiteracy, overpopulation, and agricultural unemployment, has the lowest economic level in the European Economic Community. The Government's economic policy is to improve infrastructure such as roads, railways, water supply, power, and drainage.[28]

In southern France development of production and processing industries of meat, dairy products, fruit, and of marketing facilities is accelerated to narrow the gap between production cost and consumer price.[28]

The above examples and the present economic situation in India clearly indicate that a nation-wide agro-industry is an utmost necessity in India.

<u>A Policy for Agro-industrial Development in India</u>

The Five Year Plans of India should incorporate an agro-industrial policy to guarantee a planned development of such industry throughout the nation phased to produce coordinated efforts and results. The aims of agro-industry can be enumerated in the Plan as follows:

1) It should employ local labor and give better wages than agriculture can afford,

2) It should introduce grade differentials and better marketing,

3) It should bring profits to the doorstep of the farmer,

4) It should improve farming practices, provide extension facilities, and increase the farmer's days on the farm,

5) It should minimize wastage, provide storage and credit, and build reserves,

6) It should encourage export of processed goods, and

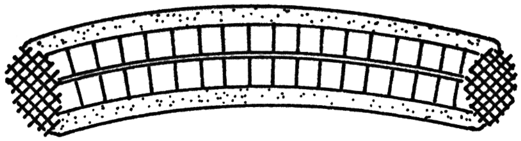
7) It should widen its effective field even beyond agriculture to evolve healthy and prosperous socio-economic structures competitive yet complementary in spirit in all states. Such cellular structures will then make a cohesive strong entity - a fully developed New India.

The Plan should leave details like financing, size, nature, and location of agro-industry to state authorities. The type of organization, physical planning of individual industries and production programming should be left with local institutions. Urban location of agro-industry should be discouraged as it eliminates the farmer from the recipients of the price spread.

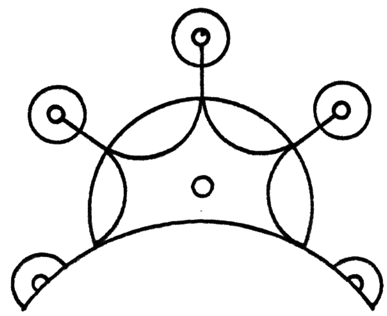
To limit the extent of this thesis further study will be restricted to a single state - that of Maharashtra, with detailed emphasis on a district in Maharashtra - Poona. States are political and linguistic regions in India, so Maharashtra can be considered as a complete region.

1.2 The Concept of an Agro-industrial Region

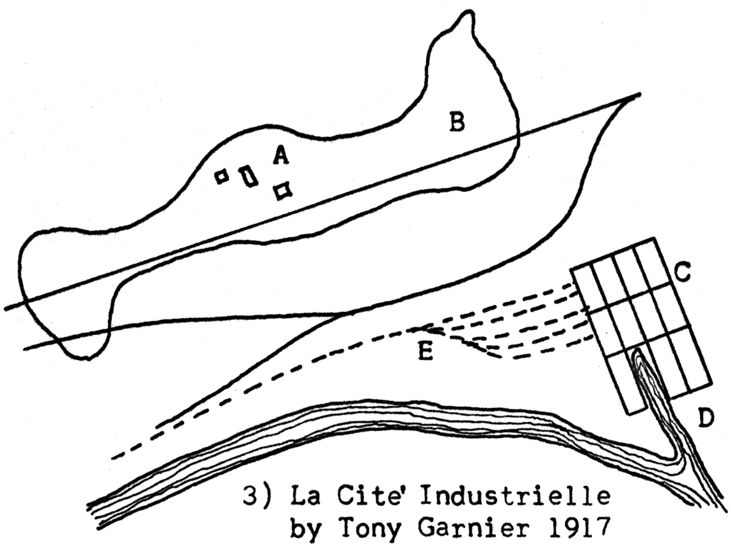
Agricultural regions coincide with geographic, geological, and climatic regions; but these together often overlap political regions. Now if a nation-wide program is to be adopted for the development of agro-industry, logically, it ought to have a bearing on agricultural regions. This is especially necessary in India where the means of transportation are not adequate, and hence the close proximity and relationship between agro-industry and agriculture is obligatory. Then because of the socio-economic problem of India discussed earlier, and because of locationing requirements which will be described later on in this part the relation of agro-industry is more with the rural area than with cities. These agro-industrial set-ups will be the hubs of activity for their related agricultural regions. Since the development of such a region is dependent on both the agriculture and the agro-industry such a region may be termed as an Agro-industrial Region.



1) The Linear City of Soria y Mata 1882

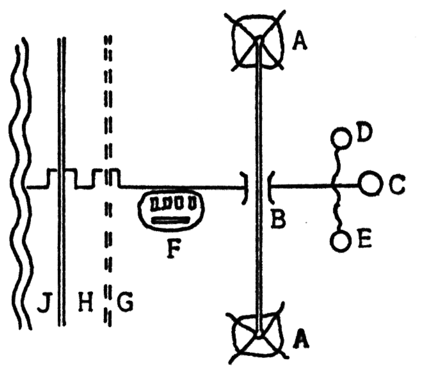


2) Central City with Satellite Towns by Raymond Unwin



3) La Cite' Industrielle by Tony Garnier 1917

A - Civic Center
B - Residential District
C - Industrial District
D - Port
E - Railroad



4) La Cite' Industrielle by Le Corbusier

A - Existing City
B - Auto Highway
C - Vertical Residences
D - Community Facilities
E - Horizontal Residences
F - Factories
G - Railroad
H - Service Highway
J - River

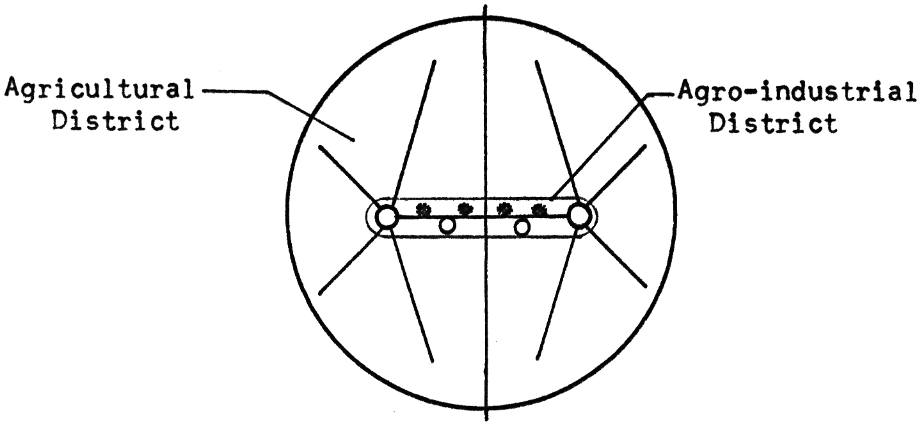
THE CITY AND THE INDUSTRY

A national survey can establish agro-industrial regions throughout India. These regions may in places cross the boundaries of talukas, or districts, or even of states. They may vary in size depending upon the volume of agricultural and industrial activity and in other characteristics depending upon their relation to market. Their development should be phased and flexible enough to allow a cellular growth. The number of agro-industrial regions in a state will depend upon necessity and upon the outlay of the development plan.

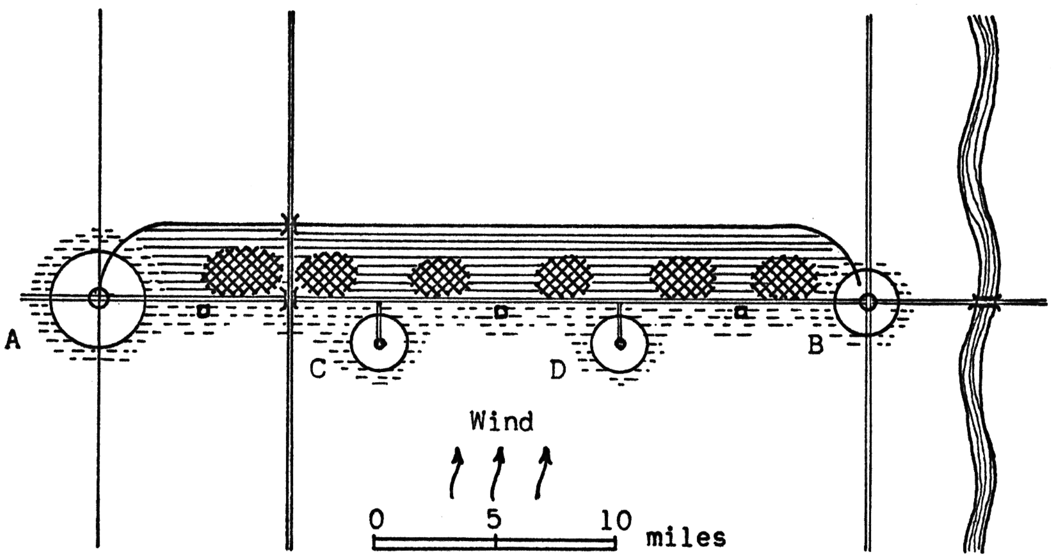
The agro-industrial region can be further split into two districts: one of agriculture and the other of agro-industry. The agricultural district will consist of 'planned farms' indulging in various cultures; while the agro-industrial district will be made up of agro-industrial parks, each park being a phase of the district plan. A question arises here as to how the agro-industrial district should be planned?

A harmonious relationship between the industry, the city, and the countryside has almost always been difficult to achieve. For industry has often brought congestion and squalor to the towns, and ruthlessly molested the landscape. As an easy solution to the intolerable conditions in the city people and industry have moved out of the city to the peripheral region. This has resulted in furhter defilement and exploitation of the region.

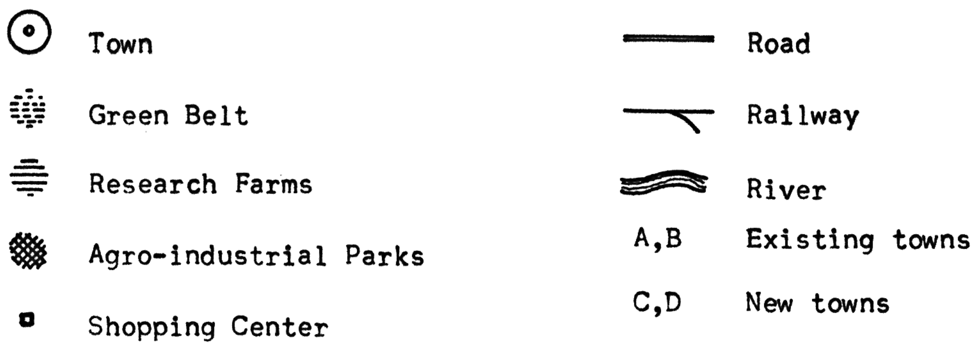
Planners and architects have come forward with various schemes for "industrial cities."[8] A few examples are: the Linear City of Soria y Mata (1882 A. D.), the Satelite Town concept of Raymond Unwin, La Cite Industrielle by Tony Garnier (1917 A. D.), and La Cite Industrielle by Le Corbusier. Of these, Garnier's plan is a compromise of the Linear City and the Satellite Towns, in that Garnier's city is still somewhat linear, but his industry is grouped together and separated from the town by a green belt. Now, how the industry



THE CONCEPT OF AN AGRO-INDUSTRIAL REGION



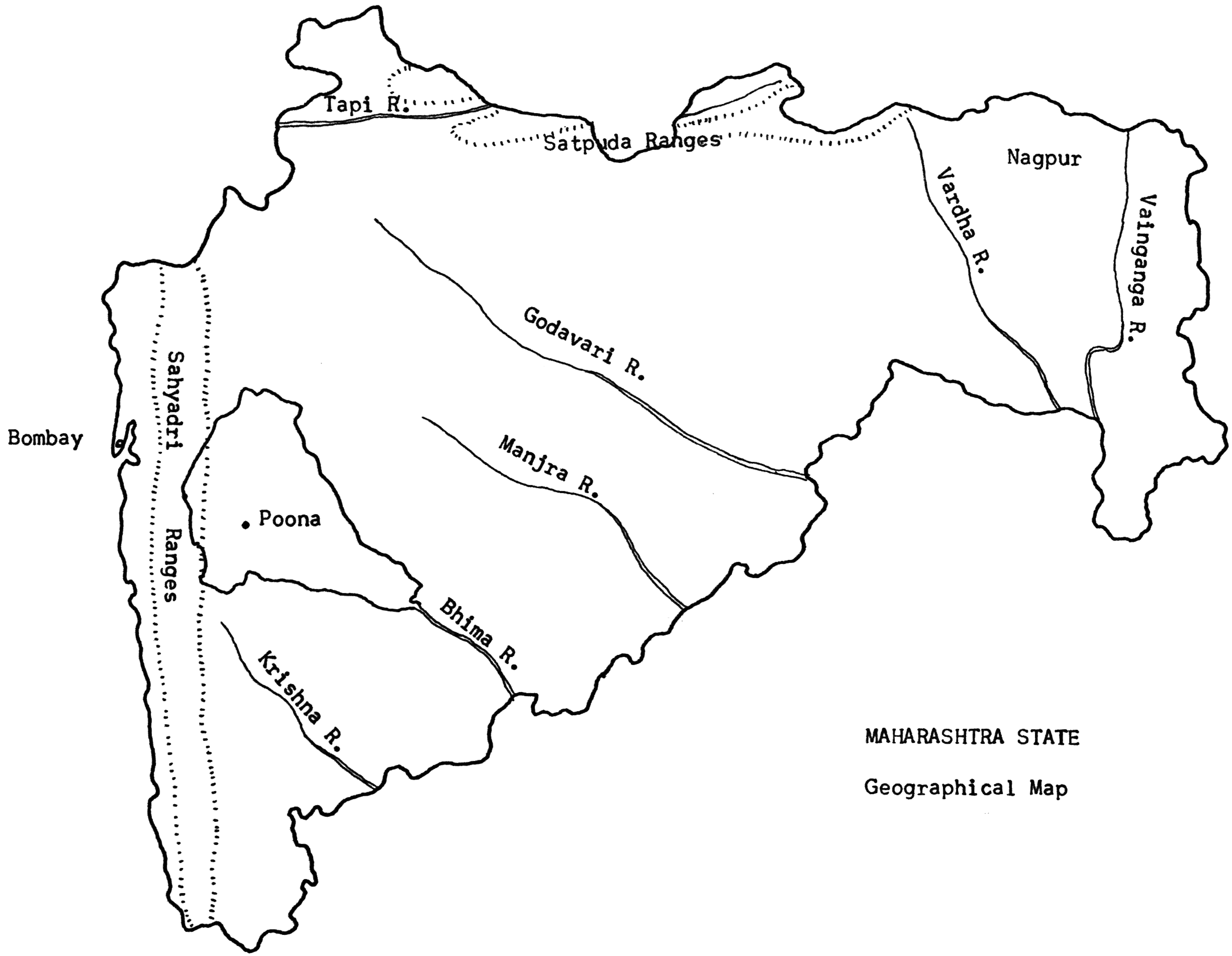
THE AGRO-INDUSTRIAL DISTRICT



should expand? The answer to this is inherent in Le Corbusier's plan. The industry ought to expand lineally between centers of populations, and along the means of transport. The Fort Worth Industrial District near Dallas, Texas could be sited as a successful example of 'linear industry.' The problem of commutation for working population can be solved by developing 'dormitory' satellite towns in parallel with the 'linear inudstry.' These towns will be separated from each other and from the industry by green belts, so that they will function closely without interfering with each other. Only shopping centers will be allowed in the green belt.

Further, a cellular structure of agro-industrial parks growing lineally is feasible since another kind of a green belt will form part of each park. Of all the industries agro-industry has the closest relation with the regional resources, the major resource here being agriculture. Industrial research into the nature of raw materials is a vital organ of any industrial endeavor. In the case of agro-industry research in the fields of: betterment of agricultural production, improvement of cultivation practices, and application of agro-industrial products to achieve the first two objectives contributes to successful operation and expansion of the industry. Research farms are the research laboratories of agro-industry, and so it is necessary to plan for them while planning an agro-industrial district. Furthermore, these farms can be used in part for industrial waste treatment. They can form buffer strips between successive parks.

After chalking out the agro-industrial regions the problem will be of locating the district and the parks. A masterplan for the district is necessary before planning individual parks. Finally would come the designs of factories and various facilities.



MAHARASHTRA STATE

Geographical Map

1.3 Maharashtra State: A Representative Situation

Maharashtra State spreads south-westward from the Satpuda ranges toward the Arabian Sea and covers an area of 118,459 square miles. A narrow land strip is formed between the Arabian Sea and the Eastern Maharashtra by the Sahyadri ranges. This strip - called Konkan - is divided into 4 districts. East of Sahyadris Maharashtra is divided topographically and climatically into two regions: the southwest called Desh (made up of 9 districts) and the northeast called Marathwada - Vidarbha (made up of 13 districts). Konkan has a 325 mile long coast, the terrain is rough. Konkan receives 80" - 125" of rain between the months of June and October, that is from the Southwest Monsoon. The 3,000 ft. high Sahyadris receive between 150" - 300" and are covered with thick forests. The average altitude of Desh is 1,400 ft. The precipitation in Desh amounts to 25" - 30". Marathwada - Vidarbha is 700 - 2,000 ft. above sea level. In addition to the rains from Southwest Monsoon Marathwada - Vidarbha gets them from southeast winds as well, the total amounting to 30" - 50". Temperatures range from $40^{o}F$ (min.) and $115^{o}F$ (max.) in east to $60^{o}F$ (min.) and $100^{o}F$ (max.) in KonKan.[2]

Water Resources and Crops

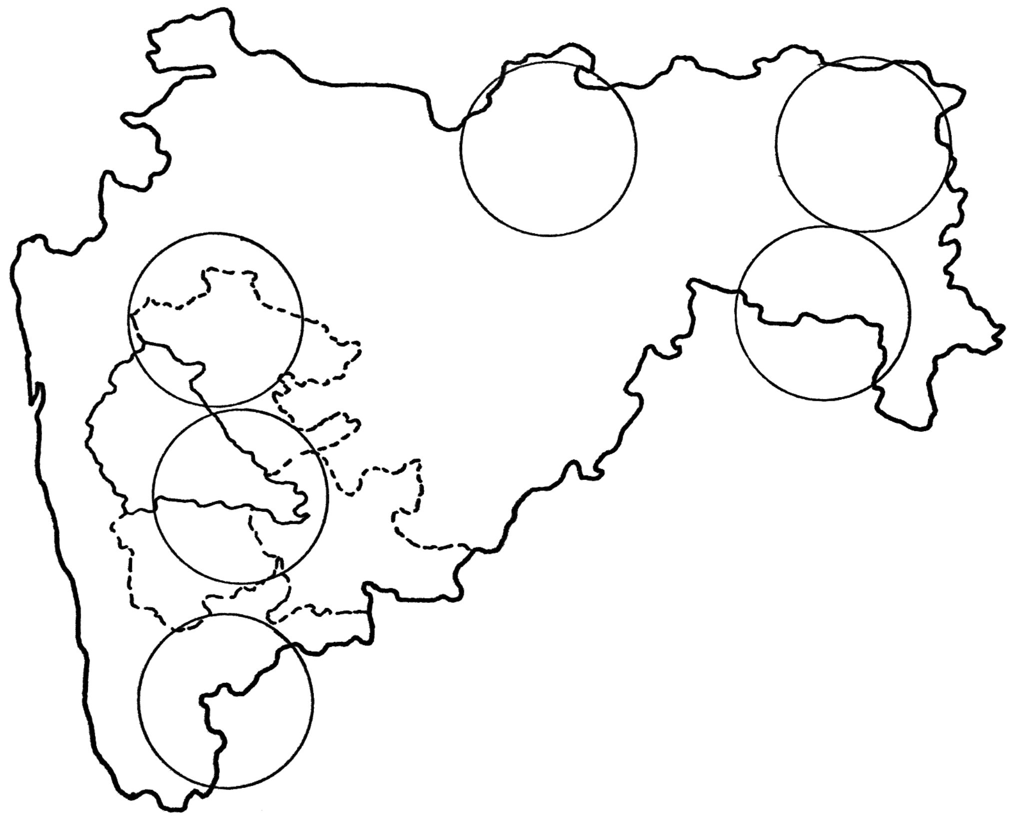
Rivers in Maharashtra, like the rains, are seasonal. There are 6,711 miles of canals that irrigate 581,000 acres of land. Another 1,184,100 acres depend on wells. Of the 46.3 million cultivable acres 7.1% area is under 'bagayat' (garden-crop) cultivation, the rest being under 'jirayat' (food-crop). Jirayat land depends on rains, while bagayat on irrigation; only 5.3% land is irrigated. Table 1 gives crops grown in various regions of Maharashtra.[2] Nearly 21% of the land in Maharashtra comes under forests; but actually only half of the forest is well preserved. Timber, firewood, lacquer and bamboo are the products from the forests. Also jungles are used for cattle-grazing. Table 2

TABLE 1: CROPS IN MAHARASHTRA

Region	Crops											
	Rice	Wheat	Sorghum	Millet	Gram	Pegion	Pea	Peanut	Scafflower	Sugarcane	Cotton	Fruit
KonKan	2											2
Desh	1	1	6	2	1	1		2	2	3	1	3
Marathwada			4		1	1		1	1	1	2	2
Vidarbha	2	1	3		1	2		1	1		3	2

TABLE 2: RATIO OF CATTLE TO FODDER-CROP LAND

Region	No. of cattle/100 Acres of Fodder Crops
Konkan	82
Desh	30
Marathwada	30
Vidarbha	44



PROBABLE AGRO-INDUSTRIAL REGIONS IN MAHARASHTRA gives the number of cattle per 100 acres of land under fodder cultivation.

People

Maharashtra has a population of 32,003,086. Of this 28.9% is urban population. Literacy is 24% and 64% of the people depend on agriculture for livelihood. Population density is higher in west Maharashtra (344/sq. mile) than in the east (206/sq. mile) Bombay, Poona and Nagpur are the three largest cities in Maharashtra, Bombay being largest in India.

Transportation

There are the following figures available on roads and railways in Maharashtra:[2]

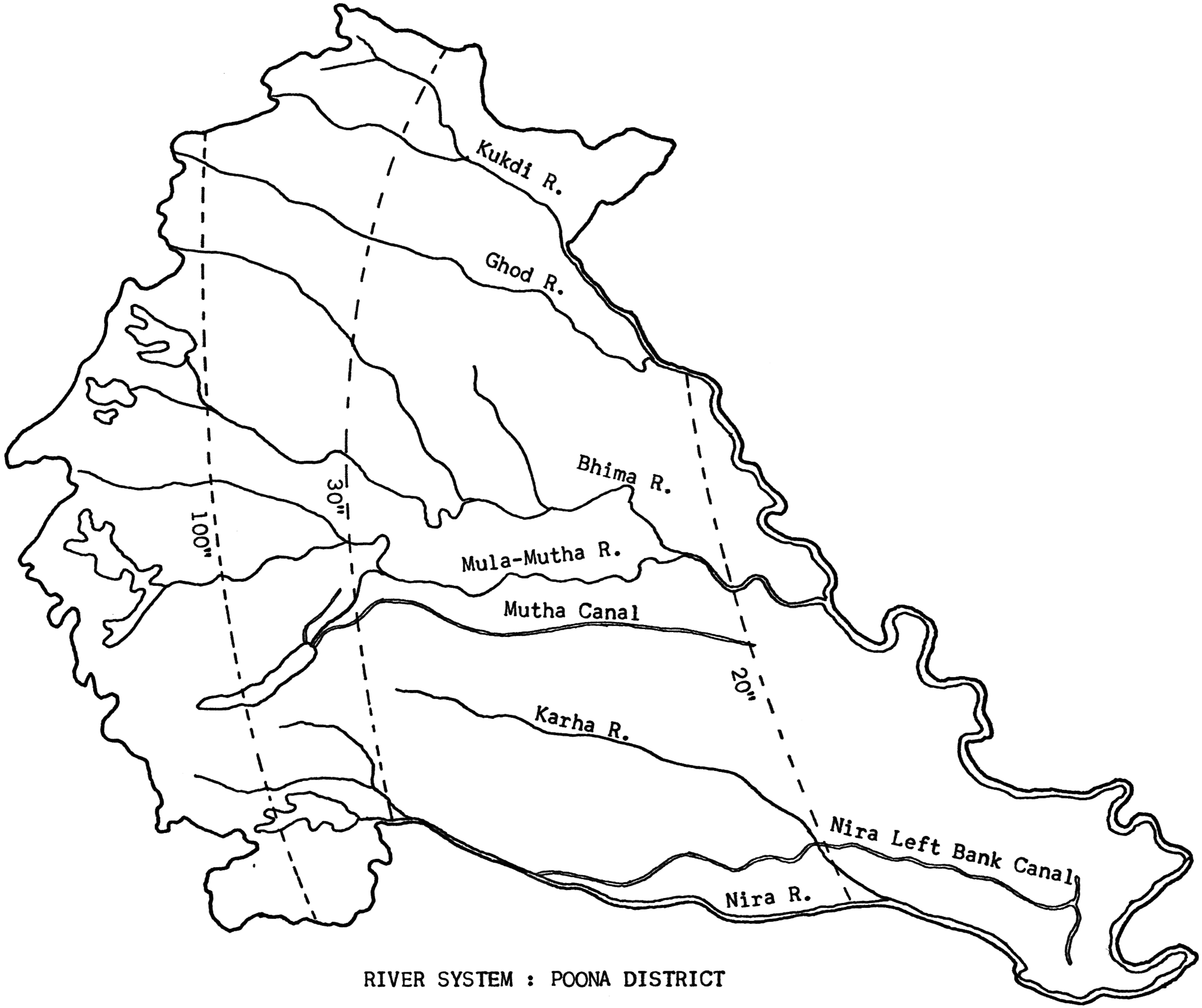
Metal (gravel) Roads	-----	13,260 miles	-----	12 miles/100 sq. miles
Dirt Roads	-----	7,554 miles	-----	5.5 miles/100 sq. miles
Railway	-----	3,070 miles	-----	2.6 miles/100 sq. miles

1.4 Poona District - Physical Data

Located between 17° 54' and 19° 24' north latitude and 70° 19' and 75° 10' east longitude the district covers an area of 5,357 square miles. It also can be divided into three regions: the western Ghats (Ranges), the Transition Belt and the Desh Tract. It rains 70" in the Ghats, 30" in the Transition Belt and 20" on Desh. Black, brown and reddish trap rocks form the understructure. The district is divided into 12 Talukas (counties).[9] Table 3 gives yearly rainfall in some selected places.

Resources

Four impounding reservoirs are built in the Ghats. There is a plan to rebuild two more that had collapsed in 1961. Rivers are formed in the Ghats and flow southeastward. In the forests in the Ghats grow teak, *Dalbergia sissoo*, *Cassia fistula*, *Acacia arabica* and *Zizyphus jujuba*. In addition to these hardwoods Mango and Jackfruit also yield construction timber.



RIVER SYSTEM : POONA DISTRICT

TABLE 3: RAINFALL POONA DISTRICT

Station	Average Yearly Rainfall	No. of Rainy Days
Poona District	36.56"	46
Poona City	26.49"	39
Lonavla City	170.08"	80
Bhor City	36.63"	65
Baramati City	20.02"	36

People

The district has 1,950,976 people of whom 42.8% live in urban areas while 52.3% still derive their livelihood from agriculture. Literacy is 28.1%.[2]

1.5 The Agricultural Economy of Poona District

Agriculture is the predominant economic activity in Poona District, though there is a growing trend toward industrialization and urbanization. The number of urban places has risen from 8 to 37 during last eighty years. The shift toward non-agricultural employment is typical of the vicinity of Poona City, and Baramati. The Ghats portion of Poona is poor in land resources, but is nevertheless rich in water and forest resources. The belt along Poona - Lonavla railway shows a growing reliance on manufacturing industry and on employment through administrative and banking activities. On the other hand 75% people in the Transition Belt and on Desh Tract are still dependent on agriculture.

The accompanying Table 4 shows the chief commerical crops.[9] Table 5 gives comparison of average wages. These will be later compared with industrial production and industrial wages. The Livestock Section of State Department of Agriculture operates three breeding stations in Sirur and Indapur talukas. Improved breeds of cows and buffaloes give 2,000 - 3,000 pounds of milk per year. The Poultry Farm near Poona City run by the Poultry Development Section distributes improved breeds of layers. Superior fleece sheep are being introduced in Daund, Purundar, Baramati and Indapur talukas by the Sheep Development Section. An Assistant Registrar is in charge of the Co-operative Department and of Marketing. A Supervision Staff and an Audit Staff work under the Asst. Registrar. Further, a supervising union is formed for every taluka by co-operative socieities registered in that

TABLE 4: COMMERCIAL CROPS, POONA DISTRICT

	Crops 'x' indicates presence in Taluka Market	TALUKAS													
		Junnar	Ambeganon	Khed	Maval	Mulshi	Haveli	Poona City	Velhe	Bhor	Sirur	Daund	Purandar	Baramati	Indapur
Oil Seeds	Peanut	X	X	X						X	X				
	Nigerseed	X	X	X											
	Safflower											X	X	X	X
	Sesamum									X					
	Red Peper	X	X	X			X						X		
Fibers	Cotton														X
	Flax														X
	Jute						X								X
	Sugarcane						X	X				X		X	X
Fruits	Banana	X		X							X	X	X	X	X
	Fig												X	X	
	Grape														
	Mango						X						X	X	
	Orange	X					X				X		X	X	
	Papaya	X					X						X	X	
	Pomegranate						X						X	X	
	Green Vegetables						X	X					X	X	
	Tuber Vegetables	X	X	X											

TABLE 5: COMPARATIVE AGRICULTURAL WAGES, POONA DISTRICT

TALUKAS	Junnar	Ambeganon	Khed	Maval	Mulshi	Haveli	Poona City	Velhe	Bhor	Sirur	Daund	Purandar	Baramati	Indapur
Average Daily wages in Rupees	1.25	1.25	1.25	1.60	2.50	2.50	2.50	1.25	1.25	1.50	1.60	2.00	2.00	2.00

area.[9]

Credit and Multipurpose Co-operatives

There are 328 Agricultural Credit Societies and 34 Multipurpose Credit Societies in operation. Farmers get credit through these societies, money-lenders and Government Land Improvement Loans. It is planned to have one co-operative society per village. It has been suggested[26] that credit should be advanced on the basis of an approved farm plan with assistance and supervision in implementing the plan. A central co-operative bank is further necessary to audit the financial dealings of village co-operatives.[23]

Supply and Marketing Services

Improved seed is distributed through registered seed growers and co-operatives. The Agricultural Department distributes compost manures and oil-cakes. The commercial crops need more supplies of ammonium sulphate and superphosphate. Regulated Markets are necessary to protect individual farmers. Warehousing for farm products is not sufficient, and the interests on credits advanced for warehoused goods are high. There are 130 co-operatives that arrange irrigation through co-operation, but water levy is high.[23]

Processing Co-operatives

Rice milling industry and sugar industry are being run as co-operative ventures. However, there are only three sugar factories, and one rice mill; while oft recommended peanut-oil mills and banana powder plants are still to come into existence.[23] There is also a dirge of cold storage for fruits and vegetables.

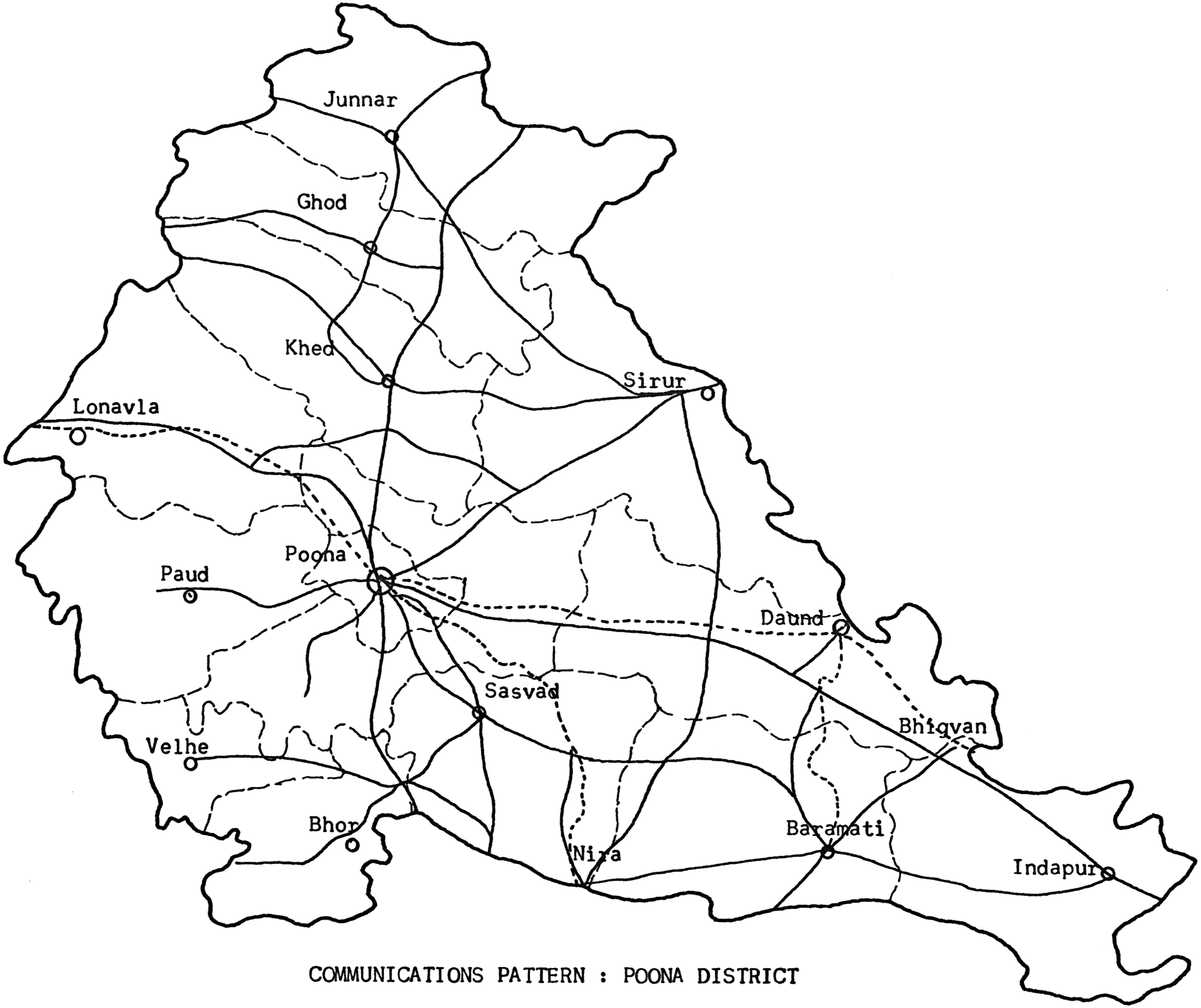
Trade and Transport

Potatoes and plantains are transported along Satara Road and Central Railway to Poona and Bombay respectively. Grapes, figs and mangoes are also sent along these routes. From Sirur, Purandar, Baramati, Indapur and

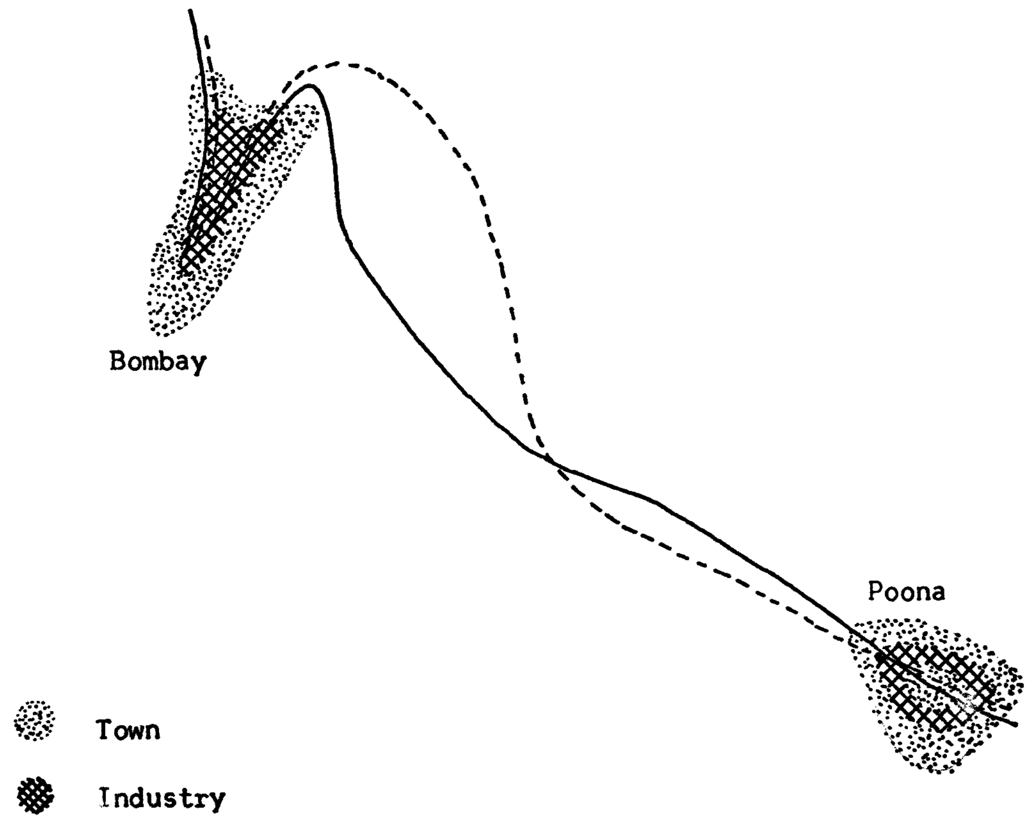
Purandar talnkas are connected to Poona by railway. Highways like Poona-Sholapur, Poona-Nasik and Poona-Bangalore radiate from Poona. There are also district roads like Poona-Baramati and Poona-Satara. Daund city is rail and road junction. Majority of the farmers still use the ox-cart for transport. A few individual farmers and co-operatives own trucks. Wooden implements are being replaced by steel ones. But the use of tractors is mostly limited to co-operative farms. Laws regarding prevention of land-subdivision, prevention of absentee ownership, and land holding ceiling have improved the status of farmers and farming. But much is to be done about farm planning, farm management, extension, organized supplies, credit and warehousing, and processing and marketing of goods. Grading and annual price controls are also necessary. A strange phenomenon is that though the agronomic activity has increased and in some cases intensified, the economic resources of the farmer have not altered much. A revised program needs to be implemented so that its advantages would permeate down to each farmer. The new status will help him help himself and hence raise production. New allied agronomic enterprise is one of the ways of boosting the farmer's resources. Since capital is scarce, use of existing resources for all such endeavors is almost obligatory.

1.6 The Industrial Development of Poona District

The story of the industrial development of Poona District is virtually that of Poona City. Poona's strategic location near two mountain passes has made it a forum of trade over past 2,000 years. The history of the city proper goes back to 800 A.D.[9] The railway link between Bombay and Poona and the pleasant Poona climate (Temperatures: $46^{o}F$ - $106^{o}F$, Precipitation 27". Relative Humidity 57.5)[9] have attracted various industries to Poona since the Industrial Revolution in India (around 1860 A.D.). The present magnitude of



COMMUNICATIONS PATTERN : POONA DISTRICT



COMPARATIVE INDUSTRIAL GROWTH
OF BOMBAY AND POONA

industry is, however, the result of the influx of industries that started in 1950's. The influx was from Bombay, where industrial growth was becoming increasingly unwieldy. One Industrial District and three industrial zones were created around Poona, and industrialists in Bombay were encouraged to locate new ventures in Poona.

The development before 1950's was of industries manufacturing consumer goods. Among these were bakeries, oil and rice mills, household metal utensil factories and rubber goods. The post 1950 industry is chiefly of capital-goods manufacturing nature. Machinery and machine tools are the main products. Also there are factories manufacturing chemicals, electrical appliances, oil engines and sewer pipes. Many of the factories are financed with foreign collaboration. Table 6 gives the industries in Poona District and the wages they give.[9]

The Pattern of Industrial Growth

While Bombay grew around industry Poona was a nucleus around which industry has developed. In both the cases the problems of employee commutation and habitation have not yet been solved. No statistics are available on the percentage of wages and daily hours spent in the travel to work by each worker; but these may be expected to be respectively 8% and 2 hours in Bombay and 8% and 1½ hours in Poona. There is no industrial housing scheme in Poona. The voluntary housing projects in villages are costly, sub-standard and without any neighborhood facilities.

There is an increasing reliance on trucks for goods movement. Traffic moves slowly within city limits since all kinds of traffic (truck, ox-carts, horse-carts, bicycles and sometimes even pedestrians) move on the same road.

TABLE 6[9]

INDUSTRIAL DEVELOPMENT: POONA DISTRICT

Type of Industry	Main Products	Location	Av. Daily Wages*
Biscuit Manufacturing	Cookies, Choclates	Poona	Rs 2-50
Rice Milling	Rice, Barley	Poona	Rs 2-68
Soap	Bar and Grain Soap	Poona	Rs 1-57
Sugar & Brown Sugar	Sugar, Br. Sugar, Denatured Spirit	Baramati Indapur	Rs 1-80
Vegetable Oil	Coconut, Peanut, Safflower Oil	Poona Baramati	Rs 1-59
Aluminum, Brass & Copper	Alloys, Cast Ware, Press Ware	Poona	Rs 3-05
Chemicals & Drugs	Pharmaceuticals, Penicillin Insecticides, Fertilizers	Poona, Haveli Bhor	Rs 2-26
Film	Movies	Poona	Rs 2-66
General & Electrical Eng.	Electrical Appliances, Surgical Instruments	Poona Maual	Rs 2-26
Glass & Glassware	Bottles, Elec. Accessories	Haveli	Rs 1-58
Paper & Board	Writing Paper, News-Print	Haveli	Rs 2-46
Rubber Goods	Toys, Hospital Sundries, Boots	Poona	Rs 1-70
Textile Mills	Cotton & Silk Cloth	Poona, Bhor	Rs 3-85 Expected
Pneumatic & Oil Engines	Pumps, Drills	Poona	Rs 3-85 Expected
Machine - Tool Factories	Machine Tools	Haveli, Mulshi	Rs 3-85 Expected
Sugar - Machinery Man'f.	Refining, Crushing Machinery	Haveli	Rs 3-85 Expected
Cement Pipes	Reinforced Pipes	Haveli	Rs 3-85
Plastics	Toys, Electrical Fittings	Haveli	Expected Rs 3-00

* Include wages of persons other than workers.

Subsidiary Centers of Industry

Industry has grown in three more places recently. Of these Lonavla is on Bombay-Poona rail and road links and has service, paints and egg industry. Bhor is 35 miles south of Poona. Two textile mills, a textile dye factory and small rice mills operate in Bhor. The third center is a small belt along the Nira canals, spread around Baromati, about 50 miles southeast of Poona. The major industry is of sugar manufacture from cane. Three of the factories are in Poona District while two are just south of the southern District Border. Of these the industrial complex at Kalamb is worth mention. There, in addition to the sugar factory the Valchand Hirachand Company runs an extensive dairy, a plastic factory, a distillery, an oil mill, a hydrogenerated oil factory and a soap factory.[9]

1.7 Industrial Location and Locational Patterns

Industrial location is influenced by various factors. The success of any industry depends on the economics of procurement, production factors and marketing. Procurement of raw materials and marketing finished products inter-react through transfer or transport. Proximity of material supply is sought when: 1) they (materials) form bulk of production process; 2) they cannot be replaced; 3) they are perishable; 4) there is weight loss in processing; 5) finished products have low value per unit; and 6) supply of material is steady.[6] These factors are true for almost every agro-industry and hence a proximity of material supply is sought. The energy sources and type of energy required for processing the raw materials are a guiding factor in location. Amounts and types of water, electricity, gas, coal and oil required and the extent of their availability and cost of supply determine the site that will offer the energy in a steady economic flow. Quality and amount of water required for processing, cooling and other purposes is also a deciding element. In Maharashtra there is a shortage of gas and coal so the choice is between oil and electricity of which the present trend in Maharashtra is toward electricity.

Climate has its effect on processing, labor and management. Temperatures, seasonal differences, humidity, air pressure, winds and monotony are to be considered for the climatic requirements of the processes, open storage and operations, heating and cooling costs, labor productivity and easy management.[10] In Maharashtra the temperature range is almost the same in all regions. However, rainfall varies from 250" to 10" or less per year. Both extremes should be avoided.

The next factor is availability of labor. Under this comes the labor market, labor costs, labor stability and labor commutation. Skilled labor is available in the proximity of big cities like Bombay and Poona; but there the labor costs are high, stability is less and commutation problems are on the increase. Agro-industry needs semi-skilled labor for most part; and this is available in small towns where labor costs are comparatively low. Again agro-industry employes a number of women, who would not travel far to a job and this is possible only in small towns. One of the purposes of agro-industry is to employ unemployed labor - including women.

Availability of capital varies regionally. The immovability of capital goods limits relocation. The existence of banks, credit co-operatives and stock markets promises capital and invites location. Individual and private capital is very sensitive to location and locational change. The problem here is only of new location. Private capital should be considered together with co-operative capital; but, whichever be the capital, immediate returns should not be given preference over distant but distinct returns for the economy of the state.

The types and uses of by-products and wastes, market capacity, competing modes of transport, production volume, shifting population, technological changes in means of transport also increases or decreases desirable distance between the industry and the market.[30] In Maharashtra the rail and truck traffic are improving and less time is required to move goods. People are moving to cities for lack of jobs in the countryside.

Having arrived at the proper location for an agro-industrial district the question would arise: in what locational pattern should industry be planned? It has been found that activities thrive best when planned in groups in a metropolitan or regional master plan. A planned industrial district provides better services and a control over industrial nuisance. It retains stability in location and employment. It increases the economic base of the community. In detail the points in favor of industrial districts can be listed as follows:[22]

1. Heavy and continuous lorry traffic in dangerous in residential areas and is better restricted to a zone.
2. Public services such as water, gas and electricity can be more cheaply provided for groups of factories than if they were scattered.
3. Railway sidings and canal and river side access can be more cheaply provided for groups of factories.
4. Steam heating and process steam can be more cheaply provided for groups of factories.
5. Public transport can be more easily provided.
6. Canteens, welfare and sports facilities and medical services can be shared in a group.

7. A display center and club for industrialists where they can entertain their customers can be better designed for a group.
8. Inter-related industries can economize in transport by being close to each other and through interchange of ideas.
9. A handsome grouping helps to advertise every tenant.
10. Grouping is more economical in land because the demand can be averaged out between expanding, declining and static industries and between large, medium and small factories so that the amount of reserve land needed is less.
11. Industrial processes are always changing and an industry which uses impeccable methods today may find it necessary to adopt processes which will be a nuisance to its surroundings; a factory once built may be occupied by a series of tenants each with different processes.

The earlier proposition that the Agricultural Region should have an Agro-industrial District at the hub can be accepted after considering the above points. Then the other part of the proposition that the District be built up of a cellular structure of Agro-industrial Parks should also be accepted. For it is possible to design each of such parks to meet the immediate needs only and to suit the contemporary technological advances, and yet the District on the whole could be ambitiously and ideally planned for many years to come.

The masterplan for the District and for any one Park will depend upon the location and immediate and future needs of the Region. The State of Maharashtra can be expected to develop three Agro-industrial Regions in the west part (around centers of sugar industry) and four in the east (around cattle, cotton and cereals business). Poona District would mainly fall under one of these Regions and will be studied for the location of the Agro-industrial District.

1.8 Trends and Needs in Industrial Growth of Poona District

It has been seen that the major center of industrial activity is in Poona City. Also, it was observed that the new industries chiefly produce machine tools, electrical appliances and instruments and chemicals. The above industries are growing in number, and they illustrate the trend in the types of industries. The trend in the nature of finance is toward collaboration between Indian and foreign capitalists. In location the industry is growing westward from Poona along the Bombay - Poona railway and road; while residential areas are growing southward from Poona.

The above industries are basic to any industrial development and hence their growth is desirable provided provision is made for labor-housing and community-facilities. But there is need for the development of additional types of industry. These are related to the agricultural produce of the District. For example, there are three sugar factories of which only one distills denatured spirit from molasses. There is considerable opportunity for industries manufacturing cane wax, cardboard; and fertilizers and feeds from molasses.[20] Due to increased production of grapes, oranges and bananas there is also a demand for canning of fruits and pickles and for banana-powder plants. Co-operatives have come forward to start rice-mills and vegetable oil-expelling plants. Cold storage and warehousing are badly needed.[23] The dairy industry suffers from unregulated market and unstable prices; to alleviate this 'milk marketing boards' and milk-processing plants are necessary.[9,23] The small scale tanning industry is declining inspite of the fact that 90,000 pelts (kips and buffs) could be produced each year. The reason for this decline may be the lack of finance on part of the individual tanners and unregulated markets.[9,23,29] Poultry farm enterprise is increasing and there are good prospects for poultry - and egg - plants.*[5]

The Intensive Agricultural District Program is developing designs for improved implements for tillage, planting and threshing. Small workshop-cum-factories are necessary to manufacture these implements. Most of the soils need nitrogen, phosphoric acid and potash. Therefore factories to manufacture fertilizers and to mix manurers as well as warehouses for storage should be built.[23,27]

These agro-industries are of crucial importance in the agricultural and general economy of Poona District. Hence it is imperative that all of these be started in as short period as possible. The advantages of planning industries in parks are already discussed. Additional benefits in grouping agro-industries will be discussed later. But it could be said here that it will best to locate these agro-industries in a park or in parks. A master-plan ought to be prepared for such an agro-industrial park in which priority should be given to industries that are urgently needed either to process major agricultural or allied agricultural produce and by-products or to serve as raw materials for these.

An evaluation of "the agricultural economy of Poona District" (1.5) and of "the industrial development of Poona District" (1.6) brings some of the industries mentioned above into a 'top priority list'. The existing and

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* Letter dated 10-23-64 from Dr. Earl N. Moore, Consultant, Poultry & Livestock, the Ford Foundation Intensive Agricultural Districts Program 4. Tolstoy Marg, New Delhi 1, India.

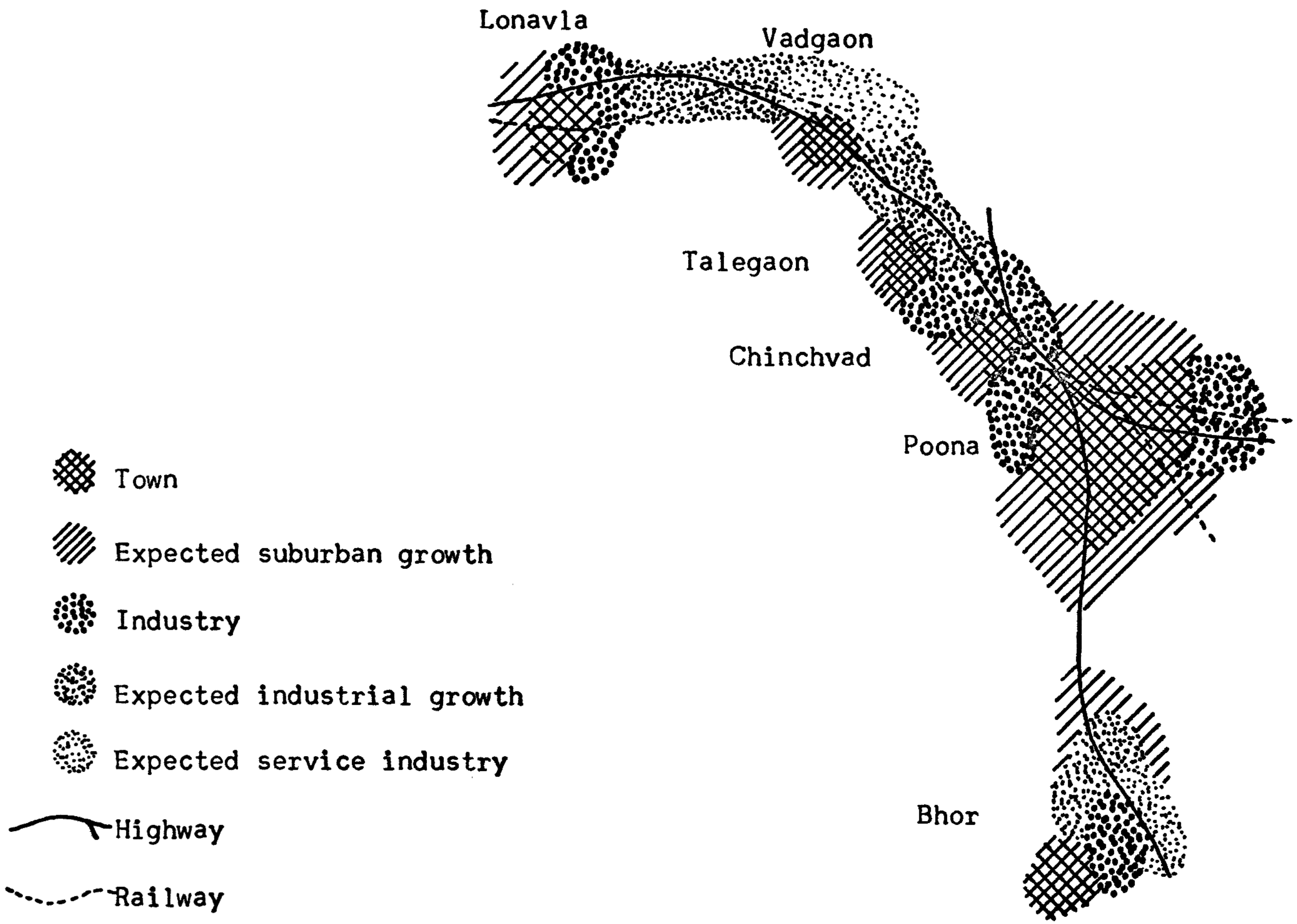
expanding sugar industry, chicken farms and grape, orange and oil-seed culture indicate industries to make use of the by-products and wastes of sugar factories, to manufacture chicken feed and to mix chicken manure, to process eggs, to can fruit juice and to expel vegetable oil. They also call for a workshop-cum-factory to manufacture improved implements for agriculture. Next to these in importance come factories to manufacture and mix fertilizers, plants to process milk and the tanning industry. The third and final phase of the master plan will provide for expansion of first-phase industries and for allied ventures. Thus in the final phase in addition to the chicken-feed and chicken-manure mixing plants there will be operations like cattle feed mixing and rice and sorghum milling: the egg plant will expand to include an evisceration plant; the oil-mill may start either hydrogenating oil, or manufacturing margarine or soap, the implement factory will expand to manufacture larger machines; while the milk plant may go in for milk products and a leather business may evolve out of the tannery.

Each phase of the master-plan will have to provide for adequate and flexible warehousing, transport, housing and other civic facilities.

Now, before tackling the problem of location the question of assured supply of raw materials arises. The supply in this case is mostly the product of agricultural and allied-agricultural enterprise. Since individual resource (capital) formation is slow the existing co-operative societies have to serve as the basis to a hypothesis:

<u>The Intensive Co-operatives Districts Program.</u>

This program will cover existing and new co-operative societies. The basic principle will be that of Kaira Milk Scheme in Gujrat State where co-operatives regularly supply milk to the milk plant at Anand. Contracts will



GRAPHICAL LOCATION ANALYSIS, 1: POONA DISTRICT

one inch = ten miles

be drawn between the factories and such co-operatives whereby oil seeds and fruits, eggs, chicken and milk will be supplied by co-operatives to conform with the grades and market demands and at fairly stable prices. Individuals with adequate resources may also enter in similar contracts with the industries. These individuals and mainly the co-operatives will hold shares in the inudustries, though the co-operatives or individuals launching the industries may be different.

Locational Problems

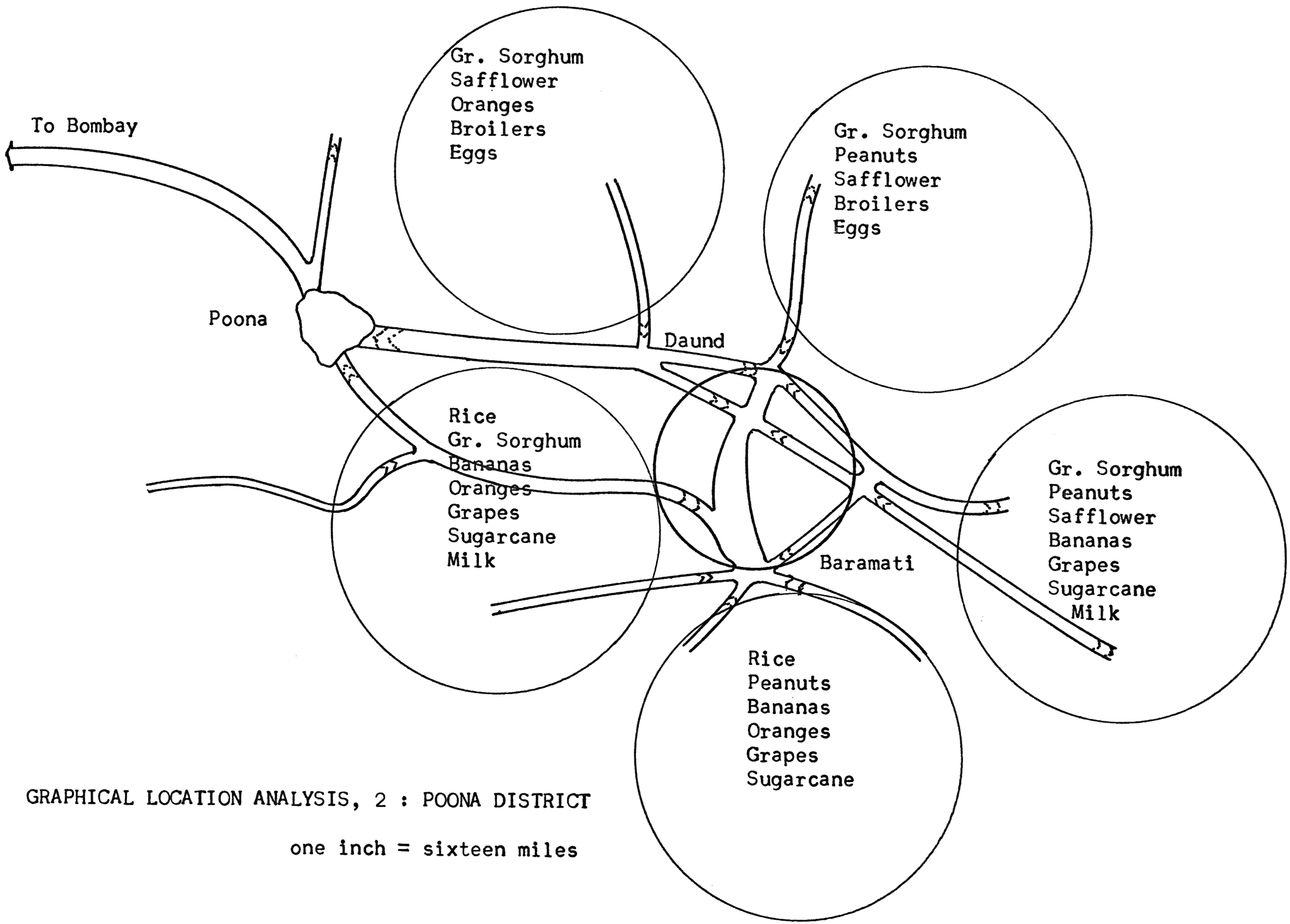
As far as the preference of the financiers for a particular location goes any location in the District will be as good as other; since the finance will be by co-operatives, sponsored by the State Government.

It was indicated earlier that there are three possible choices of location, namely: Lonavla, Bhor and Baramati; Poona proper being precluded as there are 'industrial estates' (parks) already in operation there. These three will be examined for merits in i) weather, ii) supply: material and labor iii) services iv) transport and market and v) civic implications.

It rains 150" per year in Lonavla, and this suggests (together with the mountainous terrain of the place) a location east of Lonavla, say at Vadgaon. Of the raw materials supply of rice is assured, also there is a big egg farm near Lonavla, Labor will be available mostly from Lonavla, with a higher wage rate though, since the maintenance of the Bombay-Poona railway and road through the mountain pass is a major employment. The supply of hydro-electricity and water will be ample. Repairs and part-replacement of machinery will be easy because of the proximity of Chinchwad Industrial Estate. The railway and the Bombay-Poona road certainly give easy and quick transport, they also bring the markets of Bombay and Poona within easy reach. The type of the park calls for a considerable (big) area of activity, which would eventually attract population and service industry. The danger is that of a development similar to 'ribbon development'. Since duplication of facilities is not feasible for many years commutation for school, supplies and entertainment by the people to Lonavla is inevitable. This would in turn result in congestion on the Lonavla-Poona rail and road service.

Bhor has textile and chemical industries and is on the south border of the District. The weather is similar to Poona and suitable to industrial development. The main supply is again of rice. Population is about 9,000. Hence labor is dear as there is already employment and jobs in textile mills are better paid. Supply of hydro-electricity and ample water is available. There is no rail connection between Bhor and Poona, though the road transport is good. This will be a good location to attract population from Poona. But the present industries and the raw materials and labor available suggest that a type similar to the existing industry should be encouraged here: with the possible exception of a rice-mill.

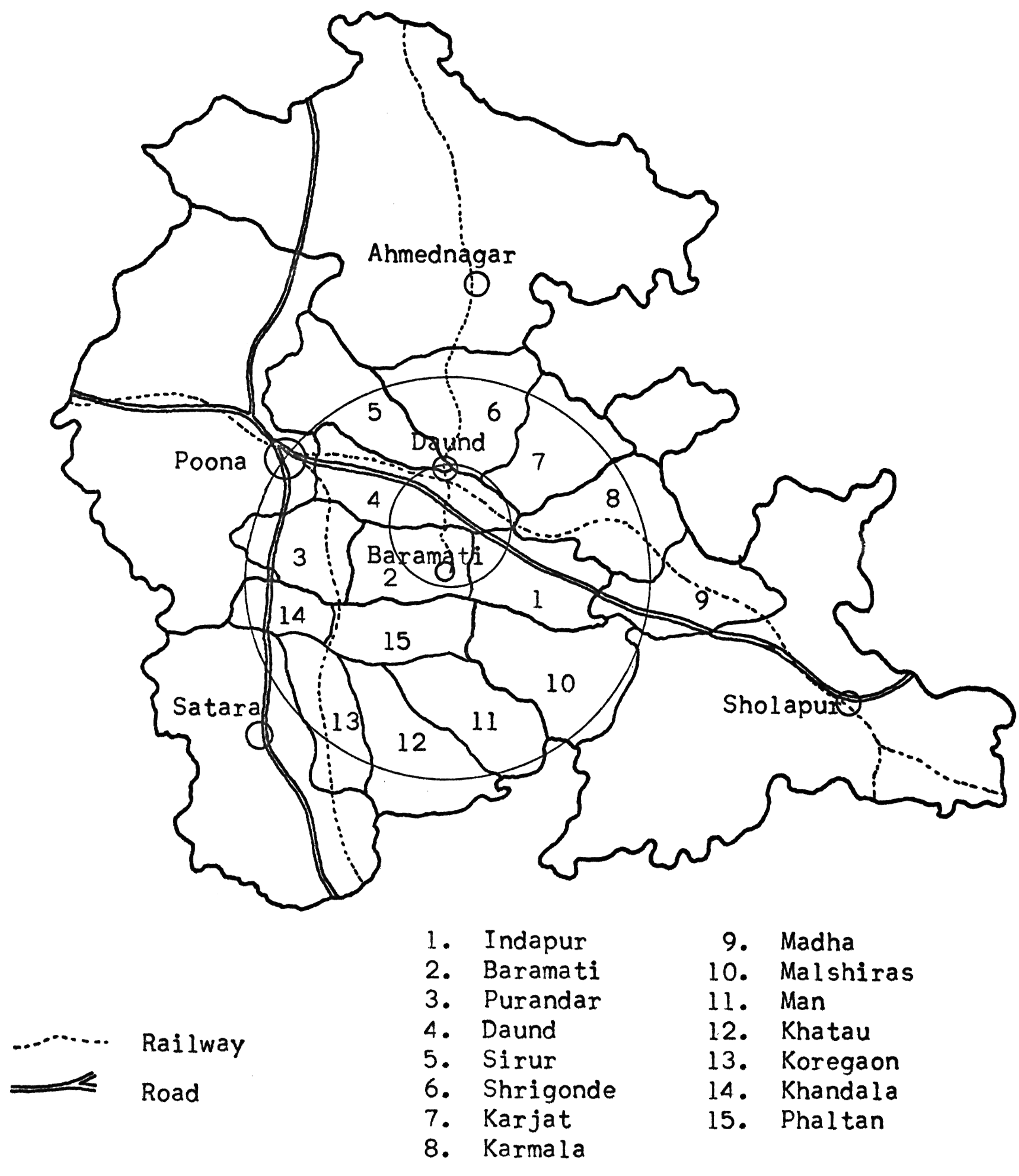
It rains about 20" per year in Baramati and the climate is fairly dry. Temperatures range from minimum 40^{o}F in winter to maximum 105^{o}F in summer. The diagram shows Baramati as an approximate center of the agricultural activities. In fact it is a market where most of the products cited are assembled.[3] The diagram also shows the locations of sugar-factories. As earlier mentioned one of these factories has launched some other agro-industries as well, proving thereby that there is potential for such industries in this area. Looking at the map of Maharashtra and the increasing number of sugar factories, the three sugar-factory - centers could be expected to be the centers of future agro-industrial activity as well. Population of Baramati



GRAPHICAL LOCATION ANALYSIS, 2 : POONA DISTRICT

one inch = sixteen miles

AGRO-INDUSTRIAL REGION AND DISTRICT FOR POONA DISTRICT

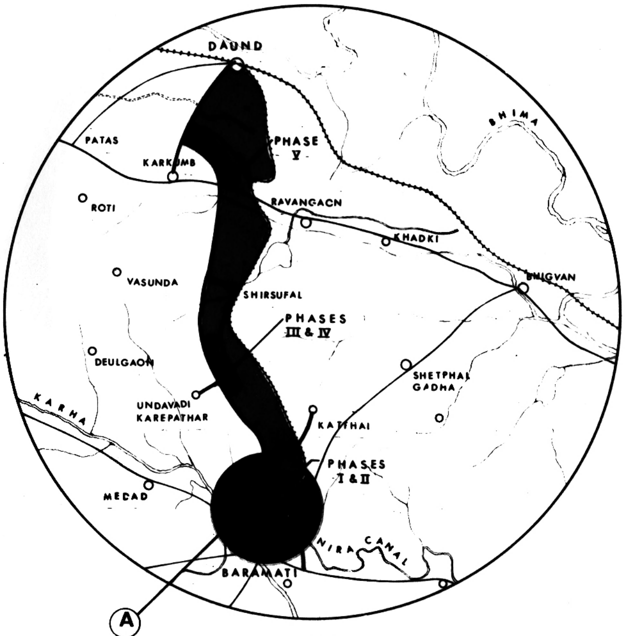


1. Indapur
2. Baramati
3. Purandar
4. Daund
5. Sirur
6. Shrigonde
7. Karjat
8. Karmala
9. Madha
10. Malshiras
11. Man
12. Khatau
13. Koregaon
14. Khandala
15. Phaltan

is about 25,000, and though there is industrial employment to the south of the town labor is cheap compared to that in the vicinity of Poona, Lonavla and Bhor. The influence-area shown to the Northeast of Baramati (out of Poona District) in the State map is known as 'drouth area' as it is subject to dry years. Employment opportunities are badly needed in this area. Services of electricity and water are available, though arrangement for sewage disposal will have to be made. There is a narrow gauge (2'-6") rail track between Baramati and Daund; Daund is a junction. If the 'park' is located in this area, this track will have to be made broad-gauge when the master-plan reaches its second phase. There is road-transport between Baramati and Poona; but for quicker transport the road linking Baramati with the Poona-Sholapur highway will eventually have to be widened. The revenue of Baramati is, even today, better than that of any other town of equal size in the District. There are complete schooling facilities. A 'park' in the vicinity will enhance the revenue further and additional civic facilities could be planned for the consequent increase in population.

Comparing the relative merits a location near Baramati seems logical.

(A letter from the Industries Commissioner, Directorate of Industries, Maharashtra Government, dated January 21, 1965, gives the following information: For an industrial park near Baramati electricity can be provided from Koyna Hydro-electricity and water can be lifted from Nira left Bank Canal. In fact the Government has decided to set up an industrial estate near Baramati.)



PROPOSED
BARAMATI DAUND AGRO-INDUSTRIAL DISTRICT

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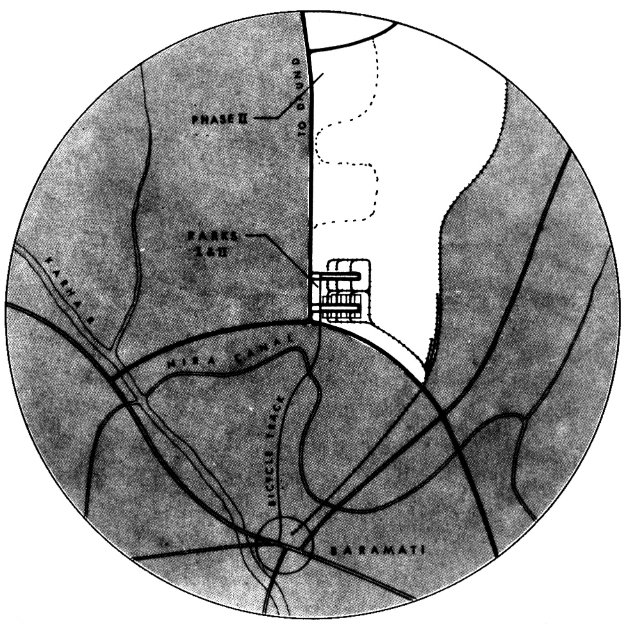


DETAIL (A)

0 ½ 1 MILES

P A R T II

A DEMONSTRATIVE SOLUTION

PLANNING AN AGRO-INDUSTRIAL PARK

2.1 A Comprehensive Plan

Baramati is the headquarters of sugar business in that part of Poona District. It is also the main market for fruit and grain so the Agro-industrial District can start from Baramati. The district south and west of Baramati should be marked off as Agricultural Region for the obvious reason that it is most profitably cultivated. A development eastward from Baramati would be going away from the Poona market. But a development northward toward Daund will be desirable for Daund is a junction of rail and road traffic and the final, much bigger pahse of the Agro-industrial District will be best located near Daund. So then there will be three zones proceeding in parallel from Baramati to Daund: the residential, the industrial and that of the research farms. Since the prevailing wind direction is from west the dormitory towns in the residential zone should be to the west of the 'parks' and the 'research farms' should be east of the 'parks'; since the farms may accommodate ranches and stables, poultry batteries and experimental sections for sewage treatment and manure application.

The plan for the Agro-industrial Park will be based upon: the number and sizes of industries that will finally occupy the park, the number and shifts of employees, manufacturing processes, utilization of by-products and wastes, material handling methods, required warehousing facilities, modes of employee-transport and the location of administrative, utilities and service facilities. Zoning within the park is essential to make the best use of the land. The park will be divided into the following zones:

1) Administration and public relations

2) Employee facilities and parks

3) Management of utilities and services

4) Odorless factories

5) Factories with odor possibility

(Factories with dust problems will have dust-absorption systems, hence no special zone for them)

6) Truck and bus depots

7) Easements for railway

Restrictive covenants and lease restrictions

Restrictive covenants generally apply to the use of the land, to specific improvements and to uncovered property-lease restrictions usually related to the good maintenance by the tenants, rules regarding alterations and additions, and regarding use of the building for specific purpose, prohibition of sub-letting, refuse dumping, and letting oil, grease or other deleterious matter (to) enter the drains. The management may also specify rules regarding truck-loading and parking. Architectual standards are given when factories are to be built by tenants. It is more economical to build the factories and lease them; it is also easier this way to control the design. So this latter method will be followed.

Layout of the Park

The park is expected to be owned by the government and leased to co-operatives and individual entrepreneurs. It will also serve as a prototype, so it will be planned to be economically ideal. In the industrial estates in India the ratio of plot area to covered area is usually 1.5:1; however the United Nations Mission recommends 4:1 ratio. So the latter ratio will be aimed at. This will allow 100% expansion for most of the factories. Gordon Logie has recommended a plot subdivision whereby the boundaries between two lots can be flexible to allow lateral expansion.[22] This park will provide for expansion within the lot and development of sister enterprise on the neighboring lot.

Roads, parking and trucking

Less than 1% of the working population is expected to travel by car. The Park will be within 2 miles of residential area and it is assumed that 60% of the people will use bicycles. A segregation between pedestrian, bicycle, car and truck, and rail traffic will be attempted. Naturally separate provisions will be made for bicycle and car parking, truck docks and rail docks. Each factory will be provided with truck and rail docks.

The design of the park is diagramatic to the extent that in the absence of availability of contoured maps a rectangular level plan is adopted. The nature of traffic crossings and grouping of vegetational masses are therefore schematic; in actual plan they must relate to the contours and land forms. The juxtaposition of various activities and their inter-relationship are factual, since they are designed for a specific location.

2.2 Data Analysis

The statistical data about agricultural production in Maharashtra cannot be found in detail. Considering the present methods of transport a region of roughly 50 miles radius circle is chosen to represent an agro-industrial region with Baramati as its center. A total of 15 talukas from 4 districts fall within this region. In the absence of availability of complete production records for these talukas the information in Table 7 was constructed from different statistical tables.[2] Hence it is only a rough guide for determining expected industries and their sizes. The minimum feasible size of any industry is a better determinant in such a case. The industries mentioned in Chapter II are given preference in this park for they are needed and the agricultural activities in the region can support them.

TABLE 7: AGRICULTURAL PRODUCTION IN THE AGRO-INDUSTRIAL REGION (All figures in hundreds)

Talukas	PRODUCTS										
	Rice	Gr. Sorghum	Millet	Peanut	Safflower	Banana	Orange	Grape	Sugarcane	Cow Milk	Buffalow Milk
	Tons									Pounds	
1. Indapur	5.1	324	21.3	4.1	23	6	8	9	305	320	120
2. Baramati	11.4	279	35	2	19	6	40	9	380	303	132
3. Purandar	12.6	156	63	3.5	--	2	48	18	40	220	108
4. Daund	2	292	20.8	2.8	21	2	24	4.5	48	280	54
5. Sirur	1	227	71	---	25	1	64	----	22	360	48
6. Shrigonde	1.6	356	31	3.4	37	1	16	4.5	33	400	60
7. Karjat	2.4	319	18	5.2	28	2	3	0.5	15	300	42
8. Karmala	3.6	329	22	26.4	37	4	1	0.5	11	310	90
9. Madha	5.1	381	11	41.5	37	12	--	----	22	380	180
10. Malshiras	5.1	242	33	17.5	9	6	8	9	532	343	138
11. Man	2.8	41	134	3.4	2	5	1	1	18	243	108
12. Khatau	31.4	72	141	35.6	2	4	5.6	----	18.6	264	276
13. Koregan	2.4	108	43	64.5	4	6	16	1	11	184	293
14. Khandala	5.9	50	34	5.5	2	2	5	0.5	3	100	54
15. Phaltan	9	184	51	3.4	9	6	16	4.5	323	260	120
Total	101.4	3360	729.1	218.8	255	65	255.6	62	1782	4267	1823

TABLE 8

POULTRY INDUSTRY: SUPPLY AND REQUIREMENTS

Item	Amount per week	Amount per hour
Broilers	53,500 no.	1,100 no.
Eggs	1,536 cases	32 cases
Feed reqd.	648 tons	13.5 tons
Manure yield	600 tons	12.5 tons
N 2.1%	1.91 tons	
P_2O_5 6.2%	5.93 tons	
K_2O 3 %	2.86 tons	

TABLE 9

FEED COMPOSITION: LAYERS

Ingradient	Pounds	Protein	Calcium
1) Rice Polishings	14	1.54	0.005
2) Sorghum Gluton Feed (24%)	10	2.40	0.015
3) Greens	5	0.75	0.065
4) Dried Citrus Pulp	10	0.60	0.190
5) Wheat Middlings (16%)	7	1.12	0.070
6) Wheat Bran	5	0.75	0.050
7) Peanut Meal (45%)	5	2.25	0.008
8) Safflower Meal (22%)	15	3.30	0.037
9) Fish Meal (60%)	3	1.80	0.150
10) Molasses (10%)	10	0.30	0.050
11) Brewers Molasses Yeast	4	1.08	0.003
12) Ground Limestone	4	----	1.520
13) Steamed Bone Meal	3	----	0.720
14) Penicillin Mycelinm	5	----	-----
Target	100	15.00	3.00
Actual	100	16.20	2.883

Poultry industry is new in Maharashtra, also it is growing in a disciplined way. But production data is not available. Hence certain assumptions were necessary to arrive at some quantity of supply of broilers and eggs. It was assumed that each of the 15 talukas start 12 small (6,000 birds) poultry farms, making a total of 180 farms. Half of these produce broilers and the rest eggs. If each of these farms had one weeks start over the other the total production, feed requirements and supply could be as listed in Table 8.. Even manure quantities are worked out, for this can be used in future for cattle feed mill and for soil-building. Table 9 indicates feed requirements. One of the objectives of the park is to utilize by-products within the park. Hence a layer-feed analysis was made to see how many of the by-products in the park can be used for feed and in what quantities. Only layer-feed formula was worked out since this study deals with Egg Drying Plant in detail later on. It should not be difficult to adjust the feed mill to broiler-feed when the need arises.

Another plant that is studied in detail is the Milling Complex. It is for milling rice, grain sorghum and layer-feed and for pressing oil from peanut and safflower. Of these the Feed Mill is designed to meet feed demand of layers and broilers. The remaining mills are designed on the minimum scale to provide as far as possible enough by-products for the feed mill.

The First Phase of all plants in the park starts at the minimum profitable size, and on one shift basis. In the Second Phase they will run three shifts. And in the Third Phase they are expected to double the production area. These factories are planned in two zones as mentioned earlier. The remaining zones are also planned in three phases. Table 10 gives a three phase schedule of industries and other facilities in the park. Building areas for Milk Plant

TABLE 10: PHASED SCHEDULE OF INDUSTRIES, AGRO-INDUSTRIAL PARK 1, BARAMATI-DAUND AGRO INDUSTRIAL DISTRICT

PHASE I: 1965-70 A.D., PHASE II: 1970-75 A.D., PHASE III: 1975-80 A.D.

	D A I L Y	V O L U M E	H A N D L E D							Building Area			Site Area	No. of Persons			Site Area
	Raw Material			Finished Product			By-Product or Waste			Sq. Ft.			Sq. Ft.	Employed			Bldg. Area
Phase:	I	II	III	I	II	III	I	II	III	I	II	III		I	II	III	III
TYPE																	
Milk Plant	2,000 Gal.	5,000	10,000	2,000	5,000	10,000				9,300	9,300	18,600	66,000	30	40	60	3.55
Margarine Plant	2 Tons	4	6	2	4	6				9,300	9,300	18,600	66,000	10	20	30	3.55
Peanut Oil Mill	8 Tons	12	24	800 Gal.	1,200	2,400	4 Tons	6	12					8	16	20	
Safflower Oil Mill	8 Tons	12	24	800 Gal.	1,200	2,400	4 Tons	6	12					8	16	20	
Rice Mill	12 Tons	24	--	9 Tons	18	--	3	6	--	32,986	32,986	44,972	158,400	10	20	--	3.50
Sorghum Mill	16 Tons	48	96	15	45	90	1	3	6					10	20	30	
Feed Mill	30 Tons	90	180	30	90	180	-	-	--					10	20	40	
Manure Mixing Mill	30 Tons	90	180	30	90	180	-	-	--	9,300	16,000	24,800	88,000	10	20	40	3.55
Paper Board Mill	30 Tons	50	100	27	45	90				9,300	16,000	24,800	88,000	20	30	60	3.55
Broiler Plant	2,000 Birds	4,000	8,000	2,000	4,000	8,000	0.5 Tons	1.0	2.0	9,300	9,300	18,600	66,000	20	30	60	3.55
Fruit Juice Plant	16 Tons	20	40	12	15	30	4	5	10	9,300	9,300	18,600	66,000	20	30	60	3.55
Egg Drying Plant	250 Cases	750	1,500	2.84 Tons			0.25	0.75	1.5	9,300	9,300	18,600	66,000	30	60	120	3.55

TABLE 10: CONTINUED

	DAILY VOLUME HANDLED									Building Area			Site Area	No. of Persons			Site Area
	Raw Material			Finished Product			By-Product or Waste			Sq. Ft.			Sq. Ft.	Employed			Bldg. Area
Phase:	I	II	III	I	II	III	I	II	III	I	II	III		I	II	III	III
Banana Powder Plant	4 Tons	8	16	2	4	8	2	4	8	9,300	9,300	18,600	66,000	30	40	60	3.55
Agro-Implement Factory	1 Tons	2	3	20 Units	40	60				9,300	9,300	18,600	88,000	20	30	50	4.73
Leather Finishing Factory	40 Pelts	60	100	40	60	100				9,300	9,300	18,600	88,000	30	60	100	4.73
Cafeteria (each)	100 Persons				150				200	3,200	4,000	6,000	36,000	20	30	40	6.00
Child Care Center	30 Children				40				80	2,000	3,000	6,000	36,000	2	3	6	6.00
Administr'n& Maint. Bldgs										8,000	16,000	22,000	80,000	80	130	240	3.55
Laboratory										3,200	4,000	6,000	36,000	10	15	30	6.00
Guest House	5 Guests				10				18	2,000	3,000	5,000	20,000	4	6	8	4.00
Power Plant	450 Horse Power				450				1,250	2,700	2,700	5,400		10	15	30	
Water Tower	60,000 Gal.				80,000				150,000	900	900	1,800	60,000				8.35
														Total		1,104	4.42 Gross

and Chicken Plant were derived from bulletins published by United States Dept. of Agriculture. Areas for the Cannery and Banana Powder Plant were approximated from correspondence with FMC International of San Jose, California. The space requirements for the Paper Plant and the Tannery were deduced from descriptions in books: Industrial Architecture and Industry in Town respectively.[22,25] The Fertiliser Mixing Plant will be similar in operation to the Feed Mill, hence is expected ro have similar space requirements. The number of employees in each case is worked out on the basis of work-stations and area of each plant. The building by-laws in Maharashtra stipulate 1 latrine for every 25 females or males and 1 urinal for every 50 males. It also states that 12 sq. ft. area per worker should be provided in factory lounge and that cafeteria accommodation for 30% of workers of largest shift at the rate of 10 sq. ft. per persons shall be provided.

Space requirements within Egg Plant and Milling Complex were arrived at from the following analysis.

<u>Egg Plant</u>

Process Flow Design

a. Productive capacity : 250 cases 1 day to 750 cases 1 day

Future : 1,000 cases 1 day to 1,500 cases 1 day

b. Types of products : Dried Whole Eggs

Future : Dried - Whole Eggs, Yolk, Albumen

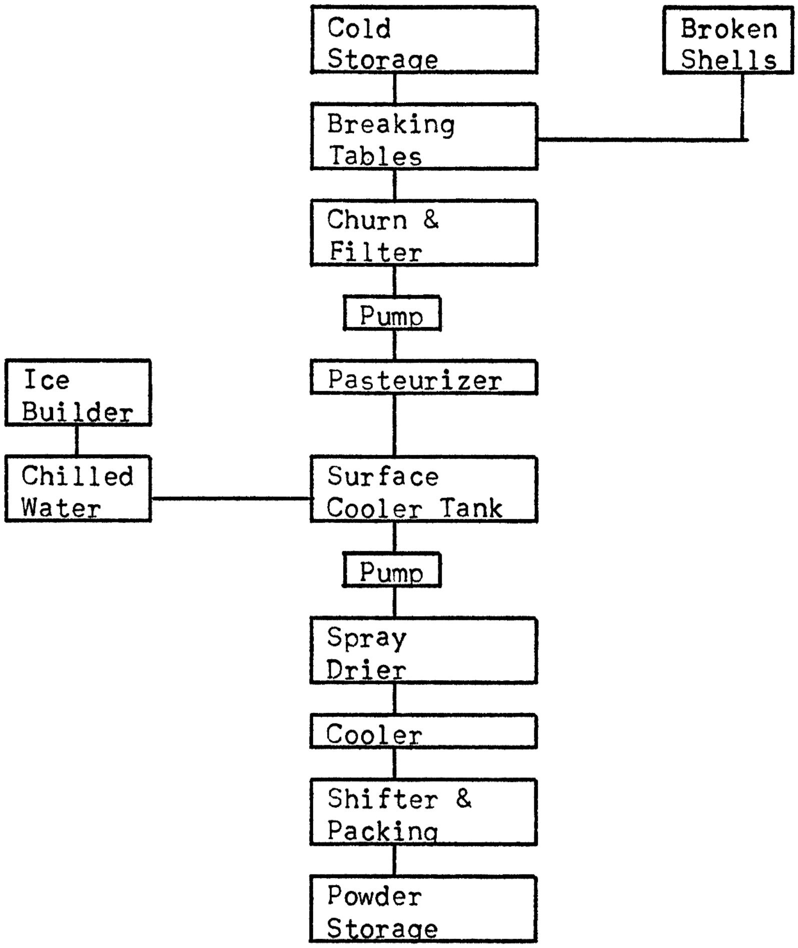
c. Shell Egg Receiving Description : Three foot by four foot pallets to handle 30 cases of eggs.

d. Transportation for Egg Receiving :

70% by truck, 20% by rail, 10% by bicycle rickshaw

e. Market Demand : 100% drums

FLOW DIAGRAM: EGG DRYING PLANT



f. Finished Product Method of Transportation :

70% by truck, 30% by rail

g. Normal Backlog : 10 days, 2,500 cases

Cooler area @ 2.5 cases per sq. ft. should be 1,000 sq. ft.

At 70% occupancy factor gross cooler area = 1,430 sq. ft.

h. Method of Breaking : Hand breaking, 1.5 cases 1 hour 1 woman

Therefore number of women = 22 say, and number of tables = 11

i. Liquid Yield : 39.5 lbs. 1 case or 39.5 X 33 (cases 1 hour) = 1,300 lbs. 1 hour

j. Blending and Filtering : Combination churn and filter

k. Liquid Storage : 800 gallon refrigerated surface tank

l. Pasteurizer : 2,000 lbs./hour pasteurizer

m. Drying : Marriott Walker Spray Drier

n. Cooling and Shifting : 350 lbs./hour

o. Powder Storage : 2,840 lbs./day

Handbreaking for eggs is given preference over machine-breaking though the latter is faster. Labor is cheap in Maharashtra, while a breaking machine will have to be imported and its cost will be prohibitive. But all the processes after breaking are mechanized and spray-drying is adopted over shelf (or tunnel) drying to ensure maximum sanitation and product recovery.

Rice and Sorghum Mill[7,24]

Process Flow Design

a. Productive Capacity : Rice : 12 tons, Sorghum : 16 tons

Future : Rice : 24 tons, Sorghum : 48 tons

b. Types of Products :

Whole grain rice, half grain rice, broken rice, hulls, bran, polish Sorghum atta 1, atta 2, gluten, bran

c. Grain Receiving Description : 60% bulk, 40% sacked

d. Transportation for Grain Receiving :

40% truck, 40% rail, 20% ox-cart

e. Market Demand :

60% bulk, 40% sacked

f. Finished Product Method of Transportation :

50% truck, 30% rail, 20% ox-cart

j. Bins Storage :

Inbound :

Rice : 250 days, 4,000 tons - 4 silos, 30 foot diameter, 87 foot high

: 24 hour bins - 3 bins, 6 foot diameter, 22'-10" high

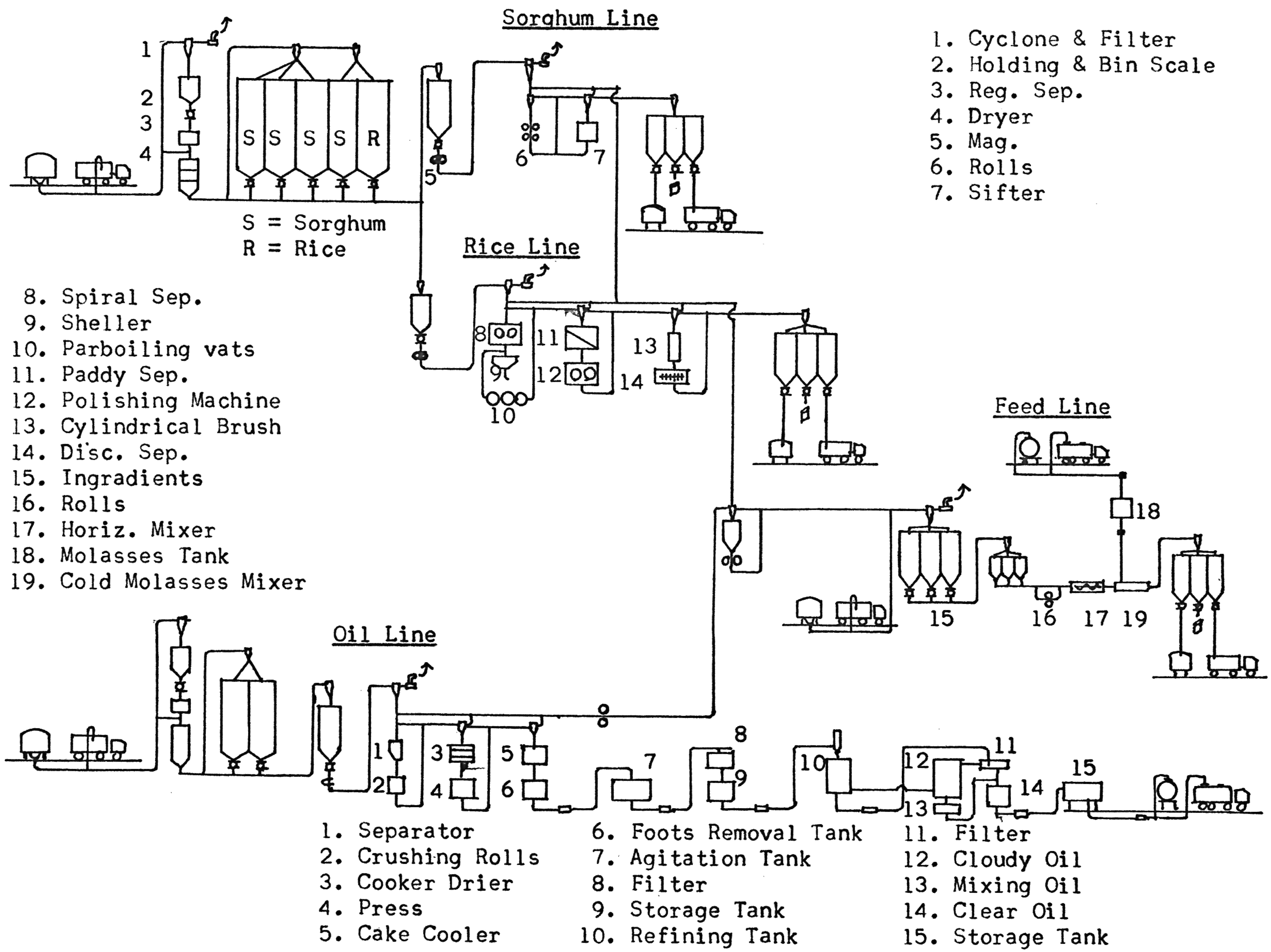
Sorghum : 250 days, 13,000 tons - 14 silos, 30 foot diameter, 87 foot high

: 24 hour bins - 4 bins, 6 foot diameter 22'-10" high

Outbound :

Rice : 50% whole grain - 6 tons - 7 days - 42 tons - 4 bins, 6 foot diameter, 22'-10" high

15% half grain - 1.8 tons - 7 days - 12.6 tons - 1 bin, 6 foot diameter, 22'-10" high



FLOW DIAGRAM : MILLING COMPLEX

5% broken rice - 0.6 ton - 7 days - 4.2 tons - 1 bin - 6 foot diameter, 22'-10" high

25% hulls + bran mixture - 3 tons - 7 days - 21 tons - 4 bins, 6 foot diameter, 22'-10" high

Sorghum : 60% atta 1-30 tons - 1 day - 30 tons - 3 bins - 6 foot diameter, 22'-10" high. 2 silos, 30 foot diameter, 87 foot high.

30% atta 2-15 tons - 1 day - 15 tons - 2 bins - 6 foot diameter, 22'-10" high.

5% bran - 2.5 tons - 7 days - 17.5 tons - 3 bins - 6 foot diameter, 22'-10" high.

Peanut - and Scafflower Oil Mill[18]

Process Flow Design

a. Productive capacity : Peanut oil 2.5 tons/day

Safflower oil 2.5 tons/day

Future : Peanut - 5 tons/day

Safflower - 5 tons/day

b. Types of Products : Peanut oil, Safflower oil

Peanut cake, Safflower cake

c. Grain Receiving Description : 60% bulk, 40% sacked

d. Transport for Grain Receiving :

40% truck, 40% rail, 20% ox-cart

e. Market Demand : 100% bulk

f. Finished Product Method of Transport

60% tank trucks, 30% rail, 10% tank-carts

j. Bins Storage :

For 36% oil factor

Peanut : 8 tons/day - 225 days - 1,800 tons - 2 silos - 30 foot diameter, 74 foot high

24 hours bins - 2 bins - 6 foot diameter, 22'-10" high

Safflower : 8 tons - 225 days - 180 tons - 2 silos - 30 foot diameter, 74 foot high

24 hours bins - 2 bins - 6 foot diameter, 22'-10" high

k. Oil Storage :

800 + 800 gallons/day - 1 days - 2 tanks 800 gallons

\- 2 tanks 20,000 gallons

Feed Mill : Process Flow Design

a. Productive capacity : 30 tons/day to 90 tons/day

Future : 120 tons/day to 180 tons/day

b. Basic Formula Diversification : 6 formulas

c. Types of Feed Manufactured : 100% poultry

Future : 80% poultry, 20% cattle

d. Texture of Feed : 100% mash

Future : 80% mash, 20% crumbles

e. Ingradients Receiving Description : 100% soft

Future : 80% soft, 20% grain

f. Method of Ingradient Receiving :

80% bulk, 20% sacked

g. Transportation for Ingradient Receiving :

44% pneumatic, 26% truck, 20% rail, 10% ox-cart

h. Market Demand :

60% bulk, 40% sacked

i. Finished Product Method of Transportation :

60% truck, 30% ox-cart, 10% rail

j. Operation Inventory :

Rice polishings	14%, 7 days, 29.4 tons, 1 bin 12 ft. dia. x 33.6 ft. high
Sorghum gluten feed	10%, 7 days, 21 tons, 1 bin 12 ft. dia. x 33.6 ft. high
Greens	5%, 10 days, 15 tons, 1 bin 12 ft. dia. x 33.6 ft. high
Citrus pulp (dried)	10%, 7 days, 21 tons, 1 bin 12 ft. dia. x 33.6 ft. high
Wheat Middlings	7%, 10 days, 21 tons, 1 bin 12 ft. dia. x 33.6 ft. high
Wheat bran	5%, 10 days, 15 tons, 1 bin 12 ft. dia. x 33.6 ft. high
Peanut oil meal	5%, 5 days, 7.5 tons, 1 bin 12 ft. dia. x 12 ft. high
Safflower oil meal	15%, 5 days, 22.5 tons, 1 bin 12 ft. dia. x 33.6 ft. high
Ground limestone	4%, 10 days, 12 tons, 1 bin 12 ft. dia. x 12 ft. high
Fish Meal	3%, 10 days, 9 tons, 1 bin 12 ft. dia. x 12 ft. high
Brewer's yeast	4%, 10 days, 12 tons, 1 bin 12 ft. dia. x 12 ft. high
Steamed bone meal	3%, 10 days, 9 tons, 1 bin 12 ft. dia. x 12 ft. high
Penicillin Mycelium	5%, 10 days, 15 tons, 200 sq. ft.
Molasses	10%, 10 days, 30 tons, 1 tank 5,000 gallons

It was decided to adopt a single storeyed construction for the factory areas in the Milling complex. Because the single storeyed construction has the following advantages over the multi-storeyed type:

The single storeyed mill is cheaper; it takes less area; and it is more flexible.

The Feed Mill will utilize banana peel from the banana powder plant in third phase when it will mix cattle feed in addition to chicken feed. The filtered sludge from the oil mill will be pumped in that phase to the feed mill.

Through the entire milling complex Buhler Fluidlift Penumatic Conveying System will be adopted. Pneumatic conveying has many advantages over conventional conveying system. It usually needs more power. But in favorable instances a Fluidlift requires only 25% as much power as a suction type pneumatic system. This system claims to have the following advantages: Each conveying line has its individual blower. Hence it is easy to regulate pressure automatically.

It is sanitary; no possibility of infestation.

Only 1/15 to 1/20 of the amount of air is required in a suction-type pneumatic system.

Different products can be conveyed through the same line.

Storage bins can have very flat piling angle.

Erection is simple because of small diameter of pipes and simple design.

2.3 General Considerations

The Data Analysis revealed that space requirements for various factories within the park did not vary to a great extent. It also brought out that some industries needed hot air for processing - like the egg and banana drying plants, while others, like milk plant, broiler plant, cannery and margarine factory needed chilled water. It was decided to plan for equal size lots as far as possible and to group factories of similar utilities where practicable. The nature of grouping is also affected by the interdependability of plants. The feed mill utilizing rice polish, sorghum gluten, and oil cakes needs to be close to all these mills. Again it is desirable to locate the cannery close to the feed mill as the former supplies dried citrus pulp to the latter. The margarine factory has to be close to the oil mill with a feed from milk plant. Also it is necessary to transfer banana peel from banana plant and waste from broiler plant to the feed mill through least possible distance.

During the first and second phase of the park individual laboratories for each of the factories would not be economical. Hence a central laboratory to serve all the plants is planned. In the third phase the factories will have their own laboratories and the central laboratory will then carry on research for the research farms. Two central cafeterias to cater all the plants through all phases are planned so as to be within 400 feet walking distance from any one plant. These are placed in a 'green' - a park-like strip where only bicycle and pedestrian traffic is allowed. Bicycle parking and a child care center (creche') for the babies of working women are located in the same strip. Weighing facilities for all trucks are provided in the truck depot. Administrative building, guest house, health center and union, and physical plant with water tower are planned in one zone, while the paper mill, the tannery and the waste filtration plant are grouped on the leeward side of the park. A bus depot is planned near the entrance of the park. Buses will commute between Baramati and the park and later on also between the new dormitory town and the park.

One purpose of planting is to 'scale down' the tall grain elevator forms and relate them to human scale. Indigenous plant material will be used. Tall trees with wide spread like neem (Azadirachta indica A Juss.), peeple (Ficus religiousa L.), siris (Albizzia labbak Benth.) will be planted to balance the towering effect of the grain elevators. The approach avenue to the park can be flanked by umbar (Ficus glomerata Roxb.) and vad (Ficus bengalensis Linn.), Ambia (Magifera indica L.), bakul (Mimusops elengi L.), bahra (Cassis fistula L.) and shindi (Phoenix sylvestris Roxb.) will go in the administrative zone. Apta (Bauhinia racemosa Lam.), palas (Butea monosperma O. Ktz.), bondal (Lagerstroemia lanceolata) and pangara (Erythrina indica Lam.) will be planted along the bicycle paths and the road around the central 'green'.

2.4 Materials and Methods for Construction

There are many governing factors in selecting material and methods for construction of the buildings in the Agro-industrial Park. First, they should give esthetic integrity to the park design. Second, they have to be durable and of easy maintenance. Thirdly, they must be fire resistant. Then, they should facilitate quick construction. And finally, they should be economical.

Considering these factors a reinforced concrete frame construction is adopted for all structures in the park; for this meets all the five requirements. Reinf. conc. frame is the cheapest in India at present.[12] The structures are divided into four classes: 1) Administration, Maintenance and Laboratory buildings 2) Guest House, Cafeterias and Child Care Center 3) Milk, Margerine, Broiler, Canning, Banana Powder and Egg Drying Plants and 4) Oil, Rice and Sorghum, Feed, Fertilizer, and Paper Mill, and Implement and Leather Finishing Factories.

The buildings in the first class have prestressed concrete "double tee" roof and cavity walls of precast concrete panels. In the second class they have fuse' (ceramic bottles) shell roof. This French construction has been patented in India by an engineer in Bombay. The ceramic bottles are exposed on inside to give a pleasing terra cotta ribbed ceiling. Fuse' is cheaper than concrete shell, but costlier than similar shapes in corrugated galvanised iron. Exposed brick will be used for filler walls to match the ceiling. A roof consturction similar to that in first class is used for structures in third class, but the cavity walls are made up of precast concrete panels on inside and painted G.I. siding on the outside. A two hinged concrete gable frame construction is used for fourth class structures. Walls have internal panels of precast concrete, ceilings are precast gypsum board. The outer skin for walls and roofs is of corrugated galvanized iron, that portion on the walls being painted. In the last two cases particular attention has been given to air movement within the cavity of two skins for walls and roofs to reduce heat gain by the factory interiors. The G.I. sheets for walls are painted in dark colors; this will help to heat the air in cavities behind the sheets and hence to make it rise quickly. A prestressed concrete flat roof construction, as proposed for first and third class, will be a little costlier than conventional concrete construction. It is used because it reduces dead load on columns and spans greater lengths with comparatively smaller depths. The tee beam span and in most cases the girder span is the same through the structures of both classes. Hence very few forms are necessary for the precast prestressed beams and girders and so the cost per unit will be considerably reduced.

The precast two-hinged gable frames will be of 30'-0" and 40'-0" spans and between 18'-0" and 45'-0" heights. These will be provided with brackets for carrying cranes where necessary. Extensions will be spliced onto these frames with steel splice plates.

The precast concrete panels and corrugated G.I. siding for walls are designed for easy erection and removal, so that walls can be reused after extension. All precast panels will be cast in only two sizes: one for the offices and other for the factories. Their surface treatment will however vary to avoid monotony and to meet certain functional requirements.

Fabric and Structure of Egg Drying Plant

The orientation - like most other plants is north-south. Hence different treatments are given to north, south and east, west walls. The area is mainly divided in two parts: the office and the factory. The office has a height of

9'-8" between the floor and the bottom of beams. Height in factory area is 15'-8" clear.

Roof: Roofs over the office and the factory are similar. They are made up of 4'-0" wide precast prestressed concrete "double tee" panels spanning 30'-0" between 20'-0" span precast prestressed concrete girders (forming 20'-0" x 30'-0" bays). An integrated water-proofing and heat-insulation system is designed to cover the slab. This consists of corrugated G.I. sheets spanning between average 2" x 4" teakwood sleepers. The sleepers run east-west and are placed over polyethelene vapor-barrier. East-west ridges and gutters are formed at 40'-0" on centers. Rainwater downtake pipes are placed 30'-0" on centers. The air plenum between the sheets and the slab is free to move with the prevailing west wind, as the eaves have louvered openings. To assist the air movement by pressure differential 4" dia. G.I. stack pipes are placed 30'-0" on centers on the ridges.

Walls: North and South precast concrete panels are onto steel "I" section castelated mullions. The mullions are in turn bolted to roof and floor beams. Ventilated air cavities are maintained between the inside and outside panels. Steel windows are welded to the mullions. Inside panels are painted white on the outside with plastic paint on inner face. Joints are covered with aluminum cover strips. Outside panels are painted white on inside and have washed aggregate (blue basalt) finish. Door and window frames are painted black. East and West again castelated steel mullions span between the roof and floor beams. To these mullions concrete panels are bolted on inside and corrugated G.I. sheets are painted white from inside. Sheets in the upper part have a 6" cavity between them and the inside panels while in the lower part it is 3". This is done so as to introduce more air to the vertical air cavity and hence to increase its upward speed. This air is given an outlet at the eaves (as for that in the roof). The sheets in the lower part are painted rust red on the outside, those in the upper part are painted blue gray.

Internal walls in office area are 2" thick gypsum board plastered and painted on both sides. Internal walls in factory area are 8" thick brick walls plastered and painted both sides. Cooler walls including external panels are 8" thick brick walls lined with 4" thick cork inside; 4" thick cork ceiling is fixed to the soffit of beams.

Floors: In office area 4" thick concrete is laid on crushed packed rock (murum) and is covered with 3/4" thick polished sandstone (tandur) tile. In the factory floor is generally 6" thick with single reinforcing and is cast in two thicknesses of 4" and 2", the top thickness being poured while the bottom one is still green. The top layer is mixed with "hardonate". A 4" thick additional slab is cast under the drier as per the drier manufacturer's requirements. The dock floor is 1 1/2" thick sandstone tile over 4" thick concrete. Floor trenches running east-west 40'-0" on centers carry rain water from the downspouts, or drain pipes and power cables and steam lines. Secondary trenches carry cable branches and chilled water.

Trucking Area: This has a 6" thick concrete pavement laid to grade on 5" crushed packed rock.

Noise Control: The egg breaking operation is not noisy. Walls of the drier are insulated.

<u>Fabric and Structure of the Milling Complex</u>

The construction of office area is similar to that in the Egg Drying Plant. However this office will not be air-conditioned, as the factory area is not air-conditioned.

Factory Frame: Precast two hinged concrete gable frames spanning 30'-0" and 40'-0" and placed 15'-0" on centers, with extension arms in the oil-mill for the second and the third phase extensions. Steel lattice joists span between the frames to carry 2" thick gypsum board and corrugated G.I. sheet roof. The tees on the legs of the frames carry 2" thick precast concrete panels and corrugated G.I. sheet siding. The precast panels and siding on the gable ends are bolted to castelated steel 'I' joists that span between the floor beams and the gable beams. A continuous air sleeve is formed around the inner air tight walls and ceiling; this air is allowed to rise as it gets heated by sun and it escapes through outlets at the ridge.

The painting of walls is similar to that for the Egg Plant.

Floors: Factory floors are 8" thick reinforced both ways and poured in two thicknesses of 6" and 2", the top 2" layer cast while the lower layer is still green and polyvinyl acetate cement is mixed in it for providing resistance to oils.

Bins and Silos: Corrugated G.I. bins have been used for daily supply and to store daily production. These are placed 14'-0" above finished grade on a framework of steel columns and girders, so that trucks can go under the hoppers. The hoppers have a 60° angle of discharge.

Silos for reserve storage are made of slip-form concrete. Concrete bins cost almost as much as steel bins, but they have less maintenance and are more fire resistant.[16] Silos in all plants will be 30'-0" in diameter. Hence a reduction in unit cost is expected through repeated use of forms. Loading and unloading sheds will be steel frames covered with corrugated asbestos cement sheets. Silo bottoms have a 45° angle of discharge. Interstitial spaces between silos will also be used for grain storage. Silo roofs will be reinforced concrete, and gravity-slides and cyclones will be supported on lattice joists forming pyramidal frames. Weighing hoppers and the dryer will have steel frame construction.

Pneumatic lines between silos and bins and between factory and bins will be carried over steel lattice girders. Storage tanks for molasses and oil will be of welded steel plate and fluids to and from them will be pumped through underground pipe lines.

Noise Control: Milling operations are often noisy. So the office and the factory areas are in different buildings. Further, machines will be mounted on insulated foundations.

2.5 Factory Services and Utilities

Ventilation

Natural vs. artificial: Natural ventilation introduces the problem of eliminating dust both coming into a plant and that leaving it. Dust coming into a food processing plant contaminates the food, while dust emanating from operations like milling contaminates the outside air. Therefore natural ventilation through windows will be used only in administrative offices. All manufacturing areas will be artificially ventilated. In-coming and outgoing air will be filtered where necessary. Some of the plants will be entirely air-conditioned. Air-conditioning means year-round cooling here since the climate never warrants heating. These will be the plants where products may get spoiled in high temperatures.

Steam and Chilled Water for Processing

There are demands for both in the park, but demand for chilled water is greater than that for steam.

Through the first two phases plants may have their own boilers and refrigeration units. In the third phase the physical plant will supply heating and refrigeration services to the plants that need them.

Lighting

The question of lighting is closely associated with ventilation. Artificial ventilation usually calls for artificial lighting. For in subtropical regions artificial lighting builds less heat load than does natural lighting and so a comparatively lesser air movement is required with artificial lighting. Hence it is decided to depend entirely on artificial lighting through the manufacturing areas.

Levels of Illumination

It is more economical to work out illumination levels on 90% accuracy basis (as the British do) than on 99% accuracy basis (as the Americans do). For a relatively tremendous amount of foot-candles is necessary to increase the accuracy level from 90% to 99%. Again light of 90% accuracy level is not harmful to eyes. Next, lighting must satisfy the interest-comfort needs of the human being and still enable him to see, clearly, what he is viewing, and to carry out his work without handicap.[21]

The general lighting level should be sufficient. But it should not be achieved through luminous ceiling. For esthetically such a ceiling often produces flat and dull environment. Also it is uneconomical. The flatness of light can be broken up where a large area of light is combined with other darker areas. This can be achieved through bulbs of different power above the ceiling, or through ceiling pattern, or through downlights integrated with a luminous ceiling. Spot lights do away with the necessity of imposing maximum needed amount on all tasks. A relatively even illumination can be achieved by overlapping pools of light from incandescent downlights. Such

TABLE 11

RECOMMENDED LIGHTING REQUIREMENTS

Building Type	Lighting Level in Lux*						Type of Lighting				
	Office		Storage		Wk. Area		Fluorescent		Incandescent		Col Corr
	Gen.	Spot	Gen.	Spot	Gen.	Spot	Dir.	Indir.	Dir.	Indir.	Mer Vap
1) Milk Plant	150	500	150		150	700		x	x		
2) Margarine Plant	150	500	150		150	700		x	x		
3) Oil Mill	150	500	100	300	100	400		x	x		
4) Rice & Sorghum Mill	150	500	100	300	150	700		x	x		
5) Feed Mill	150	500	100	300	100	400		x	x		
6) Fertilizer Mill	150	500	100	300	100	400		x	x		
7) Paper Mill	150	500	100	300	100	700		x	x		
8) Broiler Plant	150	500	150	300	200	1000	x	x	x		
9) Fruit Juice Plant	150	500	150	300	200	1000	x	x	x		
10) Banana Powder Plant	150	500	150	300	200	1000	x	x	x		
11) Egg Drying Plant	150	500	150	300	200	1000	x	x	x		
12) Implement Factory	150	500	150	300	300	4000	x	x	x		x
13) Leather Finishing Factory	150	500	150	300	150	3000		x	x		x
14) Guest House	150	500	150	300	150	2000	x	x	x	x	
15) Administration Bldg.	150	500	150	300			x	x	x	x	
16) Power Plant	150	500	150	300	150	2000		x	x		
17) Child Care Center	150	500	150	300	150	1000		x	x	x	
18) Cafeterias	150	500	150	300	200	2000	x	x	x	x	
19) Laboratory	150	500	150	300	300	4000	x		x	x	x
20) Sanitation Bldg.	150	500	150	300	150	2000		x	x		

* 1 Ft. Candle = 10.8 Lux

light gives clarity and enough contrast for a task. Incandescent lights generate more heat than the fluorescent lights. But the above practice will reduce the power intake by dropping the general illumination level. And holes can be provided in the fixtures for incandescent lamps to take up hot air to the plenum above ceiling.

The above considerations have been of guidance in determining light levels in various plants and buildings of the park.

Wiring and Power System

Flexibility in wiring is necessary in wiring layout. Floor ducts for wiring are useful where machines with large capacity drives are housed and where layout is not subject to frequent changes. Cabling along roof framework is preferred where some changes are anticipated. Conduit is used where very few changes occur, cable top system where changes are not frequent, and bus bars where changes are made frequently.[25]

Color Scheme

Color is closely associated with lighting. A color scheme can make good lighting more effective, or it can increase glare and have a detrimental effect upon vision. The Munsell range has been generally adopted for working out industrial color schemes. Color is used on exteriors and in interiors to help create a pleasant atmosphere, color for machinery has an additional purpose of delineating important moving parts - this is achieved through contrast in brightness, strength and color. Light reflecting and emitting color improves visibility and has a longer life. Matt paints are good, as they give a diffused reflection. Process line monotony can be relieved by painting alternate machines in different colors. Machines painted in colors complementary to the background lessen eye fatigue. The following criteria are used when

TABLE 12: CONTROL OF INDUSTRIAL NUISANCE AND WASTE

Plant	N U I S A N C E				W A S T E		
	Noise	Smell or Fumes	Dust or Grit	Control	Nature	Pretreatment	Treatment
1) Milk Plant	o			Rubberized	Washings		Chemical Precipitation, Sedimentation
2) Margarine Plant					Washings		Chemical Precipitation, Sedimentation
3) Oil Mill					Washings, Oil	Oil Removal	Chemical Precipitation, Sedimentation
4) Rice & Sorghum Mill	o		o	Sound Insulation Dust Recovery	Washings		Chemical Precipitation, Sedimentation
5) Feed Mill	o		o	Sound Insulation Dust Recovery	Washings		Chemical Precipitation, Sedimentation
6) Manure Mixing Mill	o	o	o	Sound Insulation, Manure Drying	Washings		Chemical Precipitation, Sedimentation
7) Paper Board Mill		o		Frequent Washing	Waste Fiber	Filteration	Clarification, Sedimentation
8) Broiler Plant					Putrescible	Screening, Grease Removal	Sedimentation
9) Fruit Juice Plant		o		Frequent Washing	Putrescible	Screening	Sedimentation
10) Egg Drying Plant			o	Dust Recovery	Washings		Sedimentation
11) Banana Powder Plant			o	Dust Recovery	Washings		Sedimentation
12) Agro-Imp. Factory	o			Sound Insulations	Washings, Oil	Grease Removal	Sedimentation
13) Leather Finishing Fact.		o		Leeward Location	Currying Water		Sedimentation, Chemical Precipitation

giving consideration to a color scheme:

1. Brightness - Cream paints and bright clean colors are undesirable. A gray paint of lower reflection is recommended.
2. Motion - Distraction by moving parts should be eliminated by putting a screen behind the process and painting it in a neutral color.
3. Contrast - Contrast should be sufficient to create work-interest and to give better visibility. It should not be distractive. Strong colors should be sparingly used.
4. Simplification - Minimum number of hues and a simple discipline yield better results. However monotony must be avoided.
5. Cleanliness - Oil and grease repelling paints help the workers in keeping the sorking space clean.

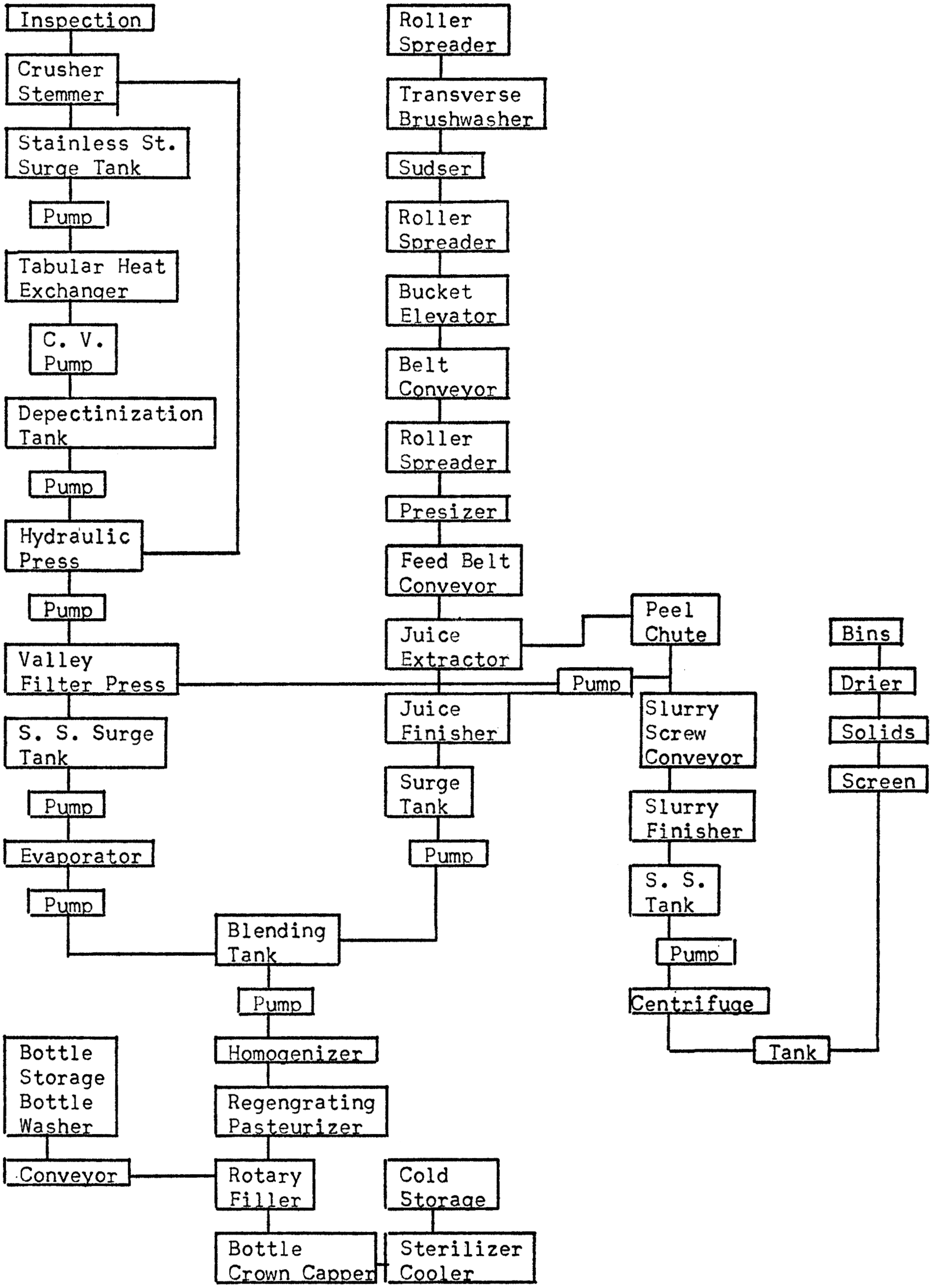
Waste Disposal[5]

Most of the dry waste and by-products will be used within the park for manufacturing purposes. Filtration will be used in some cases for maximum recovery of filterable waste. Waste water and sanitary drainage will be taken to sedimentation tanks for treatment. The effluent will be sprayed at the rate of 60 inches per year on the research farms. In the rainy season the effluent will be discharged into Nira Left Bank Canal. Table 12 gives methods of control for nuisance and waste.

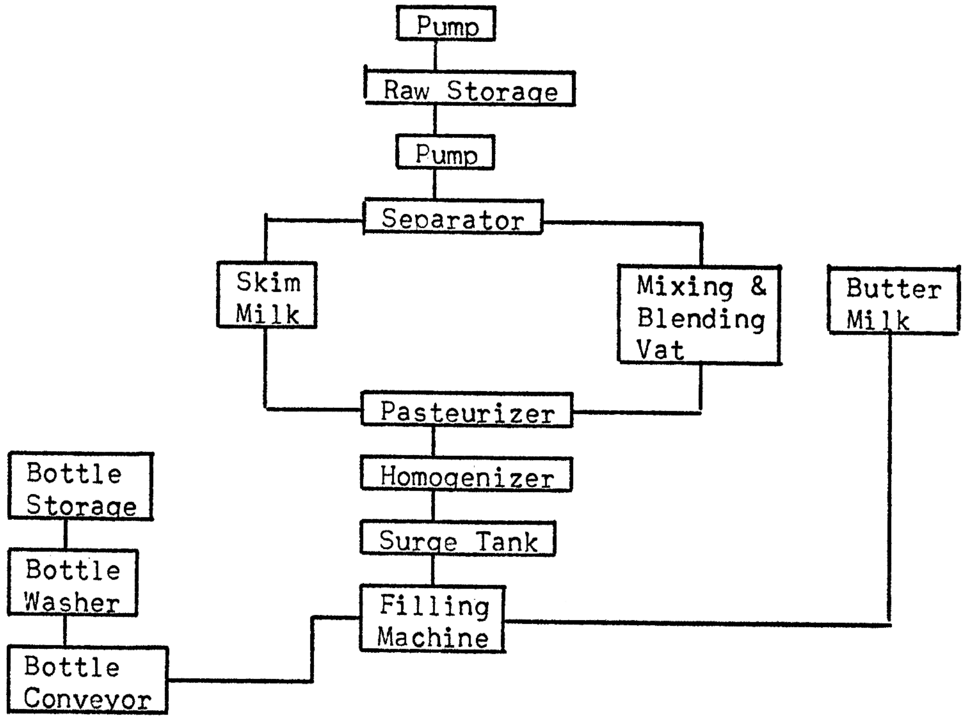
Services and Utilities Carriage System

An underground tunnel will be used to distribute electricity water lines, and steam from the power plant to individual factories. The top slab of the tunnel will form the pedestrian ways where it will be possible to do so. Chilled water line will be buried 5 feet below the finished grade. The tunnel walls will also carry pneumatic lines conveying products from one plant to another. The drainage pipe will run under the park-like strip.

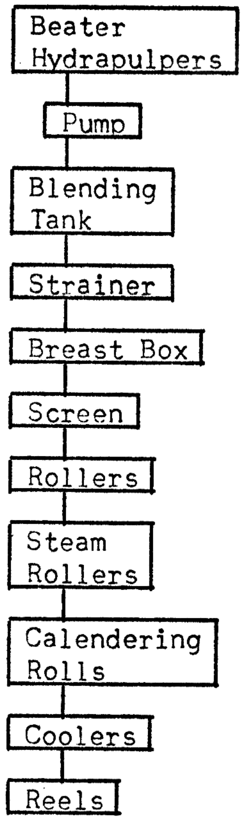
FLOW DIAGRAM: GRAPE & ORANGE JUICE CANNING[1,3]



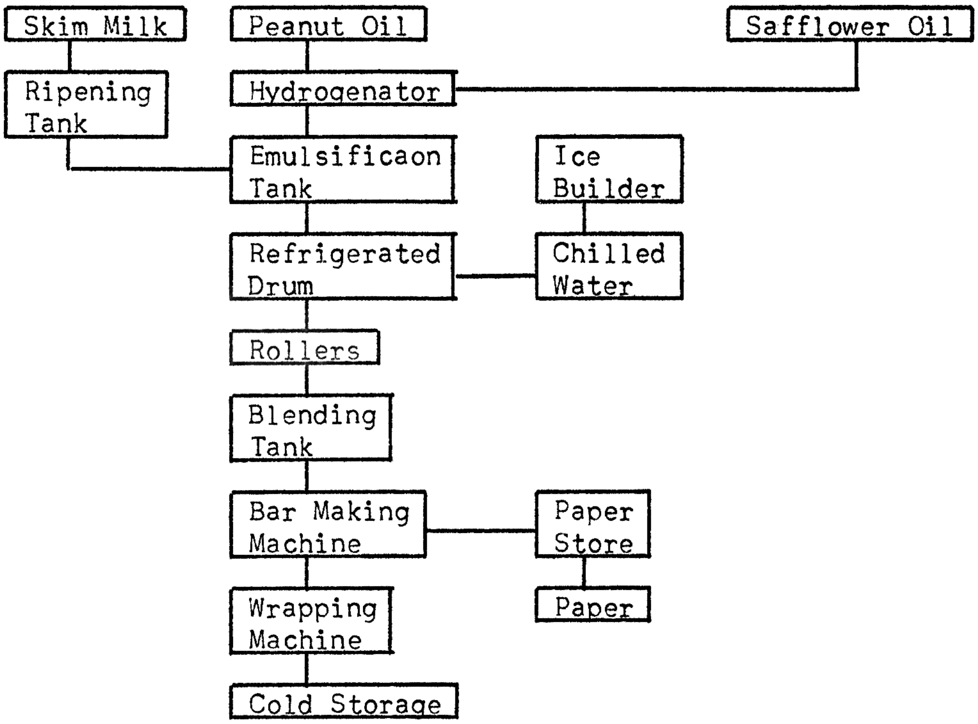
FLOW DIAGRAM: MILK PLANT



FLOW DIAGRAM: PAPER MILL



FLOW DIAGRAM: MARGARINE FACTORY



2.6 Epilogue

The design of this prototype "Agro-industrial Park' has been controlled by various limiting factors. Two major factors are capital and labor. The plants are moderate in size as capital is not readily available. They are not thoroughly mechanized; for creation of employment opportunities is one of the major aims of this park. Technical advances in agriculture in the Agro-industrial Region are few and so the implements factory cannot manufacture sophisticated and large machinery, nor can the fertilizer mill produce chemical fertilizers. Amount of agricultural produce per acre is very low compared to many other countries and means of transport are modest in capacity, speed and efficiency; these together naturally limit the size of the park. Construction methods and materials are such that concrete or wood shell forms are not possible. Prefabricated materials are few, fewer are of good quality. Aluminum is costly, so is porcelain covered steel. So all prefabrication must be on-site and there is not much choice except concrete.

Even prestressed concrete, slip-form concrete, and fuse' are new to the area but these are introduced because they are possible, economical and durable. Again mechanical equipment used for construction is not as good as in U.S.A. This restricts sizes of componant units.

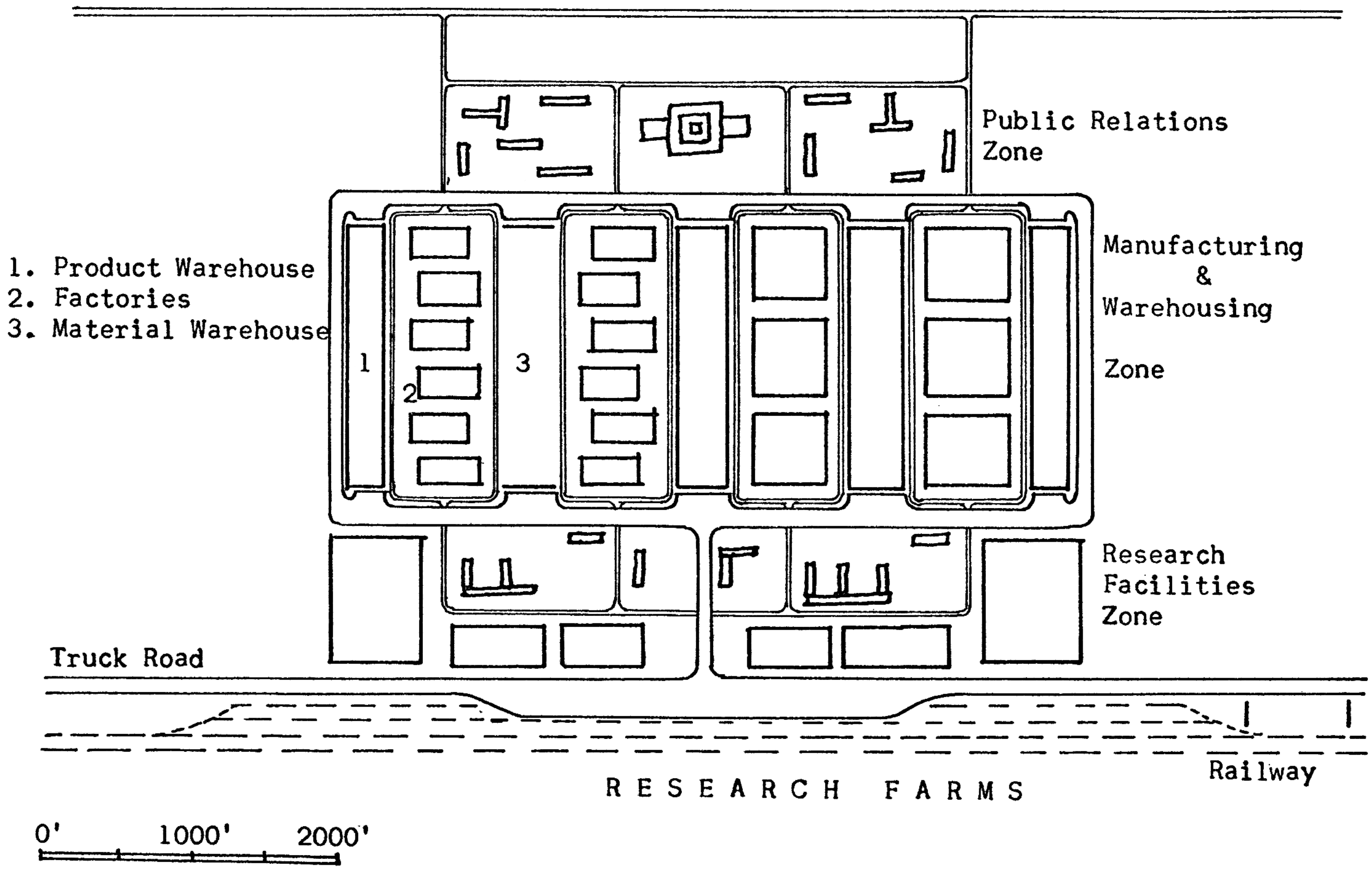
Future Aspirations

The master plan for the Agro-industrial District provides space for a similar park for additional industries in its second phase. A much larger area has been allotted for a park in the third phase of the plan. Plants with large production capacity will move in at that time. The fourth phase will allow for industries that will manufacture capital goods for agro-industry. The fifth and final phase will be a combination of both types of industries. They will be located near Daund and at that stage they could be compared with the present similar American industries in volume, techniques and appearance.

It follows that each phase will include research farms and their sizes will be in proportion to the volume of industrial activity.

Building, manufacturing, transportation, cultivation, and mechnical techniques are going to improve and these will influence every aspect of subsequent park designs. It will be possible then to separate warehousing from manufacturing areas. For raw materials and finished products can be conveyed over greater distance through pneumatic lines and belt conveyors. There will be no railway sidings for factories. Instead there will be a single railway depot where piggy wagons will be switched between road and rail. Building areas will be consolidated and land will be more economically used. There will be three major zones in the park system: public relations, manufacturing and warehousing, and research. Every attempt will be made to beautify the public relations zone to attract retail and wholesale customers. Manufacturing zone will have interior landscaped courtyards within the buildings. Also each factory will provide all facilities for the workers. In short the factories will be 'turning in'. The research zone will be devoted to agricultural chemical research - excluding production, which must be done in the manufacturing zone.

Under the master plan for the District development plans for the following villages will be made to accommodate increased population, traffic and business as a result of the industrial development: Katphal (Phase III), Undavadi Karepathar and Shirsuphal (Phase IV) and, Karkumb and Ravangaon (Phase V).



A SCHEMATIC DIAGRAM FOR AN AGRO-INDUSTRIAL PARK

NEAR DAUND IN 2000 A.D.

<u>Application in other regions</u>

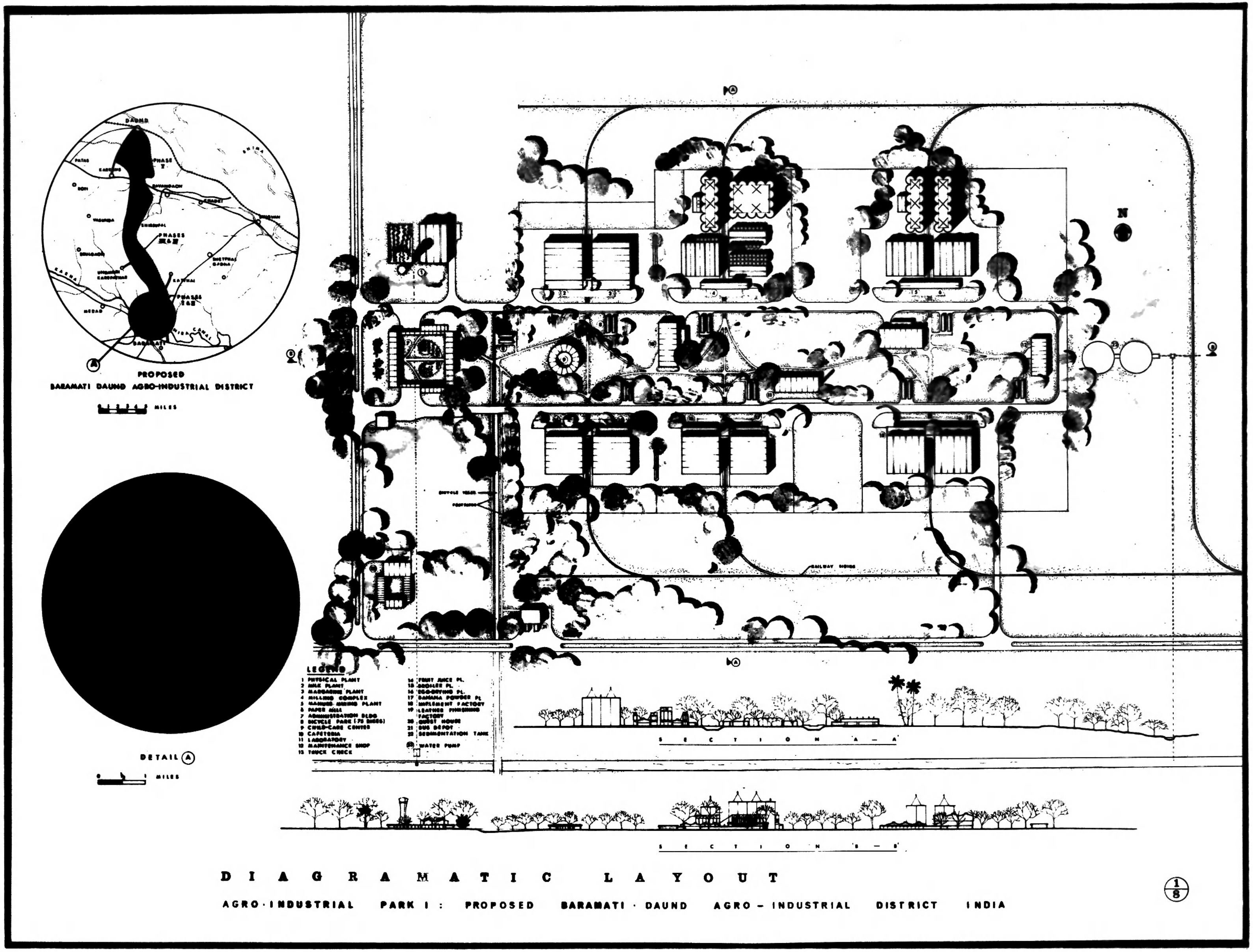
The principles of an Agro-industrial District Master Plan should apply to any region in India, though the details may vary. The principles can be recapitulated as follows:

The District should be away from industrialized metropolitan area to create its own 'pull'. It should mainly consist of industries and research farms, and these should be of cellular pattern, dovetailed into the centers of population and the Agricultural Region.

The general pattern of the cellular growth should be lineal, but it will be governed by the geological and geographical factors, population centers, availability of utilities and patterns of transportation; the last three must be planned in relation to the planning of the Parks.

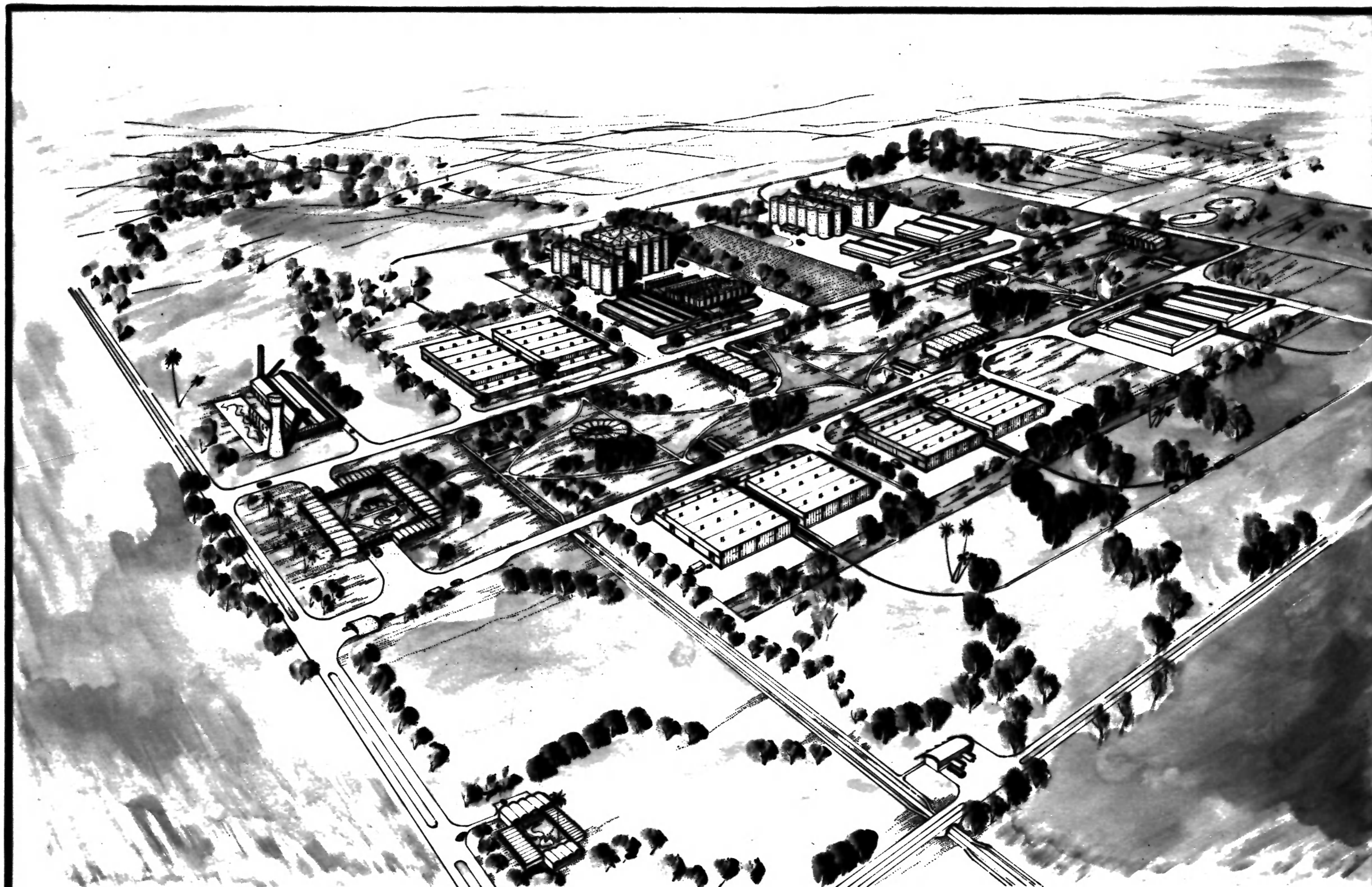
EXPLANATION OF DRAWING NO. 1

The 'Diagramatic Layout' is for Park 1 in 'Detail A' on the left side. The rectangular shape may be changed to fit the contours for actual execution of the plan. The layout shows industries in their final phase.


PROPOSED
BARAMATI DAUND AGRO-INDUSTRIAL DISTRICT
0 1 2 3 4 5 MILES
DETAIL A
0 ½ 1 MILES
N
LEGEND
1 PHYSICAL PLANT
2 MILK PLANT
3 MARGARINE PLANT
4 MILLING COMPLEX
5 MANURE MIXING PLANT
6 PAPER MILL
7 ADMINISTRATION BLDG
8 BICYCLE PARK (75 BIKES)
9 CHILD-CARE CENTER
10 CAFETERIA
11 LABORATORY
12 MAINTENANCE SHOP
13 TRUCK CHECK
14 FRUIT JUICE PL.
15 BROILER PL.
16 EGG-DRYING PL.
17 BANANA POWDER PL.
18 IMPLEMENT FACTORY
19 LEATHER FINISHING FACTORY
20 GUEST HOUSE
21 BUS DEPOT
22 SEDIMENTATION TANK
23 WATER PUMP
SECTION A–A
SECTION B–B
DIAGRAMATIC LAYOUT
AGRO-INDUSTRIAL PARK I : PROPOSED BARAMATI · DAUND AGRO – INDUSTRIAL DISTRICT INDIA
1/8

EXPLANATION OF DRAWING NO. 2

The view is from southwest. It shows the 'guest house' in the center-foreground.

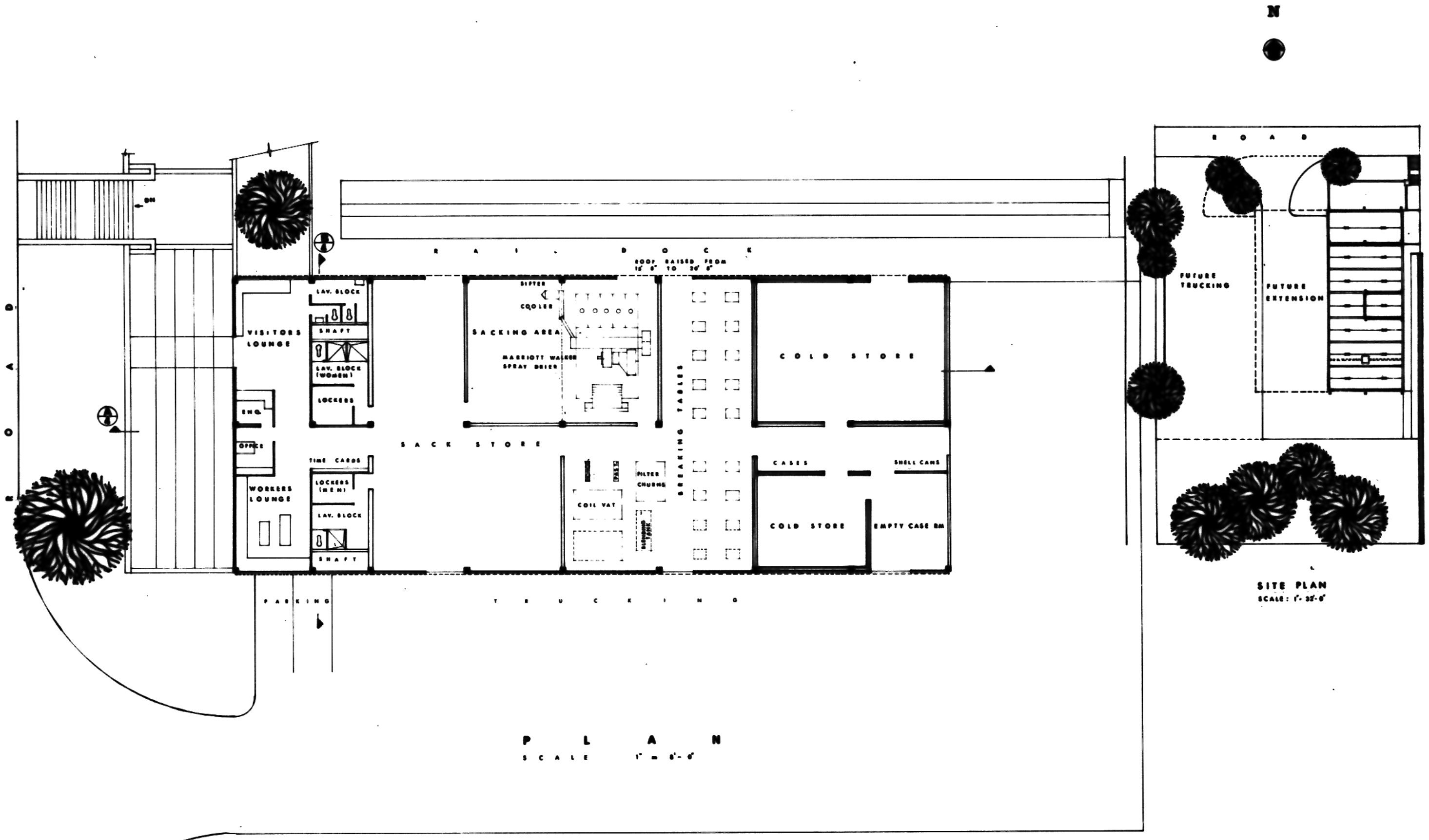


BIRD'S EYE VIEW

AGRO-INDUSTRIAL PARK I : PROPOSED BARAMATI-DAUND AGRO-INDUSTRIAL DISTRICT, INDIA.

EXPLANATION OF DRAWING NO. 3

The drawing gives plan and site plan for 'an egg-drying plant.' The site plan shows room for 100 percent expansion of the plant.

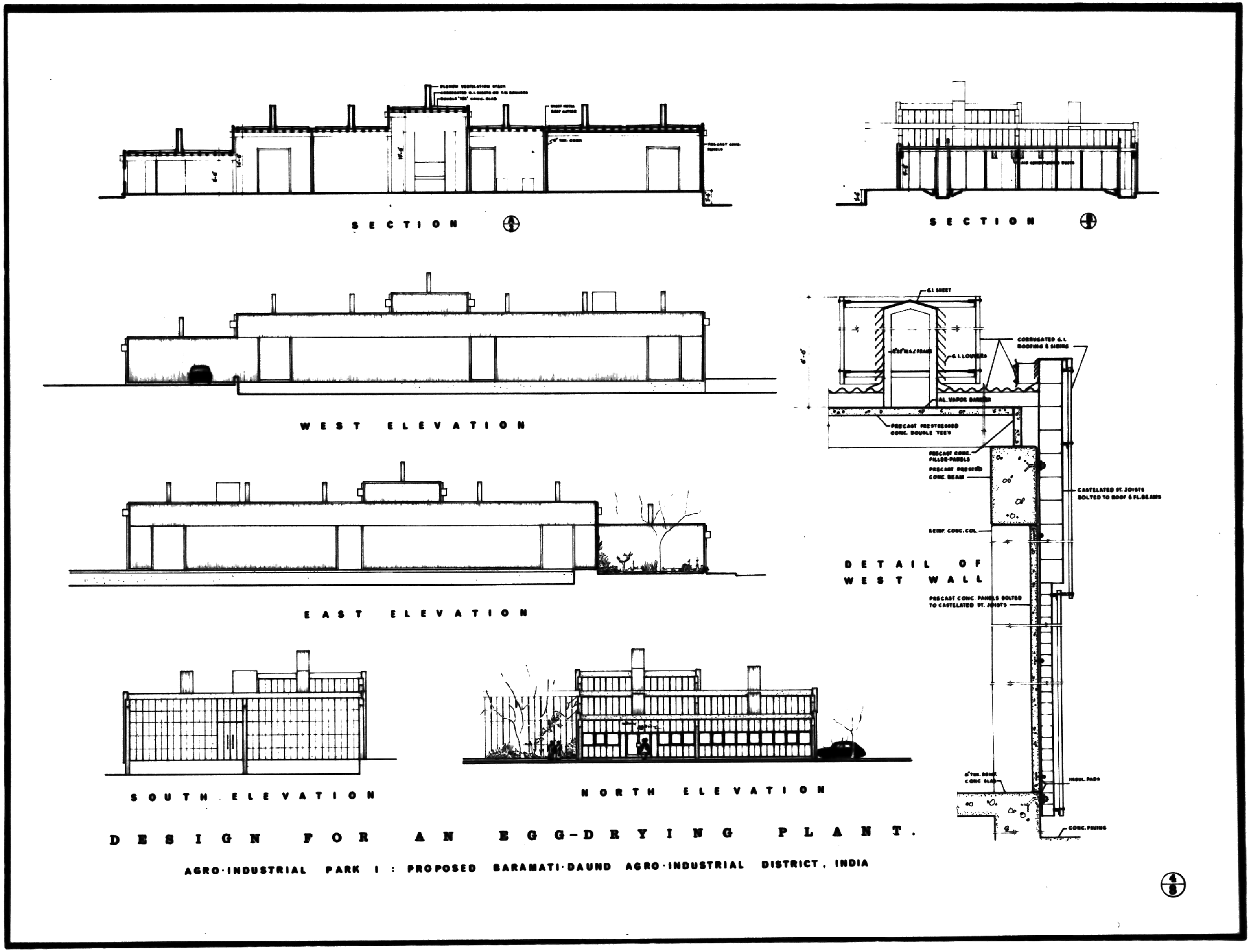


DESIGN FOR AN EGG-DRYING PLANT.

AGRO-INDUSTRIAL PARK I : PROPOSED BARAMATI-DAUND AGRO-INDUSTRIAL DISTRICT, INDIA

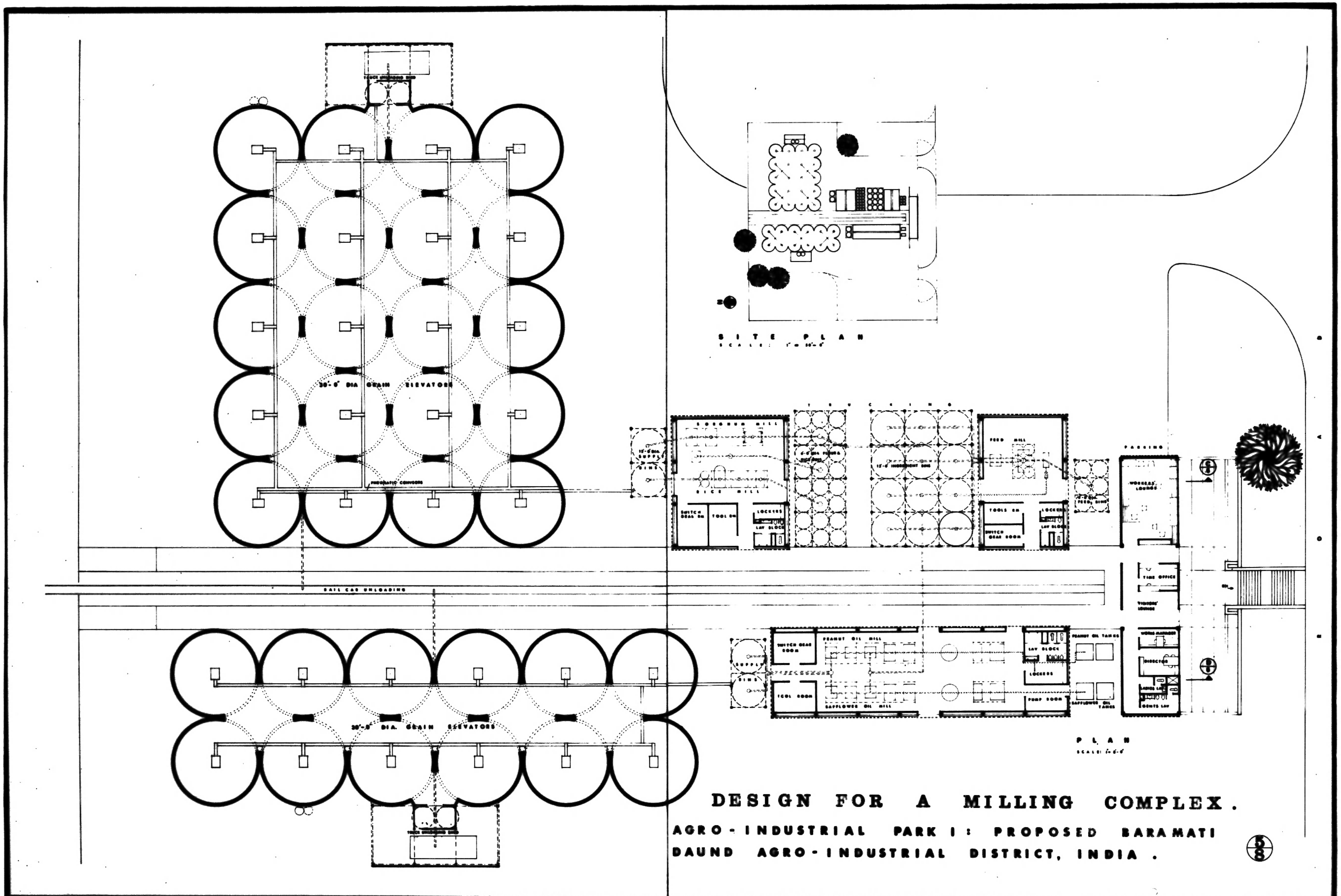
EXPLANATION OF DRAWING NO. 4

The drawing gives elevations, sections and details for the egg-drying plant. The 'west wall detail' is of factory - and office wall.


SECTION
SECTION
WEST ELEVATION
EAST ELEVATION
DETAIL OF WEST WALL
G.I. SHEET
CORRUGATED G.I. ROOFING & SIDING
G.I. LOUVERS
AL. VAPOR BARRIER
PRECAST PRESTRESSED CONC. DOUBLE 'TEE'S
PRECAST CONC. FILLER PANELS
PRECAST PRESTRD CONC. BEAM
CASTELLATED ST. JOISTS BOLTED TO ROOF & FL. BEAMS
REINF. CONC. COL.
PRECAST CONC. PANELS BOLTED TO CASTELLATED ST. JOISTS
INSUL. PADS
CONC. PAVING
SOUTH ELEVATION
NORTH ELEVATION
DESIGN FOR AN EGG-DRYING PLANT.
AGRO-INDUSTRIAL PARK I : PROPOSED BARAMATI-DAUND AGRO-INDUSTRIAL DISTRICT, INDIA

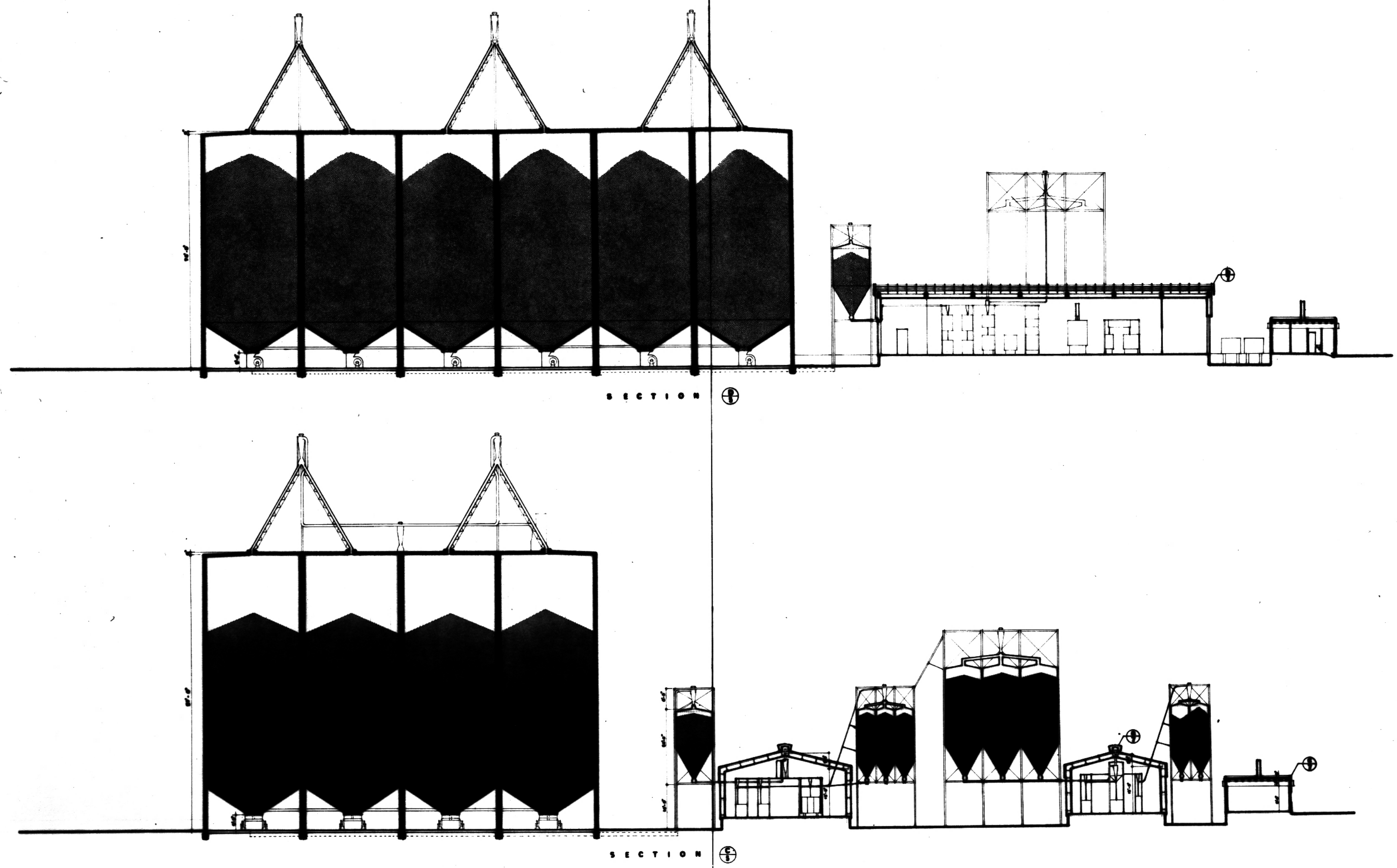
EXPLANATION OF DRAWING NO. 5

The drawing gives plan and site plan for 'a milling complex.' The elevator area will not expand but there is provision for expansion of the mills. For explanation of machinery layouts in the mills refer to the Flow Diagram on page 53.


SITE PLAN
PLAN
RAIL CAR UNLOADING
DESIGN FOR A MILLING COMPLEX.
AGRO - INDUSTRIAL PARK I : PROPOSED BARAMATI
DAUND AGRO - INDUSTRIAL DISTRICT, INDIA.

EXPLANATION OF DRAWING NO. 6

The drawing gives two sections through the milling complex; the upper one is through the oil mill, while the lower one is through the rice and sorghum mill.

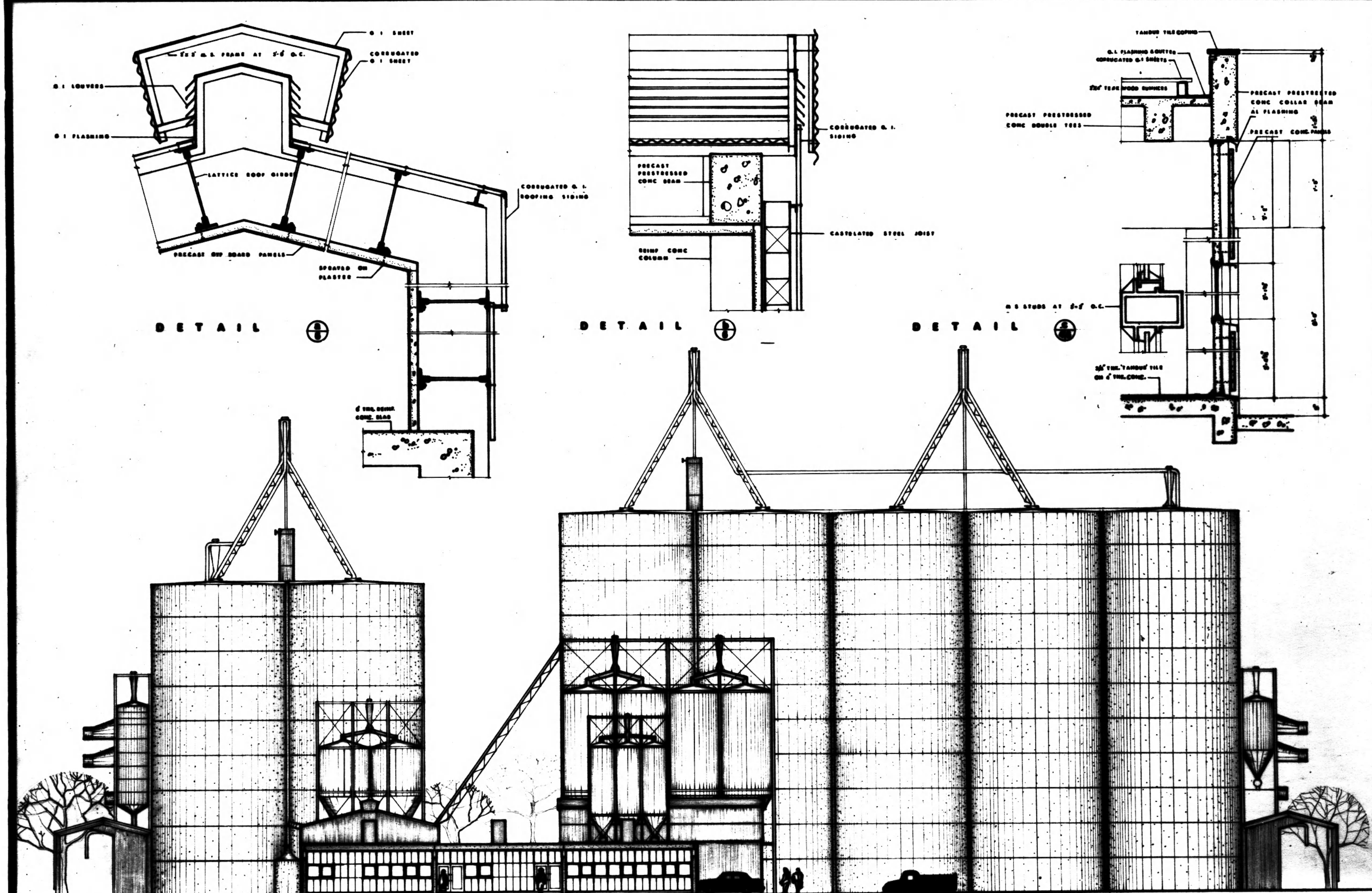


DESIGN FOR A MILLING COMPLEX.

AGRO-INDUSTRIAL PARK I : PROPOSED BARAMATI-DAUND AGRO INDUSTRIAL DISTRICT, INDIA.

EXPLANATION OF DRAWING NO. 7

The drawing gives an elevation and details of the milling complex. Detail C at top-right holds good for the front wall of the Egg-Drying plant as well.



SOUTH ELEVATION

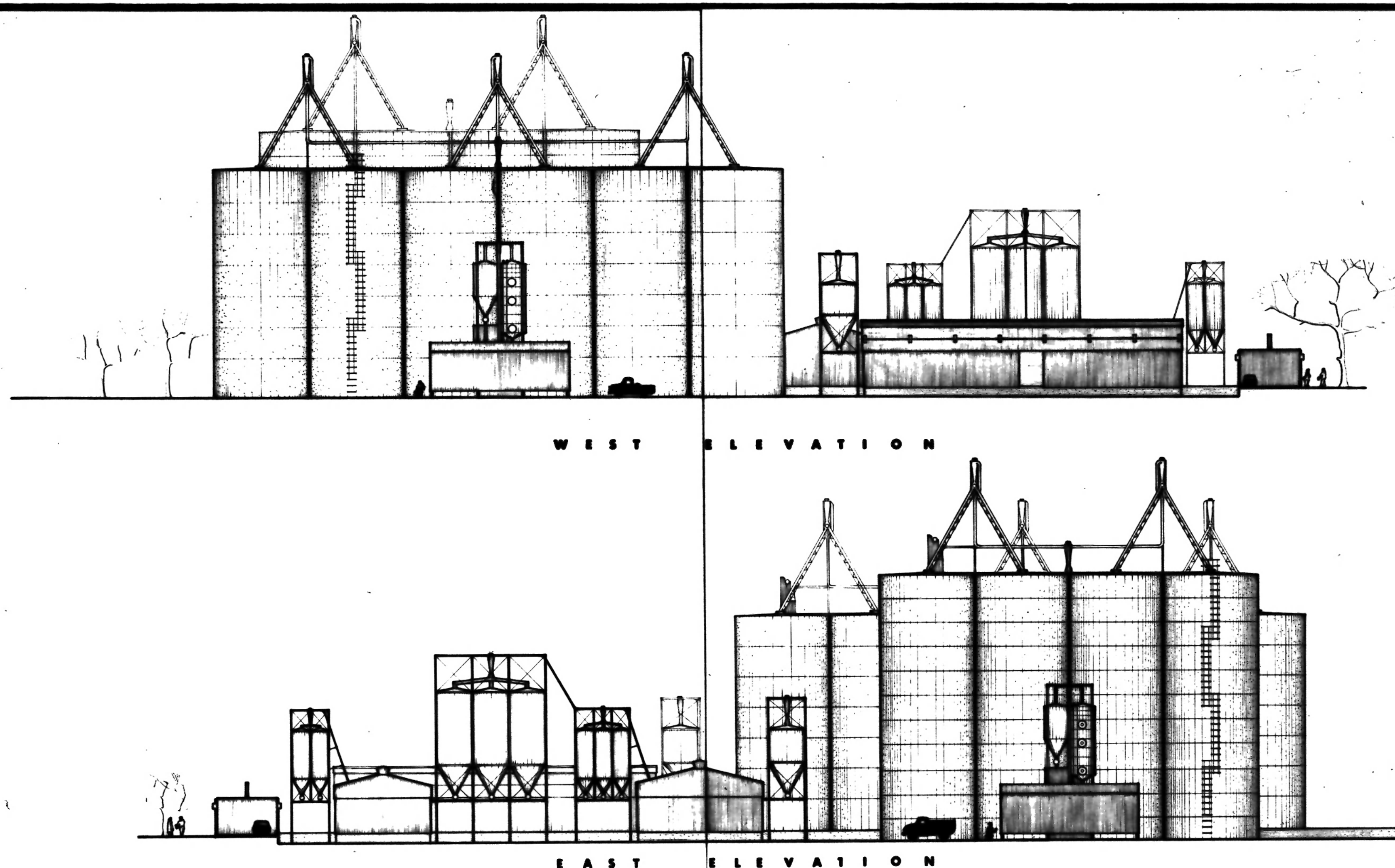
DESIGN FOR A MILLING COMPLEX.

AGRO-INDUSTRIAL PARK I : PROPOSED BARAMATI-DAUND AGRO-INDUSTRIAL DISTRICT.

7/8

EXPLANATION OF DRAWING NO. 8

The drawing gives east and west elevations of the Milling Complex. West elevation shows brackets for expansion of the oil mill.



DESIGN FOR A MILLING COMPLEX.

AGRO-INDUSTRIAL PARK I : PROPOSED BARAMATI-DAUND AGRO-INDUSTRIAL DISTRICT, INDIA.

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