Effectiveness of snap traps on capturing rodent and small mammals in rural area of two provinces (Yogyakarta and West Java) in Indonesia

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Abstract. The study was conducted to determine the effectiveness of snap traps on capturing the rodents and small mammals in two provinces (Yogyakarta and West Java). A small rural area surrounded by large scale rice crops which indicate rodent damage seasonally was selected as the study site. The trappings were executed during the period of November 2018 – August 2020. Consecutive trappings were performed in two regions using snap traps baited with fresh salty fish and roasted coconut. Around 40-65 traps were set in West Java study sites and 60-65 traps in Yogyakarta for every single trap night, respectively. We checked the captured animals in the early morning and collected them for identification and sexing. In the late afternoon we continued with cleaning of the traps and put in the new same type of bait. A total of 517 animals were obtained with the proportion of the two sexes was almost the same (45.45% males:54.40% females). Based on the physical characteristics, those captured animals were three rodent species (Rattus argentiventer, Rattus tanezumi, Bandicota indica) and one species of insectivore (Suncus murinus). Regarding trapping rate of success, Yogyakarta denoted average values (21.38% in the first trapping and 26.04% from the second trapping) compared to West Java which was only accounted for half of them (11.31% and 11.24% from the first and second trapping, respectively). The heterogeneous habitat configuration probably allowed this situation to occur in Yogyakarta. Moreover, rodent control activities in West Java were implemented more intensively compared to Yogyakarta.

1. Introduction
Rodent invasions which are related to diseases and control issues are a world-wide communal health distress. This leads to obtaining insignificant consideration and frequently induced personal willingness to manage. This situation mostly disturb the municipal deprived people due to the condition in poor societies encourage rodent breeding, such as bad hygiene and drainage, exposed sewers, unmanaged garbage, inappropriate packaging of foodstuff and cooking as well as overpopulation of households [1,2] Epidemiology a certain subject studying on the correlation between the appearances of rodents in human living space and its risk to occurrence of several numerous of rodent-born diseases such as plague, leptospirosis, Lassa Fever, salmonellosis, rat-bite fever, viral hemorrhagic fevers and murine typhus [3-5]. In most cases, through animal bites, food...
contamination by rodent urine, or by animal role as the vector for other organisms such as fleas, those diseases are transmitted to human beings[2-7].

Most people rely on rodenticides to manage rodent infestations since they are recognized to be the most effective method of control [8]. A previous study in Cilamaya subdistrict (West Java - Indonesia) reported that majority farmers used rodenticide (98.3%), however none of them used anticoagulant rodenticides which are readily offered in the resident supplies. This type of rodenticide is the only registered rodenticide used for rice farming in Indonesia. A special case was widely use of nematocide (Temix) which available in small plastic sachets without instructions for its application. This compound is a potent aldicarb that has been banned in the United States of America since the 1940s. Of particular concern is the high use of organophosphate ‘azodrin’ (monocrotrophos) and endosulfan ‘akodan’ because they are mixed with vehicle oil and spread on the flooded rice paddies. Rats that penetrate the paddies get the chemical on their fur and die when they ingest the chemicals through preening themselves. Both chemicals alter the central nervous system and are wide-ranging spectrum poisons. Although monocrotrophos is rapidly degraded and does not stay in the environment, water birds [8-9], aquatic invertebrates, mammals, bees and fish are remarkably sensitive to monocrotrophos and its tolerably toxic to fish and earthworms [10]. The World Health Organization declares that this is an extremely toxic chemical and care should be selected to prevent pollution of soil grains and may consume years to entirely decompose. Endosulfan can also accumulate in organisms that exist in polluted water [11]. These substitute rodenticides applied by farmers are thought as they are user friendly, easy to find and cheap to purchase. Therefore, this case is an example of major environmental concern due to chemical practice by farmers in West Java. Most local farmers believe that using akodan is effective to control the rats, however some of them consider that the chemicals are not environmentally safe [12].

The similar use of illegal pesticides such as those mentioned above for rodent control has been associated to poisoning on human being in deprived surroundings in Zimbabwe, Brazil, South Africa, United States and Israel [2, 13-20]. Insecure contact to pesticides leads to serious strong effects (such as birth imperfection, cancers, asthma, reproductive obstacles and neurological weaknesses [21-25]. Such studies focusing on pesticide health appearance are well documented from agricultural areas [26-30, 31-32] and from municipal districts [33-34]. The important consequence of poisoning by rodenticides has been admitted as a public health concern by the United States Environmental Protection Agency (EPA). In 2011, the EPA issued a prohibition on the domestic application of most toxic rat and mouse poisons because of the careless of unintended exposures to these compounds [35]. In South Africa, parallel prosecution has not been engaged even though there appears to be a cumulative number of children healed for poisoning accredited to the intoxication of street pesticides [36, 13, 16].

Non toxic rodent control methods are necessary in these at risk communities due to an overuse of pesticides for rodent control [8]. However, only few studies which record people’s mindset concerning rat traps utilization instead of pesticides. Studies in countryside areas have revealed that rat traps are an adequate alternative control method for rodents interfering in agricultural production [8, 37]. The use of non-toxic substitutes such as rat traps involves a change in target for people to admit that these alternatives are as applicable and achievable as pesticides. Several factors have been acknowledged that are beneficial for interpretation of trap implementation and appropriateness in unfortunate societies such as whether traps are observed to be useful, whether they are simple to operate, whether there is a supplementary advantage to using them and range of the rodent invasion [38-42].

This study aimed to investigate the effectiveness of using snap traps on capturing the rats in rural communities in two provinces in West Java and Yogyakarta. The reasons for deciding these two provinces as the study sites are regarded as the center for rice production which linked to rodent as the main pest in rice cultivation. This situation leads to implementing some more practices on storing the rice in their own house for temporary access and daily needs. Their common practices therefore attract the rats to invade and destroy their rice yield stored in the house.
2. Methodology

The study was conducted in two provinces (Yogyakarta and West Java), by selecting those as the main rice production center which linked rodents as the major pest. A small rural area surrounded by a large scale of rice crop which indicates rodent damage seasonally was decided as the study site. Two villages (Jayakerta and Mulyasari) from two different sub districts in West Java were assigned as the trapping sites. The other two villages in Yogyakarta (Jogorejo and Kaliduren) as the trapping sites are also regionally separated subdistricts. Generally, local farmers implement common practices within a whole planting season including the way how to store their rice yield at home after harvesting. Most of them sell the rice yield directly when they finish harvesting and keep a little amount of rice at home for daily consumption. They keep the rice in a bag and tight them with a rope which is then stored in a particular spot close to the kitchen or in a specific space.

The trappings were executed twice during the period of November 2018 – August 2020. Consecutive trappings were performed in two regions using snap traps which were previously marked with permanent markers individually (Fig. 1 and Fig. 2). Around 40-65 traps were set in West Java study sites and 60-65 traps in Yogyakarta for every single trap night, respectively. A fresh renewed bait consisting of salty fish and roasted coconut was set daily in the late afternoon on a small well on the top surface of the trap as the bait container. These traps were then located on the trapping area following their runway with the signs of their appearance (i.e. feces, broken rice bags with remaining husk on the floor, urine odour in the ambient space). Early morning on the next day, we checked every single trap and collected the trapped animals. Then we recorded the trap number, identified and sexed these animals as well as counted the number of traps with the captured animals. The next step was cleaning the traps by spraying them with 70% of ethanol. The remaining bait was discarded and replaced with the fresh new ones [31-21].

3. Results and Discussion

Based on the species of captured animals, we found that data from West Java trapping was more diverse compared to Yogyakarta work. Three species of rodent (R. argentiventer, R. tanezumi and B. Indica) and one species of small mammal identified as insectivore (S. Murinus) were gained from both provinces (Figure 3 and Figure 4). However, S. murinus was rarely found during the trapping in Yogyakarta. Only one individual of S. murinus of the total 250 animals caught was obtained from
Yogyakarta trapping site both in the first and the second round. Although the two trapping sites have similar characteristics, R. tanezumi tended to dominate the local population. On the other hand, in West Java the dominant species was S. murinus which is not categorized as rodent, but has been known as an insectivore. This trend is presented in Table 1 and 2 signifying from the first and the second round of trapping. In terms of animal sex, population from either in West Java or Yogyakarta denoted almost a similar proportion. The males and females in West Java study have a small difference in the number of individuals recorded (41.6% : 58.4%). Moreover, an exactly similar ratio between those two sexes was exposed from Yogyakarta trapping which accounted for 49.6%:50.4% (Table 3). This data is consistent with previous study reporting that the comparison between males and females of rodents in wild populations is 1 : 1 [43].

**Fig 3.** Trapped animal (S. murinus) was found dead on the snap trap number 52.  
**Fig 4.** Different species of rodents and small mammal (insectivore) collected from one night trapping.

| Table 1. Diversity of rodent species and small mammals in two different provinces (West Java & Yogyakarta) captured from the first round using snap traps, 2018-2019. |
|-----------------------------------------------|
| % species of total animal | R. argentiventer | R. tanezumi | B. indica | S. murinus |
|-------------------------------|-----------------|-------------|-----------|------------|
| **West Java**                |                 |             |           |            |
| Males (N=42)                 | 8 (6.4)         | 4 (3.2)     | 5 (4.0)   | 25 (20.0)  |
| Females (N=83)               | 12 (9.6)        | 10 (8.0)    | 13 (10.4) | 47 (37.6)  |
| Total =125                   | 20 (16)         | 14 (11.2)   | 18 (14.4) | 72 (57.6)  |
| **Yogyakarta**               |                 |             |           |            |
| Males (N=69)                 | 6 (4.8)         | 45 (36)     | 0         | 18 (14.4)  |
| Females (N=56)               | 1 (0.8)         | 21 (16.8)   | 1 (0.8)   | 33 (26.4)  |
| Total = 125                  | 7 (5.6)         | 66 (52.8)   | 1 (0.8)   | 51 (40.8)  |

The fact that B. indica is rarely found in Yogyakarta trapping site might correlate with the habitat structure of this trapping site. As we noticed that the trapping site in Yogyakarta was a more organized and hygienic village compared to West Java. They have a good infrastructure in terms of a waste water tunnel in the village and good management for collecting the garbage. On the other hand, people in West Java trapping sites have lower socio-cultural background with lower education level and mostly are labourers or small farmers. Their environment was not managed in a good way with a
bare waste water channel and scattered trash found abundantly. This situation absolutely creates a beneficial habitat for *B. indica*. The other thing to take into account is that the socio-cultural of local people was also different. This issue definitely influences their awareness and willingness to protect themselves from the risk of rodent appearance in their village either related to economic or health implications.

**Table 2.** Diversity of rodent species and small mammals in two different provinces (West Java & Yogyakarta) captured from the second round using snap traps, 2019-2020.

| 2nd Trapping | % species of total animal |
|---------------|--------------------------|
|               | *R. argentiventer* | *R. tanezumi* | *B. indica* | *S. murinus* |
| West Java     |                        |              |              |              |
| Males (N=69)  | 13 (9.2)               | 15 (10.6)    | 9 (6.3)      | 33 (23.2)    |
| Females (N=73)| 14 (9.9)               | 15 (10.6)    | 7 (4.9)      | 36 (25.4)    |
| Total = 142   | 27 (19.1)              | 30 (21.2)    | 16 (11.2)    | 69 (48.6)    |
| Yogyakarta    |                        |              |              |              |
| Males (N=55)  | 0                      | 36 (28.8)    | 0            | 19 (15.2)    |
| Females (N=70)| 0                      | 38 (30.4)    | 0            | 32 (25.6)    |
| Total = 125   | 0                      | 74 (59.2)    | 0            | 51 (40.8)    |

**Table 3.** Sex ratio of the captured animals from the first and the second round of trapping in two different provinces (Yogyakarta and West Java), 2018-2020.

| Trapping Site | Male (N) | %     | Female (N) | %     |
|---------------|----------|-------|------------|-------|
| West Java     |          |       |            |       |
| 1st round     | 42       | 15.7  | 83         | 31.1  |
| 2nd round     | 69       | 25.8  | 73         | 27.3  |
| Total         | 111      | 41.5  | 156        | 58.4  |
| Yogyakarta    |          |       |            |       |
| 1st round     | 69       | 27.6  | 56         | 22.4  |
| 2nd round     | 55       | 22.0  | 70         | 28.0  |
| Total         | 124      | 49.6  | 126        | 50.4  |

The species dominance of captured animals found in Yogyakarta and West Java was influenced by the habitat and source of food. In West Java some rice milling units were found which can be the best living spot for the small insects as the postharvest pest. Absolutely, these small insects have an important role as the prey for the insectivore by supporting the food. During the trapping, we observed
so many similar insects inhabiting the store house (Figure 5). Therefore, they survived and multiplied with the support of abundant food around this trapping site. Additionally, insectivore is a member of mammals performing a quick reproduction. In contrast, we only noticed a few rice milling units in Yogyakarta which tend to minimize the main habitat for supporting their breeding. The village in Yogyakarta as the trapping sites also signified a very dense population of the houses. This easily facilitates the rodent (*R. tanezumi*) to reproduce quickly. This is a reasonable point of view, as the local houses get more crowded than rodents keep reproducing to obtain their new generation. Similar studies also note this factor, which is habitat structural complexity, seems to be more important than vegetation composition for the occurrence of small mammals [44, 45].

![Figure 5](image_url)  
**Fig 5.** Small insects as the storage pest found during the trapping in West Java (A & B).

**Table 4.** Trap success of snap trap on capturing rodents and small mammals in rural areas from two different provinces (Yogyakarta and West Java), 2018-2020.

| Trapping Site | ∑ Day of Trapping | ∑ Trap Night | ∑Trapped Animal | Mean of Trap Success (%) |
|---------------|-------------------|--------------|-----------------|-------------------------|
| **West Java** |                   |              |                 |                         |
| 1st round     | 17                | 1,105        | 125             | 11.31                   |
| 2nd round     | 31                | 1,250        | 141             | 11.28                   |
| **Yogyakarta** |                   |              |                 |                         |
| 1st round     | 9                 | 585          | 125             | 21.37                   |
| 2nd round     | 8                 | 480          | 125             | 26.04                   |

Mean trap success of each province is denoted in Table 4 with higher values obtained from Yogyakarta work which almost doubled from West Java both coming from the first and the second round of trapping. This finding is consistent with previous studies reporting that there are many variables that can influence the trapping success. These variables include type of the trap, formation of
trapping arrangement, bait preference [46, 47], regional weather [48], season and stage of moon [49]. Moreover, trap efficacy for a certain species might differ in different localities [50]. There is no single trap model that will catch individual members of a local ecological community of all species, sexes, and age structure with equal probability [46]. Some other ecologists advised that to obtain a broad representation of the local small mammal fauna, we need to combine on using trap types as much as possible [51, 52, 53, 54]. However it really depends on the goal of our research. In this current study, as this is a preliminary work, we only still focus on determining the effectiveness of snap traps on capturing rodents and small mammals in rural areas. Therefore, we do not include those factors in this study as the variables to record. We will continue with more comprehensive observation and consideration including using several types of trap models in different habitats.

In conclusion, there are three rodent species trapped (R. tanezumi, R. argentiventer, and Bandicota indica) and one insectivore (S. murinus) from both locations (Yogyakarta and West Java). The snap traps are effective to catch both types of arboreal and terrestrial rodents, even insectivores living in store houses. This means that the snap traps are effective to catch those rodents from different niches. Mean of trapped success for both seasons either in Yogyakarta or West Java is almost the same which is indicated by relatively similar values. Snap traps are more effective to catch the rodents& other small mammals in Yogyakarta. However, it does not represent the richness and diversity of the local community of rodent fauna since a particular trap is not suitable for capturing all rodent species. A deep understanding by continuing work is required to gather broad information on this issue related to the complexity of those aspects.

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