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RAT REDUCTION WITH INDIGENOUS METHODS

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INTRODUCTION

Mujumdar (1968) has recorded that there are 566,000 villages in India as compared to 2699 towns, and that there is 322,460,000 acres of cultivable land and probably 500 million domestic rats in India.

The food production target in 1968 in India was to be 110 million tons. National rodent committee 1967 mentioned of a loss of one million ton of food grains by rats alone. Deoras (1968) has mentioned that 3 common rats in Bombay were consuming 26 gm. of food grains per day, that is, about one ounce, while the quantum of cereal rations available per man in some parts of India is 6 oz. per day. If rat reduction was done, this 16% denial of human food could be saved, and 7.7% import of food grains improved (Deoras 1968).

It was further observed that the small rat Laggada booduga climbed up a paddy plant and ate every grain, while the field rat B. bengalensis took a few grains, may cut a plant and remove it to burrows. The presence of the bigger rat drove the smaller ones away. The smaller rats did more damage than bigger ones, and if indiscriminate baiting was done, the bigger ones that did less damage were wiped out, leaving the smaller ones to do more damage. The knowledge of the frequency of rat population and the habits seemed necessary to do a large-scale rat eradication programme.

Rat eradication programme's if not continued every year bring about an increase of about 40% in the rat population. Considering the meagre staff employed by the Agriculture Department in various States, it was very necessary that this continuity has got to be maintained by someone else apart from government employees, and these would be the Agriculturists themselves. The farmer has apart from Agriculture operations, to look to other pests also, as such, unless specially interested or disturbed, he normally does not devote sufficient time and money, from his small per capita income.

Rat control measures are well-known. The improper use of zinc phosphide and other poisons have killed poultry and even domestic animals. Rats died in the open (or crevices) of poison baits, leave a foul smell also. The farmer therefore needs to be assured of safety and less of a nuisance and be convinced that if efforts are properly applied he stands to gain thereby.

Government of Maharashtra was interested in rodent control and had sanctioned Rs. 3,21,000 to purchase rat poisons vide CPS 3066A of 2.3.1967. A meeting was held in the chambers of the Deputy Secretary, Agriculture Department, Government of Maharashtra, where Dr. V.G. Joshi, Additional Director, Agriculture, Dr. P.J. Deoras, Assistant Director, Haffkine Institute, and Mr. Talgiri, Director, Plant Protection were present. It was decided in this meeting to make the best use of this amount to go in for pilot scheme to get the maximum results from the amounts sanctioned and cultivate motivation of the farmers, The pilot scheme was to be done initially in 4 villages of Panvel Block and Dr. P.J. Deoras was to initiate, formulate and execute the scheme. Later on the entire Block was to be taken and then the District.

With a view to start this motivation in the farmers, studies were initiated in 1967 in four villages of Panvel Block, 45 miles from Bombay. Here the frequency of different rats was first studied. The damage aspect of rat to grain, houses, clothing, material and health was brought to the notice of villagers and baiting inside the houses was avoided. The eradication was started with the denial of rats access to houses, use of rat repellent like 50% BHC and 1% Malathion around houses, educating the public of rat damage and the actual control work for 4 monsoon months only.

The last point was taken into account, because it was observed that since the rainfall was up to 3136 mm in 4 months the fields were flooded and the rats migrated towards higher ground or residential areas where there would be a concentration of all rats. The rats were removed by trapping from houses, poison baits were applied in bait boxes outside, and the rat burrows fumigated with sulphur dioxide. The trapped bigger rats were skinned and

the hide sold to tanneries for 30 paisa which became an incentive to farmers. This gave encouragement and a number of local volunteers came forward to complete the project. The work was stopped as the rains ceased and the crop was ripe in the field.

The pilot scheme undertaken at Kalundre, Koike, Kon and Palaspe (population 6310, houses 2932) for 4 months was responsible for collecting 2063 rats of which only 95 were by baiting. It showed that the predominant rat there was R. rattus (2055) and the female rats were in an overwhelming majority. The damage to clothing was Rs. 621/- apart from food grains and cattle fodder. The amount of bait used in traps was 67 kg of which rats consumed 15.56 kg. In the case of baits, it was 60.145 kg and used was 12.20 kg. The use of BHC 50% suspension @ 1.% and Malathion at one percent prevented re-entry of rats for six days.

The entire Panvel Block was therefore taken for eradication in 1968 on the same basis as the Pilot Scheme in four villages. Later on, next year it was to be taken into adjacent blocks. The work was to be started just before monsoon and stopped as the rains ceased and the paddy crop by that time was ripe for harvesting. No amount of baiting would succeed when the crop is full of fresh grains.

The work given here records the result of eradication up to 134 villages, by which time the monsoon had ceased.

MATERIAL AND METHODS

Panvel, Headquarters of Panvel Block lies 45 miles from Bombay. The Block has mountainous terrain in the East and South, sea and creeks in the West, and cultivable area separated by mountain ranges from Bombay in the North. The maximum temperature in the area is 30.7°C and the minimum 22.8°C. There are 104 days of rains in the year and the total downpour in that period comes to 3136 mm. The Block belongs to Kolaba District in Maharashtra State and comprises of 198 villages of which 177 have habitable houses numbering 16,785. The population as per 1960 census was 115,378 of which 97,248 was in smaller villages. Nearly 64.57% of the population are cultivators. Total area of the Block is 215.3 sq. miles, consisting of 143,400 acres; of this, 59100 acres is under crops. Paddy cultivation in 40,100 acres only, brings out rice at the rate of 1701 pounds per acre to the tune of 3,41,05050 kg., bringing to the farmers about Rs. 30,000,000 in rice produce alone. Vegetables, flowers, and fruits, as well as poultry, bring in additional income.

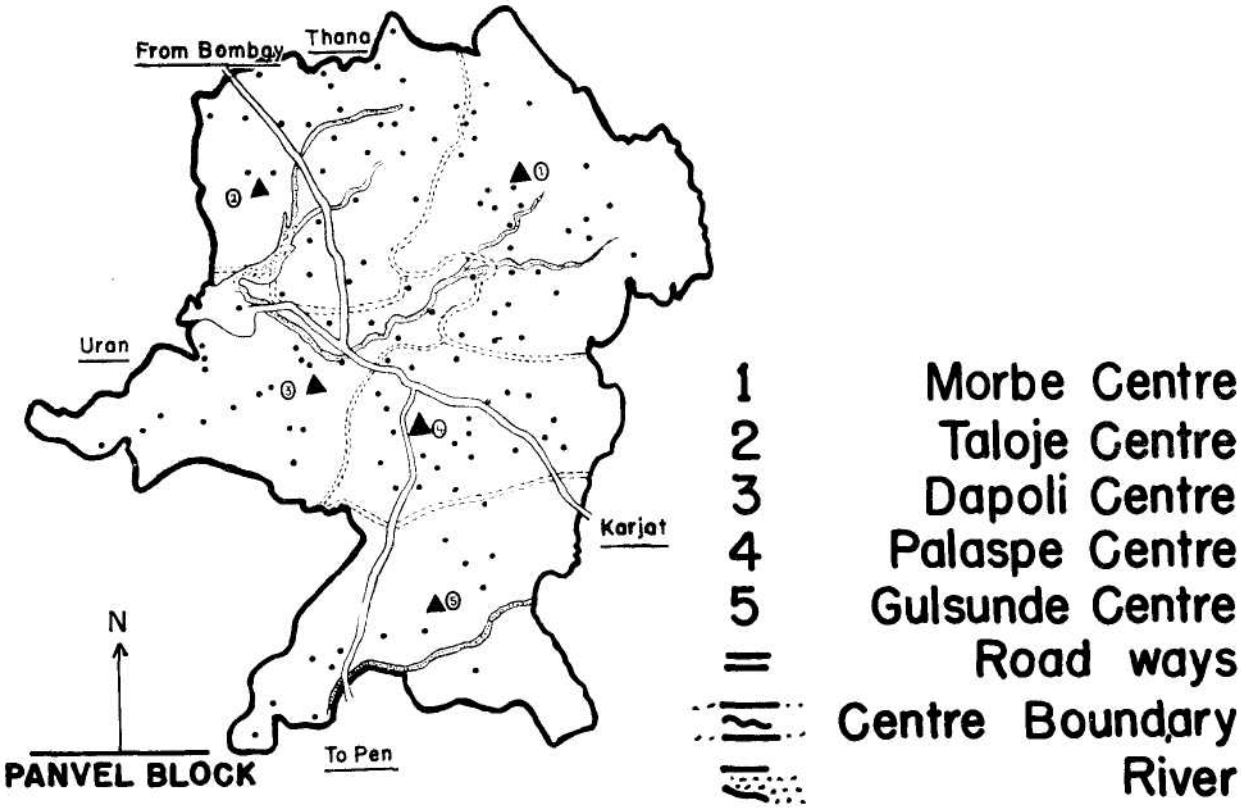
Five centres were selected for operation to various villages in groups. These were Morbe (creek filled area), Taloje, Dapoli, Palaspe and Gulsunde. Three Laboratory Assistants, four Laboratory Attendants, one Sanitary Inspector and three paid labour workers were working equally at the centres. The work was regulated by one Senior Scientific Officer, two Junior Scientific Officers of the Entomology Department of Haffkine Institute, Assistant Block Development Officer and Gram Sevaks of the area. The entire supervision, guidance, planning, execution and recording was done by the Assistant Director, Department of Entomology, Haffkine Institute.

Total number of rat traps (designed by Dr. Deoras) used were 652 and the bait boxes were 600. These were supplied by Haffkine Institute, Directorate of Public Health and the Zilla Parishad. Wheat flour used for bait was 3 quintal, and wheat grains for poison baits were one quintal. Other material used was zinc phosphide 20, Malathion 5, Benzene hexachloride 50 kg, Alluminium phosphide tablets 5000, and sulphur powder, 5 pounds.

Mode of Operation

a) Initial survey was done to see the damage done to wooden doors, windows, clothing, food grains and fodder. Rat pellets were collected to see initial infestation and they were repeated after repairing the doors, windows or spraying BHC 50% suspension at 10% of Malathion 1% around bamboo huts. This was to see and show to farmers the reduction in the infestation (reduction or status quo of pellet numbers). This was done at the end of June before the monsoon started.

b) Taking the above centres as headquarters, trapping was done in villages for four days and the party shifted to next village for trapping in houses. The records were sent to Bombay. The collected rats were deflead, sexed and were either skinned, (this was sold to Madras Tanneries) if it was a big rat, or the meat taken out to feed dogs and cats. In In case of small rats they were used to make compost after killing them by drowning. The bait in the trap was wheat flour with a dash of sweet oil.



The above map of Panvel designates the centres by numbered triangles with the villages indicated by round marks.

c) Once trapping was done, the next team started laying bait boxes outside the houses. One day of prebaiting was done with whole wheat, charcoal and a dash of oil. Zinc phosphide at 1% was mixed in whole wheat grains after a dash of oil has been applied to them. Two grammes of this bait on a piece of paper was put in each bait box. These were laid at night and removed before dawn, along with any dead rats seen in the locality. This operation was done for two days in each house and the party shifted to next village after recording the results.

d) The third team moved in to count the rat burrow openings, blow in BHC 5% in them, put in broken glass bricks and close the same after blowing in burning sulphur fumes. At some places Alluminium phosphide tablets or HCN gas was used.

e) The last operation consisted of using zinc phosphide in small paper cups that had been dipped in melted paraffin to stand the moisture of rains. These pieces were stuck to field border edges and a spray of 1% Malathion applied to inner borders of standing paddy crop. By this time the paddy had borne the grains and was getting ready to be harvested.

f) To see the effect of operations, two villages Jasai and Ris were kept as control as compared to two villages of Dapoli and Pargaon from the experimental area. The control villages were away from Panvel Block.

Observations

Table No. 1 gives the statistics of the number of villages available in India, cultivable land and the number of probable rat numbers available. This is to show the immensity of the problem.

Table No. 2 indicates the details at a glance for the Panvel Block. Since four villages were done in 1967, the remaining entire lot was taken in 1968 to be followed by ever increasing circle to take up the entire District.

Table 1. Indian conditions for rat control.

Total cultivable area	322,460,000	Acres
Total forest lands	126,099,000	Acres
Total fallow lands	54,490,000	Acres
Total pasture lands	97,720,000	Acres
Total unused lands	116,201,000	Acres
Total number of villages	566,000	
Total number of towns	2,699	
Probable rat population	24,000,000,000	
Food production	104	Million Tons
Rat damage	6	Million Tons

S. K. Mujumdar

Table 2. Particulars of area for rat control.

Panvel Block area	215.3	Sq. Miles
Rural area in the block	210.6	Sq. Miles
Population as per 1960 census	115,378	
Rural population	97,248	
Total houses	16,785	
Total area in acres	143,400	Acres
Total area under crop	59,100	Acres
Area under paddy cultivation	40,100	Acres
Produce per acre	1701	Lbs.
Cost of produce approximately	68,040,000	Rs.
Days of rainfall 104, total 3136 m.m.		
Maximum temp. 30.7°C		
Minimum temp. 22.8°C		

Table No. 3 shows at a glance the various damages seen in the houses and the number of burrows in and around.

Table 3. Damage to various articles and burrow.

Centre	Villages covered	Damage to							Other Material		No. of Houses	
		Clothing		Food		Doors	Window	Burrow				
		No.	Rs.	Kg.	Rs.	No.	No.	No.	No.	Rs.	Brick	Mud
Taloje	36	89	356	506	503	37	-	187	-	-	726	1267
Morbe	8	31	285	42	42	-	-	7	-	-	200	545
Palaspe	34	36	113	61	61	14	16	390	29	48	571	1712
Dapoli	20	228	512	93	93	2	-	58	-	-	955	1998
Gulsunde	82	9	7:25	20	16	7	3	211	-	-	481	1291
Total	126	393	1273:25	722	715	60	19	853	29	48	2933	6913

From this table, it will be seen that the loss of clothing is high-lighted. The villagers do not normally have a number of sets of clothing and whatever single set they have is a grave loss to them when damaged by the rat. This apparent loss and its protection by rat removal impress the villager. Morbe area was surrounded by water, since it is a creek area. The houses here are predominantly of bamboo matting and thatch. Hence no records of door and window damage were seen. Due to being submerged in water, baiting outside the houses could not be done here by the time the rains subsided and the time limit of finish the work was over. Once the crop in the field is ripe and grains have set in, no

amount of baiting or trapping will collect rats, and therefore all the operations in these experiments have been directed to reduce the number to the maximum before the migration to the field starts. Baiting in the field when the crop is full of grains is a failure, because the rat would prefer the fresh crop to the stale bait, that is why the operations were designed to terminate with the onset of the harvesting season. Six of the total number of houses at 9866 only 2933 were of brick and mortar, the remaining 6913 were just bamboo matting and thatch which definitely required a rat repellent to prevent rats from coming in at least for some time.

Table No. 4 shows the total number of rats trapped in 134 villages till the monsoon was over. From this table, it should be noted that there are more female rats trapped than males at all places. This means a loss in further breeding potential. Maximum rats trapped are at Taloje i.e. 7518 rats in 36 villages or 208 rats per village. It also shows that every 6th trap collected a rat. The rats were predominantly Rattus rattus. This was in confirmation of previous pilot scheme studies. This and baiting experiments have shown that, whether in the houses or outside and near fields this is the rat that predominates. It normally should be found in houses, but since it is collected in the fields also, there is an indication that it migrates to fields and comes back to its original habitat especially in the rains, when the fields are full of water. Thus attempts are made to reduce the number of this rat at its maximum concentration and at a very vulnerable time i.e. in monsoons, this would in the long run reduce the damage in the coming months also. This table also shows that B. bengalensis, Golunda ellioti and other field rats have also been trapped into houses indicating a migration towards the residential areas probably during the monsoon months.

Table 4. Rat trapping for seven days in various villages of the centre.

Centre	No. of villages covered	Population	Area Houses Acres	Area Farm Acres	No. Traps Set	No. Traps with Rat	Rats trapped Male	Rats trapped Female	Total Rats caught
Taloje	36	15517	15676	11116	11200	3030	3339	4179	7518
Morbe	8	3529	4802	1597	1483	231	196	311	507
Palaspe	34	17231	12268	7421	6403	967	923	1187	2110
Dapoli	28	19166	15187	8125	4957	595	880	1094	1974 233
Gulsunde	28	10278	15132	4051	7070	900	702	1148	1859
Total	134	65721	63066	32310	31113	5723	6040	7919	14191

Rattus rattus - 12894; B. bengalensis - 168; B. gigentia - 89; L. booduga - 5; G. ellioti 2; M. musculus - 1; Suncus coeruleus - 794; Unidentified – 233.

Total number of rats collected by trapping was 14191 in 9846 houses, and this is approximately two rats per house. Taloje is a biggish village with a sprawling market of fish and grain and the place showed maximum damage as well as collection.

Table 5 shows the baiting record, giving figures of dead rats in villages up to the time rains ceased. Morbe remained inaccessible due to creek waters and this moisture prevented baiting till the last date. A total of 2203 rats have been collected dead. At all the centres the female rat was collected more in numbers. This was outside the houses. This means that during this period, this breeding potential was reduced. Secondly, the predominant rat species in the dead were Rattus rattus, the house rat. B. gigentia the bigger field rat which does so much damage has been killed more in numbers than by trapping. Total numbers of bait stations kept were 20332 and the bait consumed was 5752. That means nearly every fourth bait was taken. The number of rats collected dead is just about less than half i.e. 2203 of the bait consumed. Taloje centre collected more dead rats than any other ones. Total wheat used for bait making was 213170 gm. out of which 57875 gm. was

Table 5. Rat baiting by zinc phosphide @ 1% for two days.

Centre	No. of villages	No. of Bait Box Set	No. of Bait Station Bait-Eaten	Bait consumed in Grms.	Total Rats Killed		
					Male	Female	Total
Taloje	20	10575	3878	39135	365	816	1386
Morbe	Houses surrounded by rain.						
Palaspe	23	2697	550	5500	139	225	364
Dapoli	25	4372	921	9210	81	120	201
Gulsunde	24	2688	403	4030	128	124	252
Total	101	20332	5752	57875	913	1285	2203

R. rattus - 1708; B. bengalensis - 165; B. gigentia - 248; L. booduga - 1 ; S. coeruleus - 81

consumed. This means that nearly one fourth of the wheat grains as bait were taken up by the rats. Total area outside the houses was 32010 acres and in this 2203 rats were killed. Total area of houses was 63066 and in this 14191 rats were trapped. This means in baiting, 1/14 parts and in trapping l/4th part is the ratio of the kill.

Table No. 7 shows that the total area under cultivation was 10270 and the total area covered was 2487, i.e., one fifth of this was covered for burrows. Total burrows treated were 13539. It may be clarified that only one opening was treated. This was the fresh one; the remaining were closed. The actual holes would then be on an average five times the number of treated holes. This was with 10% BHC dust or sulphur or cynogas or tablets of Alluminium phosphide, after glass pieces have been put in and the openings closed. Cynogas and sulphur fumes were used in 2 and 3 villages. Zinc phosphide capsules coated with wax were put on field borders for stray rats to be killed and Malathion at 1% was sprayed at the junction of field border and standing crop to prevent the rats from entering the fields. Alluminium phosphide tablets were used at two centres and sulphur at one centre.

Table 6 gives an account of initial rat density in the control as well as villages in the centres under experimentation. It will be seen from this table that in the case of Dapoli and Pargaon the rat density has decreased after four months of experimentation while in the case of control it has increased or remained stationary.

Table 6. Rat reduction evaluated.

Villages	Rat Density Before Expt.			Rat Density After Expt.		
	Date	Days	Rats Trapped	Date	Days	Rats Trapped
			Experimental			
Dapoli	10-6-68	2	44	10-10-68	2	5
Pargaon	10-6-68	2	157	10-10-68	2	32
			Control			
Jasai	16-6-68	2	69	10-10-68	2	51
Ris	16-6-68	2	20	10-10-68	1	26

Table 7. Post baiting operations in burrows and field borders.

Centre	No. of villages covered	Total area in acres: Under cultivation	Total area in acres: Covered	No. Burrow openings treated	B.H.C. 10% in kg.	Allumi-nium phosphide tablets No.	Gases: Sulphur	Gases: HCN	Zinc Phosphide capsules kg.	Malathion 1%
Taloje	13	4204	470	2382	20				36	
	3	1105	800	2950		2250				1
Gulsunde	13	2672	90	720	3.40				6.80	
	3	623	45	830		1800				1
Dapoli	4	1009	745	4596	47.77		1		47	
	2	657	337	2061				3		1
Total	38	10270	2487	13539	70.17	4050	1	3	89.80	3

DISCUSSION

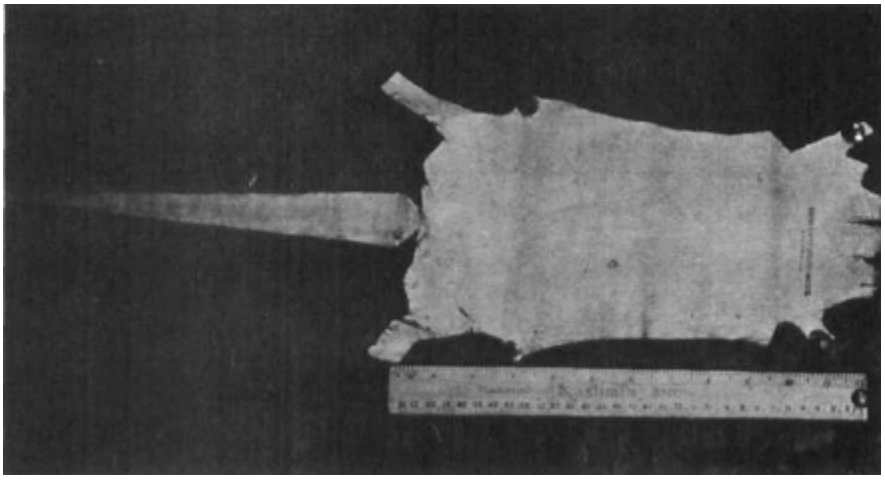
Rats do a lot of damage. W.H.O. World Health Magazine, of April 1967 at page 3, puts the loss of stored cereals at 33 million tons a year and 20% of the loss to planted crops due to rats all over the world. The same journal at page 16 mentions that "The saving in grain resulting from anti-rat measures alone was reckoned to be sufficient to provide food for 900,000 people." This was an observation of the condition of rat problems in the town of Bombay alone.

India was importing nearly 9.4 million tons of grain from the U.S.A. in 1966 and 3 rats were damaging nearly one ounce per day. Rat control was therefore imperative. The funds available for such a purpose were limited and whatever was available had to be used to get the best results.

Rat control measures are well-known. They consist of rat prevention and rat destruction. Rat prevention is a very wide term and it includes motivation also.

There was no point in doing rat eradication here and there. It had to be started from a focal point and the area enlarged to cover the state.

At the outset, let us call this programme as rat-reduction and not control. Rat-reduction is necessary for Agriculture as well as Public Health problems. Normally, these two aspects are kept separately. It is said that a rat in a house is a public health problem and that in the field an agriculture problem. From the work done at Panvel, it is noticed that the house rat migrated both ways, and both the aspects have to be taken together, Rat-reduction could be done all the year round but when the crop is in grain-stage the rats will not come to baits. It is therefore desirable to do this before the crop ripens. In the paddy growing area, the fields are full of water during monsoons and the rats have to migrate. This migration creates a concentration near residential areas, where they get shelter and food. It is therefore desirable to attack a concentration and do the maximum reduction. The rainy season in India is correlated with the rat breeding season. Rat-reduction operations at this time reduce the further breeding potential. Six of the total rats reduced i.e. 16394, there are 9199 females. If these females had bred, and on an average 5 young ones were born, the place would have had 45995 rats by the time the crop was ripe and damage started. Trapping was found desirable as the farmers saw with their own eyes the large number of rats collected and transported. Secondly, it made them available for skinning and the skin sold for tanning at 30 paisa per skin. Trapped rat meat was given to pet dogs and cats and this saved some food for human consumption. In baiting, the dead rats die in crevices and the foul smell was unbearable to the farmers.



Skin of Bandicota gigentia. It has been tanned to be used as kid leather. The tail grains are good for wrist watch straps. Length 12 inches. Locality of collection Panvel, near Bombay in Maharashtra, India. This development was made to give farmers a motivation, so that he gets some money if rats are killed and the skin fetches some remuneration.

Zinc phosphide in three cases during these experiments killed 3 poultry animals when one bait box was toppled. The rat died of this poison were once eaten by a cat and it died. The skin of a rat died of poison does not come out intact, nor is the meat fit for animal consumption. Lastly, it was noticed at one place that one trap collected a maximum of 16 rats at one time. This will never be possible by a single bait. Being safe the farmers preferred traps to a poisonous bait.

Zinc phosphide was used only in bait boxes to prevent its intake by domestic animals. It also gave a psychological effect. Bait box and bait station for safety was desirable. Insecticide dusted bait boxes reduced fleas that would move after rat death.

The filling of burrow holes with glass pieces was done as this was possible for any farmer. He cannot always have access to Alluminium phosphide or H.C.N. A cheap sulphur gas generator was designed and this the farmers could rig out themselves.

Once the operations were coming to a close, and as the crop was getting grains, some stray rats tried to migrate back to fields. The paraffin coated zinc phosphide capsules did kill a few of them. The spraying of 1% Malathion in the field borders touching the plants had the effect of repelling the rats for 7 days. They went towards the field, but returned to eat the zinc phosphide capsules.

The work was stopped with the termination of monsoon even though only 134 villages were covered by trapping and 101 by baiting and only 17 by burrow closing. This deadline gave an idea as to how much could be done and the results obtained. However, the villagers requested to complete some more villages and Table No. 8 shows the total reduced up to December, 1968.

Dr. Shrivastava (1958) has used chemicals and chemosterilants in the millet fields of Kalyanpur Block at Kanpur. Dr. Pingale (1953) had used good storage facilities and again chemicals. But both these schemes were done with the help of government staff, and there was no motivation of the farmers. Secondly, these chemicals cannot be applied without expert guidance. In the case of traps the illiterate farmer can set it himself. Lastly, the present method is to be done for only four months in a year.

Table 8. Details regarding population, houses and rats destroyed in different centres in Panvel Block up to December, 1968.

Sr,No.	Centre	No. of villages covered	Houses	Population	Total rats trapped	Total rats baited	Total rats destroyed
1	Taloje	41	3914	24015	8609	1609	10218
2	Morbe	32	1716	10022	1942	352	2294
3	Palaspe	37	3711	18313	2456	400	2856
4	Dapoli	32	3638	21259	2453	219	2672
5	Gulsunde	29	1665	10110	1865	355	2220
		171	14644	83709	17325	2935	20260

The cost of the operation could be estimated from the following available expenses.

CONCLUSION

I.	1. Traps purchased by Zilla Parishad 300 in number @ Rs. 12/- per trap. Remaining were on loan.	3,600
	2. Cost of bait boxes @ Rs. 1/- per box (600 in number)	600
II.	1. Wheat for baits 500 kg.	250
	2. Oil as attractant 20 pints.	75
	3. Zinc phosphide 20 1b. @ Rs. 7/- per lb.	140
	4. Benzene hexachloride 101 dust 50 kg. @ Rs. 5/- per kg.	250
	5. Malathion 5 lbs. donated by Pest Control Pvt. Ltd.	
	6. Alluminium phosphide tablets 5000 donated by Excel Industries	
	7. Sulphur powder 1 kg donated by Haffkine Institute, Bombay	
	8. HCN powder donated by Directorate of Public Health	
	9. Old newspapers and broken glass in bags.	20
	10. Petrol charges for conveyance	1,000
		5,915
III.	1. Daily wages labour for the period.	6.664
	2. Salaries of staff from Haffkine Institute, Directorate of Public Health, Directorate of Agriculture and Zilla Parishad is borne along with the traveling allowance and daily allowance by the respective Units.	–
	Grand Total	12,600
	Since the rat trap is a permanent investment for at least 5 years, it should not be taken into account here. The cost then would be: (Negative side)	9,000

Positive side

a) Total rats killed 20,260
b) Damage to crops and material is to be taken into account that is saved.
c) Total skins collected and sold were 50, and the meat given to dogs and cats was 20 kg.

SUMMARY

Rat reduction measures were done in 171 villages of Panvel Block in Kolaba District of Maharashtra State. It started with rat preventive measures to doors and windows and the spraying of BHC and Malathion around bamboo matting huts. With the onset of rains trapping was done by "Deoras traps" inside houses and poison baiting by zinc phosphide on the outside. Rat burrows were closed by broken glass after the pumping in of BHC 10% dust, or sulphur fumes, or HCN or Alluminium phosphide tablets. Lastly as the rains subsided zinc phosphide capsules dipped in melted wax were put on field borders and Malathion 1% sprayed in the field near crops. Total rats reduced were 20260, of which 17325 were by trapping and 2935 by baiting. In the collection, R. rattus species predominated and female rats were more in numbers than the males in all species of rats reduced. The cost of operations minus the salary and allowances of permanent staff came to Rs. 9,000/-.

Public Health and Agriculture aspects were joined together and the rat reduction was done only for four months in the year when the monsoon was on, the paddy fields were full of water and the rats migrated to residential areas for shelter. Public motivation was done by showing the damage and utilizing the rat skin and meat.

ACKNOWLEDGEMENTS

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