On-Farm Local Rice Cultivars and Pest Diversity Identification of Kasepuhan Customary Communities in Banten Kidul

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ABSTRACT

Local rice cultivars have distinct characteristics that are loved by the locals, e.g. taste, quality, and softness. Owing to years of adaptation, local rice cultivars are also more resistant to pests (animal pests, diseases, weeds). Nonetheless, the people of Kasepuhan Banten Kidul's customary communities stay loyal to these cultivars. For decades, they have been practicing traditional farming. However, the varieties of local rice cultivars being planted are declining from year to year, prompting conservation efforts to be taken. This research aims to identify the types of local rice cultivars in Kasepuhan Banten Kidul and the pests associated with them. The research methods used are descriptive qualitative and quantitative. The qualitative method is used for the morphology of the cultivars, while the quantitative method is for the abundance or quantity of the pests. The quantity and diversity of the pests are subsequently analyzed using the Shannon-Wiener index (H' index). The sampling method used in this research is systematic random sampling. The research findings show that there are 3 categories in general, i.e. *pare*, *cere*, and *ketan*, each of which demonstrates morphological diversity. To date, there are 11 types of local rice cultivars planted by the farmers of Kasepuhan customary communities, i.e. *Tampey*, *Beureum*, *Sogleng*, *Srimahi*, *Srikuning*, *Kiara*, *Hurik*, *Kewal*, *Petay*, *Ketan White*, and *Cere*. Additionally, there are 13 Arthropods species of pests and natural enemies identified in the rice field agroecosystem of Kasepuhan, i.e. *Chanaphalocrosis medinalis, Dasychira inclusa, Leptocorisa acuta, Nilaparvata lugens, Zosteria sp., Munia sp., Pachydiplosis oryzae, Pomacea panaliculata, Nezara viridula, Harmonia octomaculata, Araneus diadematus,* and *Oxyopes lineatus*. Meanwhile, in terms of pest diversity, only a few pests or diseases are found to be dominating. The reason is that farmers in these communities only plant rice once a year, thereby helping maintain the balance of nature. The dominant pest associated with the local rice plants is golden apple snails. A Shannon-Wiener analysis measures an index of 2.27, which indicates moderate pest species diversity and a stable ecosystem in the area being studied.

Keywords: local rice cultivar, pest diversity, Kasepuhan Banten Kidul customary community

INTRODUCTION

Rice is one of the most important commodities in Indonesia (IRRI, 2006). Banten is an Indonesian province that has a fairly high level of biodiversity in rice varieties, especially *padi gogo*. It is being managed by the locals according to local wisdom and based on suitability with the local environment. Many customary communities are still surviving in Banten Province, including Kasepuhan and Baduy. Based on a study by Iskandar & Iskandar (2017), the Baduy people in Banten maintain ecological wisdom in their efforts to have in-situ biodiversity conservation of local rice cultivars and are able to store rice in *leuit* (traditional Sundanese rice barn) for a sustained period of time. According to Iskandar and Ellen (1999), the Baduy communities of Banten have a total of 89 local cultivars they use in traditional farming, including by Kasepuhan Banten Kidul customary communities.

Kasepuhan Banten Kidul customary communities adopt a unique farming system that is different from the usual modern farming system. Their customary law only allows rice to be planted once a year. Planting and harvesting are carried out at the same time, typically in September, according to the customary leaders' instructions. The types of rice cultivars (accessions) being planted will usually alternate each time in accordance with the customary law. Following the annual harvest festival (*seren taun*), rice fields will be fallowed and used as fish ponds or for planting secondary crops. However, the varieties of local rice cultivars planted by the communities are showing a declining trend from year to year. According to the customary leader of Kasepuhan Sinar Resmi, Mr. Asep Nugraha, there are at least 140 known types of local rice (Supriatin, 2012). A study by Kelana *et al.* (2016) shows that Kasepuhan Banten Kidul customary communities have no less than 69 local rice accessions based on the identification made by *Rorokan Pamakayaan* (agricultural expert) of Kasepuhan Ciptagelar. The Center for Plant Variety Protection and Agricultural Permits (*Pusat Perlindungan Varietas Tanaman dan Perizinan Pertanian* or Pusat PVTPP) of the Ministry of Agriculture has assisted Mr. Asep to compile descriptions of local rice varieties, in collaboration with the Agricultural Agency of Sukabumi District. With this assistance, the descriptions of 15 out of 68 local rice varieties in Kasepuhan have managed to be completed and submitted to Pusat PVTPP (Ministry of Agriculture, 2017). Nevertheless, most of the younger generations of Kasepuhan Ciptagelar are unfamiliar with the names and characteristics of these local rice accessions. In general, they are acquainted only with 3 types of rice, i.e. *pare*, *cere,* and *ketan*.

Based on the information given by the locals, the practice of local rice farming according to local wisdom has been carried out for generations and is effective at keeping the pest populations (animal pests, diseases, weeds) economically at bay. It is thought to have an impact on the presence of pests on lands and their surrounding ecosystems. However, no research has been conducted on this subject. According to a study by Ramadhan *et al* (2018), Kasepuhan communities show their caring for the environment by not using chemical fertilizers when farming rice and other crops. Moreover, rice is only planted once a year to allow rest for the grounds before they are ready for the next planting season. Rice is normally alternated with fish ponds or secondary crops. Ramert *et al.* (2002) argue that a mixed cropping method, especially intercropping, can be a particularly effective tool for pest and disease management in the organic farming system. Another benefit of the mixed cropping method is improved soil fertility management.

Therefore, this research aims to identify (1) local rice cultivars that are still and no longer used for planting, (2) pests (animal pests, diseases, and weeds) associated with the local rice cultivars that are still used for planting, and (3) connections between the pests and the rice cultivars.

RESEARCH METHOD

This research was carried out in Cibeber Sub-district, Lebak District, Banten Province. It was conducted in 3 Kasepuhan customary communities, i.e. Kasepuhan Cisungsang, Kasepuhan Citorek, and Kasepuhan Cicarucup. The formula of the Shannon-Wiener index is used to calculate the abundance of pests and natural enemies in rice farms.

The research was conducted in Kasepuhan Cicarucub Adat Banten Kidul, Cibeber Sub-district, Lebak District, chosen for its traditional rice farms that reflect the characteristics of the local customary communities. Data collection involved several steps: first, local rice varieties were identified through in-person interviews with farmers and customary leaders. Second, the morphology of rice grains was determined by observing the external characteristics of the rice plant, including husk color, rice color, grain shape, and the condition and color of the awn (Semwal et al., 2014). Third, the morphology of rice panicles was assessed by examining the overall shape of the panicle and stem length (short-long) (Mulyaningsih & Indrayani, 2014). Finally, data on arthropod species, including both pests and natural enemies associated with rice plants, were also collected in the Kasepuhan Banten Kidul area.

The arthropods observed in this research are those classified as pests and natural enemies. The main pests attack various stages of the rice plant's life, from vegetative to ripening. The data on pest species were acquired from on-farm observation. The species were identified according to Borror & White (1970), while the data on pest control were collected from interviews with farmers.

The species of arthropods, both pests and natural enemies on-site, were observed visually using a random sampling technique. Each sample unit is $1m^2$ in size, and 9 sample units were collected in an X pattern from each plot of a rice field ($1500m^2$). The quantity of each species was counted, for which the diversity index was calculated using the following formula:

H' = -Σpi.LogPi, where

H' = Shannon-Wiener diversity index

Pi = ratio between the total individuals of one species and the total individuals of the entire samples within a plot (n/N).

RESULTS AND DISCUSSION

Traditional Rice Farming by Kasepuhan Banten Kidul Customary Communities

Kasepuhan Banten Kidul customary communities live in several different administrative areas throughout Cibeber Sub-district, Lebak District, Banten Province. The currently surviving communities are concentrated in a number of villages, i.e. Cicarucup, Cisungsang, and Citorek. To date, the communities in the three villages are still practicing traditional farming (Yusanto *et al.*, 2014), with each having a distinctive farming method

Rice Planting System in Kasepuhan Banten Kidul

A *tegel* planting system is used by Kasepuhan communities to plant rice (*Oryza sativa* L.). However, the system is less productive compared to the *legowo* planting system. This is supported by the findings of a study by Ikhwani *et al* (2013), suggesting that the latter has a greater chance of producing more seeds because of its ability to accommodate much more populations and adaptive varieties in a controlled planting environment. The distance between each planting tile in the *tegel* system adopted by Kasepuhan farmers is 20 x 20 cm and 20 x 25 cm, with 2-3 panicles of precisely 40-day-after-planting (DAP) rice as seedlings. They have to strictly follow this requirement because it is believed to have an impact on the growth of the rice plants. The communities also employ a traditional method of harvesting. They use tools, such as *ani-ani* or *ketam* (wooden or bamboo palm knife) and *tolok* (bamboo woven basket). These tools are more suited to the relatively taller habitus of their rice compared to the new varieties. Harvesting is carried out at the same time on the customary leaders' orders and has to be completed within a week.

Local Rice Cultivars in Kasepuhan Banten Kidul

The local rice cultivars found in Kasepuhan Cicarucub, Kasepuhan Citorek, and Kasepuhan Cisungsang are quite diverse. This research identifies 11 local rice cultivars that are still in use in Kasepuhan Cicarucub, 9 in Kasepuhan Citorek, and 11 in Kasepuhan Cisungsang, as shown in tables 1, 2, and 3.

Table 1. List of Local Rice Names in Kasepuhan Cicarucub

Padi		**Ketan**		**Cere**	
No.	**Local Name**	**No.**	**Local Name**	**No.**	**Local Name**
1	Padi Hurik	1	Ketan Hideung	1	Cere Koneng
2	Padi Srimahi	2	Ketan Bodas	2	Cere Beureum
3	Padi Sogleng			3	Cere Kadut
4	Padi Marilen				
5	Padi Kiara				
6	Padi Beureum				

Source : Primary Data

Table 2. List of Local Rice Names in Kasepuhan Citorek

Padi		Ketan		Cere	
No.	**Local Name**	**No.**	**Local Name**	**No.**	**Local Name**
1	Padi Kewal	1	Ketan Bogor	1	Padi Cere
2	Padi Kui	2	Ketan Lengasari		
3	Padi Peuteuy	3	Ketan Jogja		
4	Padi Srikuning	4	Ketan Hideung		

Source : Primary Data

Table 3. List of Local Rice Names in Kasepuhan Cisungsang

Padi		Ketan		Cere	
No.	**Local Name**	**No.**	**Local Name**	**No.**	**Local Name**
1	Padi Tampey	1	Ketan Hideung	1	Cere Geudeng
2	Padi Geude	2	Ketan Bodas	2	Cere hawara
3	Padi Uni			3	Cere Bogor
4	Padi Bogor				
5	Padi Hawar				
6	Padi Terong				

Source : Primary Data

Table 4. Results of Identification and Observation of Types of Local Rice Cultivars

No.	Morphological Characteristic		Planting Location	Awn (√/-)	Other Characteristics
1	Rice Name Type of Rice Shape of Grain Color of Grain Color of Rice	:Tampey :Padi beuneur/biasa : Oval : Yellow : White	Rice Field	√	Having a curly awn
2	Rice Name Type of Rice Shape of Grain Color of Grain Color of Rice	: Beureum : Padi beuneur/biasa : Oval : Black : Red	Rice Field	√	Having a curly awn

3	Rice Name Type of Rice Shape of Grain Color of Grain Color of Rice	: Sogleng :Padi beuneur/biasa : Oval : Black : White	Rice Field	√	Having a curly awn, panicle from stem is long
4	Rice Name Type of Rice Shape of Grain Color of Grain Color of Rice	: Srimahi : Padi beuneur/biasa : Round : Yellow : White	Rice Field	-	Panicle from stem is long
5	Rice Name Type of Rice Shape of Grain Color of Grain Color of Rice	: Srikuning : Padi beuneur/biasa : Oval : Yellow : White	Rice Field	√	Panicle from stem is very long
6	Rice Name Type of Rice Shape of Grain Color of Grain Color of Rice	: Kiara : Padi beuneur/biasa : Round : Yellow : White	Rice Field	-	Having a dense rice texture, panicle is short
7	Rice Name Type of Rice Shape of Grain Color of Grain Color of Rice	:Hurik :Padi beuneur/biasa : Round : Yellow : White	Rice Field	√	Panicle from stem is long
8	Rice Name Type of Rice Shape of Grain Color of Grain Color of Rice	: Kewal : Padi bener/biasa : Oval : Dark Yellow : White	Rice Field	-	Having a non-curly awn
9	Rice Name Type of Rice Shape of Grain Color of Grain	: Petey : Padi bener/biasa : Oval : Light Yellow	Rice Field	-	Having a non-curly awn

	Color of Rice	: White			
10	Rice Name Type of Rice Shape of Grain Color of Grain Color of Rice	: Ketan putih : Padi bener/biasa : Round : Black : White	Rice Field	√	Having a curly awn
11	Rice Name Type of Rice Shape of Grain Color of Grain Color of Rice	: Cere : Padi bener/biasa : Oval : Yellow : White	Rice Field	-	Having a non-curly awn

Source : Primary Data

Table 4 above outlines the results of the identification of local rice cultivars that are still in use and stored in the rice barns. They typically have an average shelf life of 5-7 years. The types of rice considered most superior and regular features in Kasepuhan Cicarucub are *Hurik* and *Srimahi*. Both share similar positive traits including having a strong stem, an average height of 150 cm and above, large grain, long panicle from the stem, broad leaf, long shelf life of 15-30 years in *leuit*, and resistance to diseases. The types of local rice frequently found in Kasepuahan Citorek were *Kewal* and *Kui*, while *Geude* was the most common in Kasepuhan Cisungsang. As a rice variety, *Geude* had the advantages of having a shelf life of 12-15 years, a strongly attached blade, and gradually decreasing sugar content as it ages.

A flower cluster of rice is called a panicle. It consists of 8-10 nodes that divide into primary branches, which further divide into secondary branches. From the panicle base on top of the node, one primary branch will typically spring, but in certain circumstances, the node may produce 2-3 primary branches (Chang *et al.*, 1965). Based on the morphology of the panicle, it was found that the local rice cultivars vary in shape, the color of the husk, the presence of the awn, and the color of the awn.

Identification of Arthropods (Pests and Natural Enemies)

The pests found attacking the rice plants in Kasepuhan Cicarucup are as follows:

a. Rice Leaf Folder (*Chanaphalocrosis medinalis*)

The rice leaf folder attacks rice leaves. Its larva feeds on the green tissues inside the folded leaf, leaving white streaks on the blade. This pest damages rice leaves during the vegetative and reproductive stages.

b. Tussock Moth Caterpillar (*Dasychira inclusa*)

The tussock moth caterpillar attacks the rice plant during the vegetative and even germination stages. This pest feeds on the leaf margin and blade, leaving only the midrib. The attack becomes more severe in the dry season.

c. Rice Bug (*Leptocorisa acuta*)

Rice bug sucks out the contents of developing grain during the milk stage, therefore causing discoloration, calcification, and unfilled or empty grain. The infected grain has a dark-spotted husk.

d. Brown Planthopper (*Nilaparvata lugens*)

Brown planthopper causes the rice plant to look as if it were burnt (hopperburn). This pest attacks the rice plant from the seedling to the milk stages. The symptom is that the leaf and stem turn yellow before becoming brown and dry.

e. Munia (*Munia sp.*)

Munia attacks the rice plant from the milk stage to the harvest stage. This bird eats the entire ripening grain, therefore causing a direct loss of yield. This pest also causes damage to rice panicles. The attack typically occurs at dusk.

f. Wild Boar (*Sus scrofa)*

Wild boar attacks the rice plant during the ripening stage before harvest, causing damage to the plant.

g. Rice Gall Midge (*Pachydiplosis oryzae*)

Rice plant is vulnerable to rice gall midge attack from the germination to panicle initiation stages. The symptom is that a tubular gall is formed causing the leaf to roll like an onion leaf. As a result, the infected plant cannot form a panicle, and the attack can stunt growth and fertilization (leaf curls-in, preventing fertilization).

h. Golden Apple Snail (*Pomacea panaliculata*)

Golden apple snail is predominantly found during the vegetative stage of the rice plant.

i. Green Stink Bug (*Nezara viridula)*

Meanwhile, the natural enemies identified in the rice fields of Kasepuhan Banten Kidul customary communities were as follows:

a. Ladybird Beetle (*Harmonia octomaculata*)

This insect is a natural enemy from the order *Coleoptera*.

a. Robber Fly (*Zosteria sp.*)

This fly is an insect from the order *Diptera* and the family *Asilidae*, which is classified as a natural enemy.

b. Cross Spider (*Araneus diadematus)*

An *Araneus diadematus* spider is also called a crowned orb-weaver spider. It is among the most effective natural enemies in the rice farm.

c. Lynx Spider (*Oxyopes lineatypes*)

Oxyopidae spider is a non-orb weaver spider. It is found on top of rice leaves. This spider is classified as a natural enemy.

The abundance of arthropods, both harmful pests and beneficial natural enemies, found in the traditional farms of Kasepuhan Banten Kidul is outlined in Table 5. Table 5 shows that the rice fields in Kasepuhan had a high level of animal diversity, measuring at 2.27 in the Shannon-Wiener index. Having a high H' index indicates that the agroecosystem environment is stable. A stable ecosystem is more resistant to pests because each trophic level in the food pyramid is always maintained at a balance. Every chain in the food web is also occupied by primary consumers, secondary consumers, and so on so that the quantity of each population remains under control. This research identified 4 species of natural enemies, i.e. *Oxyopidae* and *Araneus diadematus* (spiders), *Coccinellidae*, *Harmonia octomaculata* (ladybird beetle), and *Zosteria sp*.(robber fly). The main factor contributing to the stability of the agroecosystem in Kasepuhan is their once-a-year simultaneous planting season, which is carried out with minimal use of agricultural input.

Table 5. Abundance of Animal Species in the Rice Fields of Kasepuhan

No.	**Species**	**N**	**N**	**n/N**	**ln pi**	**pi x lnpi**
1	*Chanaphalocrosis medinalis*	57	471	0.12	-2.11	-0.26
2	*Nilaparvata lugens*	79	471	0.17	-1.79	-0.30
3	*Zosteria sp.*	12	471	0.03	-3.67	-0.09
4	*Pomacea panaliculata*	98	471	0.21	-1.57	-0.33
5	*Pachydiplosis oryzae*	31	471	0.07	-2.72	-0.18
6	*Nezara viridula*	25	471	0.05	-2.94	-0.16
7	*Sus scrofa*	2	471	0.00	-5.46	-0.02
8	*Dasychira inclusa*	17	471	0.04	-3.32	-0.12
9	*Araneus diadematus*	9	471	0.02	-3.96	-0.08
10	*Harmonia octomaculata*	32	471	0.07	-2.69	-0.18
11	*Leptocorisa acuta*	65	471	0.14	-1.98	-0.27
12	*Munia sp.*	28	471	0.06	-2.82	-0.17
13	*Oxyopes lineatypes*	16	471	0.03	-3.38	-0.11
	Σpi.lnpi					-2.27
	- Σpi.lnpi					2.27

Planting rice once a year simultaneously is highly effective at suppressing pest populations since it leaves no food for the pests throughout the rest of the year. Yaherwandi (2009) argues that the abundance, total species, and families of *Hymenoptera* parasitoid insects found on vegetables and rice plants farmed in a polyculture ecosystem are higher than in a monoculture ecosystem. On farmland, farming practices have a very significant impact on insect diversity (Rizali *et al*., 2002)..

The farmers of Kasepuhan communities rarely use synthetic fertilizers; instead, they rely only on straw compost. This practice has a tremendous impact on the biodiversity of soil microorganisms, thereby contributing to a healthy condition. According to Iskandar (2003), in production, straw compost has a role of boosting the formation of productive tillers, which consequently results in a higher count of panicles/clusters and per 1000-seed weight. The compost contains a variety of microorganisms beneficial to the growth and formation of tillers, for example, photosynthetic bacteria and nitrogen-fixing bacteria identified on the leaves of some of the species tested. Research by Babalola *et al.*(2012) on tomato plants shows that the total microbial count is significantly higher after the addition of compost at a 20 t/h dosage. Applying compost increases soil organic carbon and microbial activities, which improves the physical quality of the soil. In general, it has the ability to enhance the chemical, physical, and biological properties of soil, thus helping stimulate growth in tomato plants. A study by Chau & Heong (2005) concludes that organic fertilizers and manure are more effective than chemical fertilizers at stimulating growth in rice plants and building tolerance to pests and diseases. The effects are evident in increasing plant height, total tiller count, and SPAD index, and decreasing stem borer, brown planthopper, and leaf roller caterpillar populations, as well as less occurrence of blast and sheath blight diseases. The primary defense mechanism of rice is influenced by nitrogen and phosphate contents (the lower, the better) and potassium levels (the higher, the better) of the plant's tissues. Furthermore, the application of manure and organic fertilizers also contributes to protecting natural enemies living on-farm.

In addition, pesticides are also rarely used by the farmers of Kasepuhan, which has a positive impact on the conservation of natural enemies that can suppress herbivore (pest) populations. Agroecosystem management is essentially introducing biological control by optimizing the role of natural enemies as a factor limiting the growth of herbivore populations in an ecosystem. It can be achieved through a higher level of biodiversity from increasing vegetation diversity. In doing so, a polyculture farming system with optimum agronomic settings can be adopted to ensure maximum and sustainable land productivity (Thoeming and Poehling, 2006). Kasepuhan Banten Kidul customary communities have never suffered from crop failure due to pest attacks. The farming system applied by the farmers in these communities has met the criteria of sustainable agriculture or organic farming. Sugito (2003) states that the steps that need to be considered when implementing sustainable agriculture are, among others: (1) maintaining and improving soil fertility by applying the right farming technologies to increase crop yields; (2) mitigating land degradation resulting from land management practices that are against the conservation principles; (3) emulating the processes that take place in a natural ecosystem, such as trying to ensure a cycle of organic matters and nutrients; (4) increasing the soil holding capacity; (5) reducing the use of external chemical input, such as by substituting inorganic with organic fertilizers; (6) empowering farmers to build confidence in the success of their farming business; and (7) promoting the efficiency of production processes, which can ultimately boost profits and earnings.

CONCLUSION

The research concludes that the farmers of Kasepuhan Banten Kidul customary communities have a distinctive traditional farming method. The basic attribute that sets it apart from the modern farming system is its once-a-year planting season, followed by conversion to fish farming or secondary crops. Both planting and harvesting begin at the same time on the orders of the customary leaders. The farmers rely on straw that they compost into the soil as a source of nutrients. There are currently 11 types of local rice cultivars that are still in use by these farmers, i.e. *Tampey*, *Beureum*, *Sogleng*, *Srimahi*, *Srikuning*, *Kiara*, *Hurik*, *Kewal*, *Petay*, *Ketan Putih*, and *Cere*. The most common ones are *Kewal*, *Kui*, *Hurik*, *Srimahi*, and *Guede*. From the results of identification, 13 species of animals are found in the agroecosystem of rice fields in Kasepuhan, i.e. 9 species of pests comprising *Chanaphalocrosis medinalis*, *Dasychira inclusa*, *Leptocorisa acuta*, *Nilaparvata lugens*, *Munia sp.*, *Pachydiplosis oryzae*, *Pomacea panaliculata*, and *Nezara viridula*, as well as 4 species of natural enemies comprising *Zosteria sp.*, *Harmonia octomaculata*, *Araneus diadematus*, and *Oxyopes lineatus*. However, the ecosystem is completely stable, proven by measuring at 2.27 in the H' index, which is classified as high diversity of organisms.

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APPENDIX

		
Image 1. *Dasychira inclusa*	Image 2. *Leptocorisa acuta*	Image 3. *Zosteria sp.* robber fly
		
Image 4. *Nezara viridula*	Image 5. *Harmonia octomaculata*	Image 6. *Oxyopes lineatypes*
		
Image 7. *Pomacea canaliculata* eggs	Image 8. *Araneus diadematus*	

		
Image 9. *Padi Srikuning*	Image 10. *Padi Beureum*	Image 11. *Padi Cere*
		
Image 12. *Padi Kewal*	Image 13. *Padi Sogleng*	Image 14. *Padi Tampay*