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Design of Poultry Slaughterhouse – Land & Location

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Preface

Ideally a Handbook should not relate to current events or current situations – it should confine itself to time-independent general principles and practices. Preoccupation with current events and current situations belong to the realm of newspapers and journals. However, in writing this Chapter we decided to put our observations and analyses in the present context prevailing in India. So even as we digressed from the principle enunciated above, we did note that decisions relating to identifying a suitable piece of land on which to locate a poultry slaughterhouse are strongly influenced by the present situation. They are time-dependent.

In discussing location and land suitable for poultry processing, we were also able to identify structural problems faced by this industry, solutions to which fall within the ambit of national agricultural, water management and wastewater disposal policies and laws. We have amplified these aspects here. Therefore this Chapter ought to find use not only for students of poultry processing, but also for planning authorities.

Chicken are one of a number of poultry species – turkeys, ducks etc, all belong to this broad category. Within poultry itself, there are two main significant streams – broilers, which are bred for meat and layers, which are bred for table eggs. Backyard poultry breeds which are promoted by our research institutions for the benefit of small and marginal farmers, fall between these two categories – they produce eggs and are also slaughtered for meat.

A poultry slaughterhouse may process broiler or even layer hens, which are typically culled at the end of their egg-laying lifespan, at around the 65th week of their lives. However the number of layers culled each year is insignificant in comparison with the number of broilers harvested for slaughter. Likewise the population of backyard poultry is very small and their farming is widely dispersed all over India. So this category does not and can not form part of the feedstock for poultry slaughterhouses.

Therefore when we mention poultry slaughter, we mainly mean slaughter of broilers. We have generally used chicken, broilers and poultry to mean meat birds in this Chapter. This flexibility of nomenclature is understood from the context itself within the industry, but since we expect this Chapter to be read by people outside of this industry, we felt the need to make these distinctions.

1 What Factors Are Essential for A Poultry Slaughterhouse?

There are eight essential requirements for poultry processing. These are:

Table 1 Essential Requirements And Features For Poultry Processing		
	A poultry slaughterhouse…..	Remarks
1	…needs lots of water	Must have easy and constant access to raw water. The smallest plant needs 25 litres of water per bird. A large plant processing 6000 birds per hour (BPH) and above, needs 13-15 litres per bird. Since a plant location must be chosen to facilitate growth, at its peak of growth and expansion, a 6000 BPH plant may use 1512 kilolitres of fresh raw water for two shifts per day. Water CANNOT be recycled.
2	…. must be close to live bird supply	Transportation always causes some death especially in warm climates. To keep dead-on-arrival (DOA) figures low, proximity of farms is important.
3	…. needs convenient discharge of treated liquid effluent	Discharge requirement quantitatively equals raw water usage. Existing Indian laws forbid discharge of raw wastewater or even treated wastewater into natural waterways, municipal drains, irrigation canals and over land except over cultivated land provided the plant owner enters into a written agreement with the local authorities (e.g. village *sarpanch*) for it. Else the plant owner must himself own all the land over which he can spread treated wastewater. This is called the **zero discharge policy**. At the same time prudence requires that he must also have access to a natural water-course for discharge into (at his own risk) during monsoon when crop irrigation is unwanted or unfeasible. In other words he must either violate the law or shut down his plant during monsoon rains.
4	….. needs labour	To avoid having to build lots of residential/hostel accommodation for staff, a poultry slaughterhouse must be located reasonably close to a village, hamlet or town.
5	….. cannot be built close to certain structures	Such as places of worship and archaeological sites. Nor too close to human habitations as residents may object to the odour nuisance from the operation.
6	…. must have good and reliable access to plenty of power	Small plants need 350-450 kVA of power. Larger plants may need 1500 kVA. Reliable supply cannot be had from an 11 kV agricultural grid. The best supply is at 32 kV, i.e. directly from a sub-station, possibly through a dedicated feeder. Proximity of sub-station is therefore important if the cost of the dedicated feeder is to be kept low.
7	….. must have reasonable proximity to market and town(s)	Processed meat is not much affected by distance to market. Proximity to towns is important for the convenience of plant workers' families.
8	….. must have sufficient area of land.	An absolute minimum of 3.5 acres of land is needed for a start-up capacity, with larger holdings of upwards of 6 acres for a normal plant (not counting area needed for item 4). Many companies in the south have opted for closer to 100 acres since land is cheaper there than it is in the north.

2 Challenges To Growth In Poultry Processing

Modern broilers have been raised from strains of wild native jungle chicken which were painstakingly hybridised and selectively bred over the past century in the West, Australia and Israel. Over time, two monopolies have emerged in this sector by acquisition and merger of dozens of independent breeds over the latter half of that century. At present there are only two global monopolies for high performance broiler breeds – Aviagen and Cobb. These companies also have a near monopoly over layer breeds.

Backyard poultry breeds developed by our own research establishments are no match for breeds from these global monopolies. Although backyard breeds provide livelihood to poor and marginal farmers and should be encouraged for that reason, for healthy growth of the broiler meat sector we cannot avoid the use of day old chicks (DOC's) from these global monopolies. Poultry processing is an intensely scale sensitive industry which cannot be based on intermittent, geographically dispersed and small numbers that backyard poultry farming can supply.

In India there are several constraints to the growth of a modern broiler agronomy which can find expression in the availability of quality processed poultry meat on supermarket shelves. Some of these constraints have already been mentioned in table 1, but are included here. They are:

(a) A severe paucity of good locations for poultry processing plants - there being limited availability of water in sufficient quantities, particularly in the central and southern zones;

(b) Limited availability of red zones (officially designated as suitable for, or simply set aside for ventures aiming to slaughter animals for human consumption);

(c) A shortage of locations that are sufficiently distant from populated areas and suffer no local resistance on account of the smell nuisance, particularly in the densely populated riverine zones in the north;

(d) The zero discharge policy is impractical and forces investors to purchase large tracts of land. This is particularly inimical to growth of this industry in the riverine zones because land is extremely expensive and viable agriculture in these areas needs multiple cropping per year – not plantations that can be harvested only once in several years;

(e) Insufficient trained manpower and managers educated in this field – veterinary college syllabi have not been designed for this branch of agronomy – the emphasis has been almost entirely on milch cattle farming;

(f) Control of the market by a monopoly in supply of modern broiler breeds through an engineered price manipulation[1];

(g) There is a competition between organised processing and wet-market[2] processing. Since a majority of processing plant owners are themselves integrators and produce DOCs in their own farms and also own slaughter facilities, they divert their live birds to the wet-market when live bird prices rise, and so they become party to the monopolist's strategy of creating large, cyclic price swings.

Although price swings affect the overall availability of live birds, it is instructive to examine the growth of poultry processing in the Country to understand what effect these swings have on processing capacity build-up. We have data from 2002 to 2023 for this purpose. In the 3rd quarter of 2002 the gross processing capacity in the organized sector[3] was 13,000 BPH[4]. By end-2024 it will have reached 165,400 BPH, comprising 61 plants in the organised sector with an average capacity of 2711 BPH[5]. This translates into a growth rate of 12.25% CAGR[6] over this twenty-two year period. It is noteworthy that this growth rate is significantly higher than that of the broiler farming sector.

We believe market forces, technology and simple economics have driven this differential growth and there may be more unutilised potential for growth in poultry processing provided other constraints are removed.

Such constraints can be removed by careful planning and we will return to them later in this Chapter. We will find that when we have removed most of these, only two will remain to limit further growth of the overall poultry industry in India – both layer and broiler segments. These are (1) our existing disconnect from global trade and (2) non-adoption of GM maize and soybean which are the main ingredients of poultry feed. Over time both these factors have helped to maintain monopoly for breeding stock and deterrence of competition from global players. Competition that would have led to improved efficiencies and, consequently, to more employment and growth.

3 Water Availability And Plant Sites For Poultry Processing

In the beginning, design of poultry processing machines was wasteful of water. But starting from the mid 1970 this industry made impressive reduction in specific usage of water across all processing steps[7]. Now it has reached the limits in this aspect and there does not appear to be any room for further reduction. A seminal study carried out by *Carawan et al* is presented in an article on the subject of water usage and the unfeasibility of recycling it within the plant[8]. This article is posted on the Aptec website and the specific water requirement for processing poultry has been given in row 1 of table 1.

In the light of these water usage bench-marks, let us review the present size of this industry and develop growth targets to reach the status of a developed economy by mid century. We will then be able to identify hurdles that stand in our path and seek solutions for them.

From the existing corpus of 61 organised sector slaughterhouses which constitute a gross capacity of less than 15% of the total poultry consumed nationwide, poultry processing is getting performed efficiently and hygienically[9]. As mentioned above, the remaining 85% takes the wet-market route which is unhygienic, wasteful of resources and out of sync with the poultry processing standards worldwide.

This 15% share must rise dramatically if this industry is to be brought to par with the developed world. We believe that when a country establishes capacity to process at least 70-80% of the number of broilers its farms produce, it can effectively shut down the wet-market. So we may like to aim at 75% capacity processing by 2047 to reach that goal. Say 45% processing level by 2035 and 75% by 2047. To simplify our calculations, we will assume that neither the broiler farming sector nor per capita consumption of chicken meat show any growth over these periods.

Using data available with us, we have calculated the additional number of poultry processing facilities of today's average size that must be set up to reach these targets. The figures are:

Table 2 Additional Number of Poultry Slaughterhouses Required		
	Number of additional processing facilities required for target processing...	
	..by 2035, to reach 45% processing capacity	158[10]
	..by 2047, to reach 75% processing capacity	158

Unfortunately there simply are not enough suitable plant sites in India for so many poultry slaughterhouses.

For all twenty odd poultry processing plants (or 50% of processing capacity) that Aptec has designed and helped build in India, the most serious challenge has always been identifying a suitable plant site. Our practical experience in identifying and evaluating suitable plant sites should support this claim.

Table 3 Division of Features and Functions into Primary Processing and Secondary Processing With Process Division into Hub & Spoke Facilities	
Functions/Sections/Facilities	**Location**
Arrival, killing, evisceration, chilling, primary weighing & grading of carcasses, coop & truck washing (primary processing steps). Wastewater treatment, rendering, raising steam, blast freezing, frozen stores & related refrigeration plant, large electrical sub-station (essential utilities for primary processing).	Hub
Housing for essential operating, security and maintenance staff	
Portioning, de-boning, packing and shipments to bulk consumers only and to immediate neighbourhood; in reefers, with thermal tracking. (secondary processing steps but only meant for bulk shipments from Hub).	
Fleet of large reefers for shipment of fresh chilled skin-on carcasses packed in plenty of shell ice, once or twice a day to Spoke plants, in reefers with temperature tracking. (service facilities to be maintained in Hub).	
Computerized web-based delivery platforms for order booking & tracking using purpose-designed apps (service facilities for Spoke)	Spoke
Refrigerated work-space at +12°C, with work tables, cone de-boners, and/or Japanese cut-up lines, disc cutters, tray packing machines. Screw chillers for thawing frozen carcasses as required. Plate freezers, small single-chamber blast freezers, small frozen stores, chill stores for reception and dispatch and accompanying dedicated refrigeration units. Because of small size these can have skid-mounted dedicated CFC/HFC type refrigeration machines. (machinery at Spoke)	
Fleet of 3 tonne and 1 tonne reefers; motor cycle fleet with riders for shipment of packaged portioned or de-boned fresh-chilled poultry to customers against orders. (service facilities to be maintained at Spoke)	
Bones, gristle and trimming waste etc; frozen skin can be shipped back from Spoke facilities in delivery reefers to the Hub plant for rendering and for aggregation and sale to RTE customers respectively, on return trip of reefers.	

4 Solutions

We propose a two-pronged strategy to overcome this problem. The first is based on a proper understanding of the process itself, based on which we can split or divide the processing activity into two stages, each of which can function at a separate location. We call this the **Hub & Spoke Model of Poultry Prcessing**. The second strategy is an itemised scrutiny of each hurdle to the growth of this industry and suggest custom solutions. But first we will take up the Hub & Spoke Model and while discussing it, we will have the opportunity to itemise these individual hurdles.

4.1 Split The Process And Plant – Use The Hub & Spoke Model

This model is based on a close examination of eight features of the process listed and discussed below. Some of them emerge as hurdles while others appear to favour splitting the process into Hub and Spoke, these being two halves of the process, separated into convenient sections that may function independently at different locations.

Poultry processing produces whole or portioned chicken, with each being either blast-frozen for long term storage or fresh chilled for immediate consumption (within 4-5 days of processing). In the case of portioned chicken, the market has a long laundry-list of product specification starting from cuts and packing size to whether or not the portions have skin-on or are deskinned, whether marinated or not, and so on. It should be clear to us that there is no disadvantage in splitting the primary and secondary steps (identified in table 3) into two locations as Hubs and Spokes. In fact there exist excellent reasons to split them.

Aptec developed this model during September 2020 and privately distributed a short note on it among poultry processing plant owners. Later, following an interview conducted by Asian Poultry Magazine in October 2020, they published a report on this model in their January 2021 issue.

4.1.1 Intensity of Scale Economies

Poultry processing is highly scale sensitive[11]. Machinery manufacturers now offer line speeds of up to 15000 BPH. As you go up the capacity ladder, the specific processing cost per chicken falls significantly. And here we are, struggling at an average capacity of 2711 BPH. Imagine the scale economies the processing industry is losing! If only we could improve scale economies in processing, poultry meat could become cheaper across the board.

4.1.2 Capital Intensity

Poultry processing is very capital intensive, requiring heavy investments. However the bulk of the investment goes into primary processing. Table 4 shows this. Here you may note that the primary processing stage uses the bulk of the capital in processing equipment. Added to this is the need to invest large funds in refrigeration, waste-water treatment, rendering and electrical sub-station in primary processing, The capital needs of secondary processing is overall lower not only in processing machinery but also in connected load and refrigeration because much smaller capacities of these utilities are required. Besides, the secondary processing end needs neither rendering nor wastewater treatment nor complicated machinery.

Table 4 Capital Cost Comparison of Primary & Secondary Processing Sections in Some Large Processing Plants

Description of plant	Investment % in processing machinery in	
	Primary processing	Secondary processing
4000 BPH with moderate secondary processing (portioning & packing)	3.7	96.3
6000 BPH with high level of automation in secondary processing	10.9	89.1
8000 BPH with automatic portioning, packing & machinery for KFC 9pc cuts	24.7	75.3
9000 BPH with moderate level of automation in secondary processing	10.8	89.2
Weighted average % investment	14	86

4.1.3 Hunger For Resources

Poultry processing requires lots of water, generates need for a large effluent treatment facility and uses plenty of power for operation, mainly in refrigeration and rendering. But most of these resources are restricted to primary processing departments which include live bird hanging to whole carcass chilling with water and flake ice, freezing of carcasses and a primary weight-wise grading of carcasses. Blast freezing of whole carcasses can be undertaken at the Hub, helping to smoothen the mismatch between farm output and demand for chicken meat. The Hub location could build large blast freezing capacities and frozen stores, thus qualifying them for MOFPI's cold chain capital subsidy. This would enable them to benefit from periodic live bird price gluts. With adequate freezing and storage capacities, gluts would be progressively smoothened and poultry farming would become a low-risk activity and attract more rural youth into contract farming of broilers.

4.1.4 Labour Requirements

A typical 6000 BPH plant needs from 300 to 400 workers if both primary and secondary processing stages are combined at one location. Of this, only 60-80 workers are required in primary processing, the rest being needed in secondary processing. Besides this, labour requirement in primary processing must be very skilled while labour in secondary processing generally needs one or two weeks of training. Because labour

and staff number is small for Hub facilities, and such facilities need to be located in up-country areas, plant promoters may provide on-site housing and other facilities to them. Spokes may be built close to towns on industrial estate plots or in existing industrial sheds taken on lease. There are always some unused plots or sheds in industrial estates near most towns and cities. Labour requirement for Spokes may be sourced from among young unemployed youth resident in the nearby towns. This means that the staff needs no purpose-built housing and may use existing mass transit networks for commuting. Were the Hub & Spoke model to be implemented, manpower problems could be solved by extending the Skill-India initiative to cover this sector. By way of social engineering, a team could periodically pick promising young candidates from the wet market and give them on-the-job training in existing modern poultry slaughterhouses, to be later absorbed in Hubs.

4.1.5 Work Schedule

In a slaughterhouse the primary processing shift operation begins very early in the morning to match the arrival of live birds at the plant. Transport of birds generally occurs at night to save them from heat stress and reduce DOA. The primary shift starts at around 0600 hrs and ends at say 1500 hrs whereas the secondary shift starts at 1100 hours and ends at 2000 hrs or goes beyond it, depending on workload. The secondary shift is staggered because of a technological factor called **maturation.** For maturation whole carcasses are rested for 4-5 hours at between -1 and +4ºC to make poultry meat more tender and juicy. This results in a natural separation in the overall poultry processing activity. If maturation is allowed to happen during transport of carcasses from Hub to Spoke, we can effectively increase the shelf life of fresh-chilled poultry by 4-5 hours. This will happen because we will have merged two serial value-addition activities, namely maturation and transport to market within that time-slot

Table 5 Emerging Segmentation in the Marketplace

Players	Skills/Barriers
Integrators, Industrialists ("Hub")	Can create barrier to competition by • having captive live bird supply • having access to capital • employing engineers, veterinarians and food technologists to run large, high technology, low processing cost plants
Merchandisers ("Spoke")	Can create barriers to competition by • consumer marketing skills • proximity to consumer • knowledge of local culinary traditions • piggybacking complementary items (eggs, red meat, fish, pork, beef, quail, rabbit, RTE, RTC, spices, condiments, seasonings) in their product-mix and so spread the operating cost

4.1.6 Rendering

Slaughtering waste is generated in primary processing and to protect the environment, reduce the spread of avian diseases and recover valuable protein from waste, one requires to have a rendering facility attached to each slaughterhouse. Secondary processing, on the other hand, generates practically no waste, except some bones when it is required to convert portions into bone-less meat. These bones can be rendered along with slaughter waste if they are delivered into the intake hopper of the rendering plant at the Hub.

4.1.7 Land

For treatment of wastewater, primary processing needs a large plot of land. Given the condition that treated wastewater must be used for irrigation, primary processing must occur in the midst of up-country agricultural crop or plantation land. Secondary processing has limited need of land as it generates no waste water stream. It can therefore conform to industrial estate standards and be located near towns, closer to consumption centres.

4.1.8 Inventory Management

In a large processing plant the preoccupation of managers in primary and secondary processing are very different. The manager of primary processing handles veterinary, technical and machine maintenance issues while the manager of secondary processing grapples with logistical, scheduling and inventory management issues. No doubt, there are several common concerns like biosecurity, hygiene and workers' safety, but the difference in their focus is important.

Secondary processing can produce a large number of product types or SKUs[12]. These are distinguished, one from another, by the size of packing, whether frozen or chilled, whether mixed portions (curry-cuts) or only one type of portions in a pack, whether skin-on or skin-off, whether bone-in or bone-out, whether edible offal or prime chicken portions, whether bulk-packed for institutions or small packs for consumers, whether marinated or not and so on. So the larger his operation and the farther he is from the consumer, the harder does the inventory management job of the manager get and from time to time he may get burdened with unsold inventory, which he must get rid of, by offering discounts.

4.2 Emerging Market Conditions Suit The Hub & Spoke Model

In recent years a number of companies have sprung up as **home-delivery** outfits. From each centre they cater to a geographically small market which their delivery boys or small trucks can service directly. They hold an undifferentiated inventory of fresh-chilled whole carcasses which they source from existing poultry slaughterhouses and process them into the desired SKUs against orders received by mobile phones or over the internet. So they do not have any dead inventory to carry.

Table 6 Ongoing Transitions in the Processing Industry

Trend	Example
Ongoing consolidation by brand leaders	• Suguna purchases Alpha Agro, SHL Agro, evaluates Caris Pure. • Shanthi, Godrej and Suguna evaluated purchase of Amrit's defunct plant, then drop it. • CP uses Penn Foods, ProTAC • Licious, Fresh to Home, Nandus, Zomato use ProTAC, Miki, Huda, Penn.
Business model options for integrators	• Promote their own brand or • Become commodity suppliers to emerging breed of web-based food delivery platforms like Amazon, Fresh to Home, Licious, Swiggy, Zomato, etc.

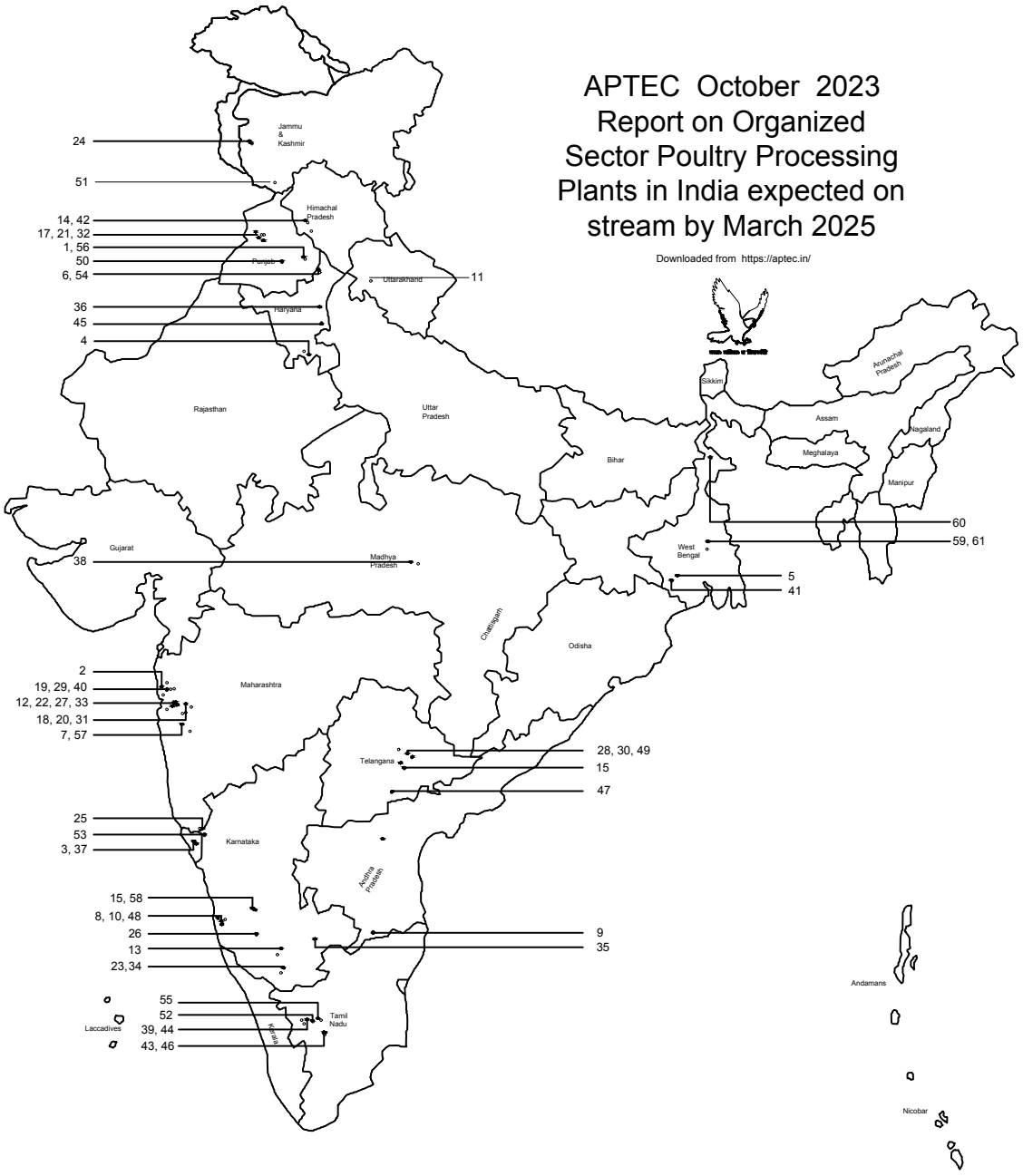
As municipalities chased most of the wet-market vends out of cities and towns over the recent past, these operations went underground and become invisible. Some of them took a cue from the home-delivery outfits and climbed onto their band-wagon. In effect the municipal drive made the wet-market computer-savvy and their members set up web-based home-delivery platforms. Like the current phenomenon of *cloud kitchens,* we now have *cloud-slaughterhouses* as wet-market butchers no longer need to display the actual slaughter process. This development fails in terms of product hygiene, biosecurity and sanitary disposal of processing waste. These clandestine operators continue to dump their processing waste onto landfills or into municipal drains.

If the processing industry sets up a sufficient number of Spoke units it may benefit from the home-delivery trend and together they may either improve processing conditions in these clandestine cloud slaughterhouses or cause them to shut down. The industry may also try promoting entrepreneurship among urban unemployed youth by including them in a franchise arrangement at spoke establishments, just as reducing price volatility by Hubs may promote unemployed rural youth to take up contract farming.

For the processing industry to adopt this idea, large integrators should convert their existing plants into Hubs, operating 2 shifts, the better to utilise their assets. Simultaneously the industry should rapidly set up many Spoke facilities close to cities and towns. To sum up, by splitting the process into two steps, we contain pollution, better manage water and power requirements at fewer locations, where we can solve these issues more efficiently because the solutions themselves exhibit scale economies. Besides, by restricting pollution generation and abetment to fewer locations, better control and compliance may become feasible. The poultry processing industry can leverage recent market developments and adopt emerging business models to expand product distribution and encourage enterprise among youth.

5 Water Stress - Cause & Effect

Although India remains well endowed with freshwater, population and over-exploitation of riverine and groundwater for flood irrigation has created scarcity in several regions. The principal culprits are (a) the commercial cultivation of paddy in low rainfall areas such as Punjab and Haryana (b) stubbornness of some regional governments to adopt sensible river water sharing formulas and (c) bad agricultural policies implemented by short sighted governments in the past.



1	Alchemist	11	Doon Valley D'door	21	Rai Poultry	31	Penn Foods	41	Shalimar Galsi	51	Star Poultry Jammu	61	WBLDC, Harin II		
2	Al Halal Foods	12	Godrej Tyson Taloja	22	KGN Poultry	32	Perfect Poultry	42	Shalimar Una	52	Suguna, Vayalur				
3	Ambica Chicken	13	Godrej Tyson Hosk	23	Kavi Proteins	33	Premium Chick	43	Shanthi Feeds	53	Suguna, Belgaum				
4	AOV Agro	14	Goel Foodworld	24	Khazir Poultry	34	Pragati Broilers	44	Sivasakthi Agro	54	Suguna, Lalru				
5	Arambagh	15	Goldchick	25	Kwality Animal Feed	35	ProTAC Foods	45	Skylark Foods	55	Swami Feeds				
6	AV Ventures	16	Golden Hatcheries	26	Lifeline Feeds	36	RM Delicious	46	SKM Feeds	56	Syra Foods				
7	Baramati Agro	17	Healthy Choice	27	Maval Agro	37	Royal Foods	47	Sneha Farms	57	VH, Kamshet				
8	Bharat Agrovet	18	Huda Foods	28	Mayuri Broiler	38	Sabir Qureshi	48	Souza Hatcheries	58	VH, Davangere				
9	CP India	19	Hybro Foods	29	Miki Exports	39	Saffa Foods	49	Srinivasa, Taniki	59	WBLDC, Harin I				
10	Coastal Farms	20	Japfa Comfeed	30	Nafees Poultry	40	Sethwala Foods	50	Star Foods	60	WBLDC, Siliguri				

Figure 7 Location of organised sector poultry slaughterhouses in India, October 2023

5.1 Bad Agricultural Policies

We give here two examples of this last mentioned reason. Number one is the promotion of irrigated soybean cultivation in central India. This region had a traditional agronomy of coarse cereals which

performed well with limited rainfall. This agricultural tradition was well balanced with cattle farming because the biomass generated by coarse cereals fed the cattle. With the promotion of soybean, irrigation took centre-stage and since soybean does not generate biomass suitable for cattle, this traditional agronomic practice fell into disuse.

The second example is large scale introduction of sugar cooperatives in rain-deprived regions of Maharashtra. Although this did generate a favourable environment for a local politician to rise spectacularly, it created an unwarranted need to flood-irrigate a region where coarse cereals had ruled the roost.

Finally we must acknowledge that growth of the Indian economy is driving increased water usage across sectors. In step with this, wastewater generation is increasing significantly and in the absence of proper policies and measures for treatment and management, the existing freshwater reserves are being depleted, polluted and vast areas are now water-stressed.

Given this background, any growth of the poultry processing industry will remain constrained by the availability of water and location of new facilities may seriously conflict with the other, more primary needs for water - for household needs and irrigation of crops. There are few locations, specially in the plateau and in the south, where adequate uninterrupted supply of raw water exists for this industry after meeting these more important and sensitive needs. Therefore unless new red zones are identified and earmarked for this activity, future growth and distribution of new facilities will not only be restricted but may occur sub-optimally.

5.2 Skewed Growth

Figure 7 shows the distribution of poultry slaughterhouses in India. To get further details of slaughterhouses listed in it, refer to a current Industry Report, a copy of which is posted bi-annually on the Aptec website. You will also find the latest version of this map there. It is interesting to note how skewed the location of plants is, in comparison with the distribution of meat consumers over the Country. Entire Uttar Pradesh, Bihar, all seven sisters of the north-east, Orissa, entire central India, Rajasthan and Gujarat have no processing plants. Haryana has the highest concentration of vegetarians but also hosts several processing plants. Does that mean that regions that have no plants consume no poultry? It means that processed poultry is being frozen, hauled long distances and sold at a tremendous disadvantage in competition with local wet-markets. These factors actually further depress consumption in these areas.

6 Solutions

6.1 Balance The ‘Wastewater For Irrigation’ Contract

Earlier we mentioned the pollution abatement rule which requires poultry processors to enter into an agreement with nearby *panchayats* for use of treated wastewater for irrigation. A legal arrangement requires all participants to conform, but as stated in this rule, while the poultry processor appears obliged to deliver irrigation water, no reciprocal obligation binds the farmer to depend primarily on this water for irrigating his crops. He remains free to choose canal water or tube-wells for his needs. The contract must aim to conserve canal and tube-well water as long as a nearby plant remains under obligation to supply treated wastewater for irrigation. Also the poultry processor requires some relief from his obligations for the duration of the monsoon season. He cannot be expected to shut down operations when the farmers have no need for irrigation water.

We believe the best solution lies in (a) the pollution control board permitting discharge of treated wastewater into irrigation canals subject to automatic continuous monitoring and logging devices being attached to the discharge points at processing plants, or (b) legislating a form of **ownership of irrigation rights**. Under this scheme, the processor may buy **irrigation rights** for a certain agricultural acreage near his plant on payment of a fraction of the registration fee. Once the processor has secured such a right, the law will prohibit the farmers owning adjacent crop land to draw ground-water or canal water for irrigating their land with, as long as the processor is ready to supply them treated wastewater conforming to the discharge standards laid down by the pollution control board for such irrigation. This will protect the farmer, groundwater resources and an unfair cost burden on processors.

6.2 Bundle Wastewater Treatment And Irrigation With Food Parks Projects

Of the 61 organised sector poultry slaughterhouses listed in Aptec's current Industry Report, only eight are in food parks or industrial estates[13] and they constitute only 13.9% of the total capacity. Why do such plants prefer greenfield where they need to get CLU (changed land usage under zoning laws) certificates, build a lot of infrastructure and draw dedicated power lines instead of choosing industrial estate and food park land? Why have industrial estates and food parks failed in their objectives?

Industrial estates and food-parks offer plots of land which are woefully unsuited for processing because (1) the plots are too expensive, (2) too small, (3) have no provision for common wastewater treatment, (4) nor reasonable access to agricultural land on which to dispose the treated wastewater (5) provide neither back up power nor common steam supply. In fact, in developing industrial estates, local and central government alike are behaving more like real estate developers rather than industry facilitators[14]. As a result investors prefer greenfield sites, obtain CLUs and set up all facilities including dormitories for essential staff, all by themselves. The zero discharge rule further reduces the lure of industrial estates and food parks.

6.3 Identify New Red Zones In Line With Riverine Planning

Particularly for peninsular and central India, the government is in the process of joining rivers, making piped water supply available from barrages and setting up several multipurpose hydrological projects. Study of a master map of such projects should help the pollution control authorities to identify new spots where water will become available through these efforts for industrial use. If this is jointly done by all concerned government agencies, new red zones may be identified on poor soils along the new waterways. Once such new red zones are declared, new poultry farms and Hub processing facilities could be set up in a planned manner and linked by roads to all nearby consumption centres with new Spoke facilities.

7 Water Pollution Mitigation And The Karnal (Snake-Oil) Technology

For a long time pollution control authorities have been selling the idea of setting up eucalyptus plantations on land owned by poultry slaughterhouses to manage their treated wastewater discharge. Briefly, this theory recommends eucalyptus plantations because this tree is declared to be most efficient in losing water through transpiration. The Karnal University is the most visible promoter of this idea – in fact it is called the **Karnal Technology**. We have studied this proposition over a long period and could not restrain ourselves from exposing this so called 'technological solution'.

What are the principal and fundamental arguments against this technology?

(1) If the treated wastewater conforms to Indian standards, and is still unsuitable for discharge into waterways, is it not incumbent upon the standards institutions to issue fresh and more stringent standards for treatment in consultation with the pollution control authorities?

(2) If the pollution control authorities are unable to enforce proper wastewater treatment and discharge, can they hide the failure of the executive function by taking legislative action instead of overcoming their executive failure?

(3) Does deliberate and planned transpiration of treated wastewater not worsen water stress? Should treated water not be allowed to return to subterranean aquifers to raise the seriously falling water table instead of forcing plant owners to contribute to cloud formation at their cost?

(4) Why must industrial estates, especially those promoted as food parks, not offer common treatment of wastewater for the entire facility? Would such an arrangement not considerably improve monitoring and control, and if the discharge standards were brought up to mark, could not food parks also include crop irrigation as their stated objective and thus make it another incentive to the local population, who routinely protest against acquisition of their land for building food parks on?

(5) Why insist on eucalyptus plantation for accelerating transpiration? If transpiration is your objective, can you prove that eucalyptus is indeed the most efficient choice?

The first four questions are rhetorical – they already contain their own answers. But the last needs further explanation.

7.1 Genesis Of 'Guilty Eucalyptus' Hypothesis

Depletion of groundwater in Punjab and present day Haryana (which was earlier a part of Punjab) was first noted shortly after independence. When populations were exchanged, DPs entering eastern Punjab encountered much worse agricultural conditions than they were used to in western Punjab. The land that they had fled from had one of the world's most developed irrigation canal networks, built over decades past by the British.

Wealthy immigrants set about improving their new land in east Punjab. They created large crop fields and planted eucalyptus as windbreak on walkway *bunds* or footpaths around these fields. The Punjab government paid special attention to *choes* which brought in large quantities of sand and boulders from the Shivalik hills which had been denuded by the British of their forest cover to meet their war requirements. The farmers also drilled a large number of tube-wells for use with diesel pumps and went about flood-irrigating their land. In short order, in fact, a massive local industry manufacturing small diesel engines mushroomed all over India, making this country the world leader in this industry.

Eucalyptus has over 800 varieties and only some grow fast, tall, with few branches (hence no nesting sites for birds) and thin canopies – qualities that best suit a windbreak. These varieties were chosen by the Punjab farmers for planting all over the *bunds* separating individual fields. It was then that the Indian authorities noticed that Punjab had a rapidly falling water table. When scientists from the agricultural universities got to work, they promptly blamed this on eucalyptus.

Ask yourself – how could they have identified eucalyptus as the smoking gun? Did they carry out comparative transpiration or root structure studies on various tree species and conclude that eucalyptus was indeed the culprit? Of did they just scan the horizon for anything unfamiliar and made up their minds? It was the latter. They drew a spurious correlation and gave it the garb of a scientific hypothesis!

Did it not occur to them that flooding of fields would by itself have produced evaporative loss several orders of magnitude higher than the significantly small number of windbreak trees could? Just compare the exposed surface area offered by the collective mass of eucalyptus leaves with the surface area of the flooded fields themselves and figure it out!

To survive in the often dry and nutrient poor soils of their native habitats in Australia, eucalyptus trees can grow roots that reach depths of up to 20 meters in order to access water and nutrients. But when they grow in more fertile and humid soils, eucalyptus roots have no need to descend very far in search of nutrients and water. As such trees grow, their lateral root system spreads horizontally close to the surface of the soil, sometimes as far as 30 metres from the trunk. Experts say that 90 percent of a cultivated eucalyptus's root system is found in the top 300 mm from the surface. Root structures in such cases do not go very deep. So much so that when grown in wet or waterlogged soils, these tree gets uprooted in the mildest storms.

So can we conclude that eucalyptus windbreaks in Punjab farms were guilty of drawing water all the way from the water table and so contributing to a its fall? The farm land was well irrigated and the trees were, with the help of their lateral root system, using the flood-irrigation water that pumping brought to the surface. Clearly intensive pumping of irrigation water was the primary reason for falling water table, not the eucalyptus tree!

Endnotes:

[1] Price volatility in live broilers results in alternate periods of over-supply & crash in price and shortages & peaking of prices, once or twice a year When a monopoly engineers supply of breeding stock to create large price oscillations, it tends to wipe out any emerging competition in the market for breeding stock. This is how a monopoly is perpetuated.

[2] The wet-market is defined as an unorganized slaughter location, typically at or near mandis in India and well concealed in villages close to or within cities and towns. Villages located within towns and cities are governed by traditional land use laws and municipal land use laws do not apply there. Because of this it is convenient for the wet-market operators, displaced by municipal orders from cities and towns, to hide their operations within such villages.

[3] By our definition the organised sector comprises those having a capacity of at least 1000 BPH. There are several smaller plants but they are essentially uneconomic, given the scale economies and generally they serve as learning steps in the life cycle of a process plant. They may have chain based processing facilities or may have drum pluckers and LPG fired scalders. This sector is represented in rows 2.2 and 2.3 in table 8

[4] The 2002 capacity comprised Arambagh-Bolpur, West Bengal 2000; Godrej-Hoskote, Karnataka 1000; Goldchick-Hyderabad 2000; Riverdale-Somatne, Pune 1000; Toubro (Alchemist) Kurali 2000; Suguna-Vayalur 2000; Venkys-Kamshet, Pune 3000 =13000 BPH

[5] Refer statistics presented in the October 2023 bi-annual Poultry Processing Industry Report on this website. If not available there, e-mail us.

[6] $13000 \times 1.1225^{20} = 1,65,212$. This is the CAGR (Compound Annual Growth Rate) of just over 12.25% in capacity creation within the organized sector poultry processing industry over a twenty-two year period.

Must these figures come as a surprise? we think not. We list some articles published long ago, which presented more or less these same sentiments

(a) **Meat International 1999, Vol 9, nr 8.** Article authored by Rahul Mirchandani, a director of Aries Agro-Vet Industries Ltd, Mumbai.

Excerpts:

i "(India) produces about 400 million broilers and 30 billion eggs every year"
ii "Current market for commercial broilers is Rs 36 billion, of which share of processed chicken is Rs 1 billion, amounting to a share of 3%"
iii "Only about 1-3% of the (live bird market) is processed"
iv "rate of growth of broilers (which) is 20% a year"

(b) **India's Poultry Sector: Development and Prospects.** Maurice Landes, Suresh Persaud, and John Dyck. Market and Trade Economics Division, Economic Research Service, US DA Agriculture and Trade Report WRS-04-03. January 2004

Excerpts:

i "Information from industry sources suggests that production and consumption of poultry meat in India has grown by as much as 15 percent annually since the mid-1990s, far faster than indicated by official data".
ii "(the backyard poultry) segment is declining and probably accounts for only 10-20 percent of India's total output…. its impact is ignored in this report"

(c) **Rabobank Report Volume II Vision, Strategy and Action Plan for Food Processing Industries in India** Prepared by Rabo India Finance Pvt Ltd for the Ministry of Food Processing Industries, April 2005

Excerpts:

i "Per capita annual consumption has grown from 420 grams in 1991 to about 1.5 kg in 2003. Excluding the vegetarian population, per capita consumption is approximately 1.75 kg per annum."
ii "Contrary to perception, India has a strictly vegetarian population of only about 20% (Source: Survey concluded in the 'People of India' (study report) by the Anthropological Survey of India (1994))".
iii " A mere 6% of production (about 100,000 MT) of poultry meat is sold in processed form.".
iv " The current poultry processing capacity in India is approximately 25000 birds per hour."

(d) **USDA Foreign Agricultural Services** Report (GAIN IN5093 - 2005) prepared by V. Shanmugam and approved by Chad R. Russel of the US Embassy, New Delhi

Excerpts:

i "India's broiler production is forecast to grow by 16% to 2.2 million tons in calendar year 2006"
ii "Only about 8% of the total poultry meat production in 2004 was processed"
iii "Post forecast poultry meat consumption in 2005 at 1.9 million tons or 1.8 Kg/capita"

(e) **World Poultry Vol 22, Nr 6, 2006. India to See Tremendous Changes**. Article by Jagdish Rattanani, Mumbai

Excerpts:

i Poultry meat production is stated as "1.6 , 1.65, 1.8 and 2.0 million tonnes in 2003, 04, 05 and 06 respectively"
ii Current consumption is "1.55 Kg/capita consumption of poultry meat"
iii "The industry estimates that 98% of consumption is manually processed chicken while only 2% of total consumption is catered to by modern processing plants"

(f) **Poultry, Food Security and Poverty in India**: Looking Beyond the Farm-Gate. U. Pica-Ciamarra and J. Otte

Excerpts:

i "between 1985 and 2005 poultry meat production grew by about 12 percent per year"
ii "only 5 percent of all poultry output is marketed in processed form (Reardon and Gulati, 2008; Traill, 2006)"

Available government data consist only of periodic poultry population estimates, with the most recent estimates based on a livestock census. There are no official statistics on poultry consumption, marketing, processing, or feed use. In the absence of supporting survey information, these estimates do not have a strong statistical foundation- they merely express anecdotal sentiments. Trade associations, including the Poultry Federation of India, also do not compile industry-wide data- limiting their role only to lobbying.

[7] In a seminal work *Water and Waste Management in Poultry Processing* (Carawan et al)[1] the major uses of water in a typical 70,000 broilers per day benchmark plant in the mid 1970s was shown to be 12.28 gallons or 46.83 litres per bird. This was reduced, by careful planning and rethinking described in the above publication, to 7.81 gallons or 29.56 litres per bird. It is now at between 25 and 13 litres per bird depending on plant capacity: the higher figure belonging to the smallest plant capacity of 1000 BPH and the lower figure belonging to roughly 10,000 BPH. Beyond this capacity figure the specific water consumption does not change.

[8] APTEC Report - Water Recycling in Poultry Processing - State-of-the-Art

[9] Refer Poultry Processing Industry Report available on the Aptec website www.apteec.in for a complete list of existing plants and their capacities.

[10] Broiler production data is closely guarded by the monopoly and its Broiler Breeders' Association. Yet if available it can form the most reliable basis for estimating production and consumption of poultry in India. We were privy to this figure in 2019 when we used the annual parent (breeder hen) chick placement figure and derived the size of the market and published it in the April 2019 issue of the Industry Report on our website. It has since been removed because we follow a policy of retaining the current Report and three earlier reports at any given time. But this back issue can be e-mailed on request.

"At that time we had made enquiries and found that a total of 30 million broiler breeders (parent hens) were placed every year collectively by three breed owners in India, namely (1) the house of Cobb, operated in India by VH; (2) the house of Aviagen, operated by Aviagen India Poultry Breeding Company and (3) Indian Broilers and Hubbard India, operated by Suguna Farms and Skylark Hatcheries. Around 21 million of these are Cobb, and the remaining 9 million are Aviagen (this includes Hubbard, which is a subsidiary). Almost all of Cobb breeding stock is sold to integrators, while approximately 50% of non-Cobb stock is sold to integrators – the remaining being housed in the respective GP farmers' own integration."

"Going further, each breeder placement accounts for approximately 120 commercial DOC's per year and this in turn, at 8% growing mortality, results in 3310 million broilers, ultimately being consumed per year. The overall contribution of local backyard poultry sector and use of layer culls in the poultry meat sector is probably an insignificant amount, taken as not exceeding 10% of this figure. Therefore we take 3640 million as the total number of birds coming from the breed companies. There is negligible foreign trade yet (although the WTO ruling is expected to change this), therefore production equals consumption."

However, the 2019 method has been used here, but unfortunately we do not have access to the latest broiler breeder placement data. So we have added 10% increase over the 2019-2025 period and compiled the following table. In it we estimated an additional 10% of this base figure of 3640 million broilers. The old estimates of layer culls and country birds has been retained. So our operating production of birds per year becomes 4000 million. We can now summarize the present (early 2025) market as follows

Table 8 Calculation of Present Market Segments		
1	**Slaughtering capacity required** if all 4000 million birds produced were to be processed	1,670,000 BPH*
2	**Slaughtering capacity outside of the wet market**	
2.1	Slaughter in the entire broiler industry projected to early 2025	1,65,400 BPH
2.2	Projected capacity in the unorganized sector and cantonments (10% of row 2.1)	16,540 BPH
2.3	Estimate of the "dry processing" sector*	62,500 BPH
	Total processing capacity, all sectors, expected on stream by end of first quarter, 2025 [2.1+2.2+2.3]	2,44,440 BPH**
3	**Genuine wet market** size and percentage of total is still approximately 85% of total poultry market [(1425560/1670000)%]	1,425,560 BPH
* We take the annual production figure of 4000 million broiler birds consumed per year and convert it into processing capacity equivalent by assuming 300 days of processing at 8 hours per day. This amounts to 1.67 million birds per hour processing capacity. [4000/(300x8) = 1.67] **This is a guesstimate made by us in 2019. Together with several municipal mandis, at least half a dozen commercial enterprises were doing dry processing. Ghazipur Mandi in Delhi used to dry process about half a million birds per week, and we assume that only 5 metropolises have rid their streets of roadside slaughter by allowing the creation of their own Ghazipur style mandis or clandestine slaughter sheds. Then, assuming 40 operating hours per week, we arrive at a capacity figure of 62,500 BPH.		
If we divide the wet market capacity by the average capacity of organised sector plants (2711 BPH), we arrive at 526 processing plants. If we take 30% of this, we require 158 additional plants by 2035 and yet another 158 plants by 2047 to achieve a processing of 75% of all chicken that we consume, demand and supply remaining unchanged over the forecast periods.		

[11] Scale economies express how much more it costs to process one chicken is when it is performed in a plant running at 1000 BPH as compared to doing it in, say, a 6000 BPH plant. To obtain actual figures, download AptecApp from the Aptec website. This App allows you to choose from 5 different plant sizes, configure the product mix to your liking and it immediately generates the entire financial feasibility calculations. It also shows you how much a typical kilogram of marketable product costs to produce with your just-configured product mix and capacity settings. Maintaining the same product mix, switch to a different capacity choice and study the financials. You can read how much it costs to process at that capacity. This will illustrate the sensitivity of processing cost to scale of operation. Even within a single plant capacity setting you can choose a 20% over capacity or 20% under capacity operation and see the impact of specific processing cast.

[12] A stock-keeping unit (SKU) is a scannable bar code, most often seen printed on product labels in a retail store. The label allows vendors to automatically track the movement of inventory. The SKU is composed of an alphanumeric combination of eight-or-so characters.

[13] These are tabulated here

Table 9 Poultry Slaughterhouses in Industrial Estates And Food Parks				
	Project	Status	Capacity	Remark
1	AV Ventures at Panchkula,	In operation from beginning 2023	1500	Plant began operation in January 2023
2	Goel's Foodworld, Simla	Under installation	4000	Have just been moved out of city limits and made to comply with local zoning laws
	Godrej Tyson, Taloja	Intermittent operation	3000	Have to transport slaughterhouse waste to Bangalore for rendering it there. Wish to exit this location.
3	Lifeline Feeds, Chikmagalur	In operation, plans expansion in 2025	3000	Formed by consolidating four industrial estate plots, with three public roads separating the operation
4	Miki Exports		2000	The facility processes for Fresh To Home and Licious.
5	RFK Green, Pulwama	Installed 4 years ago, not in operation yet	2500	Delays due to difficult local conditions. May commission in 2024. Because unit was planned properly, space and other constraints typical of other food parks do not apply here.
6	Srinivasa Hatcheries, Gangavaram,	Not in operation	2000	Machinery delivered six years ago. No plans for installation and commissioning

	Kurichedu, Prakasam Mega Food Park			
7	Skylark Foods, Sonepat	In operation since 2004	1000	They have growth plans but cannot do so because they have not enough land. The plant exists on a mere 1800 SqM of land
8	Star Foods, Ludhiana	Expected to come on stream by mid 2024	4000	Plans made by Aptec by consolidation of 8 plots of land and partial wastewater treatment before pumping to common facility
13.9% of the total capacity			23000	

[14] Lifeline plant occupies 4 plots of land separated by roads having overhead and underground pipelines connecting them. Star is planned on 8 adjacent plots of land. Godrej Taloja has serious problems with neighbours and for some time was transporting tanker-loads of processing waste to Hoskote for treatment. Skylark cannot use its rendering plant because of neighbours' complaints and cannot expand for lack of space. This clearly illustrates the unpopularity of government food parks for poultry processing.