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**Authors**

Quinn, Niamh  
Htwe, Nyo Me  
Rachmawati  
[et al.](#)

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# Rodent Cycles and Outbreaks in Asia: Biological Curios and Food Security

**Niamh Quinn**

Crop and Environmental Sciences Division, International Rice Research Institute, Philippines

**Nyo Me Htwe**

Plant Protection Division, Department of Agriculture, Ministry of Agriculture and Irrigation, Myanmar

**Rachmawati**

Indonesian Center for Rice Research, Ministry of Agriculture, Indonesia

**Grant Singleton**

Crop and Environmental Sciences Division, International Rice Research Institute, Philippines

**ABSTRACT:** In Asia, rodents are known to be one of the main constraints to agricultural production where losses of just 6% of the rice crop (35 million tons) are enough to feed 230 million people for one year. Rodent cycles and outbreaks in Asia can lead to severe crop losses and result in major food shortages. Multi-annual patterns in rodent populations (rodent cycles) have been recorded in Asia and have been shown to be linked to masting events of bamboo. One example of population cycles are those associated with the flowering of the bamboo *Melocanna baccifera* in Mizoram, India, Chittagong Hill Tracts, Bangladesh, and Chin State, Myanmar. Rodent outbreaks (non-cyclic) are common in Southeast Asia. These events are driven by availability of food and recently have been linked to extreme weather events that cause asynchrony of cropping. Rodents must be managed at a landscape level to help alleviate losses for the 4.1 billion people that rely on rice as their food staple.

**KEY WORDS:** Asia, bamboo, cycles, food security, outbreaks, rats, rice, rodents

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## INTRODUCTION

By 2050, it is estimated that the world's population will reach 9 billion with the majority of these people residing in developing world countries (Nelson 2010). Increasingly, the poor rely on rice, which is the largest single source of their calories (Timmer 2010). Some 90% of the rice in the world is produced and consumed in Asia and provides between 35-60% of the total food energy for the 3 billion people living in Asia (GRiSP 2013). Due to accelerated pressure on agricultural land from population growth, it is increasingly important to address current production problems such as those caused by rodents.

In Southeast Asia, rats (*Rattus* spp.) have been identified as one of the most important pests and are a major concern when it comes to pre- and post-harvest losses. In Indonesia, rodents are the number one pre-harvest pest in irrigated rice (Directorate of Food Crops Protection, Jakarta, unpubl.), the second in Myanmar (Brown et al. 2008) and among the top 3 in Vietnam (Huynh 1987). Areas of Myanmar (Htwe et al. 2013), Lao (Schiller et al. 1999, Brown and Khamphoukeo 2007) and Bangladesh (Belmain et al. 2010) experience episodic outbreaks that cause crop losses of up to 100%.

In Asia, pre-harvest losses are usually between 5-10%. To put this into perspective, a loss of approximately 6% would result in a loss of 35 million tons of rice. This would feed 230 million people, which is equivalent to the population of Indonesia, for a year (Singleton 2003).

## CYCLES AND OUTBREAKS

There are two rodent population patterns evident in Asia. These are rodent outbreaks which are non-cyclic and outbreaks which have obvious cyclical patterns. There are several causal processes and interactions linked

to rodent outbreaks and cycles. Increased food supply is associated with these events such as masting and asynchrony of cereal crops.

## Rodent Cycles in South and Southeast Asia

There is only one documented rodent cycle in South and Southeast Asia. This is linked to the flowering of bamboo species (Aplin and Lalsiamliana 2010, Belmain et al. 2010, Htwe et al. 2010), mainly *Melocanna baccifera* but also *M. bambusoides* and *Bambusa polymorpha*. These flowering events have been observed and documented in the Indian state of Mizoram from the early 1900s (Nag 1999) and in areas of western Myanmar (Singleton et al. 2010) and southeast Bangladesh (Belmain et al. 2010). There are historical reports of outbreaks from 1910, 1958, and the most recent in 2005-2008 in these areas. These outbreaks are linked to the life span (approximately 48 years) of a particular bamboo species (Belmain et al. 2010). The most recent outbreaks occurred in Mizoram, India in 2005, and reports of outbreaks from the neighbouring Chittagong Hill Tracts, Bangladesh, and Chin State, Myanmar, came in 2007/2008.

Bamboo produces quite large seeds and can produce up to 83.6 tons of fruit per hectare (Belmain et al. 2010). It appears that aseasonal breeding occurs due to the abundant supply of bamboo seed during masting events (Aplin and Lalsiamliana 2010, Htwe et al. 2010). The outbreaks in Bangladesh were so vast that they were known locally as rat floods. In upland areas, 80-100% of the rice crop was damaged. Other important crops, such as cucumber and pumpkin, were also subject to damage (>60%) (Ahaduzzaman and Sarker 2010). During 2008, studies showed that all hill tribes in the Chittagong Hill

Tracts were severely malnourished (Belmain et al. 2008, Medecins san Frontiers-Holland 2008, Zohir 2008). Farmers in Chin State, Myanmar, reported that their crops had been wiped out within one week of the outbreak (Htwe et al. 2010).

### **Rodent Outbreaks**

Rodent outbreaks are usually associated with higher than normal amounts of food in an environment (Leung et al. 1999, Htwe et al. 2011). This can be brought on by events such as aseasonal rainfall and major climate events such as typhoons and droughts. Htwe et al. (2013) investigated the case of rodent outbreaks in the aftermath of cyclone Nargis in the Ayeyawady Delta, Myanmar. Cyclone Nargis occurred in early May 2008. From June to September 2009, over 2.6 million rodents were collected in response to a bounty introduced for their tails. This occurred through community campaigns and certainly helped reduce the impact of the rodent outbreak (Htwe et al. 2013). Nevertheless, devastation in the Ayeyawady Delta was still severe. It is worth noting that this outbreak occurred in an area where rodent outbreaks had never previously been reported.

As a result of cyclone Nargis, there were significant changes in production and cropping practices over the ensuing 18 months (Htwe et al. 2013). Planting of rice was asynchronous which extended the availability of high quality food for rodents. This asynchrony was because farming communities post cyclone recovered at different times. Many varieties of rice, brought to the delta to compensate for the high loss of seed during the typhoon, were planted and matured at different rates. The asynchronous planting of rice would generate an extension of the breeding season of the rice field rats. Prior to the cyclone, land in the Ayeyawady Delta had been cropped twice a year. After the cyclone, there was a reduction in tool and labour availability. This resulted in farmers neglecting land for at least 7 months and led to rationing crops of rice, the growth of weeds, and plenty of food for rats (Htwe et al. 2013). This provided ideal conditions for increased rates of population growth of rodents in the lower delta.

### **Factors Driving Outbreaks**

Often, outbreaks of rodent populations are driven by anthropogenic responses to climate events and in response to production shortfalls in staple crops, particularly in Southeast Asia. These anthropogenic responses are delayed or asynchronous planting due to lack of water or occasionally too much water, and also increased intensity of cropping.

In many areas of Asia, there is the ability to produce more than 2 crops in a year. It is known that breeding by rodents is closely linked to the rice cropping season (Fall 1977, Lam 1983, Htwe et al. 2012). For species such as the ricefield rat (*R. argentiventer*), if there are two crops in a year, there will be 2 breeding seasons. If there are 3 cropping seasons, there will be 3 breeding seasons.

### **Implications of Rodent Outbreaks**

Rodent outbreaks cause massive issues for the production of rice. Each day, rats and mice contaminate

more food than they eat. Therefore, rodent outbreaks are also extremely important in the post-harvest phase. In one year, 25 adult rats would eat and damage about half a ton of grain and produce about 375,000 droppings (Singleton 2010). As previously mentioned, a loss of just 6% at the pre-harvest stage is enough to feed 230 million people, which is equivalent to the population of Indonesia, for a year. These outbreaks lead to obvious issues with food security, especially when combined with events such as floods or droughts. With climate change and the chance of more extreme weather events, this may lead to greater crop asynchrony, water shortages, and more outbreaks of rodents, as well as an increase in weeds and other pest problems.

### **What Lessons Can Be Learned from the Situation in Asia?**

There is a need for monitoring of both climate and rodent populations in Asia and in other areas where rodent outbreaks can cause serious economic loss or disease outbreaks. Ideally, simple monitoring plans could be developed that can be carried out to assess the likelihood of rodent outbreaks and cycles. These would help us better understand such outbreaks and aid preparation for such events.

It is important to understand that rodent populations need to be managed at a landscape scale. In Southeast Asia, successful community initiatives are developing, whereby community action is helping to control rodent pests and curb rodent outbreaks (Singleton et al. 2005).

The most important lesson learned is the need to be proactive rather than reactive when it comes to rodent pest management. The majority of rice farmers in Asia often observe damage when the crop is maturing. At this stage, it is much more difficult to control rats as they are spread over a larger area. Rodenticides also are usually less effective when the crop is beyond the booting stage because the rodents prefer to eat the developing rice seeds.

In Southeast Asia, researchers and extension specialists are moving away from promoting the use of rodenticides. Farmers are encouraged to use simple and effective ecologically based rodent management techniques such as the community trap barrier systems to control rats. These techniques have proven very successful in many Southeast Asian countries (Singleton et al. 1999). There are also obvious environmental benefits to using a community-based system to conduct early management of rodent populations, as well as benefits to human health.

Asian farmers are frequently subsistence farmers. The crop losses suffered in Asia, however small, are not just an economic issue but can lead to food shortages. Often if these losses are moderate to severe, famine can ensue. It has been shown that having a surplus of rice to sell can raise most Asian families above the poverty line (Timmer 2010). Therefore, assisting farmers with production problems caused by rodents is not only essential in helping to address food security issues but also important in addressing poverty in developing countries in Southeast Asia.

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