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Batik Parang Harmoni Epidemi: Mathematical Modeling of Dengue Hemorrhagic Fever Transmission Incorporating Social Awareness (Analysis and Simulation)

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Abstract: Dengue Hemorrhagic Fever (DHF) is an infectious disease caused by the dengue virus and transmitted through the bites of *Aedes aegypti* and *Aedes albopictus* mosquitoes. This disease remains a major public health problem in tropical regions, including Indonesia. This study examines the influence of social awareness factors on DHF transmission through the development of a mathematical model describing the interaction between the human and mosquito populations. The model divides the human population into six compartments susceptible (S_h), aware (A), exposed (E_h), infected (I_h), hospitalized (P), and recovered (R) and the mosquito population into three compartments susceptible (S_m), exposed (E_m), and infectious (I_m). The analysis uses the *Next Generation Matrix* approach to determine the basic reproduction number (R_0), followed by sensitivity analysis and numerical simulation to study the effects of parameters on disease dynamics. The results show that increasing social awareness (u) significantly reduces the value of R_0, while higher human (β_h, β_m) and mosquito (β_h, β_m) transmission rates increase the epidemic risk. When $R_0 < 1$, the system approaches a disease-free equilibrium, whereas $R_0 > 1$ leads to an endemic state. Moreover, the rate of declining awareness $(\alpha\alpha\alpha)$ plays an important role in determining the intensity and timing of infection peaks. As an artistic interpretation, the findings are embodied in the *Batik Parang Harmoni Epidemi* artwork, which visualizes the connection between science, social behavior, and cultural values. This work symbolizes the harmony between science and culture in addressing epidemic challenges and emphasizes that enhancing social awareness is a key factor in sustainable DHF control.

Keywords: Dengue Hemorrhagic Fever, mathematical model, social awareness, numerical simulation, Batik Parang Harmoni.

Introduction

Dengue Hemorrhagic Fever (DHF) is one of the infectious diseases that remains a major public health problem in many tropical countries, including Indonesia. This disease is caused by the dengue virus, which is transmitted through the bites of *Aedes aegypti* and *Aedes albopictus* mosquitoes. According to data from the Indonesian Ministry of Health, DHF cases fluctuate significantly from year to year, with transmission levels influenced by environmental, climatic, and behavioral factors. Although various control programs have been implemented, such as source reduction, fogging, and health education, these efforts have not yet been able to sustainably reduce the incidence of the disease.

One of the key factors influencing DHF transmission is the level of social awareness among communities toward prevention and control efforts. Social awareness reflects how well individuals understand, care about, and actively participate in maintaining environmental hygiene and preventing mosquito breeding. Low levels of social awareness often result in inconsistent implementation of the “3M Plus” movement (draining, covering, and reusing containers that can hold water), thus allowing mosquito vectors to breed rapidly. Consequently, behavioral change and increased community awareness serve as

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crucial non-biological factors in reducing the transmission rate of DHF.

In epidemiology, mathematical modeling is an important approach used to understand the dynamics of infectious disease transmission. Through modeling, the interaction between human and vector populations can be analyzed quantitatively to assess transmission rates, system stability, and the effectiveness of intervention strategies. Compartmental mathematical models divide the population into several groups or classes based on epidemiological status such as susceptible, exposed, infected, and recovered. This approach not only helps describe the pattern of disease spread but also facilitates the analysis of external influences, including social and behavioral factors.

This study develops a mathematical model of DHF transmission that incorporates social awareness as a factor influencing disease dynamics. The model divides the human population into six compartments susceptible (S_h), aware (A), exposed (E_h), infected (I_h), hospitalized (P), and recovered (R) and the mosquito population into three compartments susceptible (S_m), exposed (E_m), and infectious (I_m). The analysis employs the *Next Generation Matrix* approach to obtain the basic reproduction number (R_O) as an indicator of system stability. Furthermore, sensitivity analysis is conducted to identify the parameters that most significantly affect R_O, and numerical simulations are performed to visualize the transmission dynamics under varying levels of social awareness.

The results show that increasing social awareness significantly reduces R_O and drives the system toward a disease-free equilibrium $R_O < 1$, while decreasing awareness (α) and increasing transmission rates among humans and mosquitoes (β_h, β_m) heighten the risk of endemicity. This study also presents an artistic interpretation through the "Batik Parang Harmoni Epidemi" artwork, which combines scientific curve patterns with traditional motifs to symbolize harmony between science, culture, and social behavior in responding to epidemics. Thus, this research not only contributes to the field of biomathematics but also emphasizes that enhancing social awareness is a key element in achieving sustainable and culturally grounded DHF control.

Materials And Methods

Mathematical Modeling

The human population is divided into six classes, namely:

1. S_h: Individuals susceptible to infection
2. A: : Individuals who have awareness of dengue infection
3. E_h: Individuals exposed to the virus
4. I_h: Infected individuals
5. P: Individuals under treatment or hospitalization
6. R: Individuals who have recovered from infection

In addition, the mosquito population as the disease vector is divided into three classes, namely:

1. S_m: Susceptible mosquitoes
2. E_m: Exposed mosquitoes, i.e., mosquitoes that have carried the virus but are not yet able to transmit it
3. I_m: Infectious mosquitoes capable of transmitting the virus to humans

Based on the compartmental diagram in Djuma *et al.* (2025), the mathematical model is formulated in the form of the following system of differential equations:

$$\frac{dS_h}{dt} = \Pi_h - \beta_h \frac{S_h}{N_h} I_m - (u + \mu_h)S_h + \alpha A,$$
$$\frac{dA}{dt} = uS_h - (\alpha + \mu_h)A - \xi\beta_h \frac{A}{N_h} I_m,$$
$$\frac{dE_h}{dt} = \beta_h I_m \frac{\xi A + S_h}{N_h} - (\gamma_h + \mu_h)E_h,$$
$$\frac{dI_h}{dt} = \gamma_h E_h - (q_1 + \eta + \delta + \mu_h)I_h,$$
$$\frac{dP}{dt} = \eta I_h - (q_2 + \delta + \mu_h)P,$$
$$\frac{dR}{dt} = q_1 I_h + q_2 P - \mu_h R,$$
$$\frac{S_m}{dt} = \Pi_m - \beta_m S_m \frac{I_h}{N_m} - \mu_m S_m,$$
$$\frac{E_m}{dt} = \beta_m S_m \frac{I_h}{N_m} - (\gamma_m + \mu_m)E_m \ ,$$
$$\frac{dI_m}{dt} = \gamma_m E_m - \mu_m I_m.$$

The parameters used in the model are presented in the following table:

Table 1. Parameter model

Parameter	Description
Π_h	Birth rate of human individuals
Π_m	Birth rate of mosquitoes
u	Level of social awareness in preventing the spread of dengue infection
α	Rate of decline in social awareness
β_h	Exposure rate of the human population
β_m	Exposure rate of the mosquito population
ξ	Effectiveness of infection reduction due to awareness
γ_h	Human extrinsic incubation rate
γ_m	Mosquito extrinsic incubation rate
η	Treatment rate of infected individuals
q_1	Natural recovery rate of infected individuals
q_2	Recovery rate of individuals receiving treatment
δ	Disease-induced death rate
μ_h	Natural mortality rate of humans
μ_m	Natural mortality rate of mosquitoes

Equilibrium Points

The equilibrium points of the model are obtained by assuming that the system is in a steady-state condition, meaning that all derivatives of the variables with respect to time are equal to zero, expressed as follows:

$$\frac{dS_h}{dt} = \frac{dA}{dt} = \frac{dE_h}{dt} = \frac{dI_h}{dt} = \frac{dP}{dt} = \frac{dR}{dt} = \frac{S_m}{dt} = \frac{E_m}{dt} = \frac{dI_m}{dt} = 0.$$

Based on Djuma *et al.* (2025), two equilibrium points are obtained, namely:

1. **Disease-Free Equilibrium Point (T_1)**
   This condition represents the absence of infection in both the human and mosquito populations. The equilibrium point is expressed as follows:

$$T_1(S_h, A, E_h, I_h, P, R, S_m, E_m, I_m) = \left(\frac{\alpha A + \Pi_h}{u + \mu_h}, \frac{uS_h}{u + \mu_h}, 0, 0, 0, 0, \frac{\Pi_m}{\mu_m}, 0, 0\right).$$

2. **Endemic Equilibrium Point (T_2)**
   This condition represents a state in which the disease persists within the population. The equilibrium point is expressed as:

$$T_2(S_h, A, E_h, I_h, P, R, S_m, E_m, I_m) = (S_h^*, A^*, E_h^*, I_h^*, P^*, R^*, S_m^*, E_m^*, I_m^*),$$

Where,

$$S_h^* = \frac{N_h(\alpha A + \Pi_h)}{\beta_h I_m + N_h(u + \mu_h)}, \qquad S_h^* = \frac{N_m \Pi_m}{\beta_m I_h + N_m \mu_m},$$

$$A^* = \frac{N_h u S_h}{N_h(\alpha + \mu_h) + \xi \beta_h + I_m}, \qquad E_h^* = \frac{I_h \beta_m S_m}{N_m(\gamma_m + \mu_m)},$$

$$E_h^* = \frac{\beta_h I_m (S_h + \xi A)}{N_h(\gamma_h + \mu_h)}, \qquad I_h^* = \frac{\gamma_m \mathrm{E}_m}{\mu_m},$$

$$I_h^* = \frac{\gamma_h \mathrm{E}_h}{q_1 + \eta + \delta + \mu_h}, \qquad P^* = \frac{\eta \mathrm{I}_h}{q_2 + \delta + \mu_h},$$

$$R^* = \frac{q_1 I_h + q_2 P}{\mu_h}.$$

Where each variable with an asterisk (*) denotes the equilibrium value of the corresponding compartment.

Basic Reproduction Number (R_0)

In the study of disease transmission dynamics, the basic reproduction number (R_0) plays an important role as an indicator for determining the epidemic threshold. Using the Next Generation Matrix approach (Djuma et al., 2025), the matrices F and V are obtained and evaluated at the disease-free equilibrium point (T_1), as follows:

$$F = \begin{pmatrix} 0 & 0 & 0 & 0 & \frac{\beta_h(\alpha + \mu_h + u\xi)}{u + \alpha + \mu_h} \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & \beta_m & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

$$V = \begin{pmatrix} v_{11} & 0 & 0 & 0 & 0 \\ -\gamma_h & v_{22} & 0 & 0 & 0 \\ 0 & -\eta & v_{33} & 0 & 0 \\ 0 & 0 & 0 & v_{44} & 0 \\ 0 & 0 & 0 & -\gamma_m & \mu_m \end{pmatrix}$$

With,

$$v_{11} = \gamma_h + \mu_h, \qquad v_{22} = q_1 + \eta + \delta + \mu_h,$$

$$v_{33} = q_2 + \delta + \mu_h, \qquad v_{44} = \gamma_m + \mu_m$$

The basic reproduction number (R_0) is obtained as the dominant eigenvalue, that is, the largest positive eigenvalue of the matrix ($K = F\,V^{-1}$).

$$K = \begin{pmatrix} 0 & 0 & 0 & k_{13} & k_{14} \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ k_{41} & k_{42} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

Where,

$$k_{13} = \frac{\beta_h \gamma_m (\alpha + \mu_h + u\xi)}{(u + \alpha + \mu_h)\mu_m(\gamma_m + \mu_m)}, \qquad k_{14} = \frac{\beta_h (\alpha + \mu_h + u\xi)}{(u + \alpha + \mu_h)\mu_m}$$

$$k_{41} = \frac{\beta_m \gamma_h}{(\gamma_h + \mu_h)(q_1 + \eta + \delta + \mu_h)}, \qquad k_{42} = \frac{\beta_m}{q_1 + \eta + \delta + \mu_h}$$

Since $R_0 = \rho(FV^{-1})$, t follows that

$$R_0 = \sqrt{\frac{\beta_h \beta_m \gamma_h \gamma_m (\alpha + \mu_h + u\xi)}{(u + \alpha + \mu_h)(\gamma_h + \mu_h)(q_1 + \eta + \delta + \mu_h)\mu_m(\gamma_m + \mu_m)}}.$$

Let $R_1 = R_0^2$, than

$$R_1 = \frac{\beta_h \beta_m \gamma_h \gamma_m (\alpha + \mu_h + u\xi)}{(u + \alpha + \mu_h)(\gamma_h + \mu_h)(q_1 + \eta + \delta + \mu_h)\mu_m(\gamma_m + \mu_m)}$$

Furthermore, the value of R_1 is used as the basis for proving Theorem 1 and Theorem 2, which state that:

- The disease-free equilibrium point T_1 is locally asymptotically stable if $R_0 > 1$.
- The endemic equilibrium point T_2 is locally asymptotically stable if $R_0 > 1$.

Sensitivity Analysis

Sensitivity analysis is conducted to evaluate the extent to which changes in model parameters affect the value of the basic reproduction number (R_0). The method used is local sensitivity analysis, which involves calculating the parametric sensitivity index that represents the relative change in R_0 with respect to a relative change in a given parameter. The results show that each parameter exerts a different influence on R_0. Parameters with a positive sensitivity index increase R_0 when their values rise, whereas parameters with a negative sensitivity index decrease R_0 as their values increase. In particular, the social awareness rate (u) has the most significant impact its increase substantially reduces the value of R_0. Conversely, the human transmission rate (β_h) is directly proportional to R_0; the higher the value of β_h, the greater the epidemic potential. The rate of decline in social awareness (α) also contributes to reducing R_0, although its effect is less pronounced compared to u. In conclusion, increasing the level of social awareness within the population is the key factor that effectively reduces the risk of dengue fever transmission.

Numerical Simulation Analysis

Numerical simulations were conducted to visualize the stability of equilibrium points and the dynamics of disease transmission based on predetermined parameter values. The parameters were obtained from secondary data and realistic assumptions. In the first simulation, where $R_0 = 0.92 < 1$, the disease gradually disappears from the system. The susceptible and aware populations increase toward stability, while the exposed, infected, and hospitalized populations decrease to nearly zero. This condition indicates that the system reaches the disease-free equilibrium point (T_1). In the second simulation, with parameters adjusted so that $R_0 = 1.43 > 1$, the system reaches the endemic equilibrium point (T_1).

In this state, the number of exposed, infected, and hospitalized individuals does not decline to zero but stabilizes at certain positive values, indicating that the disease persists within the population. Further analysis shows that an increase in the level of social awareness (u) significantly reduces the number of exposed and infected individuals and accelerates system stabilization. Conversely, an increase in the rate of declining awareness (α) intensifies and advances the infection peak, prolonging the duration of the epidemic. Thus, the simulation results confirm that enhancing social awareness and controlling its decline are key factors in suppressing disease transmission and maintaining system stability toward a disease-free condition.

Results And Discussion

Mathematical Meaning

The mathematical model of dengue transmission with the inclusion of social awareness divides the human population into several compartments based on infection status and awareness level. The focus, as shown in Figure 1, lies on two main compartments: the susceptible individuals (S_h) and the aware individuals (A). The compartment $S_h(t)$ represents individuals who lack preventive awareness and are therefore at high risk of infection, whereas $A(t)$ represents individuals with social awareness, such as those maintaining environmental cleanliness or engaging in "3M Plus" activities (draining, covering, and reusing containers that can hold water) and fumigation efforts. Aware individuals have a lower probability of infection, represented by the reduction factor ($0 \leq \xi \leq 1$). These two compartments are described by the following system of differential equations:

$$\frac{dS_h}{dt} = \Pi_h - \beta_h \frac{S_h}{N_h} I_m - (u + \mu_h) S_h + \alpha A,$$

$$\frac{dA}{dt} = u S_h - (\alpha + \mu_h) A - \xi \beta_h \frac{A}{N_h} I_m.$$

In summary:

- Births (Π_h) increase the number of susceptible individuals S_h.
- From S_h individuals may become aware (uS_h), become infected through infectious mosquitoes ($\beta_h \frac{S_h}{N_h} I_m$), or die naturally ($\mu_h S_h$).
- From A individuals may lose awareness (αA), remain at risk of infection (with reduction factor ξ), or die naturally ($\mu_h A$).

The two compartments are interconnected through a bidirectional flow between S_h and A governed by two key parameters:

- u: the rate of increase in social awareness, and
- α: the rate of decline in social awareness.

Thus, an increase in u or a decrease in α will enlarge the proportion of aware individuals (A), reduce the transmission rate, and maintain $R_0 < 1$. Conversely, if awareness easily diminishes or the effectiveness of protection (ξ) is low, the number of susceptible individuals (S_h) will increase, thereby raising the potential for dengue transmission.

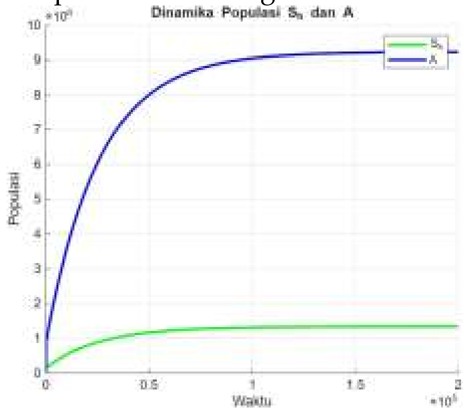

Figure 1. Population Dynamics for $R_0 < 1$

Figure 1 illustrates the changes in the number of susceptible individuals (S_h) and aware individuals (A) over time under the condition where the basic reproduction number is less than one ($R_0 < 1$). This situation represents the disease-free phase, in which the infection cannot sustain itself within the population because, on average, each infected individual transmits the disease to fewer than one other person. In general, the green curve in the graph represents the dynamics of the susceptible population (S_h), while the blue curve represents the aware population (A). These two trends exhibit different yet closely related patterns through the conversion mechanism governed by the parameters u (rate of increase in social awareness) and α (rate of decline in social awareness).

At the beginning of the simulation, both the number of susceptible and aware individuals increase sharply. The rise in S_h is mainly due to the constant human birth rate (Π_h), which continuously adds new individuals to the susceptible population. Meanwhile, the increase in A is driven by the transition process from S_h to A at a rate of uS_h, representing the community's growing awareness of dengue prevention. At this early stage, the numbers of infected individuals and infectious mosquitoes (I_m) are still very low, so the impact of infection on reducing S_h and A is minimal, allowing both to rise significantly.

Time progresses, the system begins to reach a balance between inflow and outflow in both compartments. Individuals previously in S_h continue to move to A due to increased social awareness, while a small fraction of A returns to S_h as awareness declines at a rate of αA. At the same time, the infection process gradually diminishes because the transmission rate (β_h) is suppressed by the large number of aware individuals and the protective behavioral effect ($\xi < 1$). Consequently, both curves begin to flatten and approach stable values (steady state).

After passing through the transient period, the system finally reaches a dynamically stable equilibrium, corresponding to the disease-free equilibrium point (T_1) obtained analytically. At this stage, the rate of change of both populations approaches zero, i.e., $\frac{dS_h}{dt} \approx 0$ and $\frac{dA}{dt} \approx 0$. The population values obtained from numerical simulation show that:

$$S_h^* \approx 1{,}33 \times 10^6 \; dan \; A^* \approx 9{,}23 \times 10^6.$$

The significant difference between A and S_h reflects the effectiveness of increasing social awareness in suppressing dengue transmission. A higher rate of social awareness (u) causes most individuals to move into the aware class (A), while a lower rate of awareness decline (α) allows them to remain in that class for a longer period. As a result, only a small proportion of the population remains in the susceptible class (S_h). Biologically, this represents a community condition in which active participation in dengue prevention such as maintaining environmental cleanliness, covering water containers, and avoiding mosquito bites becomes dominant. Consequently, the number of individuals exposed to infection decreases significantly, and the system gradually moves toward a disease-free state. Thus, the pattern in the left panel of Figure 1 shows that when $R_0 < 1$, the dynamics between classes S_h and A reach a stable and favorable equilibrium: the aware population increases substantially, while the susceptible population remains small. This demonstrates that social awareness plays a crucial role in shaping epidemiological stability and serves as a key factor in suppressing dengue transmission toward elimination.

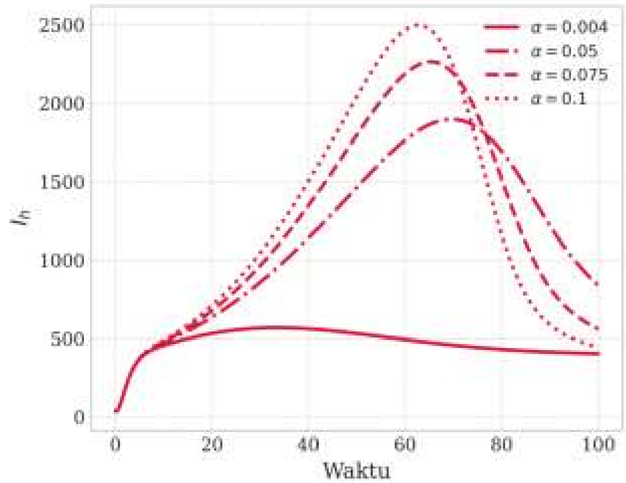

Figure 2. Effect of Changes in α on Population Dynamics

The Figure 2 illustrates the effect of changes in the parameter $\alpha\alpha\alpha$ on the dynamics of infected individuals (I_h) in the dengue transmission model with the social awareness factor. The parameter α represents the rate of loss of social awareness, that is, the rate at which individuals move from the aware group (A) back to the susceptible group (S_h) due to a decline in concern toward preventive efforts. From the graph, it can be observed that an increase in α has a clear and significant impact on the shape of the infection curve. When $\alpha = 0.004$, the I_h curve rises slowly, reaching a peak of around 500 – 600 individuals before gradually declining to a stable level. As α increases to 0.05, 0.075, and 0.1, the curve becomes steeper, and the infection peak rises sharply to approximately 2,500 individuals.

In addition, the infection peak occurs earlier with higher α values, indicating that the transmission wave becomes shorter but more intense. A large α value indicates a rapid decline in social awareness, causing many aware individuals to revert to the susceptible class within a short period. Consequently, the number of individuals at risk of infection increases drastically. The rise in susceptible individuals (S_h) accelerates the transmission rate because more individuals become available to be bitten by infectious mosquitoes (I_m), leading to a surge in infection cases.

After the peak, the number of cases decreases as many individuals have already been infected, while the susceptible population declines again due to recovery or natural death. The higher the α value, the larger and faster the infection wave occurs, making the disease more difficult to control. Conversely, a low α value indicates that the community can maintain social awareness for a longer period, resulting in fewer infection cases and slower transmission. In other words, the rate of loss of social awareness (α) is a determining factor in the magnitude of dengue outbreaks. These results emphasize the importance of maintaining community awareness in dengue prevention. Continuous education, environmental health campaigns, and routine mosquito breeding control can effectively reduce the value of α, keep more individuals in the aware group, and ultimately decrease the number of infection cases.

Philosophical Meaning

Batik Parang Harmoni Epidemi is inspired by the research titled *"Mathematical Model of Dengue Hemorrhagic Fever Transmission with a Social Awareness Factor: Analysis and Simulation."* The basic batik pattern is derived from the curves shown in Figures 1 and 2 of the study, which depict human population dynamics in response to changes in social awareness and the effect of the rate of loss of awareness (α) on disease transmission. The interwoven waveforms of the curves were artistically transformed into a visual pattern resembling the traditional *parang* motif a classic Javanese design symbolizing continuity, strength, and an unending spirit of perseverance.

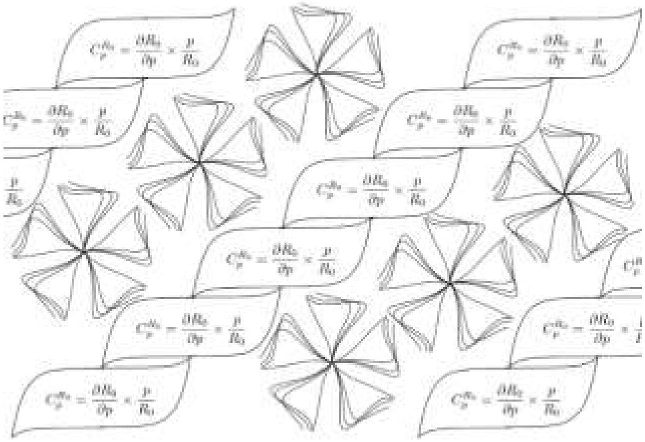

Figure 3. Batik Parang Harmoni Epidemi

The batik shown in Figure 3 illustrates how science and social awareness complement one another in maintaining the balance of life. The mathematical model's curve patterns represent the dynamics of susceptible, aware, and infected populations, while the repeating *parang* shapes reflect the enduring human spirit in confronting epidemic challenges. Together, they form a symbol of harmony between scientific reasoning and the cultural values of the Indonesian archipelago. The gentle waves of the curve pattern signify fluctuations in public awareness of disease prevention. When social awareness is high, the social system reaches equilibrium analogous to the condition when $R_0 < 1$ in epidemiological models. This batik conveys the message that social balance can only be achieved when communities act collectively with empathy and shared awareness. The *parang* motif itself embodies perseverance, continuity, and resilience. In the context of an epidemic, it symbolizes the ongoing struggle of communities and healthcare workers in controlling disease transmission. The repetitive diagonal pattern further signifies that efforts to sustain social awareness must never cease they must be carried out continuously to preserve stability. Through the fusion of scientific curves and traditional motifs, *Batik Parang Harmoni Epidemi* becomes a tangible manifestation of the synergy between art and science. It not only presents aesthetic beauty but also carries a moral message: harmony within society emerges when scientific knowledge is practiced hand in hand with cultural values and social responsibility.

Biological Meaning

Medically, *Batik Parang Harmoni Epidemi* illustrates the biological process of dengue fever transmission, which is strongly influenced by the level of social awareness within the community in preventing bites from *Aedes aegypti* mosquitoes. The wave patterns derived from Figure 1 represent the dynamics of the human population, ranging from susceptible (S_h), aware (A), and exposed (E_h) individuals to the infected group (I_h). When social awareness is high (i.e., when α is low), the number of aware individuals increases, while the infected population decreases and stabilizes analogous to a biological system successfully suppressing viral replication within the host population.

Conversely, the curve pattern in Figure 2 demonstrates the significant impact of the rate of loss of awareness (α) on the rise of infection cases. Biologically, this condition can be likened to the decline of collective immunity when communities become negligent in maintaining environmental hygiene, covering water containers, or using personal protection. As a result, the mosquito population increases and the risk of infection rises again. Thus, variations in α represent the fluctuations in human biological and social behavior that directly influence the life cycle of the vector and the transmission rate of the dengue virus.

The *parang* motif in this batik symbolizes the resilience and continuity of biological systems in facing environmental pressures. Just as the human body requires balance between the immune system and pathogen exposure, society must also maintain equilibrium between social awareness and environmental factors that cause disease. The continuous and interconnected *parang* patterns reflect the mechanism of biological homeostasis a stable condition that can only be achieved when all components (humans, environment, and behavior) function harmoniously.

Overall, *Batik Parang Harmoni Epidemi* embodies the biological notion that health is not merely the result of medical processes but also the balance between social behavior and natural biological systems. Just as the human body maintains internal stability to survive infection, society must also sustain collective social awareness to control dengue transmission. By integrating scientific curves with traditional motifs, this batik becomes a symbol of the union between medical science, biology, and human behavior in fostering a healthy and harmonious life. mentioned results in the form of sentences, not repeat them.

Conclusions

This study demonstrates that the factor of social awareness plays a crucial role in controlling the spread of Dengue Hemorrhagic Fever (DHF). Through a mathematical model that incorporates human population compartments based on awareness levels, it was found that increasing social awareness (high u) and reducing the rate of loss of awareness (α) can lower the basic reproduction number ($R_0 < 1$), allowing the system to reach a disease-free equilibrium. Conversely, a decline in awareness accelerates the rise in infection cases. The results of the simulation are artistically embodied in the *Batik Parang Harmoni Epidemi* artwork, which integrates scientific curve patterns with the traditional *parang* motif as a symbol of continuity, balance, and collective struggle. This work emphasizes that harmony between science, social behavior, and cultural values is the key to achieving sustainable public health.

Conflict of Interest: The author declares that there are no conflicts of interest concerning the publication of this article.

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