

The Nyadran Tradition Based On Ethnoscience As The Local Wisdom Of The Balongdowo Community Of Sidoarjo

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ABSTRACT

This study uncovers the hidden physics within the Nyadran tradition, an Indonesian ritual of ancestral homage. Moving beyond formulas, we employ an ethnoscience lens to reveal how this enduring local wisdom actively preserves and demonstrates core scientific principles. The research method used is descriptive qualitative in this case using journals with various primary data and interviews as secondary data in the data collection process. It is known that the stages of the Nyadran tradition can be analyzed using the concept of physics. The research results obtained are the preparation stage there is an optical concept at the time of installing the lights, the departure stage is the concept of displacement and equilibrium of rigid bodies and land winds, the stage of disposal of a chicken and larung offerings is the concept of floating objects from Archimedes' law, the stages of pilgrimage to Dewi Sekardadu's tomb are displacement, the stages of searching for kupang have the concepts of effort and energy, the stages of returning home have the concepts of displacement and sea breeze. Our findings illuminate the Nyadran not merely as a cultural practice, but as a living, applied physics lesson, offering a powerful model for contextualizing science education and appreciating the ingenuity embedded in tradition.



INTRODUCTION

History of Nyadran on Hindu/Buddha Era

The traditional Nyadran ceremony derives etymologically from the Sanskrit *śrāddha*, a ritual for venerating noble ancestors—a practice historically manifest in the glorification of statues and temples during Java's Hindu-Buddhist period (Bhawuk, 2020). This connection is substantiated by indigenous records; for example, the Mpu Prapanca inscription documents a *śrāddha* ceremony marking the twelfth anniversary of the death of Sri Gayatri Rajapatmi, grandmother of King Hayam Wuruk and daughter of Kertanegara, the last ruler of Singhasari (Hartoyo, 2017). The ritual form evolved in later Majapahit era, as evidenced by Mpu Tanakung's 1450 AD *Kakawin Banawasekar*, which describes a *śrāddha* performed by royal princes using a boat filled with flowers—*banawasekar* meaning "river of flowers." This floral boat ritual finds a monumental parallel in the Mahaśrāddha ceremony held to honor Batara Prabu Kertabumi (Brawijaya V), the last sovereign of Trowulan (Budiningsih et al., 2022). Consequently, the

contemporary Nyadran tradition, particularly its signature use of ceremonial boats (*jung*), can be traced to these documented Majapahit precursors, bridging modern practice with the archipelago's classical past.

During the Islamic era in Java, the Hindu-Buddhist *śrāddha* ceremony underwent a process of Islamization, wherein certain cultural traditions were adapted while others were intentionally modified. Figures of the Wali Songo, such as Sunan Ampel, Sunan Kalijaga, and (more controversially) Siti Jenar, are traditionally credited with preserving this ritual framework by re-contextualizing it under the Islamic term *nyadran*. This adaptation maintained core symbolic elements, most notably the *banawasekar* or "river of flowers" ritual described in Mpu Tanakung's *Kakawin Banawasekar* as a *śrāddha* performed with a flower-laden boat. On a village level, the ceremony evolved to focus on communal grave cleaning (*nyadran*) and honoring familial ancestors. The timing was also integrated into the Islamic calendar, specifically in the month of *Ruwah* (from the Arabic *arwāh*, meaning spirits) preceding Ramadan, during which families would visit graves, scatter flowers, and hold thanksgiving (*slametan*) commensurate with their means. This syncretic transformation created a distinct practice from its Majapahit predecessor, which, as recorded in the *Kakawin Nagarakertagama*, could involve grand state ceremonies lasting over a month to honor figures like Sri Gayatri Rajapatmi (Al-Aliyah et al., 2020).

Nyadran in Nowadays

Nyadran is a deeply rooted tradition in Javanese society, representing a syncretic ritual of ancestral commemoration. Etymologically, the term derives from the Sanskrit *śrāddha*, signifying "faith" or, more specifically, a ceremony of faithful remembrance for the deceased. Over time, this core practice of praying for ancestors has evolved into a comprehensive custom encompassing various local arts and communal culture (Ismail, 2021). The ceremony is also commonly known as *Ruwahan*, as it is performed during the Islamic month of *Ruwah* (Sha'bān), immediately preceding Ramadan. Historically, this timing and the ritual's contemporary form embody a profound acculturation between indigenous Javanese Hindu-Buddhist traditions and Islamic teachings—a synthesis facilitated by historical figures such as the Wali Songo, who reinterpreted the older *śrāddha* within a new religious framework while retaining key symbols like the floral offerings (*banawasekar*).

The *Nyadran* tradition constitutes a rich cultural manifestation, characterized by a series of core activities that embody communal respect and social solidarity (Kusuma, 2021). The foundational act is *bersih* or *besik*: the collaborative cleaning of ancestral graves by families and community members. Following this preparatory work, the community proceeds to the ceremonial site, where the ritual formally commences with the *ujub*—the declaration of intent and purpose—delivered by the Traditional Leader. This leads into the central act of communal prayer (*doa bersama*), offered to honor the spirits of ancestors. The entire sequence culminates in the spirit of *kembul bujana* (*kembul bujono*), a shared feast where each family contributes and partakes in dishes, concluding the ceremony with collective gratitude (*tasyakuran*).

The feast is composed of traditional Javanese dishes, which may include *ingkung* (a whole, ceremonially prepared chicken), *sambal goreng ati* (fried liver in chili sauce), *urap* (steamed vegetables with spiced coconut), *perkedel* (potato or corn fritters), *tempe*, *tahu bacem* (sweet marinated tofu), among others. Following the gathering, these dishes are first presented before a religious or community leader for a blessing (*doa*). A key ritual that follows is the exchange of food, where participants share portions of their home-cooked dishes with one another. This act of exchange reinforces social bonds and reciprocity within the community. The event then culminates as all participants partake in the shared meal together. This convivial atmosphere,

often filled with conversation and light-hearted joking (*canda*), serves not only to conclude the ceremony but also to strengthen communal familiarity and solidarity (Kasanah et al., 2025).

Ultimately, the Nyadran tradition transcends its primary function as a pilgrimage to ancestral graves. It embodies a complex array of socio-cultural values vital to community cohesion, including mutual cooperation (*gotong royong*), sacrifice, economic exchange, relationship-building, and communal sharing. These values are expressed through practices rooted in local wisdom, which accounts for the significant regional variations observed in the ritual's procession (Akmal & Hasaniyah, 2023; Saputri et al., 2021). Furthermore, the tradition is not static; it has continually evolved by incorporating diverse cultural elements, such as the presentation of various regional performing arts into its ceremonies. Thus, Nyadran functions not only as an act of ancestral veneration but also as a dynamic cultural institution that marks and sanctifies the arrival of the holy month of Ramadan.

Nyadran in Sidoarjo

A distinct regional variation of the Nyadran tradition occurs in Balongdowo Village, Sidoarjo, where the *Nyadran* festival is held by the local Kupang (mussel) fishermen during the Ruwah full moon (Auliyah et al., 2022; Kusuma, 2021). Unlike the common grave-visiting ritual, this ceremony is an expression of gratitude to God, centered on a communal midnight demonstration of shellfish harvesting in the Madura Strait. It is a unique practice specific to this fishing community, distinguished from other Javanese sea ceremonies, and involves extensive preparations culminating in a solemn banquet (*kenduri*).

The Nyadran ceremony in this region serves multiple spiritual purposes: it is an effort to honor, respect, and pray for the peaceful repose of ancestral spirits; a form of gratitude from fishermen to the Almighty; and specifically, an act of reverence for the spirit of Dewi Sekardadu (Al-Aliyah et al., 2020). Local tradition holds that Nyadran originated upon the discovery of the body of Dewi Sekardadu, who died while searching for her son, Raden Paku, after he was cast into the sea by his grandfather, King Minak Sembuyu (Mawardani et al., 2025). This commemorative tradition is maintained by the fishing communities of Balongdowo, Bluru Kidul, and Sawohan villages.

The primary purpose of this Nyadran tradition is a pilgrimage to the tomb of Dewi Sekardadu. For the Balongdowo fishing community, the ceremony holds a profound practical benefit: to ensure the smooth operation and abundance of their *kupang* (mussel) harvest, which is their primary livelihood. This connection to maritime prosperity remains the central motivation, sustaining the tradition's annual observance into the modern era as a core community belief (Mawardani et al., 2025). The execution of the ceremony follows a structured seven-stage process: preparation, departure, the ritual throwing of a chicken (*labuh ayam*), the floating of offerings (*larung sesaji*), the pilgrimage to Dewi Sekardadu's tomb, the communal search for *kupang*, and the final return home.

RESEARCH METHOD

This study employed a descriptive qualitative research design. Data were collected through a dual approach: a review of relevant literature and semi-structured interviews with key informants. The primary data collection instrument was the researcher, who conducted interviews with relevant community sources (Adeoye-Olatunde & Olenik, 2021). These interviews were supported by audio recordings and documentary photography of related activities to ensure accuracy and provide contextual evidence (Thornberg et al., 2022). The collected data were analyzed using a thematic analysis framework, which involved the stages of data collection, reduction and categorization, presentation, and conclusion drawing. The research

process is summarized in Figure 1.

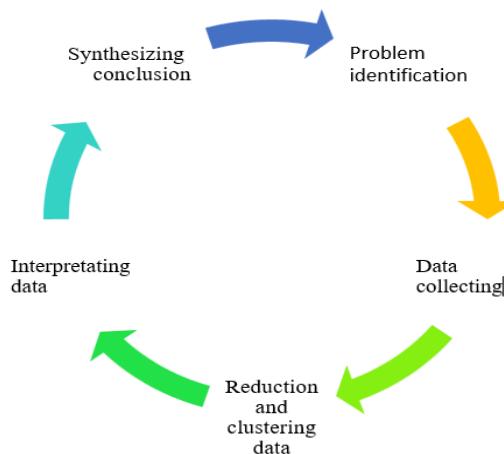


Figure 1. Research flow diagram

RESULTS AND DISCUSSION

Based on a synthesis of literature and interview data, this study identifies a significant shift in the meaning of the Nyadran tradition from its historical origins to its contemporary practice. Initially, the tradition served to commemorate the death of the Majapahit royal figure, Sri Gayatri Rajapatmi—grandmother of King Hayam Wuruk and daughter of Kertanegara (Batara Siwa Buddha), the last ruler of Singhasari/Tumapel (Hartoyo, 2017). Today, it has been recontextualized primarily as a community ritual of purification (*ruwatan*) to welcome the holy month of Ramadan. The contemporary ceremony in Balongdowo Village is structured around seven distinct stages: (1) Preparation, (2) Departure, (3) Ritual Disposal of a Chicken (*Labuh Ayam*), (4) Floating of Offerings (*Larung Sesaji*), (5) Pilgrimage to the Tomb of Dewi Sekardadu, (6) Communal Search for *Kupang* (Mussels), and (7) Return Home. Each stage carries specific philosophical values and, upon analysis, reveals distinct implications in the realm of applied physics.

First Phase

The preparatory stage involves all members of the Kupang fishing community in Balongdowo Village. Activities include preparing ceremonial food and offerings, decorating the primary boat (*perahu*), and setting up a sound system to enliven the event. From a physics perspective, this stage demonstrates several applied concepts. The physical work of decorating the boat and loading supplies directly relates to the concepts of mechanical work and energy transfer. Furthermore, the preparation of lanterns and lights for the night voyage employs principles of **optics**. The lanterns illuminate the river, and this illumination process relies on light reflection and transmission: light rays from the source reflect off the water and surrounding environment and travel to the fishermen's eyes, enabling vision and navigation in the dark (Ali et al., 2022; Giancoli, 2016).



Figure 2. Boat decorating

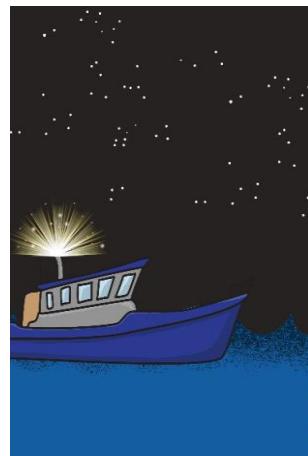


Figure 3. Adding light on boat's deck

Second Phase

After the departure ceremony, the main procession begins. This procession involves carrying *tumpeng* (cone-shaped rice dishes) and ornaments that decorate the ceremonial boat from the village hall to the departure pier, marking the start of a 12-kilometer journey to the river mouth.



(a)



(b)

Figure 4. (a) Footage of *iring-iringan* process; (b) Illustration of *iring-iringan* process

The act of transporting the *tumpeng* over this fixed path can be analyzed using the physics concept of displacement – the straight-line change in an object's position from its initial point (village hall) to its final point (pier). When a force is applied to move the *tumpeng*, this displacement is a key variable in calculating the mechanical work performed, as expressed in the fundamental equation:

$$W = \hat{F} \cdot \hat{s} \quad (1)$$

The act of transporting the *tumpeng* in a stable, upright manner also illustrates the concept of rigid body equilibrium. For the *tumpeng* to remain balanced, the net torque acting on it must be zero, resulting in no change in its angular momentum. Furthermore, as the procession occurs at night on the coast, the environmental conditions can be described by the zeroth law of thermodynamics. This law establishes the concept of thermal equilibrium, meaning if the *tumpeng*, the air, and the coastal ground all reach the same temperature through prolonged contact, they are in a state of thermal equilibrium with each other (Serway et al., 2016).

Third Phase

After the *tumpeng* is carried together with the residents, the next step is to put the *tumpeng* and the chicken that will be floated down the river into a boat to then travel to the river for the next procession.



Figure 5. Illustration of praising the sea to prevent negative manifestation through sacrificing chicken

It is one stage of the Nyadran ritual performed at the mouth of the Pecabean River with the aim of preventing disaster or calamity for the participants of the Nyadran ritual, especially toddlers, so that they do not become possessed by spirits by throwing a live chicken into the river. Throwing the chicken into the river uses free fall motion and Archimedes' law. Free fall motion is a vertical downward motion without initial velocity, only influenced by the force of gravity (Smith, 2004). Meanwhile, the chicken can float because it has a condition where the density of the fluid is greater than the density of the object.

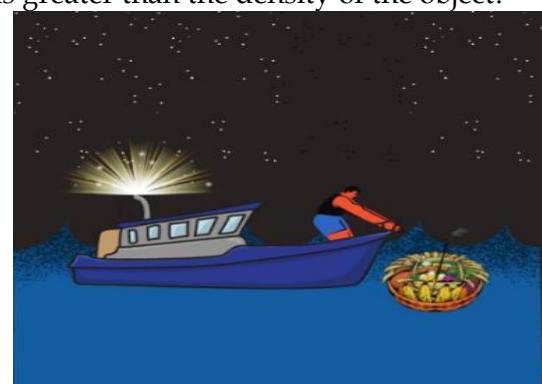
Forth Phase

Usually called cobakal, this stage is carried out at the junction of the Clangap estuary (the meeting point between the Balongdowo river, the Candi river and the Sidoarjo river) so that participants can avoid river whirlpools because this place is where the river currents meet so it is prone to whirlpools.

Melarung sesajen to the three-way intersection of the Kali Anak/Muara River, using the concepts of effort and energy, free fall, and Archimedes' law. Free fall is a vertical downward motion without initial velocity, influenced only by the force of Earth's gravity. Meanwhile, offerings can float because the density of the fluid is greater than the density of the object.



(a)



(b)

Figure 6. (a) Footage of *melarung sesaji* process; (b) Illustration of *melarung sesaji* process

Fifth Phase

The pilgrimage to the tomb of Dewi Sekardadu in Sawohan Village is the spiritual culmination of the Nyadran ritual. After descending from Kepetingan Hamlet, the community rushes to Dewi Sekardadu's tomb to pray together for their ancestors, led by local elders, and to offer offerings of food and fruit brought from their homes.

This procession can be analyzed through key physics concepts. The journey from the boat to the tomb itself involves displacement—the change in position from the disembarkation point (initial) to the gravesite (final). Concurrently, the act of carrying the offerings embodies the concept of rigid body equilibrium. For an offering tray to be transported without spilling or tipping, it

must be in a state of static equilibrium, where the net force and net torque acting upon it are zero, resulting in no change in its linear or angular momentum.



Figure 7. Dewi sekardadu tomb

Sixth Phase

The ritual proceeds with a demonstration of mussel harvesting in Permisan Bay. Participants walk from Dewi Sekardadu's tomb to the bay, a movement that again illustrates the physics concept of displacement, as defined in Equation (1). At the bay, they dive into the water to demonstrate traditional mussel-gathering techniques. This action involves significant work and energy transfer: chemical energy from the body is converted into kinetic energy for swimming and diving, and mechanical work is performed against water resistance to search for and dislodge the mussels.



Figure 8. Illustration kupang gathering process

Final Phase

The final stage of the Nyadran ritual involves the community's return voyage to Balongdowo Village. This journey, like the initial departure, can be analyzed through the physics concept of displacement, representing the net change in position from the estuary (initial point) back to the village pier (final point). The mechanical work required for this return is again described by Equation (1). Navigation during the return voyage employs key physics principles. Steering the boat involves vector concepts, as both velocity and applied force possess magnitude and direction. Furthermore, the journey is assisted by the nighttime landward sea breeze. This breeze results from the land cooling faster than the sea; the warmer maritime air rises, creating a pressure differential that draws air from the sea toward the land, providing a favorable wind for the homeward journey to the original Nyadran departure point.



Figure 9. Illustration of docking at Balongdowo Village (Start point)

Analyzing Physics Concept

Several nyadran rituals have been performed and have philosophical values behind them that can be revealed, one of which is from a physics perspective. Table 1 shows the analysis of physics concepts in each stage of the nyadran procession in Sidoarjo.

Table 1. Physics concept behind every phase in *nyadran* process

Steps	Essence of Physics
Preparation	<ul style="list-style-type: none"> • Mechanical work and energy • Light wave propagation and optics properties • Displacement concept
Departure	<ul style="list-style-type: none"> • Rigid bodies • Zeroth thermodynamic laws • Vector concept.
Sacrificing chicken	<ul style="list-style-type: none"> • Free-fall motion • Archimedes law
<i>Larung</i> giving	<ul style="list-style-type: none"> • Mechanical work and energy • Free-fall motion • Archimedes law
Pilgrimage to Sekardadu's tomb	<ul style="list-style-type: none"> • Displacement concept • Rigid bodies
Kupang (mussel) gathering	<ul style="list-style-type: none"> • Displacement concept • Mechanical work and energy
Going back	<ul style="list-style-type: none"> • Displacement concept • Landward sea breeze theories • Vector concept

CONCLUSION

Research indicates that the Nyadran tradition, while having undergone a shift in meaning over time, has retained its core philosophical value. While its external meanings have evolved, the Nyadran tradition has successfully preserved its core philosophical value as a ritual of gratitude, community, and ancestral connection amidst globalizing forces. An interdisciplinary, ethnoscience analysis demonstrates that the ritual's seven-stage procession is not merely symbolic but constitutes a practical framework for applied physics. Each stage—from preparation to return—embodies tangible concepts including optics, mechanics, and fluid dynamics. Consequently, Nyadran transcends its categorization as a singular cultural event. It represents a vital, living repository of integrated knowledge, where local wisdom and scientific

principle are inseparable. The hope is that society will increasingly recognize the value of such living traditions, ensuring that future generations do not merely hear stories of the past but can actively witness, engage with, and perpetuate this integrated cultural and scientific heritage.

AUTHOR CONTRIBUTIONS

Handika Tusuka Putra: Conceptualization, Methodology, Formal Analysis and Writing – Original Draft; **Utama Alan Deta:** Formal Analysis, Resources, Investigation, Visualization and Writing; and **Setyo Admoko:** Data Curation, Project Administration, Supervision, Writing – Review & Editing and Validation.

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