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Ethnophysics Analysis of the "*Wiwit Padi*" Tradition in Lamongan, East Java

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ABSTRACT

This research explores the ethnophysical aspects embedded in the Wiwit Rice Tradition practiced by the agrarian community of Lamongan, East Java. The study aims to identify and analyze physics concepts manifested in traditional agricultural activities as part of Indonesia's rich local wisdom. Using a qualitative descriptive approach, data were collected through literature studies, observations, and semi-structured interviews with local farmers and community elders. The findings reveal that the Wiwit Rice Tradition reflects several fundamental physics principles, including force, pressure, torque, friction, and heat transfer. For example, cutting rice stems using a sickle demonstrates the application of pressure and mechanical work, while drying rice in sunlight illustrates heat radiation and energy transformation. These physical phenomena are integrated with cultural values of gratitude, harmony with nature, and sustainability. The results highlight that ethnophysics can bridge scientific understanding and cultural practice, offering contextual and meaningful learning experiences. By incorporating such traditions into physics education, students can better comprehend scientific principles through real-life cultural phenomena while fostering respect for local heritage. This study concludes that the Wiwit Rice Tradition provides valuable insights into how indigenous practices embody scientific knowledge, supporting the development of culturally responsive and sustainability-oriented science education.

INTRODUCTION

Indonesian cultural traditions and activities contain a wealth of local knowledge related to scientific concepts, including physics concepts (Rohman & Warliani, 2025). However, the use of local wisdom as a source of physics study is still not optimal, especially in the context of agrarian culture, which has great potential to be used as a medium for learning and scientific research (Putri et al., 2025; Aprillia, 2025). Based on this, ethnophysics has emerged as an approach that examines the principles of physics found in the cultural practices of communities (Septyan & Kuswanto, 2025). This approach provides an opportunity to reveal the real connection between

traditional phenomena and physics, so that physics concepts can be understood in a more contextual and meaningful way (Nasution et al., 2025).

Ethnophysics is part of ethnoscience, which combines science with local cultural values (Suprapto & Santoso, 2025). This approach provides an alternative learning medium that is closer to the life experiences of students, thereby increasing their understanding of concepts and fostering a love for regional culture (Utami et al.,2024). Through ethnophysics, students are invited to examine physical phenomena in cultural activities, so that physics concepts are not only understood theoretically but also interpreted through facts that occur in their social and cultural environment (Rodiah et al., 2025). Therefore, ethnophysics has the potential to enrich the physics learning process, which emphasizes not only cognitive aspects but also appreciation of local wisdom (Ningrum et al., 2025).

Ethnophysics studies have been conducted on several Indonesian traditions and activities. Previous studies have found physics concepts in the process of making es dawet siwalan (Rusmaya et al., 2025), traditional games such as engklek (Sari et al., 2023), egrang (Wulandari & Fatmaryanti, 2024), and gamelan musical instruments (Aisah et al., 2025). In addition, similar explorations have also been conducted on the traditional game of *patil lele* (Rohmah et al., 2024), the traditional food klepon (Sari et al., 2024), and the "*Ancak Robyong*" culture in East Java (Nadzirin et al., 2024). The results of these studies show that local culture has a close relationship with physics and can be used as an alternative learning resource (Festiyed et al., 2024; Riswanto et al., 2025). However, not all Indonesian cultural traditions have been scientifically explored to identify the principles of physics within them, so there is still room for further research.

One tradition that has not been widely studied is the wiwit pari tradition, which is a Javanese tradition as a form of gratitude before the harvest. This tradition involves various agricultural activities, the use of traditional tools, and community interaction with the natural environment (Ummami et al., 2025; Muliyandari & Al Anshori, 2025). In each series of activities, there are physical phenomena that can be identified. In addition, the cultural values contained in the *wiwit pari* tradition also reflect the harmonious relationship between humans and nature, which is relevant to contextualize in character-based science learning (Sodiki et al., 2025; Hidayah et al., 2025; Pujianti, 2025).

Despite its strong potential as a learning resource, scientific studies on ethnophysics in the *wiwit pari* tradition are still very limited (Nisak et al., 2025). There is not much literature that systematically identifies and analyzes physics concepts in this tradition. This condition indicates the need for research that can explain the relationship between the *wiwit pari* tradition and physics concepts scientifically. This research is important so that local wisdom can be utilized as a meaningful learning resource while supporting cultural preservation.

Based on this background, this study aims to analyze and identify the concepts of physics found in the tradition of *wiwit pari*. Through this study, it is hoped that new insights will emerge regarding the potential of local traditions as a source of culture-based physics learning and that it will contribute to the development of ethnophysics studies in Indonesia.

RESEARCH METHOD

This study uses a descriptive qualitative approach with three main techniques in data collection, namely literature study, observation, and interviews. This approach was chosen because it can provide an in-depth description of the social and cultural phenomena being studied and allows researchers to analyze data systematically and contextually (Odden et al., 2024; Rukin, 2019).

The first stage is a literature study, which is conducted by examining various written sources such as books, scientific articles, and journals related to the *Wiwit Padi* tradition and relevant physics concepts. This literature review aims to trace previous research results and strengthen the theoretical basis of the study. The review process is carried out systematically, starting from searching, selecting, to synthesizing bibliographic sources to ensure the accuracy and credibility

of the information used (Chigbu et al., 2023).

The next stage is direct observation at the location where the *Wiwit Padi* tradition is carried out. Observations were made to observe community activities, the tools used, and the stages of the ritual procession in order to identify the physical phenomena that arise at each stage of the activity. This approach allows researchers to find empirical links between physical concepts and cultural practices and relate them to relevant physical principles (Qawaqneh et al., 2024).

Next, semi-structured interviews were conducted with community leaders, farmers, and village elders to gain an in-depth understanding of the values, meanings, and cultural practices involved in the *Wiwit Padi* tradition. This technique gave researchers the flexibility to adjust questions to the context of the conversation and deepen the findings of the observation (Bunyamin et al., 2020).

Data from these three collection techniques were then analyzed through triangulation to ensure the validity and consistency of the findings. Triangulation was carried out by comparing the results from various data sources to strengthen the validity of the research results. The analysis was conducted descriptively through three main stages, namely data reduction, data presentation, and conclusion drawing or verification, resulting in a comprehensive understanding of the relationship between physics concepts and cultural practices in the *Wiwit Padi* tradition (Moleong, 2015).

RESULTS AND DISCUSSION

Wiwit Pari Tradition

Wiwit Pari is a tradition of the agrarian community in East Java, particularly in the Lamongan region, which is carried out as a form of gratitude to God for the arrival of the harvest season. The term *wiwit* means "to begin," so this tradition is interpreted as a sign of the start of the rice harvesting process (Sari & Setyawan, 2022). It is carried out in the fields when the rice plants have turned yellow and reached maturity. Unlike large traditional ceremonies that are carried out en masse, this tradition is generally carried out by each farmer independently on their own land, as a personal expression of gratitude and respect for the crops that have been cared for throughout the planting season (Hidayah et al., 2025).

In its implementation, farmers prepare simple offerings in the form of agricultural products such as small tumpeng rice, side dishes, fruits, and flowers as symbols of hope for blessings, fertility, and abundance. The process begins with a short prayer asking for a smooth harvest, followed by the cutting of the first few stalks of rice using a sickle. The first stalks cut are usually tied together and stored in the house or barn as a symbol of blessing and a form of respect for the source of livelihood (Sawitri & Pujiyana, 2024).

Although carried out individually, this tradition still reflects the cultural values of agrarian communities, namely awareness of dependence on nature, appreciation for one's own work, and gratitude for the sustenance obtained. In addition to its spiritual and philosophical value, *Wiwit Pari* also demonstrates farmers' empirical knowledge in determining the harvest time based on signs from nature, climatic conditions, grain color, and the level of rice grain maturity (Dewi et al., 2025). This confirms that these traditional practices are not only ritualistic in nature, but are also based on scientific observations that have been passed down from generation to generation, making them interesting to study through an ethnophysical approach as part of local knowledge in agricultural activities (Anggrasari et al., 2025).

Physics Concept at the time Cutting Rice Stalks

When a farmer cuts a rice stalk using a sickle, a physical process involving force and effort occurs. The farmer applies force to the sickle, causing it to move and sever the fibers of the rice stalk. In physics, work is defined as:

$$W = F \times s \quad (1)$$

Where W is the effort, F is the applied force, and s is the distance the sickle moves. The greater the force applied and the longer the distance the sickle moves, the greater the work the farmer expends to cut the rice stalk.

Figure 1. Ilustration style when cutting rice stalks

In addition to effort, the sickle cutting process also involves the concept of pressure, especially because the sickle blade has a narrow, sharp tip. Pressure is formulated as:

$$P = \frac{F}{A} \quad (2)$$

where P is the pressure, F is the force, and A is the contact area. Because the surface area of the sickle tip is very small, the resulting pressure is large even though the applied force is not very great. This explains why a sharp sickle is easier to use to cut rice than a blunt tool.

The rice cutting process also involves the principle of torque when the farmer swings the sickle. When the farmer holds the sickle further from the handle's pivot point, the swing arm lengthens, increasing the torque. The formula for torque is:

$$\tau = F \times r \quad (3)$$

where τ is the torque, F is the cutting force, and r is the distance between the farmer's hand and the center of rotation of the sickle. The longer the sickle handle, the greater the torque generated, making the swinging motion more effective in cutting rice. This demonstrates that the sickle holding technique is also a practical application of physics principles, traditionally practiced by farmers in rice harvesting.

with P pressure, F force, and A area field touch. Because of the wide field end sickle very small, then the pressure generated become big although given style No too big. This is explain Why sharp sickle more easy used For cut paddy compared to blunt tool.

Cutting process rice also involves principle moment force (torque) when farmer swing sickle. When farmer hold sickle more Far from point axis handle, arm swing increase long so that moment style increase. Formula moment style is:

$$\tau = F \times r$$

With τ moment force, F force cut, and r distance between hand farmer to center round sickle. The more long distance handle sickle, increasingly big moment the resulting force, so movement swing more effective cut rice. This is show that technique hold sickle is also a implementation practical principles of physics, which have been passed down from generation to generation done farmers in the harvest tradition pari.

Friction and Pressure on Land Ricefield

When farmers walk in muddy fields, they experience the interaction between pressure and friction. Mud is malleable, so excessive pressure will cause the feet to sink. Physically, pressure is formulated as:

$$P = \frac{F}{A} \quad (4)$$

Figure 2. Farmers Walking on Mud

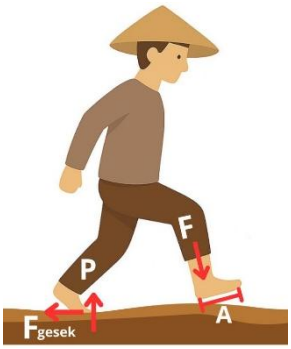

Figure 3. Illustration of the Forces at Work When a Farmer Walks on Mud

Where P is pressure, F is body weight (force due to gravity), and A is the surface area of the soles of the feet in contact with the ground. When farmers wear sandals with a wider surface area or walk barefoot, the contact area A is larger, so the pressure P exerted on the mud is smaller. As a result, their feet do not sink easily into the mud, helping farmers walk more steadily.

In addition, friction also plays an important role when walking in rice fields. Friction is a force that resists motion and is formulated as:

$$F = \mu \times \mathrm{N} \tag{5}$$

where F is the friction force, μ is the coefficient of friction between the foot and the mud, and N is the normal force (the force exerted by the surface on the body). When the muddy ground is very slippery, the value of μ becomes small, so the friction force decreases and farmers are more likely to slip. Conversely, if the soil texture is slightly rougher or farmers wear sandals with serrated soles, the value of μ increases, resulting in greater friction and more stable footing.

Pressure and friction work together to help farmers maintain their balance. If the pressure is too great (for example, when using narrow footwear), the feet will sink into the mud and friction will decrease because the slippery mud surface sticks to the sandals or feet. This makes it difficult for farmers to lift their feet and easier for them to slip.

Physics Concepts during the Harvesting Process

During the harvesting process, farmers use mechanical energy from their muscles to lift, carry, and arrange the harvest. The energy used comes from chemical energy in the body, which is obtained through the metabolism of food and then converted into mechanical energy to perform physical work. In physics, work (W) occurs when a force causes an object to move. This relationship is expressed by the equation:

$$W = F \times s \tag{6}$$

Where W = work (J), F = force applied (N), and s = distance of displacement of the object (m). When farmers lift or move sacks of rice several meters, they are performing mechanical work. The greater the mass of the sack of rice and the greater the distance it is moved, the greater the work performed.

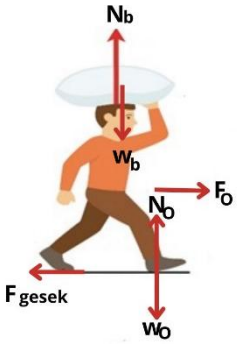

Figure 4. Illustration of a farmer carrying a sack of rice

The forces acting on the farmer when carrying the rice load are illustrated in Figure 4. These forces include:
w_b = the weight of the load (rice sack) acting downward due to Earth's gravity,
N_b = the normal force from the farmer's head that supports the weight of the load,
w_o = the weight of the farmer's body, which acts downward,
N_o = the normal force from the ground that supports the weight of the farmer's body,
F_o = the force of the muscles acting forward to produce motion,
F_{gesek} = the frictional force from the ground acting in the opposite direction to the farmer's motion.

The balance of forces in the vertical direction ($N_b + N_o = w_b + w_o$) keeps the farmer's body stable, while the horizontal forces (F_o dan F_{gesek}) play a role in the forward motion. This activity shows that in traditional agricultural activities, farmers have indirectly applied the concepts of effort and mechanical energy in their daily lives.

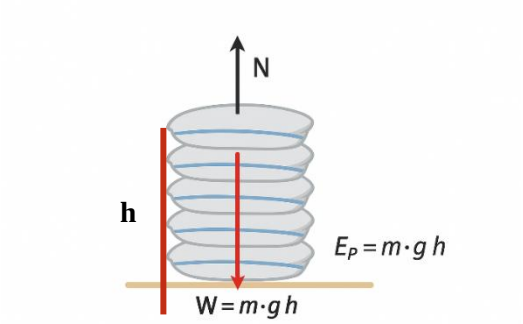

Figure 5. Illustration of gravitational potential energy in a stack of rice sacks

In addition to mechanical effort, carrying or lifting sacks of rice also involves gravitational potential energy, especially when the rice is moved to a higher place such as a storage barn or a pile of rice sacks. Gravitational potential energy is formulated as:

$$E_P = m \times g \times h \quad (7)$$

where m = mass of rice (kg), g = acceleration due to gravity (9.8 m/s²), and h = height (m). The greater the mass of the rice and the higher the storage position, the more energy is needed to lift it. This process shows that farmers indirectly apply physics concepts in their daily lives, namely by utilizing energy from their bodies to work against the Earth's gravitational force.

After harvesting, rice is dried to reduce its moisture content before being milled or stored in barns. This stage is very important because excessive moisture can cause the rice to spoil, become moldy, or sprout. From a physics perspective, the rice drying process is closely related to the concepts of heat energy and thermal radiation.

Figure 6. Farmers Drying Rice

The sun acts as the main source of energy, emitting energy in the form of electromagnetic waves. This radiant energy propagates without requiring an intermediate medium and is then absorbed by the surface of the rice grains and the floor where they are dried. As a result, the temperature of the rice increases and the water stored in the grains evaporates, reducing the moisture content. This phenomenon illustrates the mechanism of heat transfer by radiation, one of the three main ways of heat transfer besides conduction and convection. Physically, the heat

transfer received by rice from sunlight can be explained using the equation:

$$Q = m \times c \times \Delta T \quad (8)$$

where Q = heat, m = mass of rice, c = specific heat, and ΔT = temperature change. The greater the intensity of sunlight and the longer the drying time, the more heat energy is absorbed, causing the temperature of the rice to increase more quickly. However, in practice, farmers also pay attention to weather conditions, air humidity, and the thickness of the rice layer, as these factors affect the rate of water evaporation.

CONCLUSION

The study shows that the *Wiwit Pari* tradition practiced by farmers in Lamongan reflects several fundamental physics principles, including force, pressure, torque, friction, and heat transfer. These principles appear naturally in daily agricultural activities, illustrating how local traditions can serve as a medium for understanding scientific concepts in a more contextual way. The findings highlight that connecting local wisdom with physics learning can make scientific ideas more meaningful and relevant to students' lives. This study is limited to qualitative analysis and has not yet tested its application in classroom practice. Future studies are expected to explore how ethnophysics-based learning derived from the *Wiwit Pari* tradition can be implemented in physics education to support conceptual understanding and cultural appreciation among students.

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