VERTEBRATE PEST MANAGEMENT TECHNOLOGIES

1. BoRep (Olfactory repellents against wild boar)

The AINP-VPM KAU Centre has developed BoRep, an innovative olfactory repellent specifically designed to mitigate wild boar damage in agricultural fields-an issue that has caused millions of rupees in crop losses annually across southern India. BoRep leverages the highly developed sense of smell in wild boars, which they depend on for foraging and navigation. By masking the natural odours of crops, BoRep renders agricultural fields less detectable and less attractive, thereby deterring wild boars without causing harm to the animals or the environment.

The BoRep formulation has undergone rigorous multi-year testing in both experimental fields and on-farm field trials. Across multiple cropping seasons and varied agro-climatic zones, BoRep has consistently demonstrated a 60-80% reduction in crop damage. Its application is simple and farmer-friendly and applied at a rate of 2 kg per acre, using cotton cloth pouches (25 g each) tied to poles or ropes at 10 cm height from the ground, spaced every 2 meters.

During 2021 to 2025, over 15 metric tons of BoRep have been produced and distributed, benefiting more than 15000 farmers across Kerala, Tamil Nadu, Karnataka, and Andhra Pradesh. This intervention has protected more than 30,000 acres of high-value crops such as padd, cassava, bananas, and vegetables, which are particularly vulnerable to wild boar foraging. Beyond wild boars, BoRep has shown 30-50% effectiveness in deterring monkeys, a growing threat to coconut and cocoa plantations, particularly in the Western Ghats region.

Economic assessments suggest that the use of BoRep has resulted in 30-40% increase in harvest recovery, translating into savings of Rs.15,000-Rs.30,000 per acre, depending on crop type and regional wild boar population pressure. Farmers have also reported reduced need for costly fencing, traps, or night-time vigilance, lowering overall input costs and improving mental well-being.By providing a scientifically backed, environmentally sustainable, and scalable solution, BoRep is rapidly emerging as a model intervention in India's efforts to manage human-wildlife conflict while ensuring food security and ecological balance.

2. DeeRep (Olfactory repellents against Sambar deer)

The Sambar deer (Rusa unicolor) has become a major vertebrate pest in Kerala's agroecosystems, particularly in rubber plantations, vegetable crops, and fodder grasses. In young rubber trees (typically 2.5–3.5 years old), deer cause significant damage by debarking, which exposes the cambium and interrupts water and nutrient transport. Field reports from the Idukki and Wayanad districts estimate crop loss ranging from 20-60%, depending on deer density and plantation size. A conservative estimate pegs the economic loss at ₹30,000 -₹50,000 per hectare per year due to tree mortality, replanting costs, and reduced latex output.

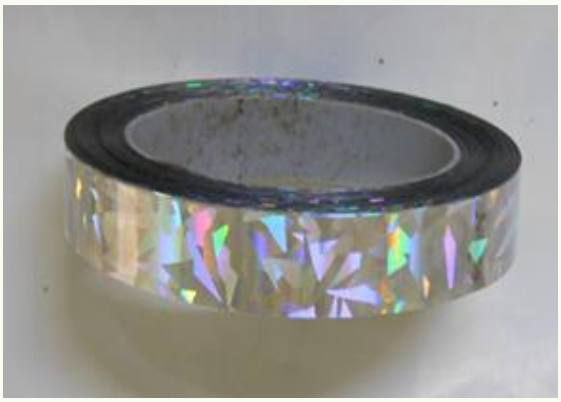
To combat this, AINP-VPM, KAU Thrissur Centre developed DeeRep, composed of plant and animal-based compounds, which do not pose threat to life of deers. DeeRep acts on the olfactory and vomeronasal systems of cervids, triggering avoidance behavior through aversive scent signals. The formulation is diluted at a ratio of 50 ml/L and can be applied via spraying on plant borders or by tying DeeRep-soaked cloth strips on trees or perimeter fences. The product is biodegradable, non-toxic, and safe for non-target organisms including pollinators, livestock, and humans.

Over the past five years (2021–2025), more than 500 liters of DeeRep have been distributed to farmers under trial and extension programs, protecting a cumulative area of 1000 acres in rubber-growing belts. Data collected through farmer participatory monitoring show an average 82–87% reduction in visible deer damage post-application. With an average dose of 200 ml per acre per application cycle, and a reapplication interval of 20–30 days, DeeRep has proven to be cost-effective at approximately Rs.15,000–25,000 per season, significantly cheaper than electric fencing or labour-intensive guarding.

3. Reflective ribbon cutter and metalized reflective ribbon

Bird depredation results in significant agricultural losses across India, affecting crops such as paddy, maize, pulses, groundnut, and fruits. Studies by the Indian Council of Agricultural Research (ICAR) estimate crop yield losses due to birds can range between 5% and 25%, and in some localized areas, losses as high as 40% have been reported. Common depredatory species include peafowl (*Pavo cristatus*), rose-ringed parakeet (*Psittacula krameri*), purple moorhen *(Porphyrio porphyrio*), weaver birds (*Ploceus* spp.), and pigeons (*Columba livia*). To address this, AINPVPM KAU Centre has developed and deployed a low-cost, eco-friendly reflective ribbon system designed to repel birds using light and sound stimuli.

The reflective ribbon cutter developed at the KAU Centre manually processes large metallized polyester sheets into 1.5 cm-wide strips, forming rolls 1000 meters in length. The ribbons utilize two primary deterrent mechanisms: intense light flashes created by the sun's reflection and humming sounds produced when the ribbons flutter in the wind. These stimuli exploit birds' acute visual and auditory senses, making the field environment uncomfortable and uninhabitable for feeding or perching. For optimal effectiveness, 10 ribbon rolls per acre are installed above the crop canopy in a crisscross pattern. The KAU Centre currently produces three variants—Scarlet Red, Golden Yellow, and Holographic, each tailored to specific light conditions and bird behaviour.



Between 2021 and 2025, the centre has distributed over 15,000 reflective ribbon rolls, providing coverage for approximately 1,500 acres of farmland across Kerala. Field evaluations involving over 250 farmers in districts like Palakkad, Thrissur, and Idukki indicated an average crop damage reduction of 65–85%. In some cases, particularly in maize and sunflower fields, losses dropped from 30% to under 10%. The unit cost of ribbon roll is Rs100, resulting in an economical field coverage cost of Rs. 8,000–Rs.10,000 per acre, substantially lower than alternatives like netting (₹3,000+/acre) or electronic deterrents. The ribbons are UV-resistant, reusable for up to two seasons, and require minimal maintenance.

4. Rodenticide applicator

Rodent infestations are an escalating threat in Kerala's coconut plantations, with crop damage ranging from 4.5% to as high as 55%, depending on regional conditions and seasonal patterns. Rodents, particularly rats and palm squirrels, Malabar giant squirrel target coconuts during the tender and ripening stages, gnawing small holes near the perianth region to feed on the inner contents. The damaged nuts not only become unmarketable but can also trigger fungal infections and secondary pest attacks, further deteriorating yield quality. For farmers, this translates into significant economic losses, often amounting to 15–30% of annual income, especially in high-density coconut-growing areas. Traditionally, rodent control has relied on rodenticide application to the tree crown - a method that demands skilled climbers, who are increasingly hard to find due to Kerala's labor shortage. The climbing process is also laborious, time-intensive, and poses considerable risks of falls and injuries, making pest control both unsafe and expensive.

To address these pressing issues, a Telescopic Rodenticide Applicator has been developed and introduced as a simple yet powerful innovation. Crafted from lightweight, corrosion-resistant aluminum alloy, the device is manually operated and designed for easy handling by farmers of all skill levels. It can effectively deliver rodenticides to a height of up to 12 meters, covering the average height of most coconut palms in Kerala. Priced at Rs. 7,500, the applicator offers a cost-effective and long-lasting solution that eliminates dependence on climbing and ensures direct, targeted delivery of rodenticide to the crown region, where over 80% of rodent damage occurs. This precision reduces chemical wastage, increases the efficacy of each application, and enhances pest control outcomes with fewer resources.

The financial and practical benefits of this tool are considerable. Farmers can cut down pest management costs by up to 40%, mainly by eliminating recurring labour charges for climbers and optimizing pesticide use. More importantly, by reducing rodent-induced losses, coconut yield can be increased by 10-20%, directly impacting farmer income.

On a one-hectare plot with approximately 175 coconut palms, this improved protection can result in additional earnings or savings of Rs. 10,000 to Rs. 15,000 per year, depending on the market rate and extent of infestation. Beyond economic gains, the targeted application promotes safer pesticide practices, minimizing environmental contamination, risks to non-target organisms, and human exposure.

5. Trap barrier system:

Rodent damage in rice cultivation has long been a persistent and costly challenge in Kerala, particularly in the deep-water rice ecosystems of Kuttanad, where standing water and complex field conditions make rodent control extremely difficult. Rats cause significant crop losses during critical growth stages, especially seedling, tillering, and grain filling by damaging young plants and feeding on ripening grains. This not only reduces yields but also compromises grain quality, threatening both food security and farmer income in the region.

To address this, AINP-VPM KAU Thrissur centre introduced the Trap Barrier System (TBS), which has emerged as a scientific, low-cost, and eco-friendly solution for rodent pest management in rice fields. Each TBS unit consists of a 5m x 4m enclosed plot surrounded by polythene sheet barriers on all four sides, with two multi-capture traps strategically placed at opposite corners. Rice seedlings planted in the TBS unit 21 days before the main field is sown, which attract rodents early. As rats enter the unit in search of food, they are either blocked by the barriers or captured in the traps, significantly reducing their numbers before they can reach the main crop.

This proactive approach has shown remarkable results. Between 2021 and 2024, farmers across 500 hectares of rice fields in Padasekharams of Kuttanad adopted TBS during both the first and second crop seasons. The impact was substantial with an average increase in rice yield of 2 tonnes per hectare was recorded, translating into a massive boost in productivity and profitability. At the prevailing market rate of approximately Rs. 20 per kg, this equates to an additional income of Rs. 40,000 per hectare, a significant return on investment considering the low cost of Rs. 3,000 per TBS unit. For collective farmer groups or cooperatives, this represents a cost-effective, scalable solution that delivers both short-term gains and long-term rodent control.

Beyond the economic benefits, TBS also contributes to sustainable agriculture by minimizing dependence on chemical rodenticides, which often pose risks to non-target species, human health, and the environment. The method promotes integrated rice rodent pest management (IPM) and encourages community participation, as multiple farmers can share units and coordinate installations for maximum effectiveness. It also supports the preservation of Kerala's unique wetland rice ecosystems by offering a non-invasive, environmentally responsible pest control method.

6. Modified Nylon Net Fencing

Wild boar intrusion poses a serious threat to agriculture in Kerala, causing crop losses of 10% to 40%, especially in hilly and forest-adjacent regions. High-value crops like banana, tuber crops, paddy, and vegetables are particularly vulnerable. Many traditional deterrents like electric fences, sound-based repellents, and trenches have proven either expensive, short-lived, or labor-intensive. In this context, Modified nylon net fencing technques introduced by AINPVPM KAU Centre has emerged as a cost-effective, eco-friendly, and community-driven solution that is rapidly gaining traction among farmers.

The system involves the installation of UV-stabilized HDP nylon nets (2-inch mesh, 1.5mm thick) fixed to bamboo or strong wooden poles at a vertical height of 4 feet, with an additional 3 feet trailing on the ground, pegged securely using wooden stakes. Nails are driven into the poles at 10–15 cm intervals for strong anchoring. If a wild boar attempts to enter the field, it gets entangled in the net and emits distress calls, which effectively deter other animals. This dual function as both a physical and psychological barrier makes it highly effective. The method has now been adopted across more than 10,000 acres of farmland in Kerala, particularly in districts like Wayanad, Palakkad, Idukki, and Pathanamthitta.

Farmers using modified nylon net fencing report a 70–90% reduction in wild boar-related crop damage. In fields where farmers previously lost Rs. 20,000 to Rs. 50,000 per acre, especially in commercial crops like bananas and tubers, many are now harvesting nearly their entire yield. This has led to increased cultivation, crop diversification, and the revival of abandoned lands in high-conflict areas. Moreover, because the method is non-lethal and environmentally safe, it complies with wildlife protection regulations while promoting sustainable and ethical pest control. Nylon net fencing not only safeguards farmer income but also serves as a scalable model for wildlife conflict mitigation in other agro-ecological zones across India.

7. Laser based animal repeller

Wildlife intrusion into agricultural fields, especially from animals like wild boars, elephants, and monkeys, causes significant crop damage every year, particularly in regions where farmland is adjacent to forests. Traditional solutions, such as bio-acoustic devices, have been used widely, but their constant sound emission often leads to animals adapting to these sounds, diminishing their effectiveness over time. To address this challenge, the Laser-Based Animal Repeller has been developed as a cutting-edge, non-lethal solution that takes a more intelligent and responsive approach to protecting crops.

The device works by detecting animal movement through a laser beam, which triggers the emission of pre-recorded distress calls and predator sounds, both of which are designed to startle and deter wildlife. This method ensures that the animals remain unpredictable and do not grow accustomed to the sounds, unlike conventional devices. Additionally, the system includes a solar-powered laser emitting unit, which ensures continuous, low-cost operation in the field, while the main unit is rechargeable through electrical power. The affordable price of Rs. 4,500 per unit makes it a viable option for small to medium-scale farmers, especially those in wildlife-sensitive regions.

The impact of the Laser-Based Animal Repeller has been substantial in field trials. Farmers have reported up to a 70% reduction in crop damage, thanks to its dynamic, motion-triggered response, which keeps wild animals at bay more effectively than static sound-based systems. Furthermore, field trials indicate that the device can increase crop yields by 30–40%, as crops are protected from destructive wildlife while growing without the constant threat of intrusion. This translates directly into higher income and improved food security for farmers, who no longer have to worry about losing large portions of their crops to wildlife raids.

The solar-powered design of the laser unit is another key benefit. It ensures low operating costs, especially in remote rural areas where access to electrical grids may be limited. By harnessing the power of the sun, the device operates cost-effectively with minimal maintenance needs, providing farmers with a sustainable, long-term solution that's not only economically viable but also environmentally friendly. This system promotes safe, sustainable farming practices by reducing the need for expensive physical barriers like fences or harmful methods like poisoning and trapping.

8. Bird nesting designs

Beneficial bird species such as barn owls (*Tyto alba*), which rely heavily on rodents for food, along with insectivorous birds like the magpie robin, myna, and house sparrow, contribute significantly to the natural suppression of agricultural pests. To enhance their role in integrated pest management (IPM), artificial cavity nesting structures have been developed and deployed. Specifically, barn owl nesting boxes designed at KAU Centre have proven highly effective, as a single owl nest is capable of suppressing rodent populations over an area of approximately 25 acres of paddy fields.

Each nesting unit costs around Rs. 3,000. In a pilot program launched in the Kavaratti Islands, Lakshadweep in a region where synthetic rodenticides are restricted due to its organic certification. This initiative aimed to evaluate the impact of biological rodent control using natural predators. With support from the Krishi Vigyan Kendra (KVK), the Department of Agriculture, and local administrative bodies, three breeding pairs of barn owls were introduced on Kavaratti Island during the 2019–2020 season.

Over a four-year monitoring period (2019–2024), more than 12 chicks successfully fledged from these nest boxes, signalling successful breeding and establishment. Field monitoring, including trapping indices and crop damage surveys, revealed a notable 40% decline in rodent-related activity and damage in the surrounding agricultural zones. Given these promising outcomes, authorities are now expanding the program to other Islands to foster long-term ecological pest control and reduce dependency on chemical methods, further supporting sustainable and organic farming practices.

9. Solar based flickering lights

The purple moorhen (*Porphyrio porphyrio*) has emerged as a major depredatory bird pest in the Pokkali and Kole wetland rice ecosystems of Kerala, where it causes extensive damage to standing paddy crops. These birds prefer to roost in stagnant water bodies dense with aquatic vegetation, particularly salvinia fern (*Salvinia molesta*), which offers both shelter and a strategic vantage point for foraging. In several pockets of Kole fields, particularly during the rabi season (December to April), farmers have reported crop damage ranging from 30-40%, mainly due to trampling and pecking during critical crop stages. The growing bird menace poses a serious threat to the productivity and sustainability of these organically certified rice ecosystems, where chemical bird deterrents are strictly prohibited.

To address this, a solar-powered flickering light scarer was developed as an eco-friendly, automated bird repellent solution. Each unit comprises a miniature solar panel (approx. 5W) and a rechargeable battery system, which stores energy during the day and emits irregular, high-intensity light flashes throughout the night and during low-light periods at dawn and dusk. These flashes mimic natural disturbances, effectively deterring roosting birds without causing harm. At a cost of just Rs. 750 per unit, the device is low-cost, low-maintenance, and ideal for community-level deployment, especially among small and marginal rice farmers.

Between 2019 and 2024, a total of 100 solar light scarer units were distributed and installed across key rice-growing regions in Thrissur, Ernakulam, and Alappuzha districts, covering over 400 hectares of Kole and Pokkali fields. Field-level observations and farmer surveys have shown a consistent 60% reduction in bird-induced crop damage in fields where the device was used. In addition, yield improvements of 15–25% were recorded in affected areas, along with a 40% reduction in labour costs previously spent on manual bird-scaring efforts.

10. Automatic cracker station

Bird and animal attacks are a serious threat to crops, especially during key growth and harvest stages. Sudden loud noises are known to scare these pests effectively. To harness this response, a fully automated cracker station has been developed that can operate 24 hours a day in all weather conditions. It uses traditional firecrackers, ignited at programmed intervals to create random, explosive sounds that deter pests within a 500-meter radius.

What makes this system especially practical is its knocked-down, modular design. Each unit can be quickly transported, assembled, and deployed on any type of terrain including remote, waterlogged, or uneven fields. Costing just Rs. 6,000 per unit, it offers a reliable and affordable solution for farmers needing continuous protection, especially in large paddy, maize, and banana fields where manual scaring isn't feasible.

More than 120 cracker stations were installed across key farming regions in Kerala by Padasekhara Samithies, with support from the centre. Field data collected by agricultural officers showed a 40–60% reduction in crop losses caused by birds and wild animals. In some locations, yield gains of up to 1000 kg per hectare were reported, particularly in rice fields during the grain-filling and ripening stages. Farmers have welcomed the device for its low maintenance, ease of use, and consistent performance during high-risk periods like dawn and dusk. The success of these units has led to plans for scaling up deployment under state-funded crop protection programs.