Tougher times for raiders of the ricefield

Roger Beckmann

Agricultural productivity in many places would be enormously improved if rodents could be effectively controlled. Roger Beckmann relates how the quest to control rats in the ricefield has advanced through ACIAR-funded research that advocates a trap system free of expensive, toxic and environmentally damaging poisons.

What is a quick-breeding, quick-eating, mobile, smart and adaptable consumer of human foodstuffs? The answer, of course, is a pest rodent. These creatures can eat our crops before we even have a chance to harvest them, stealing food that should be going into human mouths. Rodents are widespread pests but they are particularly abundant in the tropics and hence are a major problem for agriculture in many developing countries. They can also carry several serious human diseases, so proximity to them is undoubtedly a health concern.

In several Southeast Asian nations, farmers now consider that rodents (not insects, weeds or lack of soil fertility) are the number one factor constraining further rice production. In Indonesia alone, rice that could feed several million people goes to rodents every year! Most of these rodents are large, hungry rats. And the more farmers try to produce, the more food the rats receive and the more they breed—thus making the problem worse. In Vietnam's Mekong Delta, for example, agricultural success has now enabled farmers to grow three rice crops a year instead of two. The result has been three, instead of two, breedings per year for the rodent pests!

Agricultural productivity in many places would be enormously improved if rodents could be effectively controlled

All in all, agricultural productivity in many places would be enormously improved if rodents could be effectively controlled. Avid readers of *Partners* might remember that this issue was discussed in the 2000 edition (Partners 13), where a novel solution to the problem of rats in the rice was proposed. The beauty of the system described was that it did not rely on the use of expensive, toxic and environmentally damaging poisons.

Ricefield rats: in several Southeast Asian countries farmers now consider that rodents are the number one factor constraining further rice production.

This is important because many farmers in less developed countries buy relatively cheap and readily available poisons that are not necessarily intended as rodenticides. The farmers may mix these with vehicle oil and apply to a flooded rice crop. The result can be disastrous for invertebrates, chickens, ducks and fish around the plots; in addition some of the substances used are highly toxic to the farmers themselves, may not degrade in the soil and may persist as a residue in the harvested crop.

The loss of invertebrates at the base of the food web can reduce biodiversity in surrounding habitats. Such an imbalance often leads to increased damage by insect pests because of the loss of predators in the system. Furthermore, the chemicals may be directly harmful to natural predators of rodents (such as birds of prey). This in turn leads to a stronger reliance on chemicals for controlling pests. All in all, a way of managing the rodent problem that does not rely on

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TBS+TC=Success

In many Asian countries, farmers protect their crops from invading rodents by using plastic fences as barriers. Whilst this is effective for the small area ringed with plastic sheeting, the rodents are not controlled and simply go elsewhere to eat, worsening the problem in other places. Pest numbers are not reduced.

But by making small holes in the barrier sheeting, just above the level of the irrigation water, and putting trapping cages on the crop side of the holes, it is possible to trap the pests rather than just keep them out. Rats attempt to enter the fenced crop and move along the outside of the plastic sheeting until they find a hole, into which they scramble – only to find themselves in a trap on the other side. When properly built and maintained, this trap barrier system (TBS) is successful at reducing rodent numbers in an area. However, it is only cost-effective to install when losses caused by rodents are high.

A clever enhancement of this idea, offering protection beyond the fenced area, is the trap crop (TC) idea developed by Dr Grant Singleton and his group at CSIRO. The trap crop, as described in the main text, is planted before the main crop and ripens earlier, luring hungry rodents from a large area in which other food is not yet available. The trop crop is ringed with a TBS system, catching rodents as they try to enter it. The TBS+TC system offers a halo of protection of about 10-15 hectares around a small trap crop, which means that in this area the later-ripening crops do not need any expensive and time-consuming fencing. And, of course, the trap crop is harvested along with the later-maturing main crop.

It is the TBS+TC system that has proved popular with farmers wherever it has been introduced. It is most effective when co-ordinated by the community across many farms. This allows the careful siting of lure crops to make the most of the circle of protection afforded by each one.

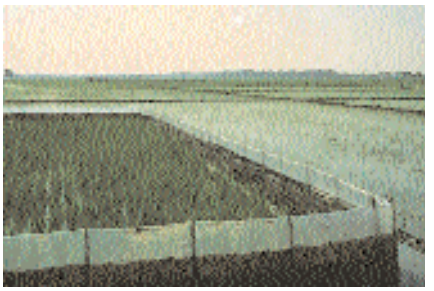
Mr Ho Van Chien (front right), extension specialist in Vietnam, explains to farmers and Plant Protection field officers the concept of a community trap barrier system. Farmers involved in a village level project on rodent management in the Mekong River Delta, Vietnam made this scale model, complete with early lure crop.

inappropriate chemical usage—or on even more worrying methods such as live electric wires around the rice field connected illegally to overhead mains-carrying cables—is sorely needed.

Lures and traps

This is where the trap barrier system comes in. The idea is based on luring rats by planting a small area in advance of the main crop. This trap crop is surrounded by a barrier interspersed with trapping cages. As the lure crop ripens to provide a tasty yield, the rats are attracted to it, and are caught in the cages of the barrier fence as they attempt to reach the crop. (See the box for further details.)

The system, the result of ACIAR-funded research over several years, has proved successful in Indonesia and Vietnam, and has now been extended to Laos, Cambodia and the Philippines. The initial cost is high for many marginal farmers (the barrier is made of plastic sheeting, the traps usually of metal). In some places, offsets can come from selling the live rats for human or animal food and re-using some of the plastic sheeting once it is no longer effective as



The trap barrier system, showing the lure crop that draws rats into the trapping cages.

a barrier. In addition, labour is required for collection and disposal of rats and maintenance of the system. Despite the costs, however, the benefits of the idea have quickly been recognised. Workshops where farmers can become informed and exchange information with others have been arranged and funded. The result has been an encouraging uptake of the technology. Indeed, in Indonesia the technology forms the basis of a new national policy on rodent pest control.

The main benefit is the reduction in chemical usage or in time spent controlling unfenced crops. The disadvantages can come from 'free-loaders'. This is because farms are small in many less developed countries. The trap crop, by attracting rodents from the surrounding area, offers a zone of protection to other farms whose owners may not have put in the effort to establish the system. Hence the need for this to work across the whole community.

A rice field is typically owned privately by the farming household and the harvested rice is the sole property of the land owner. But when a community trap barrier system is established using shared resources, such as materials and labour, a common property is created. The shared benefits are reduced rodent damage to rice in several farms, and any consumable rodents or other animals caught in the traps. The shared costs are the fence, the traps and the labour.

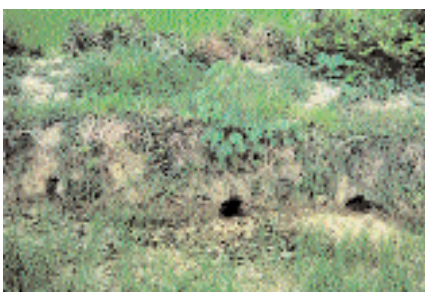
The President of Indonesia, Megawati Sukarnoputri, inspects multiple capture traps and two posters by the Research Institute for Rice rodent group. Indonesia has instituted a national control program against rodents based on the project methods.

The breeding season of the rats is linked to the seed development and ripening stage of rice crops

The implications of this have been studied by a team of anthropologists from the Philippines and Vietnam. They concluded that, in farming communities where the average farm area is at least a quarter of the halo of protection offered by the system (which is about 10-15 hectares), it is unlikely that many farmers would willingly establish a TBS alone. Instead, they may go into partnership with neighbours (who are often relatives) and expect something else in return.

The trap crop and TBS system comprise a core for community rat control. It needs, however, to be supplemented by other community actions such as good hygiene around villages and crops, planting crops within 2 weeks of each other at a village scale (synchrony of cropping), and targeted rat campaigns. The synchrony of cropping is essential because the breeding season of the rats is linked to the seed development and ripening stage of rice crops. If these stages are occurring over an extended period then the rats will continue to breed and there will be high losses to the crops that mature later and to the seedling stage of the next crop.

Rat campaigns entail digging up or fumigating burrows, using local traps, driving rats into nets and some use of poisons. In some countries, dogs are also often used to locate active burrows and to help catch rats that are flushed out from the burrows. These intense measures are only needed for about 1 or 2 weeks each cropping season and only in key rat habitats. They need to be conducted during the period from the start of land preparation for sowing crops to a couple of weeks after sowing – before rats reinvade the new crops and begin to breed.



Active rat burrows in a bund between two recently sown rice crops. Rat campaigns involve, amongst other measures, digging up or fumigating burrows.

The broad approach

Dr Grant Singleton, of CSIRO Sustainable Ecosystems in Canberra, Australia, is an expert on rodent biology. He often points out that one of the difficulties of controlling rodents is that the pests seem to appear and disappear. In other words, the population in an area can fluctuate considerably, and quickly, in line with prevailing conditions. Rodents are masters of breeding quickly to take advantage of favourable opportunities. In lowland irrigated rice, the scientists now know that these favourable opportunities are linked to the availability of rice crops at certain stages of development. Where

The system takes off in Vietnam

In Vietnam, the rodent problem has escalated in the past ten years. The area of crops with high rat damage increased from approximately 50 000 ha in 1993 to more than 310 000 ha (mainly rice) in 1997. In June 1997, the Vietnamese Ministry for Agriculture and Rural Development classified rodents as one of the three most important problems faced by the agricultural sector.

After ACIAR-funded work in the region, the Government of Vietnam has become a keen advocate of the trap barrier system of rodent management. The system has proved to be a great boon to the villagers of Bac Binh district, Binh Thuan province, where rat damage of between 20 and 100% of rice crops has led to food shortages. Many households lived in hunger for years as they received nothing or very little from their rice crops and local government had to provide them with rice seed to sow new crops. Local people had tried many traditional rat control methods such as hunting, trapping and poisoning, but the rats kept increasing.

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Mr. Lim, 52, in Ri Thanh commune said, 'My children were at the risk of dropping out of school as I had hardly managed to produce enough to provide for my family of nine. I have one hectare of land that used to produce 5 tonnes of rice per crop. However, I received just 3.5 tonnes of rice since rats hit the rice field.'

Village people in Vietnam's Bin Thuan Province attempt to catch rats by sweeping through the field. These people now have the benefit of the trap barrier system to substantially reduce rat damage.

In 2000, World Vision started the Agriculture Development Project in Bac Binh district, in order to improve the nutrition standards of children, but the project was affected by the food shortages due to rats. In 2001 World Vision, in cooperation with ACIAR, implemented the Rodent Control Project to help local people improve food security.

After 8 months implementation the project succeeded in helping people in Ri Thanh and Phan Hoa communes protect more than 50 hectares of rice, reducing the rats' damage by 40%. World Vision introduced two methods of rat control with bio-chemical and Trap Barrier Systems. Approximately 1800 rats were trapped in Ry Thanh commune from the five trap barriers during the recent crop, and more were killed by the bio-chemicals.

The local people are highly appreciative of the Rodent Control program. Mr Lim stated, 'It is easy to establish the Trap Barrier Systems. The important things are that we should work together to maintain the traps and to plant our crops at the same time. World Vision has trained us to apply the methods and become confident in implementing them.'

The provincial People's Committee and Department of Plant Protection subsequently requested World Vision to introduce the methods into every district in the province. World Vision followed up with training in six districts of Binh Thuan province and help for people to apply the new methods.

Grant Singleton advising on the construction of a community trap barrier system in Luang Prabang, Lao PDR. The mound of mud leads to multiple capture traps.

there is one crop per year, rats breed once. If there are two crops per year, rats breed twice. Usually the rats will only produce two or three litters per cropping season and the first litter born will not breed in that season. However, if the crops are planted asynchronously then the breeding season will be extended and the first litter will have time to breed, resulting in an explosion of population numbers.

Traditionally, rodents are only controlled when their numbers are high. And this is probably the worst time to deal with the problem

Therefore the most effective approach to the rodent problem is the broad one of ecologically based management. This means understanding the close connection between the pest and its food supply, and managing the problem each year at key times even when the pests seem scarce. It is a radical shift away from older approaches that relied on dealing with a problem once it appeared.

Rodent breeding strategies have implications for the human animal too. We tend to deal with problems that are immediate and apparent. And when there are no rodents around—then they are not a problem and something more urgent is tackled. This has meant that, traditionally, rodents are only controlled when their numbers are high. And this is probably the worst time to deal with the problem.

The trap barrier system catches rats before the surge in their numbers. Hence, TBS will often not catch large numbers of rats. But it will catch those rats that would otherwise spring into action and breed when the main crop becomes available. The removal of one female rat before she breeds is equal to killing 35 rats when the crop is maturing. (If the crops are not synchronous, and harvesting is extended by just 3 weeks, then the number of rats feeding on the final crop, derived from a single female early in the season, could be as high as 120!)

At first, however, farmers may be suspicious of the trap barrier system. How can it be working if the traps are not full? That, of course, is the whole point of tackling the problem when rat numbers are low. However, contact with extension officers and other farmers, along with trials that involve sceptical farmers themselves, have succeeded in convincing many communities that an integrated community approach to rodent control really is the way to go.

Of course, conditions vary from place to place, and already various local adaptations to the system have been made—in terms of the cages used, the sheeting, and the timing of the lure crop. But what is certain is that TBS but not catching at a rate sufficient to reduce the impacts of rats on crop production. This is because rats are such fast and prolific breeders. Whether the community TBS combined with other community actions will affect the rat catchers' trade remains to be seen. Certainly the incidental rat catch by farmers using TBS in southern Vietnam provides an income or food supplement that helps offset the costs of establishing the system.

Rat risotto

An interesting feature of rat control in the Mekong Delta region of southern Vietnam is the popularity of rat meat. The annual production of rat meat for human consumption is more than 3300 tonnes, and the trade is worth about US$ 2 million a year. There are estimated to be thousands of full-time rat catchers in the region and many specialist rat distributors.

Rat meat is popular in the area not just because people are short of animal protein, but also because the animals are regarded as pleasant to eat. Catching and selling rats can therefore be an important source of additional income for poor farmers.

Despite this high level of rat usage, the animals remain the main pre-harvest pest in much of the Delta. This is probably because the catching merely removes competition from the remaining rats, and therefore encourages the population to grow naturally to replace the lost animals. In other words, the rat-catchers are sustainably harvesting the animals

Rats caught in the community trap barrier system represent a valuable source of animal protein.

The good guys

Not all rodents are pests. Many have important roles in the ecosystem of an area, and rarely cause a problem for farmers. In the uplands of Laos, for example, CSIRO rodent taxonomist Dr Ken Aplin examined many rodent species and concluded that only 5-10% are agricultural pests. The remainder carry on digging, building burrows and playing their part in the food web as prey for other animals or as predators themselves.

It is important, therefore, to distinguish between beneficial and pest rodents and ensure that only the pests are caught and disposed of. For this reason, Dr Singleton's group and their collaborators in Lao PDR are launching a manual this year with a simple taxonomic rodent key for use in the field. The scientists will also educate extension staff. This is particularly important in places where fields abut forest.

CSIRO rodent taxonomist Dr Ken Aplin identifies species of rats caught in the Mekong region of Vietnam. Many of the species of rat in this region play an important role in the ecosystem and cause minimal damage to crops.

is an important way of managing the rodent problem without recourse to chemicals. In the long run, it will also be cheaper. That's good news for the environment, for farmers' pockets, and for countries struggling to export 'clean green' agricultural produce to demanding markets.

RECENT ACIAR RODENT CONTROL PROJECTS

Animal Sciences 1 Program

AS1/1998/036 Management of rodent pests in rice based farming systems
Countries: Indonesia, Laos, Malaysia, Vietnam
Organisations and Leaders:
Australia: CSIRO Sustainable Ecosystems (Dr Grant Singleton)
Indonesia: Central Research Institute for Food Crops (Dr Andi Hasanuddin)
Laos: Department of Agriculture and Extension (Dr Anonh Khamhung)
Malaysia: Universiti Putra Malaysia (Dato' Sheikh Omar Abdul Rahman)
Vietnam: National Institute of Plant Protection (Prof. Le Van Thuyet)

AS1/1996/079 Management of rodent pests in Vietnam
Country: Vietnam
Organisations and Leaders:
Australia: CSIRO Sustainable Ecosystems (Dr Grant Singleton)
Vietnam: Institute of Agricultural Sciences of South Vietnam (Mr Nguyen Quy Hung); National Institute of Plant Protection (Prof. Le Van Thuyet)

AS1/1999/026 Population models and immuno-contraceptive vaccines for managing outbreaking rodent species
Country: China
Australia: CSIRO Sustainable Ecosystems (Dr Lyn Hinds)
China: Chinese Academy of Science (Dr Zhibin Zhang)

ASEM/2000/007 Farmer-based adaptive rodent management, extension and research system in Cambodia
Country: Cambodia
Organisations and Leaders:
Australia: University of Queensland (Mr Luke K-P Leung)
Cambodia: Cambodian Department of Agricultural Extension (Mr Tea Rithy Vong); Cambodia Agricultural Research and Development Institute (Ms Chan Phaloeun)

AS1/2002/041 Ecologically based management of rodents in rainfed cropping systems in Myanmar
Country: Myanmar
Organisations and Leaders:
Australia: CSIRO Sustainable Ecosystems (Dr Grant Singleton)
Burma: (Myanmar): Central Agricultural Research Institute (Dr Saw Marco); Myanmar Agricultural Service (Dr Than Aye)