APPENDICES

APPENDICES

Appendix – I

Table 1. Calibration of temperature and humidity sensor

Time	Dry Bulb Temp (°C) (Hygrometer)	DHT22 Temp (°C)	Wet Bulb Temp (°C) (Hygrometer)	Calculated RH (%) (Psychrometric Chart)	DHT22 RH (%)
10:00	31	31.4	28.5	84	82
10:15	31.4	32	29	81	80
10:30	31.8	32	29	80.5	79.5
10:45	32	32.5	29.5	80	79
11:00	32	32.4	29.6	79	78
11:15	32.5	32.8	28.8	79	77
11:30	33	33.2	29.1	75	76
11:45	33.5	33.5	29.5	75	73

Table 2. Calibration of light intensity sensor

Sl. No.	Time	Lux Meter Reading (lux)	LDR Sensor Reading
1	08:30	13500	12800
2	08:45	25100	26000
3	09:00	19180	19300
4	09:30	22600	21300
5	12:00	81650	80800
6	12:05	61980	61900
7	12:15	80010	79000
8	12:20	76670	77000
9	12:25	84120	85000
10	12:30	68320	69000
11	12:35	79870	78000
12	12:45	82900	80000
13	01:00	67120	68000
14	01:20	71340	71000
15	01:40	85560	84000

Table 3. Calibration of capacitive soil moisture sensor

Sl. No.	SMC by Gravimetric method	SMC by sensor
1	68.02	70.45
2	67.16	69.32
3	66.01	68.2
4	65.66	67.5
5	65.5	65.23
6	62.59	64.5
7	54.92	57.5
8	52.77	56.2
9	52.5	53.23
10	56.78	57.32

Table 4. Calibration of NPK sensor

a) Nitrogen				
Reading No.	observed value (kg/ha)	observed value (N ppm)	Sensor Output (N ppm)	Deviation (ppm)
1	200	100	102.5	2.5
2	220	110	111	1
3	240	120	118	-2
4	260	130	129.5	-0.5
5	284	142	140	-2
6	300	150	148	-2
7	320	160	163	3
8	340	170	171.5	1.5
9	360	180	176.5	-3.5
10	380	190	194	4

b) Phosphorus				
Reading No.	observed value (kg/ha)	obserevd value (N ppm)	Sensor Output (P ppm)	Deviation (ppm)
1	15	7.5	8	0.5
2	25	12.5	12	-0.5
3	35	17.5	18	0.5
4	40	20	20.5	0.5
5	44	22	22.5	0.5
6	50	25	24	-1
7	52	26	25.8	-0.2
8	60	30	30.5	0.5
9	75	37.5	36	-1.5
10	90	45	44	-1

c) Potassium				
Reading No.	observed value (kg/ha)	observed value (N ppm)	Sensor Output (K ppm)	Deviation (ppm)
1	300	150	155	5
2	330	165	170	5
3	350	175	178	3
4	368	184	182	-2
5	380	190	186	-4
6	400	200	195	-5
7	416	208	202	-6
8	440	220	215	-5
9	470	235	230	-5
10	500	250	240	-10

Appendix – II

Table: 1 Economic analysis of a small polyhouse with IoT automation

Assumptions	Expected life of the system is 12 years
	Annual growth rate of costs and benefits is 5%
	Salvage value is nil
	The costs and benefits are discounted at 12%
	Cost of construction of Polyhouse: Rs 1200 per m^2
	Cost of Irrigation System: Rs 324 per m^2
	Capital cost = Cost of construction + Cost of irrigation system + Cost of IoT Automation
	Cost of cultivation of Cucumber: Rs 65 per m^2

Table: 2 Basic data used for economic analysis

Length	16m
Width	8m
Area	128 per m^2
Cost of construction	Rs 1200
UV sheet cost	Rs 6400
Discount rate	12
Growth rate	5%
Crop cultivation cost	Rs 195 (3 season)
Cucumber yield	28.23 Kg/ Sq.m (3 season)
Cucumber price	Rs 30 per Kg
Irrigation cost	Rs 324/ m^2 (One season)
Total Irrigation cost	Rs 41472
Cost of Structure	Rs 153600

Table: 3 Economic analysis of a small polyhouse without IoT automation

Assumptions	Expected life of the system is 12 years
	Annual growth rate of costs and benefits is 5%
	Salvage value is nil
	The costs and benefits are discounted at 12%
	Cost of construction of Polyhouse: Rs 1200 per m^2
	Cost of Irrigation System: Rs 120 per m^2
	Capital cost is Cost of construction + cost of irrigation system
	Cost of cultivation of Cucumber: Rs 70 per m^2

Table: 2 Basic data used for economic analysis

Length	16m
Width	8m
Area	128 m^2
Cost of construction	Rs 1200 per m^2
UV sheet cost	Rs 6400
Discount rate	12
Growth rate	5%
Crop cultivation cost	Rs 210 (3 season)
Cucumber yield	23.10 Kg/m^2 (3 season)
Cucumber price	Rs 30 per Kg
Irrigation cost	Rs 120/m^2 (One season)
Total Irrigation cost	Rs 15360
Cost of Structure	Rs 153600

Calculations

1. Capital cost= Cost of construction×Length×Width+Irrigation cost Area
2. Production cost=(Crop one cost× L×W) × (1+Growth rate/100)$^{year-1}$
3. Total cost= Operation & Maintenance cost+ Production cost
4. Benefits= L×W× Cucumber yield ×Cucumber price +(1+Growth rate/100)$^{year-1}$
5. Present worth of cost= Total cost × Discount factor
6. Present worth of Benefits= Benefits× Discount factor
7. Cash flow= Benefits-Total cost
8. Net present worth= Cash flow× Discount factor