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RAT Population Increase and Damage To Rice Plantations with Different Irrigation Systems In Wajo Regency, South Sulawesi Province

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KEYWORDS
Irrigated rice; rice lading; rainfed rice; Single Life Trap

ABSTRACT
One of the rice producing regions in Indonesia is South Sulawesi. Wajo Regency is the second highest rice producing area in South Sulawesi, after Bone Regency. Based on the irrigation system, rice cultivation in Wajo Regency consists of technical irrigation, rainfed rice fields, and rice cultivation or dry land. Agriculture with various irrigation systems has an impact on pest population levels and the intensity of attacks. The decline in rice productivity is caused by many factors, one of which is the attack of rice rat pests that occur in several areas in Wajo Regency. This study aims to measure the potential presence of rice rats in several irrigation systems in Wajo Regency (irrigation, rainfed rice fields, and dryland rice), analyze the management of rice rats carried out by farmers, and the factors that affect it. The method used is observing rice planting patterns based on irrigation systems, estimating the population level of rice rats with single live traps and the level of attack on several rice planting irrigation systems. Likewise, rice rat population management in several rice planting irrigation systems, data analysis, and economic analysis. The result of this study is that the highest estimate of rats is in dryland rice plantations. The intensity of rat attacks was highest in dry land Pr>F 0.045 the area of attack was highest in rainfed land Pr>F was 0.0171, for intensity and area of attack in generative phase 1. The success of cultivation in dry land was 16.3% in generative phase 1 which was 16.48%. The presence of rats correlates both the intensity of the attack and the area of each addition of rats will increase the intensity of the attack by 0.155% and the area of attack by 0.308%.

Introduction

Indonesia is an agricultural country where most of the population makes a living as farmers. A commodity that is widely cultivated by Indonesian farmers is rice because it is the main food crop. As much as 63% of energy needs and 37% of protein in the body can be fulfilled by eating rice. The magnitude of the benefits of consuming rice makes its availability need to be considered in order to meet the demand and needs of the community (Abas & Noer, 2019).

The main rice producing area in Indonesia is on the island of Java, besides that rice producers outside Java Island are South Sulawesi (Taufik et al. 2014), with an area of rice cultivation land of around 1,042,107.35 Ha (BPS South Sulawesi Province 2023). The highest rice producing district in South Sulawesi is Bone Regency with 165,259.93 Ha, next is Wajo Regency with 133,495.30 Ha (BPS 2023).

The cultivation of rice plants in Wajo Regency consists of several irrigation systems applied. This is in accordance with data from Diskominfo and Statistics (2020) and (Mubyarto & Ismail, 2023) which states that the type of irrigation in Wajo Regency consists of several irrigation systems, there are 3 types of irrigation systems that are widely used for rice cultivation in Wajo Regency, namely technical irrigation, rainfed, and dry land. Land use for technical irrigated rice is around 50% (86,142 Ha) of rice fields, rainfed land is about 28% (65,083 Ha), and for dryland rice is 19% (52,935 Ha), and other irrigation systems are around 3% (4.80 Ha) (Christianto, 2013).

Based on different irrigation or water use management systems in Wajo Regency, it can affect the attack rate and the population of pests and disease pathogens. The main pest that most often attacks and harms rice plantations in Wajo Regency is rats which can cause crop failure. Pallawalino (2021) stated that rat pest attacks in Wajo Regency caused crop failure. There are about a thousand hectares of rice fields that have failed crops due to rat attacks (Ema Rosalina Sipayung et al., 2018).

Rats can cause damage to rice plants starting from the time of rice seedbed until rice is ready to be harvested so that rats can attack various rice plant stadia both vegetative namely 1-30 HST, generative one (1) ie 31-40 HST and generative two (2) ie 41 HST-harvest (Christianto, 2013 and Ema et al. 2018) damage to rice plants in various phases not only to eat but due to the habit of rats gnawing crops and agricultural products so that it is detrimental economics (Brown et al., 2008)

Rat pests attack rice plants both with irrigation, rainfed and dry land irrigation systems because rats are pests that are difficult to control because they have high adaptability causing rats to live in various places both in macak-macak irrigated rice fields and sometimes flooded, rice in rainfed irrigation system land is land that is abundant water in the rainy season after a few days the water does not rain can become dry and dry land rice is rare there is water (Sudarmaji et al., 2017).

Land with irrigation, rainfed and dry land irrigation systems have different characteristics of farmers both farmer characteristics (age, education, experience etc.), cultivation methods (origin of beni, beni varieties, planting distance, planting system, planting patterns, planting rotation, weed control, simultaneous planting, etc.), pests and diseases (types of diseases, ways of disease control, main diseases, types of pests, ways of pest control, how to control pests, major pests etc.), harvest time (harvest age, total harvest, harvest interval), farm business analysis (land area, per ton production, net profit, labor) (Junianto & Siwiendrayanti, 2016).

Based on this background, it is necessary to conduct a study entitled "Rat Population Level and Damage to Rice Plantations with Different Irrigation Systems in

Wajo Regency, South Sulawesi Province" in order to assist in rat management strategies. All rat management techniques and strategies must be applied integrated, continuously and together in one large expanse and adapted to agricultural conditions in Wajo Regency. Based on this background, the objectives of this study are (1) the level of rice rat attacks on various age stadia of rice plants, (2) rice rat population management applied to several rice planting irrigation systems, (3) factors that affect the management of rice rat populations in rice plantations (Mubyarto & Ismail, 2023).

Research Methods

The research has been conducted from September 2022 to July 2023 on farmers' land with technical irrigation irrigation systems, rainfed rice fields, and dryland rice or fields in Pammana District, Abbanuangnge Village and Sajoanging District, Barangmamase Village, and Kera District, Wirae Village, in Wajo Regency, South Sulawesi Province.

Results and Discussions

Observation of Field Rat Population Level on Multiple Rice Planting Systems

Observation of the population level of rice field rats was carried out by *trapping* or cultivating rats on various rice plant stadia. *Single* live trap or single live trap to trap rats placed in rice planting areas randomly (*random*) that show symptoms of rat attack (*purposive sampling*). Harvesting is carried out three times per rice growing season, namely: (a) vegetative phase, (b) early generative phase, and (c) late generative phase.

Estimation of rat populations was carried out using the *removal method* with the (Zippin, 1958). These population estimates were based on catches on the first, second, and third nights, with rats caught counted and not released back into their habitat.
Zippin Formula.

a) Rumus untuk menghitung total tangkapan (T)

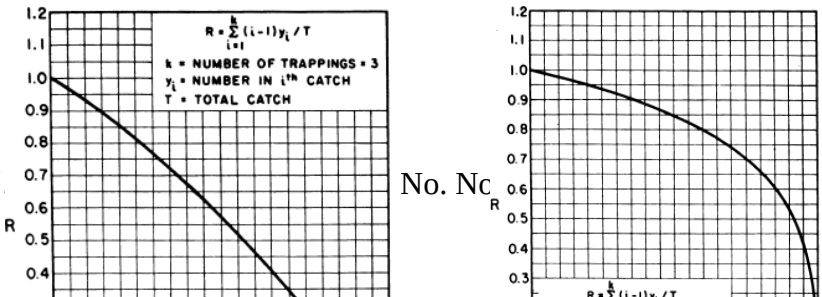
$$T = \sum_{i=1}^{3} Y$$

Y_i = Tangkapan per hari

1. Formula for calculating the ratio of the total catch (R)

$$R = \sum_{i=1}^{3} (i-1)\frac{Yi}{T} = \frac{1}{T}\,[Y_2 + 2Y_3]$$

2. The formula for determining the estimated probability of capture (P) uses figure 5a, determines (1-qk) using figure 5b (Zippin, 1958).



b

a .

Figure 1 (a) Finding the value of P, (b) finding the value of (1-qk)

1. Formula for calculating population estimation (Ň)

$$\check{N} = \frac{T}{(1 - q^k)}$$

2. Formula for determining the variance (variance) of the estimated population (V)

$$V\left(\check{N}\right) = \frac{\check{N}\left(\check{N} - T\right)T}{T^2 - \check{N}\left(\check{N} - T\right)\left(\frac{(K.P)^2}{(1-P)}\right)}$$

b) Formula for calculating standard deviation (SD)

$$SD\ (N) = \sqrt{(\check{N})}$$

Observation of Field Rat Attack Rate on Multiple Rice Planting Systems

Observation of the attack rate of rice rats in several rice planting systems was carried out by looking directly at events in the field and calculating the intensity and extent of attacks using the formula of Townsend and Heuberger (1948) as follows:

$$\text{Attack Intensity (\%)} = \frac{\Sigma \text{ anakan terserang}}{\Sigma \text{ (anakan terserang+ anakan tidak terserang)}} \times 100\%$$

$$\text{Attack Area (\%)} = \frac{\Sigma \text{ rumpun terserang}}{\Sigma \text{ (rumpun terserang+ rumpun tidak terserang)}} \times 100\%$$

The *sampling* technique of rice plants was carried out using *the diagonal transect method* on an area of ??1 ha, observed as many as 25 rice clumps with a distance between clumps, an example of 3 steps (Ditlin of Food Crops, 2018). In 1 ha of rice plantation, the level of damage was observed, namely the intensity and area of the attack. Observation of damage to rice plants was carried out three times per rice growing season, namely in: (a) vegetative phase, (b) early generative phase, and (c) late generative phase (Wahyana, 2015).

Rat Capture Success

Harvesting was carried out in irrigated, rainfed and dry land rice plantations by installing 60 traps per 1 ha, installed for three consecutive nights on vegetative vase, generati one and generative two using grain *lure* and roasted coconut (Juniarto & Siwiendrayanti) 2016). The success of catching rats (KP) or trap success can be analyzed according to the results of (Sudarmaji et al., 2017) research, using the following formula:

$$\text{Trap succes} = \frac{\text{Jumlah Tikus Tertangkap}}{\text{Jumlah Perangkap x Lama Pemasangan Perangkap}} \text{ x } 100\%$$

Data Analysis

Data analysis from the calculation of observations of rice rat attack rates on several rice planting systems was checked using fingerprints and honest real difference test (Tukey) 5% with the SAS for Windows program version 9.3 device. Data analysis of the relationship between attack intensity and rat population density was analyzed with the SPSS Statisti 27 program tool, analysis of field rat population management interview data and economic analysis on several rice planting systems tabulated in tables and processed using Microsoft Excel 2013 tools (Kuswardani, 2008).

Results and Discussion

Observation of Field Rat Population Level on Multiple Rice Planting Systems

Table 1 Analysis of Rat Population Estimation in 3 phases of rice plant growth (vegetative, generative 1, generative 2) for several irrigation systems, namely irrigation, rainfed and dry land.

	Irrigation	Tadah hujan	Dry land
Vegetatif	∞	15±12	∞
Generatif 1	37±25	13±46	∞
Generatif 2	8±3	17±2	38±18

Results of rat population estimation in 3 phases of rice plant growth, namely vegetative, generative 1, generative 2 to 3 irrigation systems. The vegetative phase in irrigated and dry land obtained by the results of this ∞ shows that the rat population has increased so that different results are obtained in ∞rainfed land rat population can still be measured population estimates, population estimates that can be measured the most rats in generative dry land 2 which is 38 and in dry land for generative 1 and vegetative results this ∞ show that the estimated rat population is highest in dry land, This is because of the ability of mice that can adapt to various existing agroecosystem conditions, plus rats have the ability to multiply quickly (Ema R Sipayung et al., 2018), *besides that it was discovered by* (Noor et al., 2022) which states in the results of his research planting rice the abundance of rats in wetlands is lower than in dry lands.

Observation of Field Rat Attack Rate on Multiple Rice Planting Systems

Table 2 Analysis of the variety of rat attack intensity on 3 vases of rice plant growth (vegetative, generative 1, generative 2) for several irrigation, rainfed and dryland irrigations

	Irrigation	**Tadah hujan**	**Dry land**
Vegetatif	1,95 aA	12,05 aA	5,41 bA
Generatif 1	8,88 aA	29,39 aA	8,73 abA
Generatif 2	8,67 aA	17,76 aA	18,34 aA
Pr>F	0,1449	0,1481	0,0454

Numbers in the same column followed by the same letter showed no significant difference at the levels of 5% (lowercase) and 1% (uppercase)

Analysis of rat attack intensity in 3 growth phases can be seen in table 1 for irrigated land not significantly different both vegetative phase (1.95), generative 1 (8.88) and generative 2 (8.67) not significantly different for the three highest phases in generative phase 1 (8.88), once in rainfed land there is no real difference between the three vases, namely vegetative (12.05), generative 1 (29.39) and generative 2 (17.76) and the highest in the three generative veses 1 (29.39) in rainfed land, in contrast to dry land where the 3 phases differ markedly especially in vegetative vase (5.41) differ markedly from generative 2 (18.34). This showed that dryland rat infestation intensity was higher than in irrigated and rainfed land was corroborated also with the result of dryland Pr>F (0.0454) smaller than irrigation (0.1449) and rainfed (0.1481) less than 0.05. This can happen because in dry land there is less rat food availability and longer food sources are available where in dry land more farmers plant 1 time a year in contrast to irrigated and rainfed land. In addition, farmers planting rice after the rainy season will end and will be harvested before the rainy season again. This is in accordance with the opinion of (Nasution, 2013) who said rat attacks do not depend on the season, but there is a tendency that attacks tend to be high in the dry season compared to the rainy season. The high attack of rats in the dry season is caused by the increased need for rat food

Table 3 Analysis of the wide variety of rat attacks on 3 vases of rice plant growth (vegetative, generative 1, generative 2) for some irrigation, rainfed and dry land irrigation

	Irrigation	Tadah hujan	Dry land
Vegetatif	11,73 bA	34,40 bA	17,07 bA
Generatif 1	37,33 abA	91,11 aA	35,55 abA
Generatif 2	61,33 aA	77,51 aA	64,00 aA
Pr>F	0,0287	0,0102	0,0171

Numbers in the same column followed by the same letter showed no significant difference at the levels of 5% (lowercase) and 1% (uppercase)

The results of the analysis of the area of rat attacks on three growth vases for irrigated land each growth vase were different, so dry land was different from generative rainfed 1 (91.11) and generative 2 (77.51) did not differ markedly, but when viewed from Pr>F the smallest less than 0.05 was rainfed land then dry land and irrigation tarakhir, Judging from Table 3 the results of the analysis of the highest variety of rat attacks are in generative rainfed 1 (91.11) so in other vase rainfed land which is always high in attack area this proves the area of high rat attacks on rainfed land, this can happen because some agricultural land in Wajo regency is flooded, this is reported by DPKP Wajo, (2020) which said that there were 7,273 ha of rice for residents who failed to harvest or were destroyed due to flooding. The estimated loss for the agricultural sector alone reached 18 billion due to flooding. Irrigated rice is land that is mostly flooded while rainfed rice is in hilly areas so that rainfed rice is only a small part submerged.

Rainfed land and irrigated land are close together so that when the irrigation area is flooded, the availability of food will decrease as well as the habitat of rats will be disturbed then rats will move, rats have the ability to move 3-5 km in one night, this is in accordance with the opinion of (Sudarmaji et al., 2017) and Sudarmaji &; Herawati (2017) which states that in conditions there is not enough feed available, Rats can migrate in large numbers, and are able to reach feed sources between 3-5 km away in one night.

Table 4 Analysis of rat attack intensity on 3 irrigation systems (irrigation, rainfed and dry land) of rice plants for vegetative, generative phase 1, generative 2

	Vegetatif	Generatif 1	Generatif 2
Irrigation	1,95 aA	8,88 bB	8,67 aA
Tadah hujan	12,05 aA	29,39 aA	17,76 aA
Dry land	5,41 aA	8,73 bB	18,34 aA
Pr>F	0,0711	0,0058	0,2211

Numbers in the same column followed by the same letter showed no significant difference at the levels of 5% (lowercase) and 1% (uppercase)

The intensity of rat attacks on 3 irrigation systems, rainfed and vegetative phase dry land was not significantly different as it was in generative 2 but for generative 1 it was significantly different in rainfed land (29.39) with irrigated land (8.88) and dry land (8.73) and for the smallest Pr>F less than 0.05 was in vase generative 1 (0.0058) this shows that the intensity of attack was highest in vase generative 1

Table 5 Analysis of the extent of rat attacks on 3 irrigation systems (irrigation, rainfed and dry land) of rice plants for phases namely vegetative, generative 1, generative 2

	Vegetatif	Generatif 1	Generatif 2
Irrigation	11,73 aA	37,32 bAB	61,33 aA
Tadah hujan	34,40 aA	91,11 aA	77,51 aA
Dry land	17,07 aA	35,55 bB	64,00 aA
Pr>F	0,1220	0,0070	0,6578

Numbers in the same column followed by the same letter showed no significant difference at the levels of 5% (lowercase) and 1% (uppercase)

The results of the analysis of the extent of attacks on the three irrigation, rainfed and dryland irrigation systems in the vegetative vase did not differ significantly once in the generative phase 2 but in generative vase 1 in the three different irrigation systems, the smallest Pr>F was less than 0.05, namely in generative 1 (0.0070). This shows that the most extensive phase of attack is in vase generative 1.

Based on the phase of growth of rice plants in irrigated, rainfed, dry land both attack intensity and attack area the highest is the generative phase 1 this phase is the phase of bunting or milk ripening, this can happen because this phase rice emits a distinctive aroma as rats have a sharp splash. This is in accordance with the opinion of Solikhin & Purnomo (2008) which states that at primordial times it is possible for rice plants to emit certain compounds, such as volatile compounds or in the form of gases (volatiles) that are favored by rice field rats. During the rice bunting period, rice rats can detect the presence of rice at a radius of 200 meters with their sense of smell.

Rat Capture Success

Table 6 Analysis of Trap Succes (TS) Rats in 3 phases of rice plant growth (vegetative, generative 1, generative 2) for several irrigation systems Irrigation, rainfed and dry land

	Irrigation	Tadah hujan	Dry land	Average
Vegetatife	3,89%	3,89%	11,67%	6,48%
Generatif 1	10,56%	12,22%	26,67%	16,48%
Generatif 2	3,33%	8,33%	10,56%	7,41%
Average	5,93%	8,15%	16,3%	10,12%

Trap succes with high rat catches are in dryland rice plantations, which is an average of 16.3%, compared to the average rainfed land of 8.15% and irrigation of 5.93%, and the highest rat catch in the rice planting phase, which is in the generative phase 1, which is 16.48%. This proves that alkaline and dry land has no effect even the success in dry land from the table above rice in dry land is higher trap succes, this can happen because rats have a sharp smell where in this study using grilled coconut umapan the aroma of roasted coconut is more resistant in dry land than irrigation and rainfed which is usually exposed to rain so that roma from burnt coconut can be reduced, Genrative phase 1 becomes the most important because in this phase rice emits a scent that rats can smell the aroma, this is in accordance with the panbisa Solikhin &; Purnomo (2008) which states that at the primordial time it is possible for rice plants to release certain compounds, such as volatile compounds or in the form of gases (volatiles) that are favored by field rats. During the rice bunting period, rice rats can detect the presence of rice at a radius of 200 meters with their sense of smell. (Priyambodo, 2003) and (Siswandeni, 2020), stated that rats are animals that have a keen sense of smell so that sharp aromas make rats approach the bait and move their fists when they smell the bait. It is not only the quality of the bait that makes the dry land higher in catch, but also in the research of (Noor et al., 2022) obtained the results of his research in finding that rice planting in rat abundance in wetlands is lower than in dry land.

Conclusion

The rat population level in some rice planting systems is high, the rat population in dry land rice plantations. The rate of rat attack on various rice planting systems where the intensity of rat attack on the vase of the growth phase of rice plants (vegetative, generative 1, generative 2) for some irrigation, rainfed and dry land irrigation is the highest intensity of attack on dry land Pr>F 0.045, Area of rat attack in 3 phases of growth of vegetative rice plants, generative 1, generative 2 for some irrigation, namely irrigation, rainfed and dry land the highest area of attack in rainfed rice plantations Pr>F which is 0.0171, the intensity of rat attacks on 3 irrigation systems (irrigation, rainfed and dry land) rice plants for vegetative phase, generative 1, generative 2 the highest intensity of rat attacks in generative phase 1 where Pr>F obtained results of 0.0058 and the area of rat attacks on 3 irrigation systems (Irrigation, rainfed and dryland) rice plants for vegetative, generative phase 1, generative 2 are the highest area of rat attack in generative phase 1 where Pr>F is 0.0070. The success of rat trap succes (TS) rats in 3 phases of rice plant growth (vegetative, generative 1, generative 2) for several irrigation systems Irrigation, rainfed and dry land, high rice planting cross-sectional success in dry land is 16.3% and the highest phase of catch in genarative phase 1 is 16.48%.

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