

Broiler EC Housing : Indian Perspective

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- I. Need for Environment Control House.
- II. Fundamentals of Hot weather Ventilation.
- III. Concept of Environment House.
- IV. Benefits of Environment Control House over Open Housing.

I. What is the need of Environmental Control housing?

- All breeds are high yielding & fast growing which means faster metabolism, more heat production, more moisture loss, more oxygen requirement.
- Improving air quality within the broiler house by removing the contaminants such as dust, ammonia, carbon dioxide, carbon monoxide and excess water vapour.
- To regulate Heat Stress Index No. below 150 & reducing the Sensible & Insensible heat loss %.
- To provide thermal comfort zone and better utilisation of feed for maintenance, growth & weight gain.

When should we go for EC House ?

➤ **Extreme Climatic Conditions**

- High fluctuations in Day & Night temperatures
- Very hot summers (35 degrees plus), Very Cold winters (5 degrees)
- Insufficient Natural Ventilation
- High Humidity
- **Land/Space restrictions**

Note: Electricity should be available and back-up generator systems are a must.

II. Three important house fundamentals for hot weather ventilation?

- **Must remove heat from the birds ?**
 - Correction of air velocity by increasing the air speed to bring the wind chill effect.
- **Must remove heat from the house ?**
 - Correct air exchange capacity.
- **Must decrease the temperature of the incoming air ?**
 - Maintain the correct incoming air temperature.

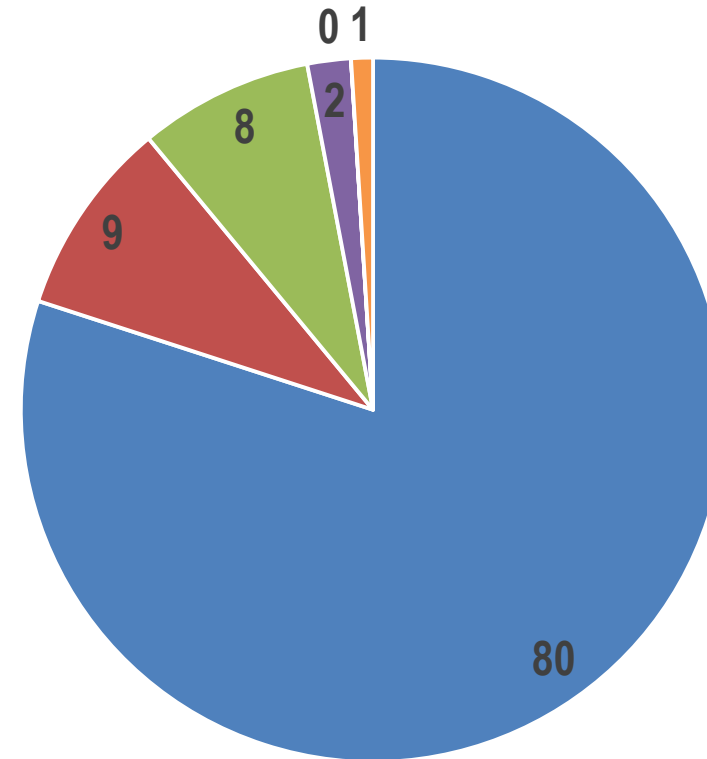


How much heat is produced from Bird and the House ?

- ✓ **Maximum heat is produced by birds !!**
- ✓ Bird body temp is 106 degree F
- ✓ **Ceiling & curtains**
- ✓ **Side wall and Lights**

80% of the heat is produced by birds and 20% through external ambient temp. from Ceiling, side curtains & side walls.

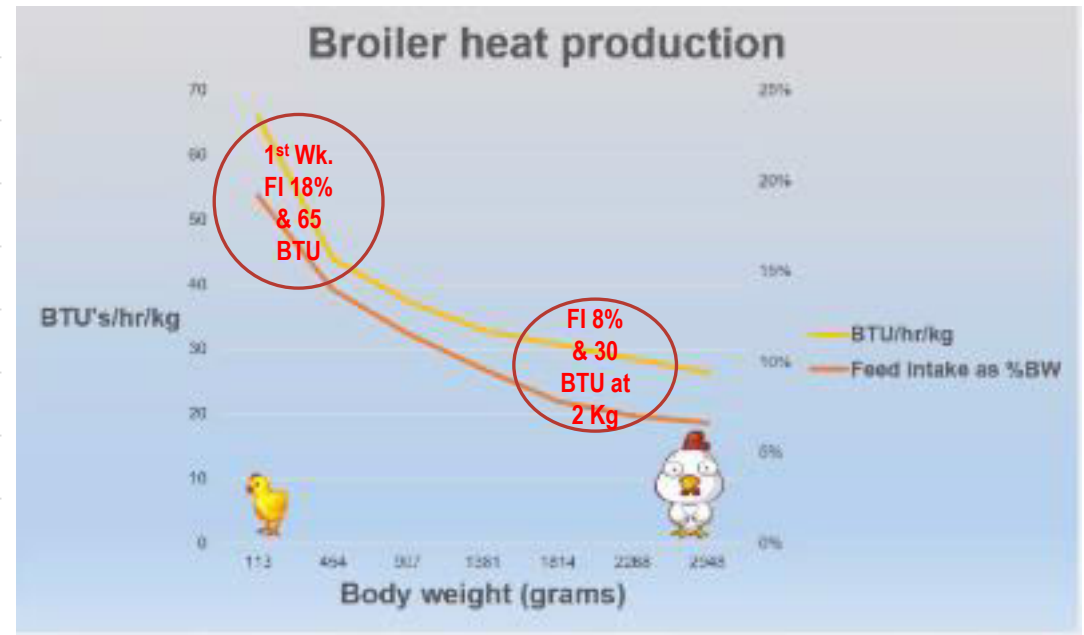
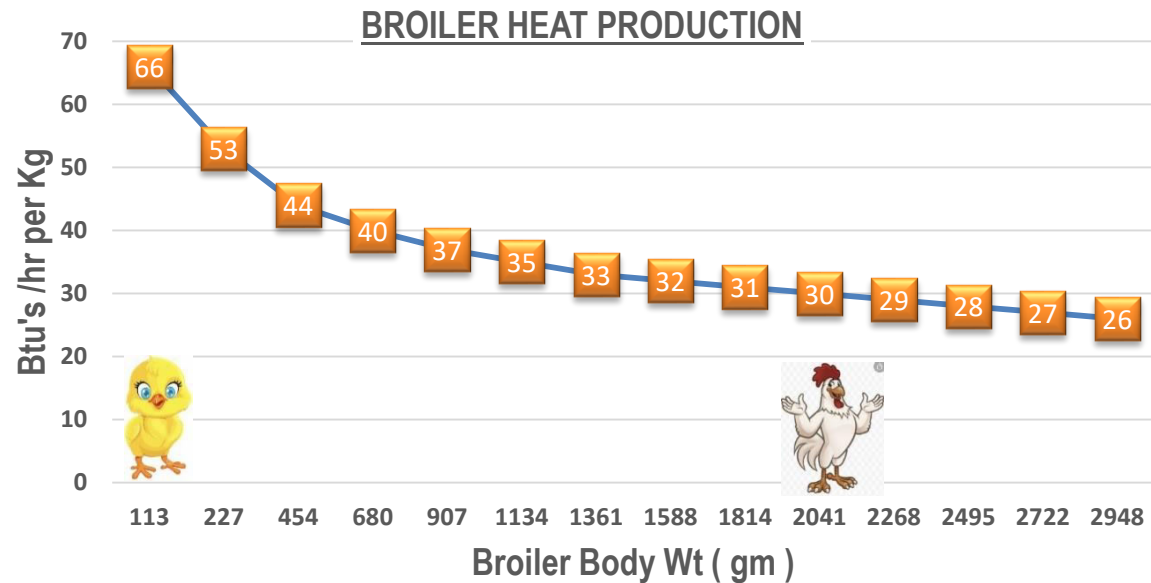
Heat produced in Broiler House (%)



■ Birds ■ Ceiling ■ Curtain
■ Side wall ■ End wall ■ Light

How much Btu's of heat Broiler produces ?

Understanding Heat Production by Broiler with increased Body Wt. and FI % of Body Wt.



- High feed intake of 18% of Body wt. producing 66 Btu's /hr. per Kg for Chicks.
- Lower feed intake of 8% of Body wt. producing 30 Btu's / hr. per Kg for 2 Kg broilers.

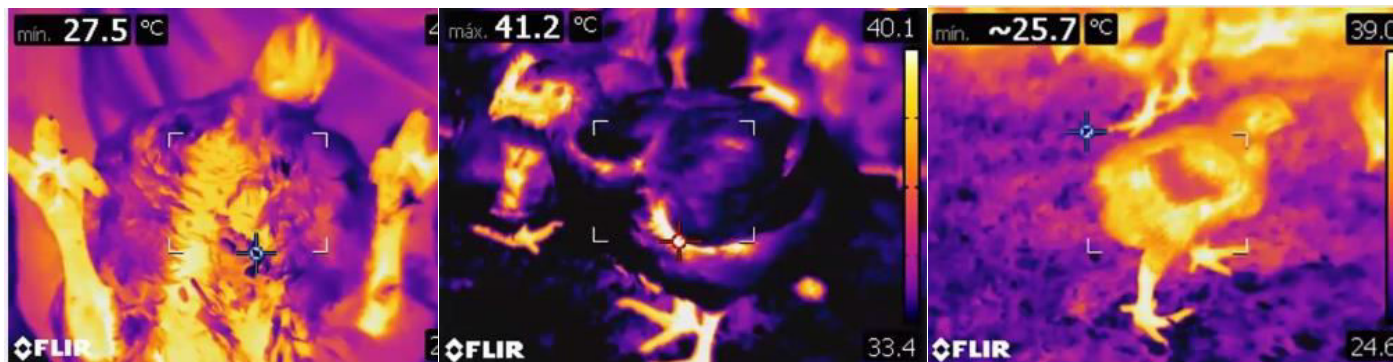
1. Energy utilisation & metabolic heat loss by broiler.

➤ Daily Calorie Consumption:

- Broiler consume 264 calories per Kg of body weight Vs. Human 25 calories.(10 times).

➤ How does a broiler use this energy?

- Roughly 25% of the energy is used for the basic functions: **Growth, physical activities, breath, pumping blood, maintaining body temperature etc.**
- 75% of the energy is given off as metabolic heat in order to survive!
- The bird get rid of this heat by two ways: – a) To the air around - 40-50%. b) Through the evaporation of moisture of its respiratory system – 50-60%.
- Once the differential between the bird and the ambient temperature decreases we need more air exchange to remove this metabolic heat.



1. How much metabolic heat is lost from Birds in a house ?

➤ Sensible Heat Production for 2 Kg Broiler in a house.

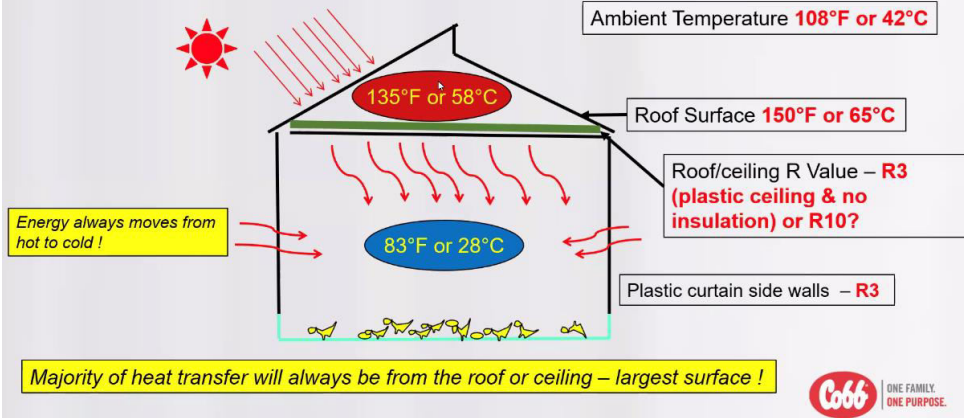
- A 2 Kg Broiler will produce approximately 30 BTU's /Kg/ hr.
- The portion released to the air in the house is most important number and is 12-15 BTU's /Kg/hr.

Broiler House Capacity	Metre	Feet
Length	100	330
Width	10	33
Total Floor Space / House (Sq.M / Sq Ft)	1000	10890
Usable Space / House (Sq. M. / Sq Ft)	981	10560
No. of Bird(Per Sq M / Sq Ft)	14.35	0.75
Live Broiler Wt (2 Kg)	2.00	2.00
Kg (Per Sq M / Sq Ft)	28.69	2.67
No of Bird per house @ 0.75 Sq. / Bird	14080	14080
Sensible Heat Produced for 2 Kg Broiler		
BTU / Kg / hr	30	
For 2 Kg Broiler BTU / hr	60	
40% as Sensible heat (BTU/Kg/hr.)	12	
Sensible Heat / House (BTU/Kg/hr.) from Birds	3,37,920	

2. Heat removal from House.

Total Sensible heat production with different Ceiling insulation at 42° C ambient temperature.

Understand your environmental limitations



Factor influencing heat Production from ambient temperature in a house.

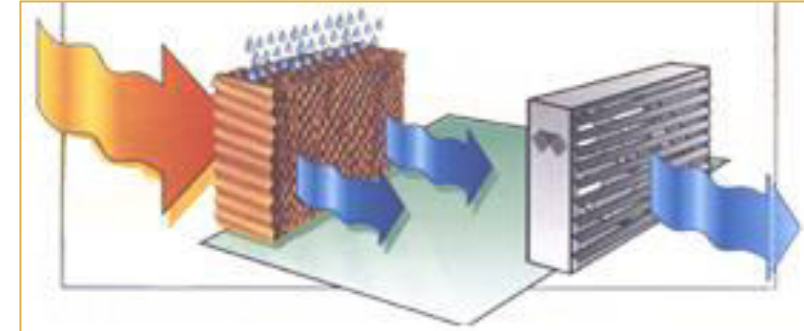
1. The area of the ceiling, curtains and side walls.
2. Insulation value of material used in the Ceiling or roof panels, side walls, end walls and curtains.
3. Differential temp. Outside / Inside .
4. Attic temperature is usually 10-20°C higher than ambient.
5. **Heat / Gain Loss = (Area / R Value) * Temp Differential**

External Ambient Temp. at 42°C					Heat Reduction	Total Heat Produced
Heat Entering through Ceiling or curtains	Metre	Feet	°C	°F	%	BTU / Kg /Hr
Length	100	330				
Width	10	33				
Ceiling Surface Area / House (Sq.M / Sq Ft)	1000	10890				
Attic Temp °C			58	135		
Inside Temp °C			28	83		
Flat Plastic Drop Ceiling of R Value 3		3				
Thermal Wrap bubble with Aluminium foil		7				
Rockwool Roof Insulation		9				
Sandwich Panel R Value 10		10				
No. of Birds / House		14080				
Heat Gain/ Loss (BTU / hr) = (Area / R Value) * Temp Diff (° F)						
Flat Plastic Drop Ceiling of R Value 3		1,88,760		5.35		5,26,680
Thermal Wrap bubble with Aluminium foil R Value 7		80,897		5.35	57.14	4,18,817
Rockwool Roof Insulation R Value 9		62,920		5.35	66.67	4,00,840
Sandwich Panel R Value 10		56,628		5.35	70.00	3,94,548
Sensible Heat / House (BTU/Kg/hr.)	3,37,920					

3. Decreasing incoming air temperature.

Evaporative Cooling or EC Housing works on the principle of Latent Heat.

- Outside hot air is mixed with water.
- Water evaporates and heat required for evaporation is taken from incoming air and it gets the air cool.
- Humidity of the air increases because of this.
- For every 1°C cooling, the RH of the air will increase approximately 4.5%.
- The energy required to evaporate one liter of water at 100°C needs 2142 BTU heat..
- As energy is removed from air it cools....temp of air decreases.



Uses latent heat to convert liquid water to vapor (evaporation)

Removes sensible heat from air

End Result: water evaporates = cooler incoming air

Decreasing incoming air temp through evaporative pads to 28°C and to maintain ΔT of maximum 2.8°C.

How big can I make the EC house ?

- **House length** should not exceed **100 – 120 metre. (320 Ft – 400 Ft)**
- Negative pressure house with good tunnel ventilation effect with ratio of 1: 10 (width : length).
- Capacity to market the birds / day or complete liquidation in 3 days.
- **Shed width** - Should be optimize with the use of Nipples and Feeder in a shed.(**Min 30 feet or 10 metre.**)
 - One Feeding Pan for max 54 birds; optimum 40 birds/pan
 - One Nipple for max. 15 birds; optimum 11 birds/nipple
- **Shed Height** – Should be as less as possible to improve air speed. (**2.4 Metre or 8 Feet.)**
- Birds catching / manure removal automated operations. Bobcat min **2.7 mt. about 9 ft. necessary.**



III. Concept of Environment Control House in India



➤ **Negative Pressure Ventilation System is operated in three different modes –**

- I. **Minimum Ventilation -**
- II. **Transitional Ventilation**
- III. **Tunnel Ventilation**

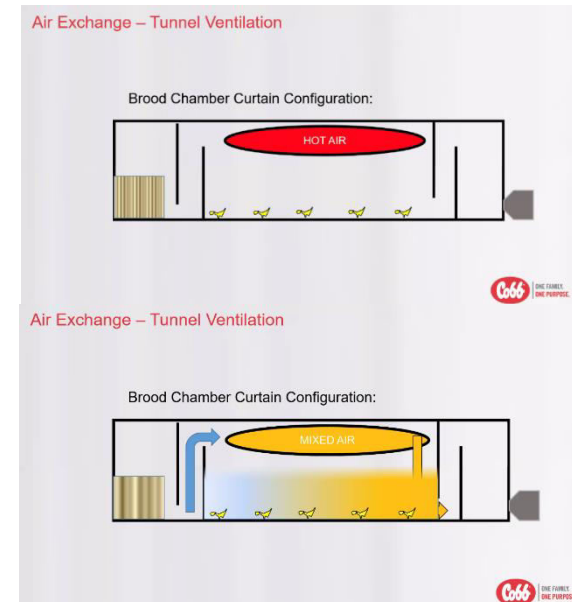
Cooling System – Evaporative Pads , Fogging and Misting.

I. EC House - Minimum Ventilation

- Minimum ventilation is used for young chicks, night –time or winter ventilation.
- This type of ventilation is time-driven and not temperature driven.
- Minimum ventilation in completely closed houses draws air through side air inlets of appx. 2” size below the ceiling with 36” extraction fans on the side walls.
- This will ensure mixing of incoming air mixed with the warm air above birds in the house rather than dropping directly.
- Minimum ventilation in EC house with side curtains can be operated with one tunnel fan and cross curtain configuration.
- We can manage minimum air exchange through Curtain configuration by avoiding the direct draught of air on chicks.

Minimum Ventilation Guide lines with side Curtains.

SHED SIZE	Metre	100	10	Feet	328	32.8		
BIRDS NO		13907						
Age			Min Ven Req		Min Ven		300 Sec Cycle	
Wk.	Kg	CFM / Bird	Fans	CFM	CFM	%On Time	On Time	Off Time
0	0.050	0.043	1	20000	598	3.0	9	291
1	0.200	0.123	1	20000	1711	8.6	26	274
2	0.500	0.245	1	20000	3407	17.0	51	249



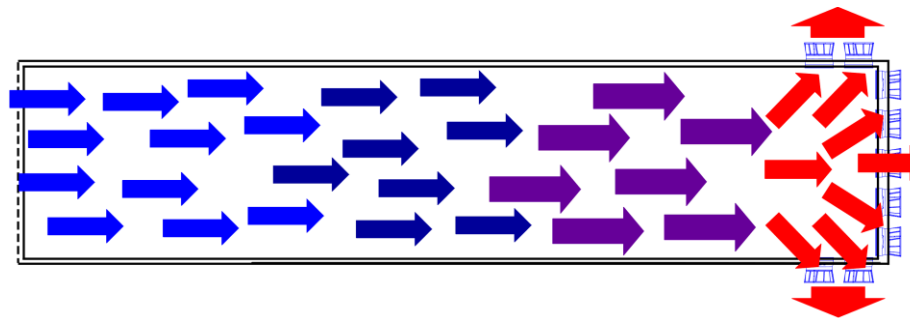
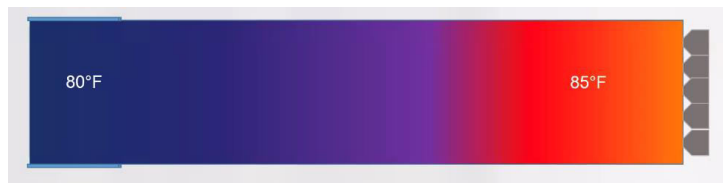
II. EC House - Transitional Ventilation

- In cold weather the house operates on transitional ventilation with air inlets and side minimum ventilation fans linked to a static pressure controller (gauge or manometer) so heat can be removed without switching to tunnel ventilation.
- Transitional ventilation is used when a higher than minimum air exchange rate is required in minimum ventilation.
- Transitional ventilation is temperature and static pressure driven.
- Commercial broiler houses operates and maintain static pressure of **0.05 to 0.10 inches or 12 pa to 25 pa.**
- **General guidelines is to open 40-50% of the air inlets required in tunnel Ventilation.**
- Sidewall air inlets of 1.7 Sq. Ft for 1000 CFM of fan capacity for air exchange creates faster inlet jet velocity.



III. EC Housing - Tunnel Ventilation & Air Exchange rate

- Tunnel is desired when bird needs the Cooling effect of wind chill in warm to hot weather by using cooling effect of high-velocity airflow.
- The wind chill effect with the higher air velocity allows bird to feel a temp lower than actually recorded by sensors.
- Air speed : 3.0 – 3.75 m/s (600 – 750 fpm)
- Air Exchange : 45 – 60 seconds (It can go up to 30 Secs or 2 Cycles / min for High temp and humidity.)
- Air volume :10 – 11 cfm / ft² in normal temp and humidity (It can go up to 15 cfm / ft² with higher temp. & humidity).
- Temperature difference over the length of the house should be maintained not more than 5^o F or 2.8^o C.
- If desired temperature are not obtainable continue to drop the set temperature – Its all about wind chill effect - how the bird feels.
- This may not provide enough air speed to cool the birds. Air speed is going to depend on stocking density!



Can EC house reduce temperature to any levels? No.

- ✓ Evaporative cooling,
- ✓ $T = \text{dry bulb} - \text{wet bulb temp}$
- ✓ Systems efficiency 75 % and the reduction is only possible to that extent.
- ✓ Example on hot and dry day ,
- ✓ Outside Dry Bulb 45°C wet bulb 24°C
- ✓ Diff = 21°C 75 % of 21 = 15.7°C ..
- ✓ Inside temp = $45 - 15.7 = 29.3^{\circ}\text{C}$
- ✓ Can not be 23 or 24°C

The extent of temperature reduction will be 75% of the temperature difference
(Ambient Dry bulb temp – Wet Bulb temp House)

IV. Benefits of Environment Control House over Open Housing.

Project Cost Comparison Open Vs. EC - House including land Cost

Project Cost Comparison				
Broiler House	Open House	EC House - I	EC House - II	EC House - III
House Ceiling Insulation	No insulation	Bubble Aluminium Wrap	Rockwool	Puff Insulated House
Flooring	Mud flooring	Concrete flooring	Concrete flooring	Concrete flooring
Shed Capacity (Birds / House)	5000	13907	13907	13907
No of Shed	2	1	1	1
Total Capacity on Farm (Nos)	10000	13907	13907	13907
Shed Dimesion (L * W) Ft	250Ft L * 25Ft W	328Ft L* 32.8 Ft W	328Ft L* 32.8 Ft W	328Ft L* 32.8 Ft W
Shed Floor Area (Sq Ft)	6250	10758	10758	10758
Land Area Required (Acre)	0.74	0.42	0.42	0.42
Land Cost @ 2000000 / acre	147.27	60.40	60.40	60.40
Poultry House	183.00	393.83	472.25	497.33
Poultry Equipments	68.50	204.43	204.43	204.43
Other Utilities	27.10	101.88	101.88	101.88
Project Cost without Land / B	278.6	700.14	778.56	803.64
Project with Land Cost / B	425.87	760.54	838.96	864.04
Total Project Cost with Land	42,58,700	1,05,76,847	1,16,67,434	1,20,16,221
Total Project Cost without land	27,86,000	97,36,847	1,08,27,434	1,11,76,221
<i>Utilities for EC House includes Stabiliser, DG Set 20 KVA, RO Plant, Electrical, plumbing, water tank, Bore well, Fencing, labour quarter,etc</i>				

Comparison for Open House (10,000 birds in 2 Sheds) Vs. Ideal EC House (100 metre * 10 metre) with side curtains.
As we increase the width and floor area of the EC house the project cost reduces.

Open Side Poultry House - New Project



- **Open Side Broiler house –**
 - Roof Cement sheet
 - Steel structure
 - Civil foundation with parapet wall
 - Side chain link and curtains
 - Concrete block or brick gable wall.



EC House with Side curtains- New Project



ROI Comparison for Open Sided Vs. EC house including land Cost

OPEN SIDE Vs. BROILER EC HOUSE (13907 BROILERS) WITH LAND COST				
INCOME	OPEN	EC-I Air Bubble	EC-II Rockwool	EC-III Puff Panel
BIRDS / BATCH	10000	13907	13907	13907
LIVABILITY	92%	96%	96%	96%
LIFTING (Birds)	9200	13351	13351	13351
AV. WT (Kg)	2.0	2.3	2.3	2.3
LIFTING (Kg) / BATCH	18400	30707	30707	30707
FEED COST	42.0	42.0	42.0	42.0
CFCR BENEFIT	0.00	0.10	0.10	0.10
Performance Benefit	-	1,28,968	1,28,968	1,28,968
BATCH / Year	6	6	6	6
Gross Profit / Year	-	7,73,808	7,73,808	7,73,808
Growing Charges / Kg	6.50	9.50	9.50	9.50
Growing Charges / Year	7,17,600	17,50,279	17,50,279	17,50,279
Total Gross Profit / Annum (GC)	7,17,600	25,24,087	25,24,087	25,24,087
PROJECT COST INCL LAND COST	42,58,527	1,05,84,454	1,16,74,712	1,20,23,477
INTEREST / ANNUM @ 10%	4,25,853	10,58,445	11,67,471	12,02,348
NET PROFIT AFTER INTEREST / ANNUM	2,91,747	14,65,642	13,56,616	13,21,739
ROI AFTER INTEREST	14.6	7.2	8.6	9.1
STD GC	7.50	9.50	9.50	9.50
ACT GC	6.50			
STD CFCR @ 2 Kg	1.70	1.65	1.65	1.65
AV CFCR	1.75	1.55	1.55	1.55
FCR BENEFIT		0.10	0.10	0.10

Open Broiler house including land cost takes almost takes 1.6 -2.0 times more for the ROI.

ROI Comparison for Open Sided Vs. EC house without land Cost

BROILER EC HOUSE (13907 BROILERS) WITHOUT LAND COST WITH DIFFERENT CEILING INSULATION				
INCOME	OPEN	EC-I Air Bubble	EC-II Rockwool	EC-III Puff Panel
BIRDS / BATCH	10000	13907	13907	13907
LIVABILITY	92%	96%	96%	96%
LIFTING (Birds)	9200	13351	13351	13351
AV. WT (Kg)	2.0	2.3	2.3	2.3
LIFTING (Kg) / BATCH	18400	30707	30707	30707
FEED COST	42.0	42.0	42.0	42.0
CFCR BENEFIT	0.00	0.10	0.10	0.10
Performance Benefit	-	1,28,968	1,28,968	1,28,968
BATCH / Year	6	6	6	6
Gross Profit / Year	-	7,73,807.73	7,73,808	7,73,808
Growing Charges / Kg	6.50	9.50	9.50	9.50
Growing Charges / Year	7,17,600	17,50,279	17,50,279	17,50,279
Total Gross Profit / Annum (Growing Charges)	7,17,600	25,24,087	25,24,087	25,24,087
PROJECT COST EXCL LAND	27,85,800	97,49,254	1,08,39,512	1,11,88,277
INTEREST / ANNUM @ 10%	2,78,580	9,74,925	10,83,951	11,18,828
NET PROFIT AFTER INTEREST / ANNUM	4,39,020	15,49,162	14,40,136	14,05,259
ROI AFTER INTEREST	6.3	6.3	7.5	8.0
STD GC	7.5	9.5	9.5	9.5
ACT ANNUAL AV GC	6.5			
STD CFCR @ 2 Kg	1.70	1.65	1.65	1.65
AV CFCR	1.75	1.55	1.55	1.55
FCE BENEFIT		0.10	0.10	0.10

EC Broiler house excluding land cost takes almost similar or 1.5 years more than the Open house depending on the location.

EC House Vs. Open House performance (North India - Summer)

- Comparison for EC Vs. Open during Summer when power consumption is higher.
- Considered North- HR with highest power cost @ Rs 8 / Unit.
- Considered power cut of 8 Hrs./day.

Summer Costing - EC House - North India					Summer Costing - Open House - North India			
Chick Placed Nos	13907	Birds Lifted	13420		10000	Birds Lifted	9200	
Sale Live Wt Kg	30866	FCR	1.62		16100	FCR	1.78	
STD FCR @ 2 Kg	1.65	CFCR	1.54			CFCR	1.85	
Mortality %	3.50%	Av. Body Wt.	2.30		8.00%	Av. Body Wt.	1.75	
MA days	37	Feed Kg	50000		37	Feed Kg	28700	
Particulars	Qty	Cost / Unit	Total Exp.	Cost / Bird	Qty	Cost / Unit	Total Exp.	Cost / Bird
Shed Cleaning			1877	0.13			2250	0.23
Rice husk / Chick (Kg)	0.35	7	34072	2.45	0.50	7	35000	3.50
Power & Fuel (0.55 Unit Rs 8 / unit; 8Hrs DG & Wood @ Rs 6	0.55		146709	10.55	0.20	8	21400	2.14
Labour (2 months) + Vaccinator + Bird Lifting	2.0	7000	35503	2.55	1.00	7000	19260	1.93
Other Expense			5000	0.36			5000	0.50
Total Expense			223161	16.05			82910	8.29
Farmer Cost / Kg			7.23	0.00			5.15	
Other Income				0.00				
Feed bags Sale	1036	7	7254	0.52	624	7	4367	0.44
Manure Sale	20.41	500	10206	0.73	14.36	500	7179	0.72
Growing Charges - (Basic GC @ Rs 9.5 / Kg			293233	21.09	Av GC	6.5	104650	10.47
FCR points benefit	0.11		68121	4.90				
Total Income	12.27		378813	27.24	7.22		116197	11.62
NET INCOME			155652	11.19			33287	3.33
Profit / Kg			5.04	0.00			2.07	

- The performance overcomes the high power & fuel cost to operate EC House with increase in Net profit.

Open side Vs. EC House performance

WINTER COSTING - OPEN HOUSE (NOV - FEB) - 4 MONTHS

Region	Farm Size	FCR	CFCR	AV B WT	M %	Farmer Exp /Kg	Income / Kg	Net Profit / Kg	EC Benefit / Kg	Times
EC HOUSE	13907	1.62	1.54	2.30	3.50	6.87	12.27	5.41		
North India - UP (OPEN HOUSE)	5000	1.67	1.65	2.10	5.00	5.06	7.88	2.82	2.58	1.92
North India - HR (OPEN HOUSE)	10000	1.70	1.65	2.20	5.00	4.92	7.89	2.97	2.43	1.82
East India - ASSAM (OPEN HOUSE)	2000	1.72	1.64	2.30	5.00	5.68	8.31	2.63	2.77	2.05
South India - KA (OPEN HOUSE)	10000	1.70	1.65	2.20	5.00	4.39	8.17	3.77	1.63	1.43

SUMMER COSTING - OPEN HOUSE (MARCH - OCT) - 8 MONTHS

Region	Farm Size	FCR	CFCR	AV B WT	M %	Farmer Exp /Kg	Income / Kg	Net Profit / Kg	EC Benefit / Kg	Times
EC HOUSE	13907	1.62	1.54	2.30	3.50	7.23	12.27	5.04		
North India - UP (OPEN HOUSE)	5000	1.76	1.84	1.70	8.00	4.06	7.14	3.08	1.97	1.64
North India - HR (OPEN HOUSE)	10000	1.78	1.85	1.75	8.00	5.15	7.22	2.07	2.97	2.44
East India - ASSAM (OPEN HOUSE)	2000	1.85	1.90	1.80	10.00	4.04	7.17	3.13	1.91	1.61
South India - KA (OPEN HOUSE)	10000	1.75	1.78	1.90	7.00	4.90	7.11	2.21	2.83	2.28

Benefits of EC Housing - - -

- Farmers broiler housing capacity increases by 1.6 times.
- Farmers net profits / Kg broiler sold is almost doubled with improvement in performance.
- Consistent performance for all the 6 batches with less stress, better health and low mortalities.
- Improves the biosecurity of the farms.
- With the increase of average farm sizes in broiler integration it is advisable to go for EC houses.

THANKS