

# PRACTICAL GUIDELINE



## Effectively Controlling Rats with Ecological Methods

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# 01. INTRODUCTION

This manual is designed to provide practical guidance on effectively reducing problems caused by pest rats and mice in your home, store, and agricultural fields. Whether you're a farmer, an agricultural expert, or simply someone looking to address these issues, this manual is for you.

Rodents have three major impacts.

1. Damage to crops in the field at any stage, causing major losses and spillage
  2. Post-harvest losses and contamination, further affecting food quality and safety
  3. Health risk to smallholder farmers
- Damage to rice is high and highly variable, from 1-60% damage is recorded. Rodes damage rice crop in all the stages of growth. They cut diagonally tillers normally 5-10 cm above the water level.
  - Rodents inflict considerable damage to vegetable crops. It is estimated to be 8.7 and

10 % in Rajasthan and Gujarat, respectively. In water melon crops the damage sometimes reaches from 70 to 80%.

- Loss of 10-15% in coconut production

Rats and mice, which are small rodents, cause big problems for farmers all around the world. They can ruin crops and make our food dirty. In India, major changes in agricultural systems have increased the rodent problem in recent decades.

The major rodent pests prevalent in India are *Bandicota bengalensis*, *Milardia meltada*, and *Mus booduga*. The overall losses of grain to rodents in India were approximately 25% in pre harvest and 25-30% in post-harvest situations bringing the loss to at least US\$ 5 billion annually in stored food and seed grain in India.

A study in 10 villages in Madhya Pradesh and Jharkhand found that farmers lose a lot of their crops because of these rodents. On average, they





lose 40% of their rice, 36% of their maize, 27% of their tomatoes, 23% of their millets (kodo-kutki), and 5% of their potatoes before and after harvesting. These rodents also damage other things like the walls of houses, clothes, wires, and even small baby chickens. It is imperative we must take action to control them.

With this manual our goal is to help you with controlling rodents, by assisting you in:

- Understanding the multitude of problems that rats and mice cause
- Learning about the behaviour of rats and mice, that is crucial for effective management
- Knowing the basics of Ecologically-Based Rodent Management (EBRM)
- Being able to deploy a set of measures tailored to your own situation.



## Why we can't rely on chemicals alone

Relying on chemicals for rodent control presents drawbacks. Chemicals may yield quick results, but rapid rodent immigration can undo the benefits, emphasizing the need to account for spatial dynamics. Three main reasons chemicals are problematic:



**1. Resistance Buildup:** Rodents can develop resistance to chemical poisons, rendering them ineffective.



**2. Learning to Avoid:** Rodents can learn to avoid chemical baits, making them less useful over time.



**3. Environmental Harm:** Chemicals have detrimental effects on the environment and other animal species, exacerbating their harmful impact.

## What is EBRM?

EBRM is all about getting to know the rodents we want to control really well. We study how they act and where they live so we can plan how to deal with them in a smart way. We want to do this without using a lot of chemicals that can harm other animals. Instead, we want everyone in the community to work together to solve the problem.

### EBRM is all about:

- 1. Understanding Rodent Behaviour:** Recognizing the behaviour patterns of rats and mice to better control them.
- 2. Targeted Management for Specific Environments:** Adapting strategies to suit different settings and key times.
- 3. Sustainable and Long-Term Effects:** Aiming for lasting solutions that reduce rodent impact over time.
- 4. Eco-Friendly Practices:** Minimizing environmental impact by avoiding chemical contamination.
- 5. Minimal Risk to Non-Target Species:** Ensuring that rodent control methods do not harm other wildlife.
- 6. Community Action:** Encouraging collective efforts to manage rodent populations effectively.



**7. Economic and Feasible Solutions:** Developing approaches that are practical and affordable, especially for smallholder farmers.

This manual serves as a resource to address the persistent challenges posed by rats and mice. By applying the principles of Ecologically-Based Rodent Management, you can not only reduce the impact of these pests but also contribute to regenerative agriculture, leading to increased yields and healthier crops while safeguarding the environment and non-target species. It's time to take rodent control seriously and act decisively to protect your resources and investments. This manual gives a range of biological and ecological methods to apply around the house and in agricultural fields to effectively control rats and mice. But first we must learn a little bit more about these small animals.



## 02. ABOUT RATS AND MICE

Rodents comprise almost 40% of all mammal species, with a diversity of more than 2000 species in 34 families. In India, there are a total of 104 species in 4 families, among them 14 species are of economic importance.

Rats and mice (rats hereafter) have always caused damage to human properties; homes, stores and fields, and carry many diseases affecting human health. The presence of rats remains a major problem for many farmers all over the world. Specific attention is required to manage and control the population numbers. Rats are pests throughout the country and cause damage by gnawing and feeding on food and assets, and through indirect damage and spoilage.

Some rats stay around the house, especially around food stores. Rats that stay near humans have a serious effect on human health and transmit multiple diseases. Other rats live in the field, with some species active during the day, but most are active at night. Rats create burrows, nests under boulders, decaying tree trunks, or various shelters on the forest floor. They seek refuge in rock crevices, caves, and even human dwellings, ranging from small huts to large city buildings. Because of their larger numbers, rats can eat large portions of standing crops and cause severe damage. They can sometimes destroy crops completely.



### Here are some general rat facts:

- Rats multiply quickly. From one pair of rats, 1250 rats can be born in one year.
- Rats greatly depend on the availability of good quality food and shelter to breed.
- Rats play a role in the transmission of more than 60 types of diseases.
- Rats usually move within 30-100 metres of their shelter each day depending on food/mate availability.
- Rats are very clever animals and can learn to avoid measures taken against them.
- Rats must drink water at least once every 2 days and must eat food at least once every 4 days.



And this table highlights the type of behaviour rats show.

Attributes	Characteristics
<b>Sight</b>	Rat's vision is very blurry, can distinguish only green-blue colours. They can discriminate between pattern and size and have good perception.
<b>Hearing, smell and touch</b>	Well-developed senses readily distinguish unusual noises, and the long whiskers on their muzzle and guard hairs on the body serve as sensitive feelers. Smell is their standout feature.
<b>Balance</b>	Excellent balancing sense enables them to run on pipes, narrow ledges or wires. Long tails act as balancing organ.
<b>Gnawing</b>	Rats gnaw to gain entrance to food and wear down their incisors to keep them sharpened.
<b>Climbing and swimming</b>	They can climb almost anything they can get their claws to hold. Many rats are excellent climbers, where specific species like bandicoot and musk rats are excellent swimmers.
<b>Travel routes</b>	They use fixed pathways, and usually move along the walls, under floors or through thick grass or litter



**! IMPORTANT!**



Rats are usually neophobic, meaning they are afraid of new things and situations. It makes them careful. This caution makes it hard to control them with chemical rodenticides. Even though rats don't have a natural resistance to zinc phosphide rodenticides, they learn to avoid them after getting a little bit sick from them. This makes them eat just enough to not die from it. Rats can't vomit, so they are even more careful when trying new foods or things they find.



Don't be fooled! You might believe that controlling rats means killing a lot of them in plain sight. However, that's not the truth. As the saying goes, it's better to prevent than to cure. Taking steps like blocking their access to shelter and food, and staying clean might not show immediate results. Still, they are more effective and last longer in keeping rats away.

## 03. READING GUIDE

Now that we have a better understanding of rodent behaviour and preferences, our focus shifts to management. We employ integrated pest management methods that involve both biological and ecological approaches. Our primary goal is not just to kill rats, but rather to keep their numbers below levels where they cause economic harm.

In an Ecologically-Based Rodent Management approach, we view rodents as a dynamic group of organisms in a specific location at a given time. This manual outlines how to manage rodent populations from this perspective.

Chapter 4 of this manual describes the basics of how to control rats. There are three essential requirements:

**1. Perfect timing:** We must control rats when

they are few and weak, before they start to reproduce.

- 2. Cooperation:** Rats easily move from one field or house to another; therefore, an entire area needs to cooperate to get good results; it is a community effort.
- 3. Combining different methods:** against rats we can't rely on just one method, as they can learn to avoid it. Deploying a set of different measures making it harder for rats to avoid.

Furthermore, this manual describes what can be done to ensure that: a) rats cannot access food, b) rats do not have a place to hide, and c) rats are reduced in numbers. In controlling rats, we divide four categories of management:

- **Chapter 5:** Rat proofing of **storage areas and household** compounds

- **Chapter 6: Cultural** methods to limit habitat options for rats
- **Chapter 7: Biological** control, let nature do the job
- **Chapter 8:** Special and **collective** actions to control rats

All measures proposed are low-cost and can be very well integrated in houses, storage structures, and fields. The goal is to grow and store food crops safely and ensure nothing is lost to rats. Additionally, we must create a safe and healthy environment for people to thrive, preventing rodent vectored diseases.

Chapters 6-8 describe the different measures in detail with examples provided in pictures. Chapter 10 is a checklist for community rat control.



## 04. BASIC PRINCIPLES OF RAT CONTROL

### 1. Together! To control rats, it is absolutely necessary to work together as a community.

If a household separately undertakes a rat control intervention in its house/storage area, rats will avoid that household temporarily and move to the neighbouring houses/storage areas where rat control measures are not initiated. Likewise, if a farmer deploys a rat control measure separately on a crop field, rats will avoid that crop field temporarily and move to (infest) the neighbouring crop fields. Some rats may even return to the original household or crop field when the rat control measures have ended. Rats are very clever animals. Therefore, rat control interventions at individual household or crop field level often yield fewer results, only

providing short-term relief. We must do collective implementation of rat control to be effective in the long term.

Therefore:

1. Talk about the rat problems with your neighbours.
2. Obtain information on the behaviour of rats from neighbours and agricultural extension staff on: when they multiply, how they feed, where they hid and how they move.
3. Organise joint planning session with your neighbours. As a group decide what method to implement and when. (see chapters 9 and 10 to help with the planning).
4. Divide the methods to be undertaken as a group and those methods undertaken individually.
5. Agree on rules to ensure that everybody does their part in the rat control campaigns. To make it successful everybody must join, and the interventions should be done at large scale.



**2. Timing! Control measures need to be timed perfectly to ensure that rat numbers are reduced before they start breeding.**

To maximize the effectiveness of rat control, it's advisable to carry out campaigns and individual rat control measures when the rat population is low, vegetation cover is minimal, and rainfall is scarce, typically during the pre-season period.

- In rain-fed crop fields, the rat population is at its lowest peak a few weeks before the rainy season (cropping season) begins. At this time, there's limited food and crop/grass cover in the fields, preventing rats from initiating reproduction and making them weaker.
- The primary goal is to eliminate potential food sources during the dry season to minimize damage to the next year's crop. The peak breeding period for rats in India is from October to December, coinciding

with the harvest season when ample food is available.

Here's a general guideline: rat control measures should be implemented towards the end of the dry (summer) season and at the onset of the rainy season. During the dry season, focus on targeting weaker rats, reducing their numbers, and preventing reproduction. At the start of the rainy season, shift your efforts to the surviving rats, incorporating various measures during land preparation and habitat destruction (see chapter 6).

For effective rat management in Madhya Pradesh and Jharkhand, the optimal period is from April to June. Implementing control methods during these months prevents the birth of many rats, primarily by reducing the adult (breeding) rat population. When conducting rat control outside the lean season, it's crucial to initiate control measures within the first 30 days after planting, before rats begin breeding. Late-season control efforts will yield minimal results.



### **3. Combine! Never rely on just 1 method, as rats will learn to avoid them.**

There are three main reasons why we need to combine different rat control methods.

- Rats are intelligent creatures that can quickly learn to avoid traps and baits. Repeatedly using the same trap may reduce its effectiveness. To increase your chances of success, it's essential to employ a variety of methods over time.
- Rats comprise a diverse group of species, each with its unique behaviours, characteristics, and skills. Consequently, it's necessary to employ multiple approaches tailored to their specific behaviours.
- When rats take refuge in areas like homesteads, crop fields, or nearby ridges, especially during heavy rainfalls, it's crucial for farmers to concentrate their rat control efforts in those specific areas. For instance, if rats migrate from grazing

lands to homesteads, initiate trapping or rat elimination at the homesteads. When they seek shelter and food in grazing lands, focus on trapping or eliminating them there. By continuously driving rats out from one area to another, you prevent them from establishing a thriving population. This approach effectively restricts their numbers.

The upcoming chapters 6-10 will provide a comprehensive overview of various rat control methods. You can select the most suitable ones based on your specific circumstances.



## 05. RAT PROOFING OF STORAGE AREAS AND HOUSEHOLD COMPOUNDS

Rats are a major problem in many houses. Rats damage clothes, furniture, electric wires, paper and money. Rats eat from the household's food stores and contaminate them. Rats create unrest in the house. Occasionally they bite children and the elderly during the night. Therefore, they should always be kept away from the house, homestead, compound, and storage areas. They should not be given any reason to come near; therefore, it is key to ensure that they cannot smell food and cannot get access to a shelter.

### We recommend the following approach:

- Start with meeting as a community to

discuss the problem and ensure everybody is aware.

- Initiate sustained community rat management campaigns that comprise the following:
  - 1. Ensuring regular **inspection** of houses, storage areas, gardens, shops, and other occupational areas
    2. Sustained **cleaning** of houses and compounds for rat harbourage and domestic **waste**, refuse, wood piles, stone piles, bushes, and unnecessary vegetation. Disposing domestic and other waste appropriately (establish a system)
    3. **Prevent** rats from entering houses; immediately repair openings in the house/ storage where rats pass through and install rat disruptors on their runways and escape routes.
    4. Using/manufacturing **rat-proof materials** for storage structures.
    5. Encouraging cats as pets and attract other

**natural predators** (e.g., install raptor perches)

6. Sustained **trapping** (e.g., monthly trapping campaigns)





**Here we explain the specific methods:**

### **1. Inspection: how to know they're around**

Recognizing the presence of rats is crucial for effective control. While spotting a rodent is the most obvious sign of a problem, you can also tell rat presence from the following signs:

- **Holes and Nests:** Mice, for example, like to make cozy nests using stuff like paper and cardboard. Some rats dig holes in the ground around buildings.
- **Grease Marks:** Rats and mice often follow the same paths, and as they go, they leave

dirty, greasy marks on walls, stairs, and near their homes. So, if you spot these marks, it's a sign they've been around.

- **Droppings:** Rats are big droppers, leaving behind up to 50 tiny pellet-shaped poops every day. You'll find these most often in places where there are lots of rats.
- **Gnaw or chew marks:** Rats have teeth that keep growing, so they chew on things to wear them down. You might notice little grooves on wood, plastic, cardboard, or even metal. They can also chew through electrical wires, which is a real problem.





## 2. Cleanliness: give rats no reason to come

In managing rats in and around houses, the first important requirement is to keep the house and the areas around the house (garden, grain storage areas, fences, hedgerows, etc.) clean.

### • Eliminate food sources:

1. There should be no open left-over food, no open piles of garbage, no open stored product or open storage. These are food sources that attract rats and provide shelter. Address spills immediately.

2. One should keep food locked away and air-tight so rats cannot smell it. All items that attract rats should be eliminated or stored in closed-off containers/boxes/jars/other.

3. Dispose waste in closed containers, keep it far away from your house and storage areas.

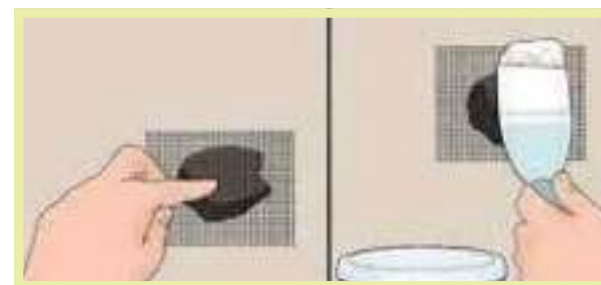


### • Eliminate water:

4. Keep all drains covered and secure.
5. Make sure hoses are not leaking, fix any defective pipes or drains.
6. Get rid of any standing water in the yard.

### • Eliminate rat hiding places:

7. Get rid of junk, lumber, old boxes, discarded appliances, chairs or beddings on the ground or under porches.



### 3. How to prevent rats from entering houses and storage rooms

It is important to make it very difficult for rats to enter houses and stores. And to stop rats from moving around houses and storage structures.

1. **Act Fast:** If you see signs of rats like fresh droppings or pathways in your yard, act quickly.
2. **Seal Entry Points:** Make it hard for rats to sneak into your house or storage areas by sealing up any holes or cracks in walls and drainage pipes. Use concrete to block off corners, so they can't squeeze through. Fill up any holes they might use to get into your home with solid materials. Don't leave them any way in.
3. **Cover Openings:** Cover the edges of doors, windows, and other openings with metal sheets to keep rats out. You don't want them sneaking in through these gaps.
4. **Secure Doors:** Install devices to keep doors

firmly closed, so rats can't push their way in.

5. **Plant Prickly Bushes:** Create a barrier around your place by planting prickly plants in a hedge or fence formation. This makes it tough for rats to move around and reach your house or storage areas.

Remember, it's a good idea to use a combination of these methods for the best results.



### 4. Good storage structures

Another requirement is to have a rat-proof storage area and storage material for grains and other harvested items. Rats should not be able to get access to stored items.

- **Placement of outside storage:** The storage should not be placed under trees, because then rats can jump in from the top. Also, there should not be bushes, garbage, or watering places around the storage system, because these will attract rats.
- **Raise storage structure on poles:** it is important to make it impossible for rats to get into the storage structure. The best way to do this is to raise the storage structure on poles, for example 0,5m from the ground, and to put iron or metal pins or disks, or barbed wire on the poles on which the storage structure stands. This prevents rats from climbing up, either because the surface is too slippery and rats will slide off, or

because the barbed wire is too prickly.

- For rat proofing of cover and plinth storage structure under outdoor bulk grain storage conditions, built plinth at a height of 2.5 feet from ground level and extend platform by one foot in all the four sides of a plinth.
- Good materials for your storage structure include iron/metal sheets that is slippery, so rats can't climb up. Wood poles to raise the structure that have metal disks around the feet. Also fine wire mesh can be used to close off the outside.



- **Metallic silos:** A recommended practice is to make special safe containers from corrugated iron sheets on poles. Such metallic silos have a special opening to take out the grain when needed. The corrugated iron prevents rats from gnawing through, and the slippery surface prevents them from climbing up to enter the silo. You can also use metal barrels as storage. Make sure to have a tight lid that fits well to close the wide mouth of the barrel.





- Hermetic bags: For storage of grains in bags, using hermetic bags is recommended. Hermetic bags are poly-ethylene storage bags with an additional plastic liner inside. When these are tightly closed (air-tight), rats cannot smell the food inside. This keeps them from gnawing through the bag and eating the grains. The hermetic bags also prove to be remarkably effective against weevils and mould aflatoxins. Hermetic bags should be used both in storage and in the house whenever possible. Caution should be taken to place grains in hermetic bags that are fully dried (10-11% moisture content).



- Smoking. To protect your maize seeds, hang it above the stove, as the smoke that rises from the stove gives the maize a bitter taste and it is said that the smoke irritates the rats. Thus protecting your maize to be sown in the next year.



## 5. Keep predator animals at home:

Keep domestic cats and dogs at home for rat control. Cats hunt and eat rats. Moreover, the smell of these animals – especially the smell of female cats (or their urine) - scares rats and prevent them from establishing a shelter nearby. Furthermore, the presence of predator animals—cats (domestic and wild), dogs, mongoose, genet, and owls—around household compounds and villages scare rats away. Rats perceive a predation risk; hence, they will limit their movement to seek food and mates. It is advisable not to chase away rat predators, but rather to attract them around the compounds and villages. Chapter 5 advises in detail how to attract predator animals.



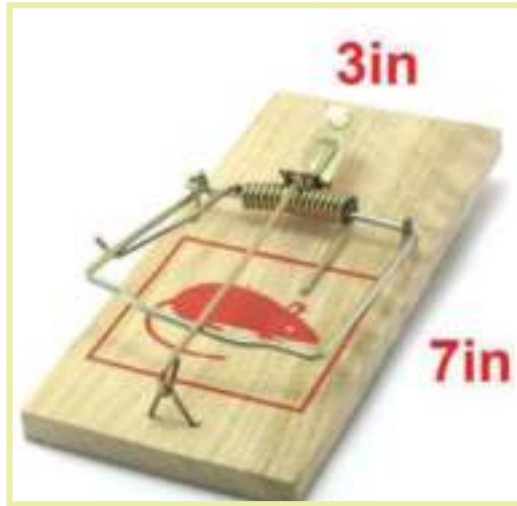
## 6. Place traps:

The final method to control rats around the house, but can also be used in the field, is to place traps, particularly in places where rats are suspected of moving and hiding. These traps can also be deployed in the field!

- Trapping is preferable to the use of poisons.

- Traps prevent rats from dying in inaccessible places and causing an odour problem.
- There are different kinds of traps, locally made or purchased from local markets, that can be deployed in fields and storage areas:
  1. stone traps,
  2. spring traps
  3. pit fall traps – e.g. with cow dung slurry and some dry leaves on top
  4. cage traps, both single and multi-capture
  5. snares – for use in coconut trees
  6. bucket traps (half-filled with water)
  7. local traps made in India







One can also devise a home-made trap; an example of how to make a bucket trap is provided below.



## Example: Home-made bucket trap.

### You need:

- 20 liter bucket or larger
- Water bottle, soda can, or pvc pipe
- Steel wire
- Stick to use as a ramp
- Water
- Bait – for example peanut butter or linseed

### How to do it:

**Step 1:** Drive a steel wire through the opposite ends of the water bottle (or any round object which can easily roll and is slippery/smooth).

**Step 2:** Drill holes in two sides of the bucket near the top where you can push the steel wire through, with the bottle in the middle of the bucket opening.

**Step 3:** Set your ramp up to the bucket opening.

Step 4: Place bait on the ramp and the rolling mechanism.

**Step 5:** Fill the bucket with water.

**Step 6:** You'll have rats climbing up to get to the delicious bait only to be dropped to the bottom of the bucket!

## 06. CULTURAL METHODS TO LIMIT HABITAT OPTIONS FOR RATS IN THE FIELDS

Rats are a major threat to crops and fodder and their numbers are increasing. There are three main reasons for their increasing population:

1. Rats have more to eat with more choice. More crops are grown in multiple cropping seasons per year, and new crop fields are being created in previous natural habitats, and the new crops (like rice and legumes) are highly liked by rats. As a result there is more food available for rats. . Also, perennial plants introduced in agroforestry systems are adding biomass (e.g., seeds and foliage) favourable to rats.
2. Rats have more places to hide and shelter. The introduction of watershed conservation measures (stone bunds, terracing, mulching) has greatly increased the number of shelter places for rats. Soil bunds are often great places for rats to hide and shelter in close proximity to food crops. Furthermore, perennial plants provide shelter for rats.
3. Rats have few natural enemies. In some areas, the natural enemies of rats (snakes, owls, raptor birds, and mongoose) have disappeared due to killings or the destruction of their habitats. A good example is the absence of trees and shrubs on which raptor birds perch in order to

make a kill. In the absence of natural enemies, rats can move freely without being preyed upon.

The measures to combat rat infestation focus on three aspects: reducing shelter, reducing food availability, and increasing predation pressure. The main measures work in combination to achieve all three aspects.

In this chapter 6, we describe cultural methods, what you can integrate in your agricultural practices to control rats. Chapter 7 details how we can let nature do the job, through biological methods, and lastly chapter 8 describes some special and collective actions for effective rat control.



**A. Methods to improve cultivation practices, such that there are fewer opportunities for rats to thrive.**

**1. Reduce crop cover** to create open space between the crops, which rats do not like, because it exposes them to their natural enemies. The result is that rats will move less and less far. You can do this through:

- 1. Regular weeding:** remove weeds and grasses within the crop, along the field bunds and in the peripheral surroundings to reduce hiding places and food options for rats. By regular removal of weeds, we can reduce the attractiveness of the field to rats, thus reducing their population.
- 2. Row/line cropping:** planting your crops in a line with space in between also creates open space between the crops, which rats do not like.
- 3. Cleaning after harvest:** Harvesting meticulously and ploughing the field also decreases food availability for rats. Clean up cut straw and other debris around fields or spread it thinly, and clean up any grain spills at harvest.



**2. Synchronized cropping within the community:** All farmers with neighbouring crop fields (clustered fields) must synchronize the timing of land preparation, planting, weeding, harvesting, and rat control measures. Planting and further management must be within two weeks of each other. Rats will have less chance of survival, because they cannot go to a place nearby where they can roam freely to eat and shelter. This prolongs the lean period for rats when they are already weak, bringing down their numbers.

**3. Consider controlled minimum grazing in fallow fields:** In many cases, grazing animals often result into destruction of ground cover by trampling the ground thus destroying rats' shelter. This results into exposure of rats to potential predators thus controlling rat populations.

**4. Cultivation of non-preferred crops:** Cultivate crops such as Guar, peppermint and Castor as a strip crop (10 meter wide) along the edge of your field.

**B. Methods to destroy the habitats of rats and ensure they have no place to hide**

Destroying rat habitats and shelters denies rats protection from predators, breeding grounds, and temporary safe havens. This results in a decrease in rat survival rates and density, and ensures that rats can only occupy crop fields later in the cropping season.

**1. Stubble grazing:** Some rats make their nests from grasses, crop leftovers, and rubbish in the fields, particularly rats that are active during daytime and require surface shelter against potential predators. By having livestock graze on these fields before planting for the new season, the rat nests will be destroyed. For example, one could practice ‘stubble grazing,’ where cattle are taken to the fields after the harvest to graze on the crop leftovers. After the cattle are finished stubble grazing, the remaining leftovers are collected and burned. This ‘field cleaning’ exercise is important to do before every new planting season starts. It gives the crops a head-start, because rats have been unable to infest the newly planted field.

**2. Flooding of burrows:** Other rats make burrows and tunnels to shelter underground, especially those species that are active at night. It is advisable to flood these burrows and tunnels with water first to kill the rats inside just before planting seeds. The water also weakens and breaks the soil inside the burrows. The rats then dig other exits and the people who are on the lookout for them, catch and kill the rats. They use whatever is around them like sticks or stones to kill the rats.



**3. Smoking out burrows:** take a clay pot and make a small hole beneath the pot. Then fill it with straw; preferably of the local millets (kodo and kutki), as it is believed that the smoke of millet-straw produces a pungent smell which is also toxic. If millet is not available, use rice straw. Next, go to the fields and start identifying large and active rat burrows. After selecting the burrow that is the main entrance/ the biggest, start digging to ensure the clay pot can fit well. The other burrow openings are covered. Then light up the dry straws, dried cow dung and put it inside the clay pot.



Once it is burnt, seal the burrow with the clay pot and start blowing smoke from the small hole made at the end of the pot. People are then on the lookout for the rats. The poisonous smoke starts filling up in the holes and the rats start coming out from the burrows and the people catch and kill them. You can use sticks or stones. You can catch an average of 15-25 per event. This is a community activity and requires at least 6-10 people.

**4. Deep ploughing** can destroy the rat burrows and tunnels. Rats can dig burrows up to 70cm deep. The ploughing depth preferably would reach this depth to destroy a large part of the rat population; however, ploughing at 20cm depth, for example, would also considerably disturb rat burrows.

**5. Destroy burrows:** In other cases, search for rat burrows and destroy these by stabbing/poking in the burrows with a pole or hayfork/prong. This can be done during the tilling and ploughing stages. When you find a rat burrow, you can also set kill-traps in front of the burrow on the runway.

6. While irrigating crops, rat burrows get flooded with water and rats start coming out of their burrows. At that time, we can kill those animals coming out manually with sticks, trap them by setting traps and with the

help of their natural enemies such as dogs, cats, owls etc.



Check regularly for evidence of rat infestation (burrows, tracks, and runways) to undertake measures.

**C. Improve the quality of soil and water conservation structures and limit their suitability as rat shelter.**

**1. Reduce the size of soil bunds:** Permanent bunds and water channels around the fields act as rat reservoirs. Rats live in these areas by making their burrows permanent and from here they can migrate to adjacent crop fields and cause damage. Rats prefer to make burrows in bunds which are thick and high. Actions that should take place include:

1. Construct no wider and taller than 30

cm x 30 cm bunds, around the field.

2. Make sure that bunds are well compacted and properly sealed, with no cracks, holes, etc. This will minimize water losses through seepage (particularly in sloping lands).
3. Adjust the spillway height to 3-5 cm for storing the same depth of water. Maintain this height to ensure sufficient water storage capacity especially during rainy or wet season. and reducing height and width of bunds (e.g. 1ft by 1ft).
4. destroy burrows (especially before planting season)

2. Keep an empty strip of land between the stone bunds and the crop whenever possible. The clear spaces expose rats to predators, and rats will





therefore avoid moving across the open space. As a result, it reduces the chance of rats crossing the open space to reach a field or compound. This can be done near stone bunds, hedgerows, enclosures, houses, and stores.

1. **You can combine this with using sound to repel rats.**
2. Polythene papers (usually the fertilizer bags) are tied in bamboo sticks and kept in the rice fields at regular interval. When the wind blows, the paper (polythene bags) create a type of sound, which control the rat movement in rice fields. This technique is very popular in Tamil Nadu, Andhra Pradesh and Karnataka.
3. Between the bunds and the main rice field, 3 feet gap is to be maintained and in this gap, empty bottles are kept with the mouth of the bottles facing opposite to the wind direction. When the air enters into the glass bottle it creates a type of noise which is highly allergic to the rats.



3. The movement of rats on top of bunds can also be prevented by placing thorny bushes or vetiver grasses (prickly/sharp) on the stone bunds. This will hinder the movement of rats and create an uncomfortable condition for them. Note: vetiver grasses must be cut low regularly to prevent rats to hide underneath, vetiver is an excellent livestock feed.
4. Thorny bushes and strips of prickly/sharp grasses at the edge of a field or between rows of crops also hinder rat movement. It creates discomfort to rats by cutting into and injuring soft parts of their body. It is best to plant thorny bushes in a narrow line, discouraging their movement while not interfering with other crops in the field.

# 07. Biological control, let nature do the job

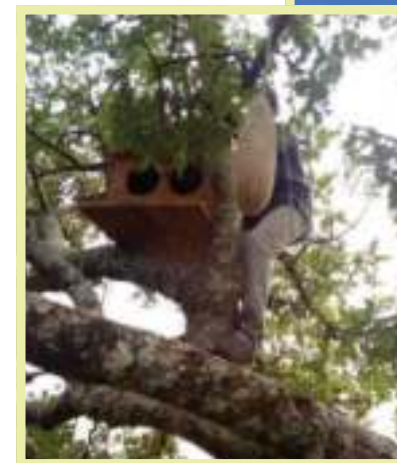
## 1. Promote natural predators.

Natural enemies of rats function as highly effective biological control agents. Owls, kites, hawks, falcons, eagles, snakes, jackals, monitor lizards, cats, mongoose etc. are the natural predators of rats and mice. These should be protected. This approach involves no killing, no chasing, and protection of habitats. As a farmer, you should actively promote and try to attract these predators to your fields. Fox example:

- Bird perch: You can erect a nine feet stick or coconut stalk in reverse position. Note: the perching pole can best be 3m high, with a 30cm bar on top, in a T-shape. This is acts as a bird perch. Do this especially in open fields devoid of trees and shrubs. Erect the poles in such fields

so that the birds sit on them and hunt down the rat population. At night time, owl or other nocturnal birds will sit and prey on the rats. This is a very cost effective measures of rat control.

- Nest box: Installing owl nest boxes on houses or trees helps to attract more owls.





- Mongooses, jackals, and snakes are other common predators of rats occurring in agricultural landscapes. They are adaptable animals and can adjust easily to changing environments. Do not kill, scare away, or clear their habitats. Then these animals are capable of significantly reducing rat populations (and rat movements) in agricultural landscapes and villages.



## 2. Repellents:

These methods have the aim to create a smell that rats don't like, by putting the material with repellent smell in front of the rat burrows, it will keep rats away. The methods below are traditional methods and not scientifically proven. Rice farmers in other parts of India employ the following methods to combat rat infestations:

- Cannabis Repellent: Farmers use 10 kg of crushed Cannabis sativa (kuvalaikai) seeds, placed in a gunny bag, which is submerged in irrigation channels. The seeds' juice and strong odor disperse

through the fields, repelling rats during vegetative, ripening, and harvesting stages. (Tamil Nadu)

- Jatropha Sorghum Bait: Half a kilogram of jatropha seed powder is boiled in 2-3 liters of water. After filtering, one kilogram of cooked sorghum seeds is spread along the bunds of rice fields. Rats consume this bait, leading to instant mortality. (Tamil Nadu and Andhra Pradesh)
- Glyricidia Plant: Cultivating glyricidia plants near rice godowns helps control rat movements. Placing glyricidia leaves inside the storage room and sealing windows and ventilation points harnesses the plant's odor as a natural repellent.
- Kaunj Fruit Skins: Farmers use kaunj fruit skins with tiny irritating hairs. Placing these skins in rat holes

causes severe itching upon contact, effectively deterring rats. The raw material is readily available in the region's wild conditions. (Uttar Pradesh)

### 3. Use plant mixtures that will sicken or kill rats.

- Three kilograms of sorghum seeds are tied in a cloth bag and soaked in 4 liters of water wherein one kilogram of urea is dissolved. After eight hours the sorghum seeds are taken out of the urea dissolved water. The sorghum seeds are spread near the burrows of the rice field. Soon after consuming the sorghum seeds the rats die. This is practiced in Tamil Nadu.
- Fully cooked parboiled paddy is mixed with furadon granules and spread in the bunds, near burrows

and other rat infested places in the rice fields. Rats are attracted to the smell of parboiled rice and eat it. After consuming the parboiled paddy, the rat will die within hours. This is practiced in Tamil Nadu.



## 08. Take special and collective actions to control rats

In addition, special measures can be taken to reduce the rat population. We describe three additional measures to control and kill rats.

**1. Deploy field adjusted trapping:** these are trapping methods that are especially useful in the field and can be used in addition to the traps already mentioned in this manual. Note: all traps mentioned can be used in the field.

- Clay-pot method: In rice fields, nearer to the bunds big mud pots are immersed to half of its height. Half of the mud pots are filled with water and chaffy paddy is put into it. The chaffy paddy mixed with the water emit a type of smell like the grain storage structure. Attracted by this smell, the rats jump into the pot but can't come out of it as it is half empty. Farmers then catch the rats and kill them.

2. Install special “large traps” called Trap

### Barrier Systems

A community-based Trap-Barrier-System (TBS) is basically a system where rats are trapped in a field that is planted shortly before the surrounding fields are planted. Rats are drawn to the newly planted field from a wide area, where they are trapped all together. A small field is closed, and eight multiple cage traps are installed on the fence; when rats enter the fenced-off field through the hole openings, they are trapped. TBS is a new, environmentally friendly, physical rat control method. The TBS method will be most effective when combined with the rat control measures described in this manual.

- These ‘barrier systems’ sometimes incorporate traps or snares set across gaps or ‘doorways’ – hence the term Trap Barrier System or TBS.
- The Malaysian Agricultural Research and

Development Institute developed the TBS concept.

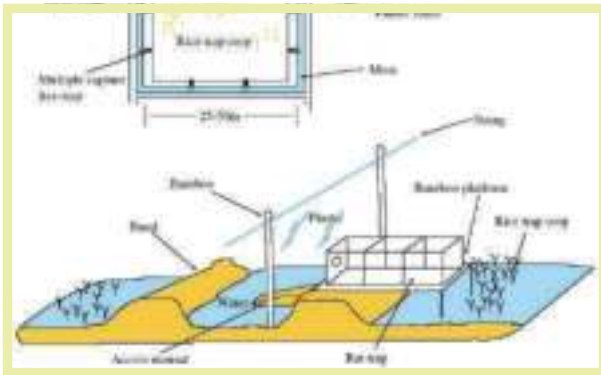
- TBS technology is part of an integrated and community-based approach to rat pest management.
- The Community Trap Barrier System method (CTBS) works best, and is most cost effective when adopted by an entire farming community.
- The CTBS is built from readily available materials and is simple to construct. However, for a TBS to work properly, these technical specifications should be met:





**Materials:**

- Plastic for barrier fence (stronger material is recommended as it will resist damage, withstand strong wind and be reusable for several seasons)
- Bamboo or wooden stakes to support the barrier and traps
- String or wire to maintain an erect barrier
- Material to fix plastic to string or wire
- Multiple capture live traps (such a trap can trap and capture multiple rats)



**Construction steps:**

1. Allocate a piece of land of 10 x 10 meters (or more whenever possible, up to 50 x 50 meters). This can be done by organising a group of farmers with clustered farms. The owners may make a deal about one or more farmers giving up a part of their land to



construct the TBS.

2. Fence the allocated piece of land with plastic (tarp) that is dug into the soil. Use stakes and string/wire to erect and secure the fence around the plot, making sure that it is dug at least 10cm into the ground and stands at least 60 cm above the ground.
3. Dig or widen existing channels to construct an encircling moat (trench/ditch) at least half a meter wide.
4. Install at least two multiple capture traps along each side. These must be held tightly against the fence, with no holes or gaps that might allow rats to bypass the traps.
5. Construct earth mounds partway across the moat, leading to traps.
6. Place kill traps along the inside of the fence to catch any rats that have penetrated the barrier. Rats will get into the trap within the fenced area.
7. Within the CTBS, multiple-capture cage traps are installed inside the plastic fence

and nearby holes that are purposefully made to allow rats to enter. Once rats have entered the CTBS, they have nowhere else to go than the traps that are set for them.

8. Plant the 'lure' crop 4 weeks before the surrounding crop is planted. Inside this trap, for instance, malt barley is planted 4 weeks earlier than in the surrounding fields. This can be done by special watering of the part of the land that is allocated for the TBS.
9. The TBS will attract rats that survive the lean season and they will be trapped, diminishing rat numbers before the planting season starts.

#### **Important!**

- Studies in Asia suggest that a 50 x 50 m TBS can protect a 10-15 ha field if correctly installed.
- Undertake the TBS early enough! Ensure

it is about four weeks prior to the normal planting time.

#### **Maintenance:**

- Empty the traps early each morning (dead rats left in the traps will discourage other rats from entering).
- Check the plastic barrier for holes each day and either repair these or install extra traps.
- Keep the moat free of grass (rats can use this to climb over the fence).
- If unable to check the CTBS for a few days, place straw in the entrance of the traps.

## 09. CALENDAR FOR RAT MANAGEMENT

	<b>Kharif (June – September)</b>	<b>Rabi (October – January)</b>	<b>Zaid (February – May)</b>
<b>Crops</b>	Paddy rice, Maize, Millets (Kodo Kutki)	Peas, chickpeas, Wheat, pulses, oilseeds, vegetables	Fallow
<b>Rat activity</b>	High	High	Low
<b>Highest damage</b>	Rice in the field, especially a lot of damage from tillering to harvesting stage.	Both field crops and storage	Storage and house
<b>Focus of management</b>	Field bunds and burrows	Field bunds and burrows, homestead land, storage area	Field bunds and burrows, homestead land, storage area, house
<b>Best management Methods</b>			
			This is the best season to manage rats!
	Bird perches	Bird perches	Close all rat entry holes
	Flooding of burrows (before planting!)	Claypot pit-fall trap	Clean fields, cut bushes
	Make bunds less than 30cm wide	Let cows graze the stubbles and trample the burrows after harvesting Rabi crop	Improve storage structures (Kothi with metal and tin sheets)
	Keep bunds clean of weeds	Keep bunds clean of weeds	Install metallic silos and hermetic bags
	Deep ploughing		Trapping
			Smoking out burrows



## 10. CHECKLIST FOR COMMUNITY RAT CONTROL MEASURES

Rat control Measure	Done where	Done by whom
<b>Some control measures on cleanliness of houses and storage areas</b>		
Keep houses and areas around houses clean		
Sealing and closing of all entry points for rats		
Air-tight storage of all food and stored grain		
Waste disposal system in place		
Rat proofing of in-house storage		
Rat proofing of outside storage structure		
Regular inspection of rat marks		
Get domestic cats or attract wild predators such as wild cats, mongooses, owls to scare away rats		
Place rat traps in select places		
<b>Controlling the environment in the agricultural fields</b>		
Regular weeding and keeping the field clean		
Row/ line cropping		
Cleaning the field after harvest		



Adjust the cropping calendar of neighbouring (cluster) farm owners so that each activity is undertaken at a community (watershed) level to ensure that rats have fewer opportunities to move between fields and get access to food and shelter		
• Synchronize planting period		
• Synchronize weeding period		
• Synchronize harvesting period		
• Synchronized rat control period		
Destroy rat habitats by flooding, burning, or ploughing the land deeply to reach their shelter. Include such measures in the regular farming preparation activities.		
Build soil bunds in such a way that they are narrow and compact. Make sure that there is not enough space for rats to hide.		
Do controlled minimum (stubble) grazing		
Leave a strip of open land next to the bunds to expose rats for predators while moving between bunds and fields		
Using sound to repel rats		

Rat control Measure	Done where	Done by whom
<b>Take special actions to control and kill rats</b>		
Deployment of repellents in the field		
Deploy plant mixtures that can sicken or kill rats		
Promote the establishment of rat predators around fields and storage areas (avoiding eliminating their habitats)		
Implement the Community Trap Barrier System (CTBS)		





# PRACTICALGUIDELINE

