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Knowledge, Attitudes and Practices of Farmers on Rodent Pests and their Management in Cold Arid Ecosystem of Leh, Jammu & Kashmir, India

Vipin Chaudhary*, R.C. Meena, Surjeet Singh and R.S. Tripathi

All India Network Project on Vertebrate Pest Management, ICAR-Central Arid Zone Research Institute, Jodhpur 342 003, India

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Abstract: Rodent pests are one of the major biotic constraints in agricultural production. Agriculture being the main occupation of rural population of the cold arid district of Leh, crop production suffers greatly due to rodent depredation in fields and storage. A structured survey of 200 farmers from 10 villages across the district was carried out during July-September, 2018 to assess the farmers' knowledge, attitudes and practices with respect to rodent management. The study revealed that pests in general are a major limitation (43% respondents), followed by poor soil (31.5%), insufficient labor (15%), insufficient irrigation water (4%), flooding (1.5%) and high cost of cultivation (1%). The farmers identified rodents as the major pest (46.5%) on their farms, followed by insects (35.5%), disease (14%), none (2.5%) and others (1.5%). The overall estimated yield loss due to rodents was 18.33%. Most of the farmers (77.7%) thought that crop yields could be increased by controlling rodents and opined that they could control rodents if they worked together through community action, although 63% were doing rodent control individually. A Majority of farmers were of opinion that chemical control (i.e., use of rodenticides in baits) was the best option but they were not aware about the risk posed by such chemicals to non-target species (53%). The farmers' could benefit from training and education on various aspects of rodent technologies including using a community approach.

Key words: Farmer's perception, rodent pest management, survey, cold arid ecosystem, Leh.

Rodents cause significant damage to crop throughout the world (Amusa *et al*., 2005; Buckle and Smith, 1994; Fayenuwo *et al*., 2007; Meerburg and Kijlstra, 2008; Parshad, 1999; Prakash, 1988; Singleton *et al*., 1999, Tripathi and Chaudhary, 2004), with yield losses of 5-15% in most countries (Palis *et al*., 2007; Singleton, 2003; Singleton and Petch, 1994, Tripathi, 2014). In India rodents are one of the most important constraints to agriculture production with 5-6% of the total food grains lost annually at the pre-harvest stage and 2.5% at storage due to rodents (Parshad, 1992). Among the field crops, rice, wheat, sugarcane and ground nut are the most vulnerable crops to rodents. In rice, rodents cause 0.44 to 60% tiller damage which accounts for 5-10% of total yield losses (Parshad *et al*., 2007). Likewise, rodents results in a yield loss of 12.4% in wheat and 22.4% in sugarcane (Parshad, 1992). Rodents are also regarded as vectors of several zoonotic diseases of humans and domestic animals (Gratz, 1994; Singla *et al*., 2003 and 2008; Mohan Rao, 2006). Despite the development of wide variety of rodent control strategies to limit damage, rodent control has not yet become an integral component of crop production and storage strategies in India.

Agriculture is the backbone of the Leh economy as it engages over 70% of the working force mostly as cultivators, agricultural laborers and livestock rearers. The rural folk of the district, subsist on agriculture for their sustenance. Barley (*Hordium vulgare*), wheat (*Triticum aestivum*) and pea (*Pisum sativum*) are the major crops cultivated in the region, besides minor crops include vegetables like cabbage, cauliflower, capsicum, brinjal, carrot etc. Due to limitations like water scarcity and harsh climate only one crop per year is grown in Leh and adjoining areas (Anonymous, 2015). Among various biotic stresses, insect and rodent pests accounted for 50-55% and weeds cause 30-35% losses **(Personal discussion, 2016 with officials of Deptt. of Agriculture).** Information about major rodent species, their distribution and biology of Leh region is very meager except some scattered reports provided by Chakraborty (1983) and

*E-mail: vipin_cima@yahoo.com

Chaudhary and Tripathi (2015). Chakraborty (1983) reported occurrence of *Apodemus flavicollis wardi* (Wroughtoni's yellow-necked field mouse), *Alticola stoliczkanus stoliczkanus* (Stoliczka's vole), *Alticola stoliczkanus stracheys* (Stoliczka's Ladakh vole), *Pitymys leucurus leucurus* (Blyth's vole) and *Cricetulus alticola* (ladakh hamster) from the Leh-Ladakh region and Chaudhary and Tripathi (2015) reported Indian field mice (*Mus booduga*) from crop fields and stores & godowns, Turkesh rat, *Rattus pyctoris* (=*Rattus turkestanicus*) from godowns and shops, Blyth's voles (*Phaiomys leucurus* Blyth =*Pitymys leucurus*) and Himalayan marmots (*Marmota himalayana*) from grass land. No scientific data, as such is available about the impact of rodents upon crops in Leh,

Our surveys indicated that rodents cause serious damage to standing crops and stored commodities in the region but there is immense lack of awareness in Ladakhi farmers about the economic losses and rodent management technologies. The study was therefore conducted to gain insight into the farmers' knowledge and attitude about rodent pests, yield losses and the practices followed by farmers for rodent management in cold arid agro-ecosystems of Leh- Ladakh, Jammu & Kashmir, India.

Materials and Methods

Study area

The study was conducted in Trans-Himalayan district of Leh- Ladakh, Jammu and Kashmir, India situated between 32°15′ to 36°00′ N Latitude and 75°15′ to 80°15′ E Longitude. Agriculture is the main occupation of the rural people of the district. Naked barley, locally known as 'grim' is the major staple food crop of the region. Wheat, pulse, oil seeds and other millets are also grown in scattered areas. The source of irrigation water is mainly streams originating from glaciers. Both diurnal and seasonal variation of temperature is very high (from 35°C during summer and -35°C during winter season). Annual average rainfall of Leh is 100 mm, which mainly occurs during May-September. Snowfall during winter (November to March) is a common phenomenon and therefore only one crop can be grown throughout the year. According to crop calendar of Leh district, barley is sown during mid of May and wheat crop is sown during last week of April to 2nd week of May.

Survey villages

Our survey was conducted by taking personal interviews about knowledge, attitudes and practices (KAP) on rodent damage and management. In all 200 farmers randomly selected from 10 villages across the district viz., Chuchoot Gongma, Chuchoot Shama, Phey, Shey, Choglamsar, Stakna, Stakmo, Sankar, Thiksey and Ranbirpor for the study (Fig. 1). In each village 10 male and 10 female farmers were interviewed.

Schedules and questionnaire

A survey questionnaire was designed to gather general information about farm characteristics and farming practices and specific information about pest problems, rodent problems, control practices, and farmer attitudes to rodent management. The questionnaire for the farmers survey was structured based on the questionnaires developed by Sudarmaji *et al.,* 2003; Tuan *et al.,* 2003; Makundi *et al.,* 2005; Brown *et al.*, 2008 used by them in Vietnam, Indonesia, Myanmar, and Africa to address rodent management issues. The questionnaire was prepared in Hindi and English and help of local office staff was taken to explain the question to farmers in their local language. Farmers were interviewed individually by local office staff that lasted approximately 30 minutes per person. The surveys were conducted from April to September 2018. We used the term 'rodents' because the region was commonly inhabited by rats, mice and voles. Two types of questions scored on a five-point Likert scale were asked to understand the farmers' beliefs and attitudes about rodents and rodent management. The first type of question was phrased as: 'How true is this: . . .', and the responses were coded as: 1: Always not true; 2: In most cases not true; 3: May be true; 4: In most cases true, and 5: Always true. The second type of question was phrased as: 'How important to you is . . .', and the responses were coded as: 1: Completely not important to me; 2: Not important to me; 3: No opinion; 4: Important to me; and 5: Very important to me. This allowed us to analyze differences in the farmer's attitudes and beliefs. We also collected baseline information on demographics and farming practices.

The data were recorded on standard formats and entered into spread sheets. Cross table and

Fig. 1. District Leh showing the approximate location of villages (marked with circle) used in the study (downloaded from Google Map).

frequency distribution was employed for data analysis and presented in the form of tables and figures. A Chi-square test was used to test for statistical significance (<alpha>=0.05) among the different respondents and their responses.

Results and Discussion

Farmers' profile

Agriculture is the main occupation of inhabitant of Leh, over 70% of working population of district is engaged in agricultural and livestock activities. Average age of male respondents was 42.21 years (± 1.05 SE, n=100) and that of females was 43.74 years (± 1.03 SE, n=100). From the respondent group both the sexes had been performing agriculture for over 20 years. Around 90% farmers owned their own land and only 10% were tenant farmers. Literacy in Leh district is very high (65.3%); among the respondent group 87% of farmers were literate (could read and write). Association of farmers with community organization was not prominent as most of the farmers (85%) did not belong to any organization. Only 15% of farmers belonging to Chuchoot Gongma and Chuchoot Shama villages were associated with the Organic Foundation of Leh. The irrigation facilities in the area are limited to the availability of irrigation water in the form of glacial streams due to low and scanty rainfall. Farmers cultivate in only one season (April to September). The main crops grown in the area were wheat (mean area sown 0.42 ha± 0.02), followed by Barley (0.13±1.01), alfalfa and potato (0.08 ha ±0.01 each). Village-wise total area under cultivation of different crops is shown in Figure 2. Other crops grown in the area include pulses, vegetables, oats along with fruit plants of apricot and apple.

Farmers Knowledge

According to the farmers (43% respondents), pests are the major constraints in crop production, followed by poor soil health (31.5%), insufficient labor (15%), irrigation water availability (4%), flooding (1.5%) and high cost of cultivation (1%). The majority of the farmers (46.5%) perceived rodents to be a major pest on their farms, followed by insects (35.5%) and diseases (14%). Only a small proportion (1.5%) cited other reasons and 2.5% opined as (none) i.e., no pest problem (Table 1). Among the pests, 55.5% of farmers attributed rodents as major problem and therefore rodents were identified as most important pest to control (57% respondents), followed by insects (26.5%; Table 1). Wheat crop was the most vulnerable to rodent damage as responded by 43.5% farmers, followed by vegetables (30%), barley (17%) and

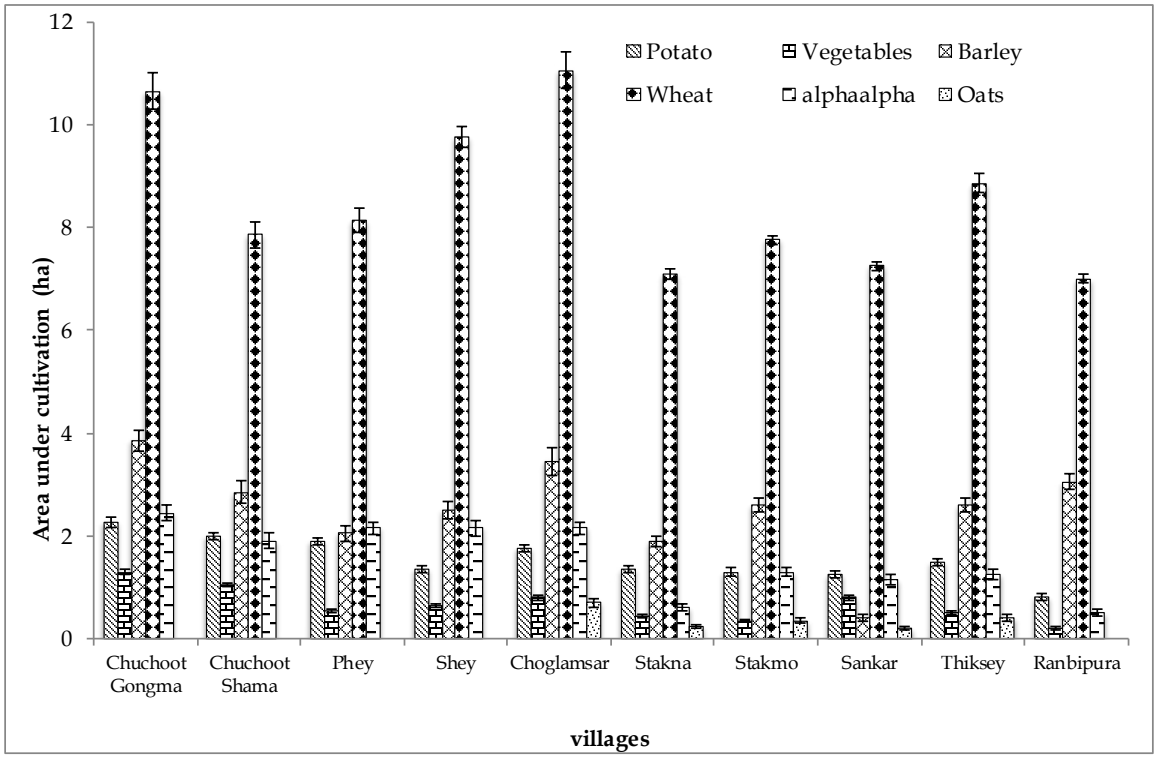

Fig. 2. Area of land (ha±SD) under cultivation of different crops in different villages.

potato (9.5%). The overall estimated yield loss due to rodents was 18.33% (±0.36 SE). Farmers response on yield losses due to rodents varied from village to village with maximum (23.5% respondents) from village Chuchoot Gongma and the lowest (14.95%) from Sankar village (Table 1). Brown *et al.* (2008) in their KAP analysis of farmers of Myanmar also considered rodents as major problem to crop production and maximum damage is caused in rice crop, though damage in mungbean, groundnut and sugarcane was also significant. The estimated

Table 1. Summary of responses to questions from farmers of 10 villages in Leh, J&K, India

Village	Constraint in production		Main pest		Pest caused most damage	Most important pest to control	Yield loss
	1	2	1	2			
1	2	3	4	5	6	7	8
Chuchoot Gongma	Pest (7)	Infertile Soil (6)	Rodents (11)	Insects (8)	Rodents (9)	Rodents (13)	23.50±1.17
Chuchoot Shama	Pest (8)	Infertile Soil (6)	Rodents (9)	Insects (7)	Rodents (15)	Rodents (9)	19.90±1.27
Phey	Infertile Soil (6)	Pest (8)	Rodents (9)	Insects (6)	Rodents (10)	Rodents (14)	20.45±1.15
Shey	Pest (12)	Infertile Soil (6)	Rodents (10)	Insects (7)	Rodents (12)	Rodents (14)	19.00±1.06
Choglamsar	Pest (8)	Infertile Soil (6)	Insects (9)	Rat (6)	Rodents (14)	Rodents (12)	19.25±1.19
Stakna	Pest (11)	Infertile Soil (8)	Rodents (10)	Insects (8)	Rodents (10)	Rodents (19)	15.45±0.60
Stakmo	Pest (10)	Infertile Soil (6)	Rodents (10)	Insects (7)	Rodents (10)	Rodents (11)	17.00±0.97
Sankar	Pest (9)	Infertile Soil (5)	Rodents (10)	Insects (5)	Rodents (12)	Rodents (10)	14.95±0.46
Thiksey	Infertile Soil (7)	Pest (6)	Insects (9)	Rat (7)	Rodents (10)	Rodents (12)	15.45±0.67
Ranbipura	Pest (9)	Infertile Soil (5)	Rodents (11)	Insects (5)	Rodents (9)	Rodents (13)	18.30±1.12
Total	Insect (86) 43.0%	Infertile soil (63) 31.50%	Rodents (93) 46.50%	Insects (71) 35.50%	Rodents (111) 55.5%	Rodents (114) 57.0%	18.33±0.36

Table 1. Contd..

Village	Crop damaged most by rodents		Best Stage for rodent control		Best method for rodent Control	Patterns of rodent damage	Farmers attitude for rodent control	Approach for rodent control	
	1 crop	2 crop	1	2				1	2
1	9	10	11	12	13	14	15	16	17
Chuchoot Gongma	Wheat (13)	Barley (5)	Harvesting (17)	Maturity (2)	Poisoning (19)	Regular (20)	Regular (20)	Group (12)	Individual (8)
Chuchoot Shama	Wheat (10)	Vegetable (8)	Harvesting (11)	Maturity (4)	Poisoning (19)	Regular (19)	Regular (19)	Group (11)	Individual (8)
Phey	Wheat (12)	Vegetable (4)	Harvesting (11)	Maturity (5)	Poisoning (12)	Regular (14)	Regular (12)	Group (14)	Individual (5)
Shey	Vegetable (7)	Wheat (6)	Maturity (11)	Harvesting (7)	Poisoning (12)	Regular (18)	Regular (13)	Group (11)	Individual (8)
Choglamsar	Wheat (8)	Vegetable (4)	Maturity (9)	Harvesting (7)	Poisoning (11)	Regular (13)	Regular (13)	Group (13)	Individual (4)
Stakna	Vegetable (8)	Wheat (5)	Harvesting (9)	Maturity (8)	Poisoning (11)	Regular (15)	Regular (13)	Group (13)	Individual (7)
Stakmo	Wheat (10)	Vegetable (7)	Harvesting (10)	Maturity (7)	Poisoning (12)	Regular (14)	Regular (11)	Group (13)	Individual (5)
Sankar	Vegetable (8)	Wheat (5)	Maturity (8)	Harvesting (6)	Poisoning (11)	Regular (15)	Regular (15)	Group (13)	Individual (7)
Thiksey	Wheat (10)	Vegetable (6)	Harvesting (10)	Maturity (8)	Poisoning (10)	Regular (12)	Regular (14)	Group (12)	Individual (8)
Ranbipura	Wheat (8)	Vegetable (6)	Harvesting (11)	Maturity (6)	Poisoning (13)	Regular (13)	Regular (16)	Group (12)	Individual (8)
Total	Wheat (87) 43.50%	Vegetable (60) 30.0%	Harvesting (99) 49.50%	Maturity (68) 34.0%	Poisoning (130) 65.0%	Regular (143) 71.5%	Regular (146) 73.0%	Group (128) 64.0%	Individual (63.0%) 31.5%

Number of farmers who responded for each category are shown in bracket. Responses were ranked in order of important for each category and mostly number 01 response is provided except for category constraint in production, main pest, crop damaged most by rodents and best stage for rodent control, where number 1&2 responses are provided (20 farmers were interviewed from each village).

yield loss due to rodents was 5-13%. Ngaomei and Singh (2016) in his survey of Tamenglong district, Manipur, India reported rodents as main pests of agricultural crops causing an annual average yield loss to the tune 19.85%. Survey from other places such as Highlands of Tigray and Northern Ethiopia, also reported rodents as the important pests and need to be controlled (Makundi *et al.,* 2005; Schiller *et al.,* 1999). The present estimated yield loss (18.33%) from cold arid regions of Leh was higher than the losses as experienced in other South-East Asian countries (5-13%) (Singleton, 2003).

Rodent management practice

Most of the farmers (71.5%) reported that rodent damage the crops on regular basis, whereas 15% respondents opined it as occasional, closely followed by category of farmers (13.5%) stating rodent problem to be rare in crop fields. Farmers usually carried out rodent control activity at maturity stage of crop but majority (49.5%) believed that rodent control could be carried out at harvesting stage, as they observe heavy rodent population under the heaps of harvested crops. Still around 12.5% farmers had no idea about the suitable timing, though they were in favor of rodent control. Generally, the critical stage when the control measures are to be initiated may vary for various crops. In Australia damage due to rodent to cereal crops such as wheat in later stages of crop development causes more significant losses to overall production than that in early stages of crop development (Ngaomei and Singh, 2016). Similarly in central Ethiopia, rodent damage in the maize field was critical after the seedling stage while in Tanzania damage in the seedling stage showed a significant impact on the potential yield of maize crops since farmers cannot replant the seeds after the rainy season advanced (Bekele *et al.,* 2003; Mulungu, 2003). In our study area, there is only one cropping season (April-

September) thus the rodent population present in the field move to stores with threshed grain after harvest. Farmers believed that control of rodents should be initiated prior to a stage when economic damage can be inflicted. Generally, control measures are applied just before the onset of breeding season of key rodent pests. Brown *et al*., 1999; Brown and Tuan, 2005 and Leung *et al.,* 1999 reported such a situation for *Rattus argentiventer* in lowland rice agro-ecosystem in Indonesia and Vietnam. The breeding dynamics of *Mus booduga* the key pest in cropping system in Leh in not much studied. For controlling rodents majority of farmers preferred poisoning (65%) (use of rodenticide bait) as the best option for control, followed by predation through domestication of cat (14%) and trapping (8.5%; Table 1). A few farmers (0.61%) used flooding as a means for rodent control and about 10% adopted other ways to get rid of rodent menace. The use of rodenticide for control of rodents did not differ significantly between the villages (n = 20 per village) (X^2 = 3.77; P>0.05) and majority of farmers (64%) advocated application of rodenticidal baits in groups. However, they were not aware of correct dosages of rodenticides for preparing baits. Though the farmers were using acute rodenticide, zinc phosphide but were not at all aware of pre baiting requirements also. A majority of farmers (73.0%) were of opinion that regular control during crop season is essential to keep the rodent damage at minimum level. A range of rodent control methods applied by farmers include use of rodenticides, bio-control and trapping. In present survey 65% respondents advocated that the use of rodenticides is the best method to control pest rodents, which is consistent with the findings of Makundi *et al.* (2005) in Tanzania and Ethopia, Brown and Khamphoukeo (2007) in Laos, Brown *et al.* (2008) in Myanmar and Rani *et al.* (2015) in Andhra Pradesh (India). Despite the use of rodenticides, farmers believed that chemicals were not safe to non-targets as reported by

Table 2. Response of farmers to question related to their beliefs about rodent management on a five point Likert scale

Villages	How true is this						
	Rodent control must be done during crop growing season	By controlling Rodents yield of wheat & barley can be increased	Rodents can be controlled	Rodents can cause severe yield loss	Rodents can be control by group approach not individual approach	Rodents have to be controlled after harvest	Chemical control is best option and unsafe to non-targets
1	2	3	4	5	6	7	8
Chuchoot Gongma	3 (13)	5 (14)	3 (9)	3 (7)	5 (12)	5 (17)	1 (9)
Chuchoot Shama	3 (12)	5 (16)	5 (10)	3 (9)	5 (14)	4 (14)	1 (10)
Phey	1 (9)	5 (17)	1 (11)	2 (11)	5 (16)	5 (15)	1 (12)
Shey	3 (13)	5 (15)	3 (9)	3 (10)	5 (17)	5 (13)	3 (10)
Choglamsar	3 (15)	5 (13)	3 (10)	3 (11)	5 (18)	5 (11)	1 (8)
Stakna	3 (11)	5 (14)	3 (11)	3 (12)	5 (13)	4 (12)	1 (12)
Stakmo	3 (12)	5 (17)	5 (11)	3 (13)	5 (14)	5 (10)	1 (13)
Sankar	1 (13)	5 (18)	3 (14)	3 (12)	5 (15)	5 (12)	1 (14)
Thiksey	3 (11)	5 (16)	3 (12)	5 (10)	5 (11)	5 (11)	1 (11)
Ranbipura	3 (12)	5 (15)	1 (12)	3 (12)	5 (12)	5 (11)	1 (10)
Most common response	55.5%	77.7%	45.5%	49.0%	71.0%	57.0%	53.0%
All villages (%)							
Always not true	21	0	35	9	0	0	53
In most cases not true	16.5	0	0	37	0	0	14.5
May be true	55.5	22.5	45.5	49	6.5	4	32.5
In most cases true	0.5	0	0	0	22.5	39	0
Always true	6.5	77.5	19.5	5	71	57	0

Table 2. Contd...

Villages	How important to you is					
	Rodent control	Increasing yield by controlling Rodents	Rodents can be controlled	Rodents can cause severe yield loss	Rodents can be controlled by group approach not individual approach	Rodents have to be controlled after harvest
1	9	10	11	12	13	14
Chuchoot Gongma	5 (11)	3 (12)	3 (9)	5 (11)	5 (12)	5 (17)
Chuchoot Shama	5 (13)	5 (16)	5 (10)	3 (12)	5 (14)	5 (16)
Phey	5 (9)	5 (17)	1 (11)	3 (9)	5 (16)	5 (17)
Shey	3 (11)	3 (15)	3 (9)	3 (13)	5 (17)	4 (13)
Choglamsar	5 (12)	5 (13)	3 (10)	3 (9)	5 (18)	5 (11)
Stakna	5 (11)	5 (14)	3 (10)	3 (11)	3 (13)	5 (18)
Stakmo	5 (13)	5 (17)	5 (11)	3 (12)	5 (14)	5 (10)
Sankar	1 (11)	3 (11)	3 (14)	3 (13)	3 (11)	5 (12)
Thiksey	5 (10)	5 (16)	3 (15)	3 (11)	5 (11)	5 (11)
Ranbipura	5 (110	5 (15)	1 (12)	3 (12)	5 (12)	5 (11)
Most common response	51.5%	63.0%	43.0%	54.5%	64.0%	65.0%
All villages (%)						
Always not true	5.5	0	35.5	12	0	0
In most cases not true	0	0	0	16	0	0
May be true	31	33.5	43	54.5	17	4
In most cases true	12	3.5	0	1	19	32
Always true	51.5	63	21.5	16.5	64	65

Sudarmaji *et al.* 2003; Tuan *et al*., 2003 for farmers of Indonesia and Vietnam in lowland irrigated rice systems. In these countries, the reliance on rodenticides was reduced by 50 and 75%, respectively, through the promotion of ecologically based rodent management strategies (Singleton *et al*., 2004, 2005; Brown *et al*., 2006). Among rodenticide choice, all the farmer used acute rodenticide (zinc phosphide) for the rodent control. The reliance on acute poison may be due to lack of knowledge about chronic rodenticides (anticoagulants) and its non-availability in Leh.

Farmers' belief in rodent management

The cropping season in Leh is very short (April-September) and only one crop is grown. Majority of farmers (55.5% stated that in most cases true) of the area believed that rodent control must be done during crop growing season and considered that control of rodents was important to them (51.5% stated always very important) (Table 2). Farmers thought that by controlling rodents, they could increase crop yield (77.7% stated that it is always true) and that increase in yield by controlling rodents was always important to them (63%). However, 35% famers believed that it is not always true that rodents could be controlled, but 45.5% believed that it is always true that rodents could be controlled. Similarly, 35.5% farmers didn't believe that rodent control was important to them, however 43% stated that rodent control was important to them. Majority of farmers believe that rodents could cause severe yield loss (49% stated may be true) and severe losses caused by rodents was important to them (54.5%). The perception of Ladakhi farmers is different from those of Tanzania and Central Ethiopia, who believe that though rodents are the most important pests, are difficult to control (Makundi *et al.,* 2005), however farmers of Myanmar believed that rodent could be controlled (Brown *et al*., 2008). More than 55% farmers believed that it is always true to control rodent after harvest and were always important to them (65% stated always very important). Majority of farmers were of opinion that chemicals used for rodent control was best option but they were not aware about risk to non-targets (53%). Farmers at large were not aware about the correct dosages of rodenticides and were thus were mainly dependent on the advice of pesticide dealers.

Majority of farmers (71%) stated that it is always true that rodent could be controlled if they worked together (in group) for rodent control and group approach was always very

important (64%). Community involvement for organizing anti-rodent campaign is desired for sustainable management of pest rodents, as it reduced possibility of re-infestation from neighboring fields. However, when farmers were asked, how do you apply rodent control measures, majority of them responded that they apply rodent control individually (63%), followed by 'no opinion' (19%) and a very small number (1.5%) opted for both (individual or in group) strategy. Rodent control on community basis is always good, as it reduced possibility of re-infestation from neighboring untreated fields. Shuyler, 1972; Morin *et al*., 2003 and Brown and Khamphoukeo, 2007 also stated that the farmers should be encouraged to work together on a community scale to gain as much benefit as possible in rodent management, similarly, their beliefs about timing and type of methods for rodent control were also contradictory. Majority of the respondents agree with the importance of rodent pest control at all the stages of crop growth and after harvest (as the harvested crop is piled in the field itself for threshing), but most of them carry out rodent control activities at a certain stages, for example during ripening of crops or after harvest. No respondent indicated the importance of rodent control at all stages and performed it. At the same time, farmers agreed with the application of several methods for effective rodent control.

Conclusion

This study has, for the first time been able to generate baseline information on the farmers' knowledge, perception and beliefs about economic importance of rodents and management strategies adopted in cold arid regions. Capacity building of farmers on effective rodent management technologies and encouragement to work together on community basis is of utmost importance for the resource poor farmers for enhanced crop productivity of Leh-ladakh region.

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