



UNIVERSITY  
of  
GREENWICH

**Greenwich Academic Literature Archive (GALA)**  
– the University of Greenwich open access repository  
<http://gala.gre.ac.uk>

---

*Citation for published version:*

Belmain, Steven (2007) Rats: an ecologically-based approach for managing a global problem. LEISA Magazine on Low External Input and Sustainable Agriculture, 23 (4). pp. 18-20. ISSN 1569-8424

*Publisher's version available at:*

[http://www.agriculturesnetwork.org/magazines/global/ecological-pest-management/rats-an-ecologically-based-approach-for-managing-a/at\\_download/article\\_pdf](http://www.agriculturesnetwork.org/magazines/global/ecological-pest-management/rats-an-ecologically-based-approach-for-managing-a/at_download/article_pdf)

---

**Please note that where the full text version provided on GALA is not the final published version, the version made available will be the most up-to-date full-text (post-print) version as provided by the author(s). Where possible, or if citing, it is recommended that the publisher's (definitive) version be consulted to ensure any subsequent changes to the text are noted.**

*Citation for this version held on GALA:*

Belmain, Steven (2007) Rats: an ecologically-based approach for managing a global problem. London: Greenwich Academic Literature Archive.  
Available at: <http://gala.gre.ac.uk/5223/>

---

Contact: [gala@gre.ac.uk](mailto:gala@gre.ac.uk)

# LEISA

December 2007 volume 23 no.4

Magazine on Low External Input and Sustainable Agriculture



Ecological pest management



## LEISA

### Magazine on Low External Input and Sustainable Agriculture December 2007 Volume 23 No. 4

LEISA Magazine is published quarterly by ILEIA

#### Address:

P.O. Box 2067, 3800 CB Amersfoort, the Netherlands

#### Visitors address:

Zuiddingel 16, 3811 HA Amersfoort

Tel: +31 (0)33 467 38 70, Fax: +31 (0)33 463 24 10

E-mail: ileia@ileia.nl

#### Editorial team

This issue has been compiled by: Jorge Chavez-Tafur, Edith van Walsum, Arnoud Braun, Karen Hampson and Wilma Roem.

#### Regional editions

##### LEISA Revista de Agroecología

The Latin American edition in Spanish can be ordered from Asociación ETC Andes, Apartado Postal 18-0745, Lima 18, Peru. Contact: Teresa Gianella-Estremis.

E-mail: base-leisa@etcandes.com.pe

##### LEISA India

The Indian edition in English can be ordered from AME Foundation, 204, 100 Feet Ring Road, 3rd Phase, Banashankari 2nd Block, 3rd stage, Bangalore - 560 085, India. Contact: K.V.S. Prasad.

E-mail: amebang@giabg01.vsnl.net.in

##### SALAM Majalah Pertanian Berkelanjutan

The Indonesian edition in Bahasa Indonesia can be ordered from VECO Indonesia, Jl Letda Kajeng 22, Denpasar 80234, Bali, Indonesia. Contact: Imam Suharto.

E-mail: leisa@indo.net.id

##### AGRIDAPE

The West African edition in French can be ordered from IED Afrique, P.O.Box 5579, Dakar, Senegal.

Contact: Awa Faly Ba. E-mail: agridape@sentoo.sn

##### Agriculturas, Experiências em Agroecologia

The Brazilian edition in Portuguese can be ordered from AS-PTA, Rua Candelária, No. 9, 6º andar Centro, Rio de Janeiro, RJ Brazil 20091-020.

Contact: Paulo Petersen. E-mail: paulo@aspta.org.br

##### 可持续生态农业

The Chinese edition can be ordered from CBIK, 3rd Floor, Building A, Zhonghuandasha, Yanjiadi, Kunming, Yunnan 650034, People's Republic of China. Contact: Ren Jian.

E-mail: renjian@cbik.ac.cn

#### Administration

Lila Felipie, Marlies Marbus and Natasha Leetion.

#### Subscriptions

Subscription rate for one year (4 issues): Northern institutions and international organisations: US\$ 45.00 (Euro 45), others US\$ 25.00 (Euro 25). Local organisations and individuals in the South can receive the magazine free of charge on request. To subscribe, write to ILEIA or send an e-mail to: subscriptions@ileia.nl  
Back issues are available on the ILEIA website or can be requested from ILEIA.

#### ILEIA website

<http://www.ileia.info>

#### Design & layout

Jan Hiensch, Leusden.

#### Printing

Koninklijke BDU Grafisch Bedrijf B.V., Barneveld.

#### Funding

The ILEIA programme is funded by Sida and DGIS.

#### Cover photo

Farmers look for insects in a pheromone trap in a groundnut field. Netharanahalli village, Bellary, Karnataka (India). Photo: S. Jayaraj.

*The editors have taken every care to ensure that the contents of this magazine are as accurate as possible. The authors have ultimate responsibility, however, for the content of individual articles.*

ISSN: 1569-8424



## 8 Enhancing the Push-Pull strategy

David Amudavi, Zeyaur Khan and John Pickett

Push-Pull is a strategy used for managing Striga and stemborers in maize. It has had considerable success in recent years, increasing yields in many farms, while also reducing soil erosion, enhancing biodiversity and improving food security. It has been adopted by 10 000 households in East Africa, disseminated through mass media, field days, shows and demonstrations. This article describes how Farmer Field Schools are increasingly being used to promote this strategy further throughout the region, and how farmers are actively facilitating this approach.

## 26 Integrated pest control for empowering women farmers

Hery Christanto

Faced with dropping rice yields due to stemborers, some women farmers in Kepanjen subdistrict, Java, Indonesia, asked local extension workers and NGOs for advice. This is how the women farmers' group was started. Since then, they have held weekly meetings in their fields, with extension workers, to discuss their farming problems and how to deal with them. The women's group now conducts experiments on pest management, among many other topics. As a result, yields have recovered. At the same time, the members of this group have become confident enough to act as resource persons for other groups.



LEISA is about Low External Input and Sustainable Agriculture. It is about the technical and social options open to farmers who seek to improve productivity and income in an ecologically sound way. LEISA is about the optimal use of local resources and natural processes and, if necessary, the safe and efficient use of external inputs. It is about the empowerment of male and female farmers and the communities who seek to build their future on the basis of their own knowledge, skills, values, culture and institutions. LEISA is also about participatory methodologies to strengthen the capacity of farmers and other actors to improve agriculture and adapt it to changing needs and conditions. LEISA seeks to combine indigenous and scientific knowledge, and to influence policy formulation to create an environment conducive for its further development. LEISA is a concept, an approach and a political message.

ILEIA is the Centre for Information on Low External Input and Sustainable Agriculture. ILEIA seeks to promote the adoption of LEISA through the LEISA magazines and other publications. It also maintains a specialised information database and an informative and interactive website on LEISA ([www.ileia.info](http://www.ileia.info)). The website provides access to many other sources of information on the development of sustainable agriculture.

Readers are welcome to photocopy and circulate articles.

Please acknowledge the LEISA Magazine and send us a copy of your publication.



## 16 Plant clinics for healthy crops

Jeffery Bentley, Eric Boa, Solveig Danielsen and A.K.M. Zakaria

At a plant clinic, any member of the community can get a diagnosis and some advice. A network of such clinics is emerging in countries as diverse as Bolivia, Nicaragua and Bangladesh. The “plant doctors” are local extension workers or farmers; its clients are all those interested in discovering what is wrong with their crops. Drawing on examples from these three countries, this article presents the plant clinic strategy, describes the possibilities it brings and also gives tips on how you could initiate a local plant clinic.

## 18 Rats: An ecologically-based approach for managing a global problem

Steven R. Belmain

Many people have problems with pest rodents. Rats damage our crops and possessions and spread dangerous diseases to people and livestock. While this can be a difficult problem to tackle, experience has shown that with the right knowledge and tools it is possible to sustainably reduce pest rodent populations. A number of research and extension institutions have recently been collaborating with farming communities in Asia and Africa to develop effective rodent management strategies. Here you can read about how communities in Bangladesh have managed to dramatically reduce rat populations, and see the difference it has made.



- 4 Editorial
- 6 **Pest management: The art of mimicking nature**  
Mans Lanting
- 8 **Enhancing the Push-Pull strategy**  
David Amudavi, Zeyaur Khan and John Pickett
- 11 **Ecological pest management for emerging pest problems**  
Bikramjit Sinha, Randhir Singha and Dhruvad Choudhury
- 12 **Traditional ecological management of late blight in potato**  
Shantanu Kumar, Uma Sah and P.H. Singh
- 14 **The theory of trophobiosis in pest and disease control**  
Maria José Guazzelli, Laércio Meirelles, Ricardo Barreto, André Gonçalves, Cristiano Motter and Luís Carlos Rupp
- 16 **Plant clinics for healthy crops**  
Jeffery Bentley, Eric Boa, Solveig Danielsen and A.K.M. Zakaria
- 18 **Rats: An ecologically-based approach for managing a global problem**  
Steven R. Belmain
- 21 **Changing the strategies of Farmer Field Schools in Bangladesh**  
Hein Bijlmakers and Muhammad Ashraful Islam
- 24 **Our experiences with modified Farmer Field Schools in dryland areas**  
Arun Balamatti and Rajendra Hegde
- 26 **Integrated pest control for empowering women farmers**  
Hery Christanto
- 28 **FFSs in translation: Scaling up in name, but not in meaning**  
Marc Schut and Stephen Sherwood
- 30 **Ecofriendly practices assist in controlling coconut mite**  
A. Vakeesan and G. Mikunthan
- 31 **Keeping the brown plant hopper at bay with SRI**  
K.Rajukkannu, P. Ramadass and J. Jecitha
- 32 **Multiple strategies on an organic farm in the Netherlands**  
Hans Peter Reinders
- 35 **Field Note: The advantages of *suve* farming**  
Patrick Mwalukisa
- 36 Sources
- 38 Networking
- 39 New Books
- 40 The ILEIA Documentation programme

## DEAR READERS

This issue looks at one of the most pressing problems which farmers all over the world face: the presence of pests and diseases in their fields. Once again, we received many contributions, and the task of selecting the articles presented here was not an easy one. It has been very interesting to see, however, that so many experiences are taking place, and that so many farmers are benefiting, in terms of yields and incomes, from a LEISA approach to agriculture. Complementing this issue, readers may be interested to look back at older issues of *LEISA Magazine* looking at pest management: please read Vol. 1, No. 6, (“Pest management: Do small farmers have effective alternatives to chemical pesticides”) and Vol. 13, No. 4 (“Fighting back with IPM”). Both are available on our website, as PDF and as HTML files.

Readers, particularly those who have received the green form with this issue, are also reminded to renew their subscriptions. It is important for us to know that you are receiving the magazine, and that you want to receive forthcoming issues. This can easily be done on our website. You are also welcome to send us an SMS with your name and subscription number, to +31 6 156 60959. Your subscription will be automatically renewed. Please also invite your friends or colleagues to subscribe – on the website, by returning the pink subscription form to us, or by sending us an SMS with a postal address.



# Rats: An ecologically-based approach for managing a global problem

Steven R. Belmain

Many people have problems with pest rodents. Rats eat our crops, contaminate our stored food, damage our buildings and possessions and spread dangerous diseases to people and livestock. Compared to insect pests, controlling rats and mice can seem difficult. Experience has shown, however, that armed with the right knowledge and tools it is possible to sustainably reduce pest rodent populations in a cost-beneficial way. In recent years, applied research on ecologically-based rodent management (EBRM) has taken place in many countries throughout Asia and Africa, involving a number of research and extension institutions working together in collaboration with farming communities to develop effective, sustainable and cost-beneficial rodent

Another common problem when dealing with rats is that there is often no clearly expressed demand for rodent control. Many rodent problems are not well understood by villagers, and the traditional methods of managing rodents are rarely adequate, so that villagers often just accept the situation. So, one of the big problems in developing better rodent management strategies is to understand their true impact on people's livelihoods. Providing people with the true cost of rodents on their livelihoods allows them to consider how much they can invest (traps, poisons, labour) in controlling rodents. Providing communities with appropriate management tools and knowledge about the rodent pests affecting their livelihoods, allows them to successfully manage their rodent pest problems in a cost-beneficial way.



Photo: Author

**The dangers of rat infestations are not always recognised – nor is the presence of rats effectively dealt with. Urine and faeces frequently contaminate stored food.**

management strategies. This article draws on the knowledge generated from these research and extension experiences, focusing on work carried out in the villages of Jakunipara, Sowara, Sahapur and Anandapur, all of them in Comilla, Bangladesh. We worked in partnership with the NGO Association for Integrated Development, Comilla, and with scientists from the Bangladesh Rice Research Institute, Australia's CSIRO and the U.K.'s Natural Resources Institute.

## Identifying the problem

Like many countries, Bangladesh has a poorly documented problem with rats. Facts on crop yield losses caused by rats are hard to come by. Prevalence of rodent-borne diseases, such as leptospirosis or typhus, is unknown. And information regarding the impact of rodents on stored food through losses and contamination is simply not collected. What we do know is that almost any agricultural crop is attacked by rodents, and they are known carriers of more than 60 life-threatening diseases. Reducing crop damage by rodents not only improves food security and nutrition, but can lead to increased income. Reducing post-harvest loss and food contamination by rats improves health and nutrition, as well as lowering disease transmission.

## Ecologically-based rodent management in practice

There was much anecdotal evidence of rodent pest problems in Comilla, but there was a need to show the actual impact of rats on people's livelihoods. Research activities showed that 5 to 10 percent of stored paddy rice was lost to rodents over each 3 month storage period, with each farming household losing an approximate of 200 kg per year. In common with most of Asia, most Bangladesh farmers stated they plant about 2 rows of rice for the rats for every 8 rows sown. Our assessments showed pre-harvest losses from rats ranged from 5 - 17 percent in irrigated and rain-fed rice fields. Farmer damage assessments highlighted some of the more overlooked impacts of rodents, namely physical damage to houses, personal possessions, roads and fields.

Through surveys and questionnaires with farmers and community members, we were able to assess the effectiveness of existing rodent management actions carried out by farmers and households. In common with most countries, Bangladesh farmers had access to some rodent control tools and methods. However, because they were not used properly, or were not well-adapted to local situations, they were often not very effective. This led to apathy and widespread acceptance of rodent pests in the environment. Rodenticides are frequently used to control rodents. Misuse of these poisons is unfortunately common. More importantly, when a rodenticide is not used correctly, it may not significantly reduce the rodent population. Other rodent management methods involving trapping and environmental management can be more appropriate for the rural and peri-urban situations found in developing countries. Adopting an ecologically-based rodent management strategy is increasingly seen as more sustainable, both economically and environmentally, than the traditional use of acute poisons.

### *Step one: Know your enemy*

As with any IPM strategy, the main principle is to "know your enemy". Not all rodent species are the same; each species has different breeding rates, habitats and species-specific behaviours. These factors will affect their pest status and the methods of control. For example, some rats like to live up high in trees or the roofs of people's houses, while others like to burrow in the ground or the walls of mud-brick houses. Knowing where rats live is important when targeting control actions.

Rodents are also highly adaptable, and the same species may exploit different foods or habitats when found in different

environments. Once armed with the basic knowledge about the rodents, where and when they cause damage and the types and extent of damage caused to different crops, stored food and health, it becomes possible to address all the problems rats cause in an integrated way. This information improves peoples' understanding of the costs of doing nothing about rats on their livelihoods and allows an assessment of potential cost-benefits when developing a management strategy.

*Step two: Know your end user*

In addition to understanding the local rodent biology and ecology, EBRM must also consider the knowledge, attitudes and practices of the people affected. Effective rodent control practice must be based on the financial and time constraints of the people suffering from rodent pest problems. Rodent-human interactions can be complex, with rats seen as food, pests, and even involved in witchcraft or religious beliefs. Understanding existing practices and knowledge helps in the design of a strategy that will be locally acceptable and sustainable.

For example, few small-scale farmers understand the difference between acute and chronic rodent poisons, and will often choose acute poisons as they see dead bodies in the morning, which they rarely see when using chronic poisons. However, chronic poisons can work well and effectively reduce pest populations, but the effects are not so clearly seen as the poisoned rodents die in their burrows.

*Step three: Know your technology*

The use of rodenticides which work by interfering with blood clotting remains a powerful tool, particularly in urban environments and for large-scale agriculture. However, their financial and environmental sustainability is questionable for the majority of situations found in rural and peri-urban communities engaged in small-scale agriculture.

Because rats are mobile, moving over large distances in their daily foraging, the main principle of ecologically-based management is that farming communities must act together. Individuals acting on their own in their house or crop field will have little impact on the overall rodent population, with rats quickly migrating back into areas from where they have been removed. This implies that communities must coordinate and communicate effectively over a large scale, and it is important to encourage high levels of community cohesion for EBRM to be successful. This can be a challenge, particularly in more peri-urban situations. The cost-benefits of working together

for rodent management means that individual investment costs are low, as the overall effort is shared by many. EBRM must therefore be a community-based effort.

Reducing the rat population through intensive trapping is labour intensive, but requires a smaller financial investment compared to the continual purchase of rat poisons (as traps can last for many years). Nearly everyone is familiar with the principles of rat trapping, and often several indigenous trap designs can be found locally. However, not all traps are the same, with some designs working far more effectively than others. Good quality traps may not be locally available, and this may need to be addressed at market and policy levels to rectify. The main principle of intensive trapping is to remove rats from the population faster than their breeding rate. Because rats breed very quickly, this means that intensive trapping must continue on a daily basis over a long period of time, with traps spread over a sufficiently large area.

Our activities in Bangladesh showed that we could dramatically reduce the rat population by more than 80 percent. This was largely achieved by communities managing a system of daily rat trapping throughout their village with about 50 percent of households trapping daily with one or two high quality kill traps. The position of the traps would rotate around the village so that every household would be involved. With continual daily trapping, the rat population crashed after 2 months and remained low as long as daily trapping continued across the village.

Another trapping technology that has been developed and used effectively in small-scale agriculture is called a Trap Barrier System. This works by enclosing a "lure" crop within a rodent proof fence that attracts foraging rodents. Multiple capture live traps are placed within the fence so that rodents are drawn to the lure crop and become trapped when trying to get near the food. Many rodents from the surrounding crop fields are attracted, effectively clearing a large area free from rodent pests, with many farmers benefiting from a single trap barrier system. Certain criteria must be fulfilled for this system to work effectively: crops must be grown at more or less the same time in adjacent farmer fields so that an early ripening lure crop can be planted within the trap barrier system. The farming community must act together to spread the investment costs of constructing and managing the system.

Rat populations can also be reduced by permanently changing the environment and the availability of food, water and nesting places that rats need to survive. These actions are commonly referred to as environmental management. They can be particularly effective when aiming to stop rodents sheltering near to human living areas, and eating stored food and water meant for immediate human consumption. For example, this may involve rodent proofing on-farm grain stores, or ensuring that locally stored water is adequately covered to prevent rodents eating, drinking and contaminating food and water with their urine and faeces. Many diseases carried by rodents occur through contamination of food and water, so environmental management must be accompanied by local education programmes to raise awareness about the risks of rodent diseases. Environmental management can also involve activities that reduce places that rodents can eat and live around villages, e.g. by ensuring that rubbish is cleared away, and removing rubble or vegetation far away from human living areas. Good sanitation can really make a major difference in the number of rodents living close to people, reducing rodent impacts on livelihoods.



Photo: Author

**A group meeting in Jakunipara: farmers tell what they know about rats and decide together what to do to control them.**





Photo: Author

Finally, in addition to population reduction and environmental management, there are actions that reduce people's exposure to rats without, perhaps, doing much about the rat population itself. Removing contact and exposure to rodents and the diseases they carry can be achieved by the actions described above, but also by encouraging and educating communities about basic hygiene, such as frequent handwashing with soap. For example, in many communities rats are hunted and eaten as an important food resource. Considering the many dangerous diseases carried by rats, the way they are butchered and cooked can have major negative implications on human health. It would be foolish to discourage people from eating rats where protein sources are scarce, but improving hygiene standards to make rats safer to consume can be achieved through demonstration and education.

#### **Monitoring the costs and benefits of EBRM**

The initial stages of implementing EBRM are often challenged with a lack of interest and doubt in local farming communities. This is because small-scale farmers who have tried to control rodent pests usually see very little benefit, often because their actions are ad-hoc, one-off, and unco-ordinated. And as is generally the case with any pest management, such actions are too little, and come too late. Farmers can, therefore, take some convincing that rodent pests can be cost-effectively controlled. And as communities have rarely experienced what life can be like in the absence of rodents, the true impact of rodents on their lives is usually grossly underestimated. A final challenge in implementing EBRM is encouraging communities to assess success by looking at the changes in their lives, and not only at the number of dead rodents they have collected. These challenges favour education and extension programmes that strongly focus on demonstration and community participation.

Our work with EBRM in Bangladesh showed a reduction in the impact of rodents by 60 – 80 percent for different measurable indicators. This was established through comparing intervention villages with non-intervention villages. Similarly, farmer assessments showed that these strategies cost about the same (in terms of money and time) as the former practices, but with

**Not all pest species are the same. Knowing your enemy is the first step of a successful pest management approach.**

a much higher benefit. As a result, the 3-step approach is now being extended widely through southern Africa via the Ecorat project (<http://www.nri.org/ecorat>). Once basic information is collected about the rats, end users and management tools, EBRM can be developed for a variety of local agro-ecological contexts. Once a few communities see the difference this type of management makes to their lives, up-scaling and dissemination to other nearby communities can occur through traditional extension channels. Rodent pests have been a largely neglected problem in the developing world, but an ecologically-based approach can triumph where poisons alone have failed, particularly when communities work together to overcome the multiple impacts of rodents on their lives. ■

**Steven R. Belmain.** Natural Resources Institute, University of Greenwich, Central Avenue, Chatham Maritime, Kent ME4 4TB, United Kingdom. E-mail: [s.r.belmain@gre.ac.uk](mailto:s.r.belmain@gre.ac.uk)

#### **References**

- ACIAR, 2001. **Non-chemical control of rodents in lowland irrigated rice crops: Using the trap barrier system.** ACIAR Research Note 26. Australian Centre for International Agricultural Research, Canberra, Australia.
- Aplin, K.A., P.R. Brown, J. Jacob, C.J. Krebs and R. Grant Singleton, 2003. **Field methods for rodent studies in Asia and the Indo-Pacific.** ACIAR Monograph 100; ACIAR, Canberra, Australia.
- Belmain, S.R., A.N. Meyer, L. Penicela and R. Xavier, 2002. **Population management of rodent pests through intensive trapping inside rural households in Mozambique.** In: Fourth International Conference on Urban Pests, Charleston, South Carolina, U.S.A.
- Gratz, N.G., 1997. **The burden of rodent borne diseases in Africa south of the Sahara.** *Belgian Journal of Zoology*, 127 (supplement 1): 71-84.
- Singleton, G.R., L.A. Hinds, H. Leirs, and Z. Zhang (eds.), 1999. **Ecologically-based rodent management.** Australian Centre for International Agricultural Research, Canberra, Australia.
- Von Maltitz E.F., F. Kirsten, P.S. Malebana, S.R. Belmain, E. Sandmann, E.J. Lundall-Magnuson, M. Mosala, R. Randela, K.F. Hlangweni, M.R. Mavasa, T.V. Mugogovhali, T.P. Nyamande, R.R. Ramugondo, T.E. Stathers and U.K. Kleih, 2003. **Developing a rodent management strategy for South Africa.** In: Singleton, G.R., L.A. Hinds, C.J. Krebs, and D.M. Spratt (eds.), *Rats, mice and people: rodent biology and management.* ACIAR Monograph Series, Australian Centre for International Agricultural Research, Canberra, Australia.