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Development of solar PV powered and wind operated deterrent system

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Abstract
A solar PV powered and wind operated deterrent system was a simple and reliable solution to reduce crop damage caused by birds and animals. The device reduced crop damage by dispersing birds and animals in a safe manner. Many traditional methods, including as scarecrow models, hawk kites, coloured lights, lasers, flashes, chemicals, and so on, are used to distract the birds and animals away, which do not appear to be particularly efficient nowadays. An effective deterrent system i.e. solar PV powered and wind operated system it was operates on solar energy as well as wind speed to overcome the major climatic disadvantage of solar or wind energy. The solar powered deterrent system operates during day time using solar energy and plays different predator sounds to scare the birds and animal. At the night time 12W LED bulb was used to scare birds and animals. Reflectors and mirror strips was used to scare birds. Wind operated deterrent system was operates when the wind velocity exceeds 1.7 m/s when system generates sonorous sounds from steel plate. A 36 W solar panel, 9 Ah battery, 12 V and 5 A charge controller was used during the study.

Keywords: Deterrent, solar PV powered, wind operated, predator sound, crop damage

1. Introduction
Agriculture is important to the economies of many countries across the world. Despite industrial development, agriculture remains the economy's backbone. Agriculture provides sustenance for people and creates a variety of raw materials for industries. Over 65 % of Indians depend on the agricultural industry either directly or indirectly for their livelihood. The yield of the crops, which is steadily declining because of climatic conditions and inadequate technological development, has a substantial impact on farmers' annual revenue. The damage caused by animals and birds, however, needs to receive special attention. Farmers use a variety of conventional and traditional strategies to protect agricultural crop from animals and birds. The extinction of some bird species may be due to common effect of many control methods in use. But it is against nature and natural imbalance. As a result, new strategies, such as bioacoustics and predators sounds were used to prevent lasting damage to Indian biodiversity
Farmers must defend their farms against animals and birds in order to avoid financial losses. Crops are damaged by animals and birds entering the farm field can be controlled and this loss of crops caused by animals and birds can be reduced through the development of a deterrent in the farm field. Deterrent is device used to dispersal of animals and birds using sound it may be predator sound and synthetic sound that makes them uncomfortable. Granivorous birds are attracted to a wide variety of arable crops, which causes significant crop damage and causes significant crop yield losses across the globe. The magnitude of crop damage caused by birds in India has not been studied, nor is the farmer aware of the issue. Estimated current loss by vertebrate mammals in India ranges between 18 to 43 %.
This research work is aimed for developing solar PV powered and wind operated deterrent system to focuses on the controlling the damage due to animals and birds in the agricultural fields.

2. Material and Methods

Table 1: Size of the panel and battery calculation of developed system

Sr. No.	Name of appliances	No. appliances (A)	Power (W) (B)	Runtime (hr) (C)	Total power (W) (A×B)	Units (Wh/day) (A×B×C)
1	Amplifier	1	40	0.8	40	32
2	Loud speaker	1	20	0.8	20	16
3	MP3 player	1	0.98	0.8	0.98	0.784
4	Relay cycle timer	1	10	0.8	10	8
5	Light	1	12	1.6	12	19.2
6					82.98 W	75.98 Wh/day

2.1.1 Solar PV panel sizing

Total daily load requirement = 75.98 Wh/d
Considering solar energy is available for at least 6 hours daily then,

Solar panel power = Total load/daily sunshine hour

$= \frac{75.98}{6}$
= 12.66 ~ 13 W

Considering 30% loss in the system then

$= \frac{13 \times 30}{100}$

= 3.9 ~ 4 W

Size of the panel was 13+4 =17 W
The available solar panel in department was 36 W was used.

2.1.2 Battery sizing

Load demand = $\frac{\text{Total load}}{\text{Nominal load}}$

$= \frac{75.98}{12}$

=6.33 Ah

Battery capacity = $\frac{\text{Load demand} \times \text{backup time}}{\text{DOD} \times \text{battery loss}}$

$= \frac{6.33 \times 1}{0.88 \times 0.85}$

= 9 Ah

2.2 Technical specification of deterrent system

Table 2: Technical specifications of the developed solar PV powered and wind operated deterrent system

Sr. No.	Component	Specification	Material used	Manufacturer
1.	Solar photovoltaic panel	Power: 36 W Voltage:12 V Size : 530×650 mm	-	Rashmi Industries Bangalore
2.	Solar charge controller	Voltage: 12 V Current: 5 Amp max.	-	Exide
3.	Battery	Voltage : 12 V Capacity: 9 Ah Max. Charing current: 2.16 Amp	-	UPlus
4.	LED light	Voltage: 12 V Power : 12 W	-	Arzar
5.	Sound deterrent	Amplifier: 40 W Speaker: 20 W Voltage: 12 V, 110 dB	-	Shree Balaji Electronics
6.	Reflector	-	Mirror and CD	-
7.	Cover box	24×46×25cm	G.I sheet	-
8.	Movable or adjustable stand	Max. Height: 2.5m Adjustable: 1.9 -2.5m	Cast iron	-
9.	Relay cycle timer - sound on for 1 min after every 10 min interval	Voltage: 12 V	-	-

2.3 Working of the developed system

The developed system of solar and wind of deterrent system was operated on the solar power and wind. The energy from 36 W solar PV panel was supplied to the battery (12 V; 9 Ah) for storage of energy through the charge controller (12 V and 5 amps). The system was operated during day and night. The solar based deterrent components operated during day time and the wind based system components were run day and night when wind speed is about 1.7 m/s. When high speed winds stroked on the fan it rotated. Fan was connected to cycle bearing at one end and other end triangle shaped structure with strikers was connected. When fan rotated cycle bearing shaft rotated the triangle shaped structure with striker stroked on steel plate and produced sonorous sound. The wind

operated frame was mounted on top of the system it could be rotated in 360° with tail was attached at one end; it was guided by wind direction. During night period the stored electrical energy was used for lighting of 12 W LED bulb. As per requirement the system height was adjusted from 190 cm to 250 cm. The solar powered deterrent was operated during day time. The energy stored in battery which was also utilized by the sound deterrent to produce noise with different predator's calls and synthetic sounds. A timer was placed in between the battery and amplifier to produce sound for 1min after every 10 min interval. The wind energy and solar radiation were utilized by the sound and the reflectors (mirror strips and CD). The reflectors reflected the sun rays and revolved by the wind power to repel birds by flashing of light on their eyes in agriculture fields. The schematic view of developed system is given Fig. 1

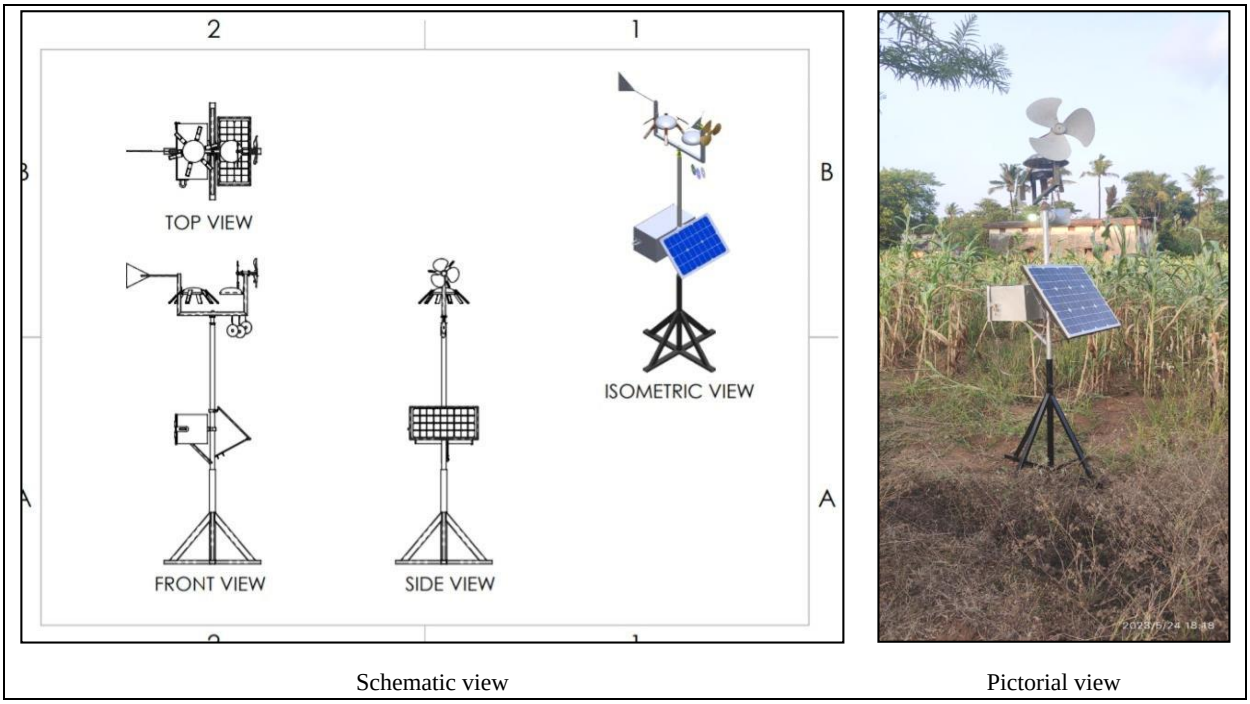

Fig 1: Developed solar PV powered and wind operated deterrent system

2.4 Performance evaluation of developed system

2.4.1 Laboratory testing of developed system

In order to test the system's various operating characteristics, a laboratory test of the developed solar PV powered and wind operated deterrent system was carried out at Energy Park, Department of Renewable Energy Engineering, CAET, Dapoli.

The developed system of solar-powered deterrent was evaluated for battery charging characteristics at no load. The charging time and battery voltage increased when the deterrent was not in use. During the system testing, measurements such as battery voltage, battery current, panel voltage, panel current, solar intensity, ambient temperature, and wind velocity were measured at 1-hour intervals. The testing was carried for 3 days. Hourly readings were obtained from 8.00 to 17.00 hours, and the data was recorded.

The performance of the battery discharge characteristics was investigated to determine the overall running period of the system while the solar-powered deterrent was not in operation. The battery was charged by a solar panel that was fully exposed to sunlight, and the battery was only utilised to power the LED light at night. The solar-powered deterrent ran directly on the solar panel via the charge controller during the day time. As a result, the battery was only required by the LED light operating at night. For the experiment, a fully charged battery was used. The battery was linked to a 12 W and 12 V LED light, and hourly readings of the battery voltage and current were taken until the battery was totally depleted. For three days, the readings were recorded.

2.4.2 Field testing of developed solar PV powered and wind operated deterrent system

The field testing of developed solar powered deterrent was first carried out in open field of Department of Agronomy, Dr. BSKKV Dapoli. Measured sound intensity in the direction of East, West, North, and South. The test was carried at three different heights these are 190 cm, 220 cm, and 250 cm with help of adjustable stand. The sound intensity was measured at every five meter intervals till 60 dB sounds was observed. First marked five meter intervals by using measuring tape and measured sound intensity using sound meter in decibels. In solar powered deterrent system different types predators sound and synthetic sounds were uploaded. For the test only one most effective sound was played and same sound range was kept for the whole test.

The wind operated deterrent was first tested in the open field. In the open field measured the sonorous sound generated by wind operated deterrent by sound meter. Sound was measured in the East, West, North, and South direction at every 5 m interval till 60 dB sound ranges was observed. The test was carried at three different heights like solar powered deterrent system.

2.4.3 Evaluation solar powered deterrent system

The actual field testing of the deterrent was done in Jowar (*Sorghum vulgare*) field. The developed solar powered deterrent was tested in the specified field area (60×30m) for 12 days to evaluate effectiveness from 6.30 am to 9.30 am in the morning and 4.30 pm to 6.30 pm in the evening. The

population of bird's maximum in evening time. Each day the number of birds present in the field was counted manually in specified field before and after the sound deterrent and reflectors were tested. For every 10 min interval the system was operated for 1 minute with different sound tracks from MP3 player.

Before trials During trials

Fig 2: Field testing of the developed system

3. Results and Discussion

3.1 Effect of height of solar powered deterrent system

At a distance of 5 meters, the maximum sound intensity levels were 95.3 dB, 91.4 dB, 93.1 dB, and 92.3 dB, in East, West, North and South direction respectively, with a wind speed of 1.9 m/s and at a height of 250 cm. The maximum sound level was recorded at 80 meters in the East with sound intensity was 60.2 dB and wind speed was 1.8 m/s. With a wind speed of 1.9 m/s, the sound reached at 60 meters in the, West, and South and intensity was 59.7 dB, 60.7 dB respectively. At 65 m sound reached in North direction was 60.4 dB and wind speed was 1.9 m/s. At 250 cm height, the maximum sound travelled up to 80 meters.

Table 3: Sound dispersal at the height of 250 cm of solar powered deterrent system

Distance (m)	Wind speed (m/s)	Sound direction			
		East	West	North	South
5	1.9	95.3	91.4	93.1	92.3
10	1.8	92.7	89.9	90.6	89.2
15	1.9	90.6	85.4	87.3	86.4
20	2.1	88.0	82.2	83.7	82.9
25	1.7	85.7	78.8	80.3	80.4
30	2.2	81.8	76.2	77.5	77.7
35	2.3	79.1	73.5	74.8	74.2
40	2.0	77.0	69.9	73.2	70.7
45	1.6	74.4	66.7	70.1	68.2
50	2.1	72.4	63.5	67.6	65.2
55	1.9	69.8	61.9	65.1	63.0
60	1.9	67.8	59.7	62.7	60.7
65	1.9	64.2	-	60.4	-
70	1.8	63.2	-	-	-
75	1.7	61.3	-	-	-
80	1.8	60.2	-	-	-

The maximum sound reached was found to be 80 meters in the East, 65 meters in the North, 60 meters in the South, and 60 meters in the West. Due to the speaker got oriented in east as the wind was blowing from the West to the East, the maximum sound was recorded at 95.3 dB in the East and the lowest sound at 59.7 dB in the west (Fig 3)

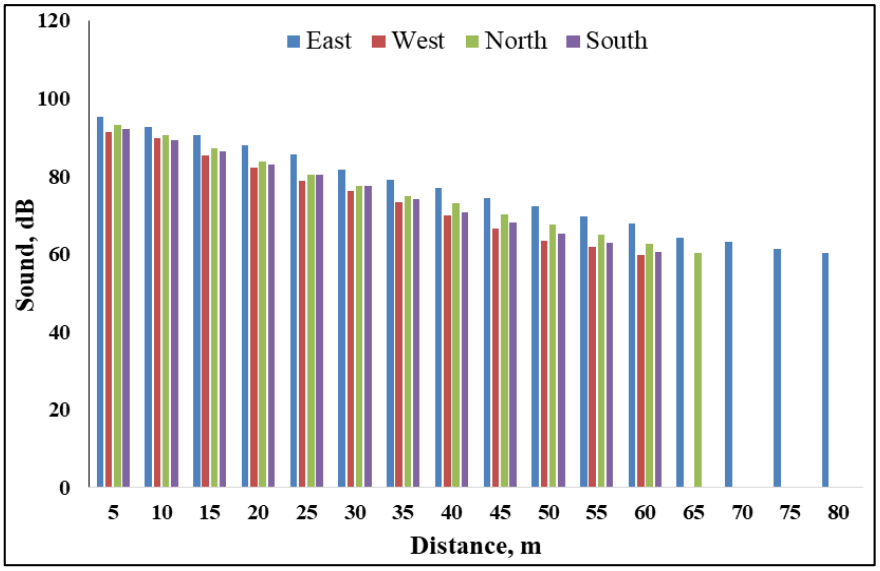

Fig 3: Sound dispersal pattern at 250 cm height of solar powered deterrent

3.2 Effect of 250 cm height of wind operated deterrent system

At a distance of 5 meters, the maximum sound intensity levels were 84.2 dB, 82.1 dB, 83.4 dB, and 82.6 dB in East, West, North and South respectively, with a wind speed of 2.3 m/s and at a height of 250 cm. The maximum sound level was recorded at 45 meters in the east with an average wind speed of 2.2 m/s. With a wind speed of 2.2 m/s, the sound reached at 40 meters in the, West, North and South was 60 dB, 62 dB and 60.5 dB respectively. At 250 cm height, the maximum sound traveled up to 45 meters.

Table 4: Sound dispersal at the height of 250 cm of wind operated deterrent system

Distance (m)	Wind speed m/s	Sound direction			
		East	West	North	South
5	2.3	84.2	82.1	83.4	82.6
10	2.2	81.7	79.0	80.5	79.1
15	2.0	78.3	75.9	77.5	75.8
20	2.1	75.4	73.2	74.8	72.3
25	2.4	72.6	69.2	71.5	69.2
30	2.3	69.8	66.1	68.1	65.9
35	2.3	66.7	63.0	65.2	62.9
40	2.2	63.1	60.0	62.0	60.5
45	2.0	60.1	0.0	59.4	0.0

The maximum sound was reached 45 m in the East, followed by 35 m in the West, North, and South. Due to wind blowing from West to East, the highest sound recorded in the East direction was 84.2 dB and the minimum sound recorded in the West direction was 60 dB. There was no much difference between 220 cm and 250 cm due increased height of the pole was tremble when higher wind speed was blown and speed of the fan would reduce (Fig 4)

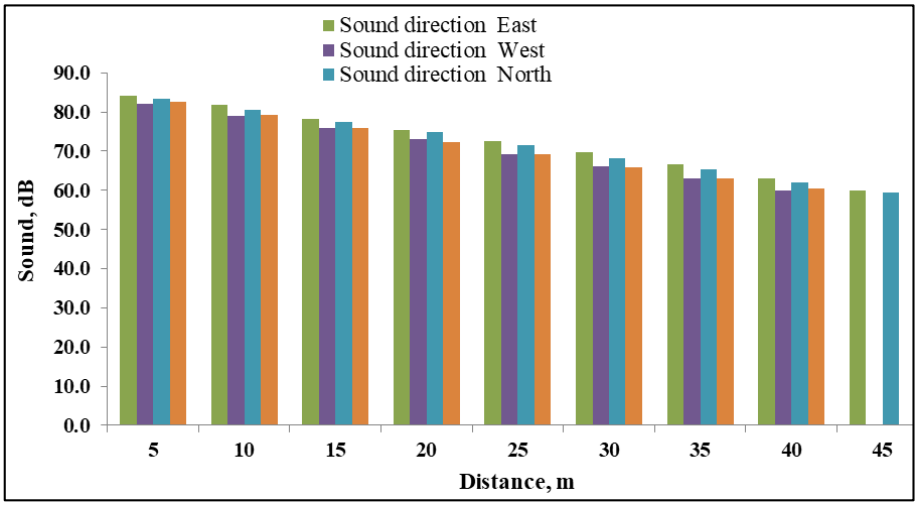

Fig 4: Sound dispersal at 250 cm height of wind operated deterrent

3.3 Evaluation of different predators sound and synthetic sound

The test was carried at Experimental Farm, Department of Agronomy, DBSKKV, Dapoli. The test was arranged in the sorghum field with area of 60×30 m. The different predator sound were uploaded those were shoebill, falcon, gunshot, eagle, cracker, man screaming, hawk, siren, lyrebird, ghost sound, 2 synthetic sounds were uploaded. The test was arranged into 3 groups to determine most effective predators or synthetic sounds. In the first experiment 12 different sounds were experimented for 5 days and out of those 7 sounds were found more effective than others. In the second experiment 7 sounds were experimented for 4 days out of which 3 found more effective than others. In the third experiment 3 sounds were experimented 2 days and found Shoebill sound was found most effective. The test was carried in the evening time when there was more bird population. The different sound tracks were played every 10 min interval to scare birds in the sorghum field.

4. Conclusion

1. When height of the stand of deterrent raised then sound reached in maximum distance from the equipment.
2. In solar powered deterrent system at the height of 250 cm the sound reached till 80m in East direction with sound intensity of 60.2 dB because the wind was blown from West to East and speaker was oriented towards east direction.
3. In wind operated deterrent system at maximum height of 250 cm sound reached till 45m in East direction with sound intensity of 60.1dB because the wind was blown from West to East.
4. Solar powered sound deterrent was more effective to control of birds than the wind operated deterrent system.
5. Solar powered sound deterrent covered more area than wind operated deterrent system.
6. Maximum number of birds flew from the Sorghum field when deterrent was on and Shoe bill sound was found to be most effective sound for bird scaring.

5. References

1. Arun PV, Murugan J, Udayakumar D, Vinithkumar V. Fabriaction of mobile ultrasonic bird repeller. International Journal of Innovative Research in Advanced Engineering. 2019;6(3):26-33.
2. Baral SS, Swarnkar R, Kothiya AV, Monpara AM, Chavda SK. Bird repeller a review. International Journal Current Microbiology and Applied Science. 2019;8:1035-1039.
3. Yun CY, Hong H, Woo S, Song S, Jo J. A study on bird deterrent system to improve the performance of repelling harmful birds. Journal of the Korean Society of Manufacturing Process Engineers. 2020;19(8):15-21.
4. Erickson WA, Marsh RE, Salmon TP. High frequency sound devices lack efficacy in repelling birds. Published in Proceeding of the Fifteenth Vertebrate Pest Conference; c1992. p. 103-104.
5. Goel S, Sharma R. Assessment of crop damage by wild animals and renewable energy interventions-A Case study from coastal odisha, India. In 2021 1st Odisha International Conference on Electrical Power Engineering, Communication and Computing Technology; c2021. p. 1-5.
6. Hamed AR, EI-Metwally WF, EI-Iraqi ME. "Utilisation sonic waves for birds controlling in crops field. Journal of Soil Science and Agricultural Engineering. 2021;12:919-927.
7. Koehler AE, Marsh RE, Salmon TP. Frightening methods and devices/stimuli to prevent mammal damage a review. Digital Commons at University of Nebraska - Lincoln Conference; c1990.
8. Laguna E, Palencia P, Carpio AJ, Mateos AJ, Herraiz C, Notario C, Acevedo P. Evaluation of a combined and portable light-ultrasound device with which to deter red deer. European Journal of Wildlife Research. 2022;68(4):50.
9. Murthi MK, Kumar RJ, Revanth S, Sakunthalanand M, Savaranan KM. Fabrication of bird repeller for agricultural purposes. International Journal for Research in Applied Science and Engineering Technology. 2021;9(2):34-39.
10. Nagaraju. P, Madhavi A, Bhavani B, Sunilkumar G, Vamsi. A solar based bird repeller to protect crops from birds and animals. International Journal of Research in Engineering, IT and Social Science. 2019;9(1):133-138.
11. Nweke FU. Design construction and characterization of a solar-powered multi-tone ultrasonic rodent repeller. International Journal of Science and Research. 2015;4:144-147.
12. Ogochukwu ES, Okechukwu AD, Nnaegbo OG. Construction and testing of ultrasonic bird repeller. National Science Research. 2012;2:8-17.
13. Owino, Omollo G, Kaburu M. Performance analysis of a proposed ultrasonic pre harvest bird deterrent system. International Journal of Innovative Research in Science Engineering and Technology. 2016;5:5198-5203.
14. Ranparia D, Singh G, Rattan A, Singh H, Auluck N. Machine learning based acoustic repellent system for protecting crops against wild animal attacks. International Conference on Industrial and Information Systems; c2020. p. 534-539.
15. Kiran SV, Manoj N, Kumar HM, Namith MN, Surekha M. Smart crop protection system from birds and animals. International Journal of Creative Research Thought. 2022;10:589-592.
16. Uzma R, Sayeed Y, Ahmed MM, Khan MZ, Siddiqui N, Shrivastava R, *et al*. Design and implementation of low-cost solar powered bird repellent technique for prevention of high economic crops. International Journal of Scientific Research in Science, Engineering and Technology. 2021;8(3):360-362.