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Can media campaign messages influence change towards ecologically based rodent management?

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Abstract

Context. In Asia, losses to rodents contribute to the undernourishment of smallholder families. Ecologically based rodent management (EBRM) has become the national policy for rodent management in rice-based agriculture in Indonesia, the Philippines and Vietnam. EBRM requires community action. Therefore we need to develop **communication campaigns that increase community involvement in rodent management**.

Aims. This study evaluates the effects of a campaign to promote EBRM in a community that suffers chronic rodent losses to their rice crop. We hypothesised that the campaign would create changes in rodent management by farmers based on key messages delivered.

Methods. We documented existing beliefs and management practices, and captured changes in knowledge, attitudes and behaviour of smallholder farmers after the campaign. We also document benefits to the community. We used qualitative tools to evaluate existing beliefs and management practices of rodents in nine villages in Zaragosa, one of which was a focus village for the campaign.

Key results. Farmers who were influenced by the campaign had significantly higher mean rank scores in knowledge and attitudes pertaining to key messages of the campaign, such as working together, proper timing of management actions, and that rodents can be controlled. Farmers who heard the campaign obtained yields that were higher by 0.7 t ha⁻¹ compared with those with no exposure to the campaign. A year after the campaign, the increase in rice yield in Zaragosa was sufficient to feed 1375 adult Filipinos for a year. The campaign influenced policy on rodent management in Zaragosa and subsequently at the provincial level.

Conclusions. **A media campaign with support from local leaders and extension staff is an effective way to disseminate EBRM, leading to positive economic benefits for smallholder farmers. A media campaign alone is less effective.**

Implications. **A communication campaign on EBRM with follow-up support from extension experts is a highly effective pathway for changing attitudes and practices of smallholder farmers on rodent management, and for effective dissemination of EBRM.**

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Introduction

Studies in communications in the 1980s found media campaigns in agriculture, health and politics had minimal effects in changing the behaviour of people (McGuire 1986; Iyengar and Simon 2000; Haug 2003). This was a controversial idea in that decade, which followed the largely campaign-oriented agrochemical era of the 1960s and 1970s (Heong *et al.* 1998; Escalada *et al.* 1999). In the 1960s and 70s increased rice production through promotion of chemical control was common and national campaigns on rodent management recommended pesticides (Navarete 1978; Hoque and Sanchez 2008). Whether it is an effect of the idea that campaigns do not work or a general lack of investment in research and extension on rodent management, activities to promote effective rodent management were minimal in the 1990s both in the Philippines (Singleton *et al.* 2008) and elsewhere in South-east Asia (Singleton 2003).

Advances in media and social science studies have countered the pessimistic claim of the 1980s; better methodological tools provided clear evidence of substantial effects of media campaigns (Adhikarya 1994; Snyder and Hamilton 2002; Haug 2003). Campaigns implemented in the political, health and agriculture arenas were successful (Heong *et al.* 1998; Escalada *et al.* 1999; Haug 2003; Seidel 2005). The Food and Agriculture Organisation (FAO) documented its experiences with media campaigns on rodent management in Bangladesh and Malaysia; both national campaigns achieved their objectives (Adhikarya 1994).

In 1997, ecologically based rodent management (EBRM) was formally described (Singleton 1997). This approach takes into account the ecology and behaviour of pest species and applies different actions at key times of the cropping calendar to keep rat populations at tolerable levels and reduce crop losses (Singleton *et al.* 1999, 2008). In 2000, research began on rodent

ecology and management in the Philippines, and led to the promotion of EBRM in 2006–2007 at a pilot site in Zaragosa, a municipality in Nueva Ecija province in Central Luzon (Palis *et al.* 2008; Zagado 2008). The *Boo! Boo! Rat! Campaign* was a strategic extension campaign to introduce EBRM in a community with chronic rodent infestation, with the goal of keeping their rice safe from rodent damage. This campaign provided an opportunity to test whether a strategic extension campaign can be an effective way to introduce EBRM. **The campaign slogan, *Boo! Boo! Rat! Palay Mo'y Ligtas 24 Oras*, suggested by farmers, means they should control the rats so that their rice crop would be safe all the time (24-hours per day).** The word 'boo boo' is a local term for an implement used in trapping freshwater fish. A wide array of promotional materials was developed in conjunction with outreach activities by local extension staff. **The most effective pathways were personal interaction with those who champion EBRM, high-profile activities including a campaign launch and TV coverage, activities implemented for at least one cropping season, and highly visible print media (Flor and Singleton 2010).**

EBRM has been disseminated in many countries including Vietnam, Indonesia, Bangladesh, Laos and the Philippines. Although EBRM has been linked effectively with national initiatives in agricultural pest management (see Huan *et al.* 2010; Sudarmaji *et al.* 2010), the literature on media campaigns used for wider dissemination is limited (Palis *et al.* 2008; Zagado 2008). No studies have evaluated if such campaigns can effect change in practices on rodent management towards the adoption of an ecologically based approach. We address this knowledge gap by presenting the results of a post-campaign evaluation of the *Boo! Boo! Rat! Campaign*. Our objectives are as follows: (1) to outline the beliefs of the rural community on rodents and common management practices in Zaragosa to set the scene as baseline characterisation on what changes were measured; (2) to evaluate whether there are changes in the knowledge, attitudes and practices of farmers after the campaign; and (3) to quantify some of the economic and social benefits of the campaign.

Methods

Key messages and dissemination of EBRM through a community campaign

The community EBRM campaign began in 2006 in the village of Santa Lucia Young, in Zaragosa. The actions emphasised in the campaign were developed through participatory decision making by the community and researchers based on a combination of local knowledge of where rodents occur in the agricultural landscape at specific times of year, and specialist ecological knowledge of the pest species of rodents (see Duque *et al.* 2008). The campaign had three simple EBRM messages: the need for the community to conduct actions in concert; the right timing and location of the actions; and the integration of affordable methods of rodent control. Village officials actively supported the activities to demonstrate effective actions and sanctioned the establishment of a rat task force. After one rice cropping season, an extensive communication drive disseminated EBRM messages through promotional materials (posters, banners, leaflets, a radio jingle, streamers, t-shirts, bookmarks,

and a television feature aired nationwide) and visits of extension professionals to other villages in the municipality of Zaragosa. Other activities that raised awareness included visits to schools to promote EBRM, and a children's pageant where the contestants were judged on the number of rat tails collected by family and friends. The campaign concluded in August 2007 (see Zagado 2008; for details). Flor and Singleton (2010) provide an overview on the communication pathways, actors and institutions associated with the dissemination of this information.

Location

The study was conducted in Zaragosa municipality (15°27'11"N, 120°47'28"E) in central Luzon, the Philippines, in 2008, a year after the completion of the intensive communication campaign. The climate is tropical with about 93% of the annual rainfall (1895 mm) occurring during the monsoon season (May–November) (Monsalud *et al.* 2003). The agriculture is an intensive monoculture of lowland irrigated rice. Farmers grow two rice crops a year: a monsoon crop and a dry season crop, on a mean farm size of 2 ha (range 0.5–7.5 ha).

Framework of the post-campaign study

We consider the rodent media campaign an intervention that may provide complimentary or opposing messages to existing knowledge, beliefs and practices. Based on key campaign messages, farmers were encouraged to shift from individual control to community actions, reactive management to proactive management, and using single methods to integrating different control methods. To evaluate whether the campaign achieved these targeted changes, we conducted a survey of the usual management practices and beliefs that influenced the actions of smallholder farmers. The methods of rodent management promoted were community action, hunting, and a community trap–barrier system (CTBS). A CTBS is a small trap-and-fence system managed by a group of farmers to provide a halo effect of protection against rats. A plastic fence with traps is used to surround the rice crop (20 × 20 m) planted 2–3 weeks earlier than the rest of the crop (see Singleton *et al.* 1998). These recommended methods are based on EBRM messages for effective management after understanding the biology, behaviour and breeding ecology of rat species in the area (Duque *et al.* 2008).

This framework is adapted from the model of Parvanta *et al.* (2007) on behaviour change following health intervention programs. We also used the theoretical lens of the Stages of Change Theory (Prochaska *et al.* 1992) to examine the differences in outcomes evident in the different villages within Zaragosa. We focussed primarily on how changes in the knowledge, attitudes and practices (KAP) of the smallholder farmers on EBRM adoption progressed after they had been exposed to campaign messages in different ways.

Qualitative and quantitative surveys

It is important to lay out existing beliefs and predispositions as a starting point in campaign evaluation because these beliefs have significant effects on behavioural responses (Graves 2002). A qualitative evaluation was conducted in August 2008

to ascertain how the campaign was implemented and whether it had an impact. Interviews and group discussions with campaign coordinators, local officials and farmer groups were done in eight randomly chosen villages (out of 19 villages in Zaragosa), as well as in the intensive campaign village of Santa Lucia Young. About 10 participants were present (range of 8–15 participants) in each group meeting.

A quantitative household survey was conducted in September 2008 of 86 respondents from the same nine villages. Each respondent was asked specific questions designed to detect whether there had been significant changes in their KAP for rodent management. *Ex post* data on knowledge and attitudes were obtained through Likert scale questions (5-point Likert scale) and analysed using the Kruskal Wallis test. Other comparisons were analysed using a Pearson Chi-square test (χ^2), paired t-tests or ANOVA. Respondents recalled control methods employed before 2006 (pre-campaign) and those they were using in 2008 (post-campaign). Data on farm characteristics and yields of rice crops pre- and post-campaign also were collected. Given the importance of rice in the livelihood of these smallholder farmers, it was reasonable to expect them to recall information such as farm size and total production of three seasons over the 1.5-year duration (Adebamowo *et al.* 2002; Khan and Kraemer 2008). Farmers' production per plot was standardised to yields per ha.

For the analysis, respondents were randomly grouped based on whether they had 'heard' or 'not heard' the campaign. As influenced by the Stages of Change Theory (Prochaska *et al.* 1992), comparisons were made based on four categories of

intervention elicited during the focus group discussions: (i) intensive campaign – farmers had consultations with rodent experts, follow-up visits by extension staff, demonstrations of the recommended methods and exposure to the promotional materials (on television, radio and print); (ii) media and consultations with extension staff – farmers were exposed to the promotional materials and had follow-up meetings where extension staff explained to farmers about rodent management; (iii) media only – farmers were exposed to the promotional materials but no follow-up activities were conducted in the area, and, (iv) no facilitated intervention – farmers indicated they were not aware of the campaign and they did not receive information on rodent management; although some in a village may have been exposed to the promotional materials. Villages that are under (ii), (iii) and (iv) are categorised to have had non-intensive interventions.

Results

Beliefs on rodents and management practices in Zaragosa

In the focus group discussions, farmers mentioned different beliefs about rats and how rodent pests should be managed (Table 1). The control methods were activities undertaken by themselves or other farmers in Zaragosa. In explaining why they choose a specific action, some of them made connections to beliefs. One farmer did nothing for fear his action will anger more rats, one just prayed or talked with rats because they could not be controlled, and one placed wire attached to main power (220 volts) around his crop to electrocute rats because he believed rats

Table 1. A collation of the beliefs and control methods of smallholder farmers in Zaragosa relating to rodents in their villages and rice crops

Belief statements	English translation
Local language	
" <i>Andyan lang yang mga daga</i> "	Rats exist in the surroundings
" <i>Magaling magtago</i> "	Good at hiding
" <i>Dala ng baha</i> "	They are brought (to the community) by flood
" <i>Ma-utak</i> "	Cunning
" <i>Nakakarinig yan 'pag pinagusapan</i> "	They hear when they are talked about
" <i>Naninira, di naman kinakain</i> "	Destructive, even if they will not eat (the plant)
" <i>Marami</i> ", " <i>nagsasama-sama</i> "	There are many of them, they go in groups
" <i>Di ma-sugpo kasi marami sila at ma-utak</i> "	Cannot be controlled because of their numbers and cunning
" <i>Kung galitin mas tatapang at manira</i> "	If angered they will be more fierce and damaging
" <i>Parte-parteng lang 'yan. . .kumakain din sila</i> "	We just share (with the rats). . .they also eat
" <i>Ipaubaya na lang sa itaas</i> "/" <i>bahala na ang tadhana</i> "/" <i>ipagdasal na lang</i> "	Leave it up to heaven/let fate take care of it/pray about it
Actions for rodent management	
Use rodenticide (zinc phosphide)	
Day hunting (e.g. flooding burrows)	
Night hunting	
Community action	
Talk with rats to dissuade them from eating all of their rice	
Clean-up/maintain hygiene	
Synchronous activities at the farm level	
Synchronised baiting	
Erect a barrier (mesh or plastic) around the seedbed	
Put live-wire (220 volts) around their crop (electrocution)	
Spread motor oil mixed with poison on flooded rice	
Do nothing	

came in high numbers from a certain section of the village during the peak of the monsoon season.

Changes in knowledge, attitude and behaviour

Respondents did not differ in their knowledge on rodent management in seven out of nine questions. However, on questions relating to increasing rice yields by controlling rats and whether rats can be successfully controlled, those who heard the campaign messages had significantly higher mean rank scores (Kruskal Wallis test $P < 0.05$; Table 2).

The attitudes of the farmers did not differ based solely on whether they had heard the campaign (Table 2). However, for three messages out of seven given as Likert scale attitude questions, those in the intensive campaign village (where 96% of the farmers had heard of the campaign) had significantly higher mean rank scores (Kruskal Wallis test $P < 0.05$; Table 2). **In the intensive campaign village, farmers gave more importance to: (i) increasing yields of rice by controlling rats; (ii) working with other farmers; and (iii) implementing control from land preparation through to the early tillering stage of the rice crop.**

Farmers who had 'heard' about EBRM practiced a greater degree of integration of two or more control methods than those who had not heard of EBRM ($\chi^2_1 = 5.64$, $P < 0.05$). Similarly, farmers who had 'heard' of EBRM applied rodent control together with other farmers more than those who had not heard of EBRM ($\chi^2_1 = 4.21$, $P < 0.05$). However, early timing of control activities did not differ significantly between those who had heard or had not heard about EBRM.

Farmers identified the CTBS as the only management method new to them. A willingness to adopt this new technology was significantly higher (49%) in the intensive campaign village where a CTBS program was established; the media coverage of the technique also influenced farmers (Fig. 1a).

In the intensive campaign village, the number of farmers who used the recommended methods remained the same or increased (Fig. 1a). One evident change was that there were more farmers who participated in community action as part of their management practice after the campaign. The use of ineffective or harmful control methods was eliminated, such as talking to the rats, and electrocution.

The changes in practices were not as pronounced in both the media-plus-consultation and media-only intervention groups (Fig. 1b, c). While there were some increase in community

action and hunting, ineffective methods were not eliminated. Where there was no facilitated intervention, there was a reduction in the percent of farmers employing effective methods (Fig. 1d).

The increased coordination of control actions is not only evident between those who had heard or had not heard or EBRM, but is also clear in comparisons between interventions. Of farmers from the intensive campaign village, 96% worked together with other farmers on rodent management rather than individually (Table 3). Fewer farmers from villages with non-intensive interventions coordinated their actions.

Observed benefits of the campaign

The most significant benefit mentioned by 60% of respondents was increased community participation with people of different ages becoming more active in management activities of rodents. These community actions promoted 'unity and closeness' in the community. Respondents indicated that after learning better ways to manage rats, farmers found fewer rats in the fields and less damage. Furthermore, farmers in the campaign villages said they now only use rodenticides when necessary. This was validated by the local government technician: after the campaign (2007–2008 dry season; DS), there were no requests for rodenticides from the intensive campaign village.

Those who had heard of the EBRM campaign had higher mean yields of rice by 0.7 t ha^{-1} in the 2007–2008 DS ($t = 2.2$, $P < 0.05$, d.f. = 81) (Table 4). There was no significant difference in yield between the treatment groups in the seasons prior to the campaign.

Those influenced by the campaign, had a 9% higher mean rice yield in the 2007–2008 DS (mean = 6.0 t ha^{-1} , $n = 42$) than in the 2006–2007 DS (mean = 5.5 t ha^{-1} , $n = 42$) (Table 4). This is a 0.5 t ha^{-1} increase for their DS rice crop yield ($t = 1.7$, $P < 0.10$, d.f. = 41).

Mean rice yields were higher in the 2007–2008 DS where there was intensive campaign activity (mean = 6.4 t ha^{-1} , $n = 24$) compared with where activities were not intensive (mean = 5.3 , $n = 62$) ($t = 3.2$, $P < 0.001$, d.f. = 84). There is no significant difference in the 2006–2007 DS ($t = 1.5$, $P > 0.1$, d.f. = 82) (Table 5).

Mean rice yields did not differ significantly between seasons for any of the interventions ($F = 0.34$, d.f. = 3, 82; Table 5). However, there are significant differences in means between interventions in the 2007–08 DS. The Bonferroni test confirmed similar mean yields for the following groupings:

Table 2. Difference in mean rank scores for key knowledge and attitude questions between smallholder farmers who had heard or not heard the media campaign, and between intervention types

	Heard media campaign				Intervention type			
	Yes ($n = 43$)	No ($n = 43$)	Diff.	p	Intensive ($n = 24$)	Non-intensive ($n = 62$)	Diff.	p
Knowledge								
Yield can be increased by controlling rats	46.5	40.5	6	0.049	48.5	41.6	6.9	0.038
Rats can be controlled	48.1	38.9	9.2	0.031	49.6	41.2	8.4	0.080
Attitude								
Importance of increasing yields by controlling rats	45.6	41.4	4.2	0.160	48.5	41.6	6.9	0.038
Importance of working with other farmers	44.1	42.9	1.2	0.730	50.0	41	9.0	0.016
Need for control from land preparation to early tillering stage	44.7	42.2	2.5	0.550	50.6	40.8	9.8	0.041

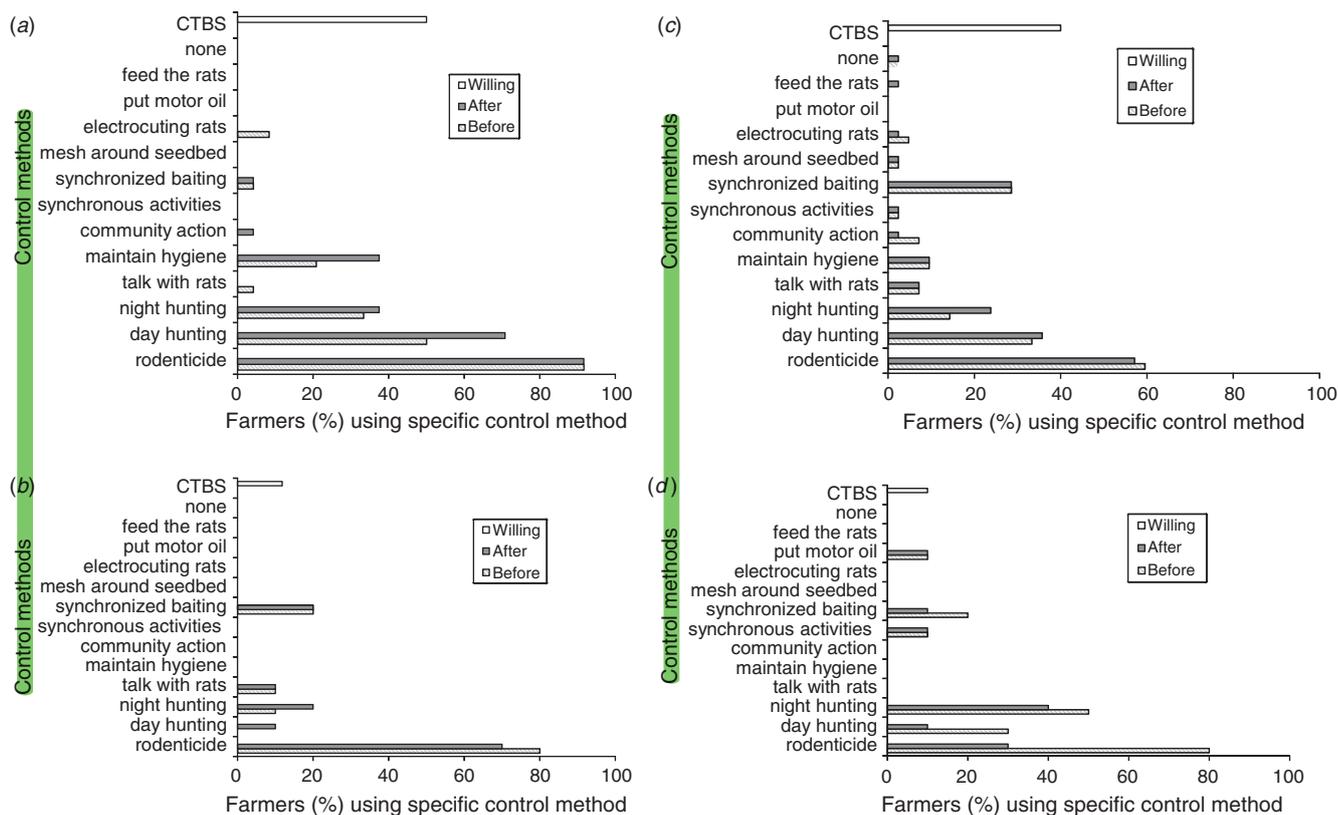


Fig. 1. Farmers (%) using specific control method before and after the campaign and willing to use CTBS in: (a) the intensive campaign village; (b) villages with media and consultation; (c) villages with media only; and (d) villages with no facilitated interventions.

Table 3. Percentage of farmers who implemented individual actions and group actions or mixed individual and group by intervention type *n* = sample size

Intervention type	<i>n</i>	Individual actions (%)	Group actions or both individual and group actions (%)
Intensive	24	4	96
Media + consultations	10	50	50
Media only	41	44	56
None	10	40	60

Table 4. Mean rice yields ($t\ ha^{-1} \pm 1$ standard error) of respondents who have heard or not heard of ecologically based rodent management DS = dry season, WS = wet season, *n* = sample size

Year and season	Heard campaign			<i>p</i>	
	Yes	<i>n</i>	No		
2006–07 DS	5.5 ± 0.30	42	5.1 ± 0.29	42	0.330
2007 WS	4.2 ± 0.19	41	3.7 ± 0.24	30	0.142
2007–08 DS	6.0 ± 0.22	43	5.3 ± 0.25	42	0.033

‘intensive’ and ‘media plus consultations’ (^A in Table 5), ‘media plus consultations’ and ‘media only’ (^B in Table 5) and ‘media only’ and ‘none’ (^C in Table 5); but mean rice yields among the three groups (A, B and C) were significantly different.

Table 5. Mean rice yields ($t\ ha^{-1} \pm 1$ standard error) of respondents by intervention

DS = dry season, WS = wet season, *n* = sample size; Bonferroni test: means with A or B or C are similar to each other but A, B, and C groupings are significantly different from each other

Year and season	Intervention	Mean yield ($t\ ha^{-1}$)	<i>n</i>
2006–07 DS	intensive	5.8 ± 0.45	24
	media + consultation	6.0 ± 0.41	10
	media only	4.9 ± 0.30	41
	None	5.0 ± 0.33	9
2007 WS	intensive	4.0 ± 0.26	22
	media + consultation	4.7 ± 0.38	10
	media only	3.7 ± 0.23	29
	None	4.1 ± 0.40	10
2007–08 DS	intensive	6.4 ^A ± 0.27	24
	media + consultation	6.4 ^{A,B} ± 0.52	10
	media only	5.2 ^{B,C} ± 0.22	42
	None	4.7 ^C ± 0.32	9

Discussion

The EBRM campaign was successful in assisting farmers to reduce rodent damage and thence increase yields. Those farmers who were influenced by the campaign (heard) had a 13% ($0.7\ t\ ha^{-1}$) higher mean rice yield compared with those who did not hear about EBRM. Also, those who heard obtained a mean increase of 10% ($0.5\ t\ ha^{-1}$) comparing yields before

and after the campaign. The total rice area cultivated by these 'adopters' in the Zaragosa municipality was 440 ha. In 2009, the mean consumption of white rice by Filipinos was 1146 kcal person⁻¹ day⁻¹ (FAO 2010). In terms of paddy rice, the annual consumption is estimated to be 160 kg person⁻¹ (F. Malabanan, coordinator of the Philippines national rice program, pers. comm.). Therefore the increase in rice yield in Zaragosa was sufficient to feed 1375 adult Filipinos for a year. Just as impressive is that these yields were maintained a year after the completion of the *Boo! Boo! Rat Campaign*.

Strategic extension campaigns, such as the *Boo! Boo! Rat Campaign*, need to have approaches and messages tailored from a participatory process (Adhikarya 1994; Seidel 2005; Zagado 2008). In Zaragosa, the campaign took into account the specific needs of farmers, and emphasised messages that complemented or countered the existing beliefs and practices. The campaign targeted changes in knowledge and behaviour in three key areas: integrating different control methods; optimising when and where to conduct rodent management; and encouraging communities to coordinate their management actions closely. These countered commonly held beliefs that given the nature and intelligence of rats, farmers can only passively manage these pests; a belief system that often leads farmers to do nothing or employ ineffective actions. Such beliefs occur not only in the Philippines but also elsewhere in Southeast Asia (see Singleton 2003; Baco *et al.* 2010). The qualitative focus group interviews and quantitative household surveys provided the tools to explore these beliefs. The statements provided by different sectors of the rural community were identified as beliefs based on what theorists defined to be four salient characteristics of beliefs: usually taken for granted or immutable; may have alternative or ideal situations; has affective or evaluative loading; and may be rooted in experience (Nespor 1987; Guise 2009).

After the campaign, farmers who had heard or had not heard about EBRM had similar levels of knowledge on rats and rodent management; as evidenced in comments from farmers that what the campaign taught was not new to them. Farmers maintain hygiene, hunt rats and use rodenticide control, although these are done reactively when rat numbers are high. Also, there are some farmers who do not implement control actions (see Table 1). There were three essential points that differed between those who heard and those who had not heard the campaign: that rats can be controlled; people need to coordinate their actions (community approach); and yields can be increased if rats are managed successfully. These points are important for self efficacy or the belief of an individual farmer that he or she can implement successful control. This is a positive outcome of the campaign because the adoption of behaviour is often affected by perceptions of self-efficacy (Coffman 2002). Importantly, this knowledge countered beliefs that rats are too cunning or there are too many to be controlled successfully. The clear conflict of introduced knowledge and existing knowledge creates a dissonance that encourages farmers to evaluate and resolve the issue (Escalada *et al.* 1999). If there is a perceived ability to succeed, which is influential for adopting new behaviours (Flynn and Goldsmith 1999), or if those who heard the campaign learned that it can actually be done, farmers gain the confidence to adopt and validate EBRM. For farmers to realise they have a basket of management options, and they can use specific control methods

when necessary, indicates a striking change in decision making, contrasting markedly from previous norms of rodent control, such as blanket applications of rodenticides and passive pest management. Similar changes in management decisions by farmers on rodent management following their involvement in community-based management programs have been reported in Laos (Brown and Khamphoukeo 2010) and Myanmar (Brown *et al.* 2008).

According to Rogers (2003), the innovation–decision process starts with knowledge or ideas about an innovation, its functions and its benefits. The next step is for actors to form a positive attitude towards the innovation, then to undertake activities leading to adoption or rejection of the innovation. Implementation or use of the innovation is then followed by seeking reinforcement or confirmation regarding the decision to adopt. In relation to this, attitudes are commonly measured in campaign evaluations because they are highly correlated with behaviour (Ajzen and Fishbein 1980; Fazio and Williams 1986). In Zaragosa, hearing the messages alone was not sufficient to change attitudes regarding rodent management. There was, however, a significant difference in mean rank scores on attitudes of those farmers involved in intensive and non-intensive interventions. This concurs with the findings of Prochaska *et al.* (2008) regarding stages of change; people at an earlier stage of behavioural change are still working through processes of evaluating and would need more support to enact the behaviour(s). Respondents from the intensive campaign village had more support, which encouraged them to adopt new attitudes and practices.

An outcome of the intensive media campaign was shifting attitudes away from passive acting and notions of farmers just sharing their produce with rats, to placing importance on controlling rats to increase yields. The key campaign messages, of working with other farmers and implementing control from land preparation through to the early tillering stage of the rice crop, were among the attitudes that were significantly different in 'adopters' (farmers who said they had heard the campaign and they changed their practices after the campaign) versus non-adopters. Farmers from the intensive campaign village in particular employed these practices.

The campaign was successful in promoting integrated management; there were clear changes in practices by those who had heard the campaign. Comparing the post-campaign practices of farmers from different intervention types, social influence was vital in generating behavioural change. A similar finding was reported from campaigns aimed at changing behaviour of college students in a health context (Haines 1996). In our study, when farmers were exposed to campaign media and had the support of extension staff and local leaders, they showed stronger changes in behaviour towards the use of effective control methods. From an environmental and human health perspective, the campaign for EBRM also eliminated the use of harmful and ineffective methods (electrocution, spread of oil mixed with poisons on flooded rice crops) compared with villages with access to media only. Moreover, while the effects in non-intensive campaign villages were less, these farmers still displayed better management practices and realised higher rice yields compared with where there was no facilitated intervention.

Successful media campaigns in the public health arena were linked with associated structural changes that encouraged target audiences to act on the recommended messages (FHI 2002; Randolph and Viswanath 2004; Avineri and Goodwin 2009). In Zaragosa, at a local scale there were important governance changes. The Zaragosa Municipal Agricultural Office empowered their extension technicians to be the champions of EBRM and campaign activities. Also the strong sanction of EBRM by local government officials encouraged individual farmers to change their behaviour.

The observed impacts after the campaign included social cohesion, which is crucial in EBRM, as documented by Palis *et al.* (2007). The campaign message that farmers need to work together was not new *per se*, but it was new in the context of rodent management. The social structures brought about by the campaign, which encouraged farmers, their children and other people within the community to all become involved, was important in creating social cohesion for rodent and crop management.

This study could not attribute specifically which interventions led to yield gains, which is a limitation that often arises in campaign evaluations (Weiss and Tschirhart 1994; Balch and Sutton 1997). There were changes in awareness of farmers about rodents, in their knowledge, attitudes and behaviour on the management of rodents, and there were more obvious impacts at the community level. Therefore it is difficult to isolate specific causal relationships. What is clear is that where there is dissemination of EBRM messages and guidance from local extension specialists, farmers can achieve higher yields. These findings are consistent with those reported elsewhere in Southeast Asia on the effectiveness of community-based EBRM at a village level (Singleton *et al.* 2005; Brown *et al.* 2006; Jacob *et al.* 2010) and in associated changes in farmer knowledge and actions (Brown *et al.* 2008; Brown and Khamphoukeo 2010). We also echo the findings of Adhikarya (1994) on the FAO's strategic extension campaigns for rodent management where the level of policy and budgetary involvement of the government contributed greatly to the success of the campaign. The involvement of the local government and agriculture office of Zaragosa during this campaign influenced policy makers at a higher level – the provincial Department of Agriculture subsequently promoted community-based EBRM over the entire province of Nueva Ecija. In 2009, a press release from the national Department of Agriculture announced that 'rat infestations in Nueva Ecija farms are minimal', citing a campaign that promoted the use of a united community effort, proper sanitation, synchronous planting, synchronous extermination of the rodents and the use of a rat-barrier system established one month before the regular planting (DA 2009).

Although the media campaign was successful in Zaragosa, we provide one important caveat – such campaigns must invest in research and strategic development of messages for mass media persuasion to be a powerful tool in influencing target audiences (Haug 2003). The Zaragosa campaign was based on a solid understanding of the biology of the pest species and rice systems practiced by farmers in the region. Therefore research on the ecology and behaviour of major agricultural rodent pests (see Singleton *et al.* 2008; and papers therein), provide an

essential platform for developing and designing messages required for a successful media campaign.

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