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ENSURING SUSTAINABLE WAQF-ZAKAT MICROTAKAFUL PROTECTION THROUGH A SYSTEM DYNAMICS APPROACH

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ABSTRACT

The Islamic financial ecosystems, such as zakat and waqf, have roles in tackling poverty and can be integrated into providing financial protection, such as death benefits to the poor through microtakaful. However, unpredictable payouts and irregular contributions can hinder the implementation of microtakaful, affecting cash flows. This paper employs a system dynamics approach to simulate the cash flows of microtakaful funds, emphasizing the influence of three key factors: the rate of new participants, the mortality rate, and the contribution rate. Note that this approach is chosen for its ability to model complex systems and predict the behavior of microtakaful funds over time. The data collected were from various institutions, including the Life Insurance Association of Malaysia (LIAM), the Central Bank of Malaysia (BNM), and the Department of Statistics Malaysia (DOSM) from 2018 to 2020. The model indicates a minimum contribution rate of RM130 per year, with a 2% mortality rate and 0.8% annual increase in the new participants. The model serves as a foundation for designing a simple and understandable non-profit microtakaful product.

Keywords: Microtakaful, Zakat, Waqf, System Dynamics, Sustainability.

INTRODUCTION

Poverty and income inequality have traditionally been among the most serious and long-lasting issues that nations have had to deal with (Diniyya, 2019). Islam recognizes the problems of poverty and has several instruments to tackle it, such as charity. There are several types of charity in Islam, which are compulsory charity (zakat), optional charity (sadaqah), and perpetual charity (waqf) (Diniyya, 2019). These instruments create a social finance ecosystem that is in line with Shari'ah (Islamic Law) principles (Tahiri Jouti, 2019). This paper focuses on using zakat and waqf to provide financial protection to the poor. The term "poor" can be defined as individuals who lack the resources to afford necessities such as food, clothing, housing, and transportation (Mamat et al., 2018). In Malaysia, the poverty thresholds have recently been revised. As of 2022, the new poverty line stands at RM2040 per month for those categorized as poor and RM1640 per month for those classified as extremely poor (Bhari et al., 2022). Hence, the involvement of voluntary sectors such as both zakat and waqf in fighting poverty is inevitable as it requires huge amounts of funds that may not be provided by the government (Masyita, 2007). Zakat's main objective is to provide financial assistance to the poor. However, there are still constraints, rules, and regulations that need to be fulfilled. Meanwhile, waqf has the capacity to reduce or eliminate constraints. The financial protection stated in this paper is to provide the people in poverty with death benefits, which is known as microtakaful. The main aim of this paper is to simulate the possibility and sufficiency of providing the death benefit as financial protection for the poor (microtakaful) by integrating the function of zakat and waqf.

Zakat is a mandatory financial contribution by the wealthy to support the economically disadvantaged, playing a key role in poverty alleviation within Muslim communities (Bin-Nashwan et al., 2020; Razak, 2020; Wulandari, 2019). Waqf involves the perpetual dedication of assets for charitable purposes, significantly impacting poverty reduction and serving either broad or specific groups (Dahlan et al., 2014; Haneef et al., 2015; Stibbard et al., 2012; Zahro' et al., 2020). The fundamental difference between waqf and zakat is that waqf has a broader scope of responsibilities than zakat. Nevertheless, there are no precise time limits for dispersing the benefits, whereas the zakat fund collected needs to be disbursed as soon as possible to the asnaf (Mikail et al., 2017).

The microtakaful industry, characterized by its unique combination of microfinance and Islamic insurance principles, has witnessed significant growth in recent years. Microtakaful originated from the two concepts of microinsurance and takaful. Microinsurance is an insurance that is designed to provide financial protection to the poor. Whereas Takaful is defined from the concept of joint benefit, mutual protection, and shared responsibility (Dahlan et al., 2014; Haneef et al., 2015) and provides financial protection which is according to shariah principles (Mroueh & de Waal, 2018). In order to access the poor, the product designed for microtakaful should be affordable to the poor and simple to understand (Abdul Ghani et al., 2021; Bank Negara Malaysia, 2016; Fikri et al., 2022; Maulida & Slamet Rusydiana, 2023; McCord, 2009; Rom & Rahman, 2012) in terms of the premium, benefits and delivery channels. This microtakaful protection is important to prevent the poor from falling and continuing to suffer in poverty (Ishak, 2020).

However, the unpredictable payout of death benefit claims, as well as irregular premium payments, makes microtakaful difficult to implement. In addition, this special group of participants has different kinds of risks (Platteau et al., 2017). Understanding the dynamics of the microtakaful system is crucial for its sustainable development. Hence, the study aims to simulate the causes and effects of policy changes affecting the microtakaful system, an area that has received little focus previously. While numerous recent microtakaful models exist (Ariffin et al., 2023), this research stands out by exclusively relying on contributions from the Zakat fund for participants, eliminating external financial assistance and ensuring the system's self-sufficiency. The complexity of cash flows in providing the benefits needs to be studied before being implemented. One of the challenges faced by microtakaful providers is to assess how changes in main variables such as the contribution rate, mortality rate, and new participants rate impact the overall performance and viability of the microtakaful system.

The contribution rate, which essentially functions as the premium needed to be paid, is substantial to the sustainability of the microtakaful system. Changes in the contribution rate would affect the cash flows, which are needed for operating expenses and to pay out claims (Berkem, 2014). The mortality rate influences the tabarru amount needed to pay off the claims. The changes in the mortality rate supposedly affect the contribution rate and thus affect the entire system (Saputra et al., 2017). More participants would lessen the effect of risk. The possible losses can be distributed over larger groups of participants, which makes the rate of new participants an important variable for this study (Wilkie, 1997). One of the approaches to solving and understanding the dynamic behavior of complex problems is using a system approach called system dynamics (Nakazato & Kohda, 2019). This approach uses time as a variable, with other variables being influenced by temporal changes (Kurnianingtyas et al., 2019).

The system approach, applied in various fields, including finance, uses stress tests to evaluate the resilience of financial institutions against macroeconomic changes and policy shifts. This method helps in forecasting potential impacts and managing economic expectations with minimal data (Anand et al., 2014; Anderson et al., 2011; Geršl et al., 2013). It can also be used as an extension to the other approaches, with the model developed from it allowing management to see the outcome or influence of any decision. In addition, new information can be added to the model as it develops, resulting in a more comprehensive decision model to assist the decision-maker (Corcoran et al., 2012).

This paper applies a system dynamics approach to illustrate how cash flow decisions impact the funding necessary for providing microtakaful to the poor, addressing a noted gap in comprehensive analyses of macroeconomic variables within this context (Masyita, 2007; Shahimi et al., 2013). In this study, we address the pressing problem of understanding the dynamics and sustainability of microtakaful systems, particularly concerning changes in three fundamental variables: the contribution rate, mortality rate, and new participants' rate. Specifically, this study focuses on simulating the effect of changes on the variables of important microtakaful system funds, such as contribution funds, tabarru funds, and management funds. The main objectives of the model are to find the minimum contribution rates for the participants as well as ensure the sustainability of all the funds required in the microtakaful system. The study's overall hypothesis states that various factors, including changes in contribution rates, mortality rates, and the rate of new participants, collectively influence the sustainability of the microtakaful system. This hypothesis encompasses the interplay of these variables and their effects on financial stability and system viability. It emphasizes the potential for nonlinear feedback loops, which will be visualized using a system dynamics approach. Through this model exploration, we aim to provide valuable insights that will determine the minimum contributions required and the deduction rates to various funds.

The paper is divided into four sections that cover the research objectives in a comprehensive manner. The first section provides a background on microtakaful, emphasizing how integrating zakat and waqf can help provide affordable microtakaful benefits for marginalized populations. Additionally, we explain the system dynamics method used to visualize the impact of cash flow uncertainties within this context. The second section explores our research methodology in detail. We outline the steps involved in applying the System Dynamics Modeling (SDM) approach, including the data sources and formulation used to develop the model. In Section 3, the results obtained from the model were presented and analyzed. The hypothetical situations were explored through scenario analysis to understand their potential outcomes and implications. Other than that, the changes in the variables in these scenarios were critically examined to provide insights into their significance within the microtakaful model. The last section summarizes the important results and implications of our research. This section discusses the important findings regarding the integration of zakat and waqf in microtakaful, emphasizing its potential for solving the financial needs of the poor. It also offers future work recommendations, indicating opportunities for additional investigation and enhancement in the field of microtakaful and its applications in poverty reduction.

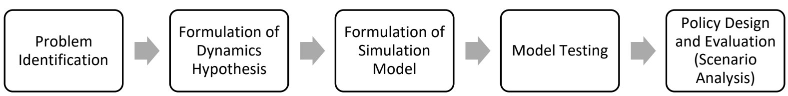
METHODOLOGY

The SDM approach is a useful tool in studying complex systems. This approach has been applied in various works in the field of operation research, where it enables the visualization of the impact of macro-level system behavior (Abidin et al., 2014; Suhaimee et al., 2021). The impact of changes to the model's variables, significant or little, can be shown using system dynamics, highlighting the risk of the fund insolvency and the microtakaful system's long-term viability (Mohamad et al., 2018). This approach can assist in simulating the outcome of the microtakaful model based on policies, circumstances, and judgments regarding the contributions necessary for each participant, as well as the amount of benefits offered.

Commonly, there are five major steps involved in developing an SDM (Abidin et al., 2014; Cassidy et al., 2019; Suhaimee et al., 2021). The steps are (1) problem identification, (2) formulation of dynamic hypothesis, (3) formulation of a simulation model, (4) model testing, and (5) policy design and evaluation. The steps can be referred to in Figure 1. The next sub-sections will briefly discuss the steps involved.

Figure 1

Steps in Developing System Dynamic Model (Sterman, 2002)



Step 1: Problem Identification

In order to design an accurate system, all problems that might arise in the changes of the components should be identified. It is important to identify the requirements to sustain and continue to provide microtakaful benefits in the long term. The purpose of this model is to simulate the impact of the microtakaful system on the changes in the essential variables. The results of this simulation should assist Zakat and Waqf institutions in designing a microtakaful product that can be sustained in the future.

The main variables discussed in this paper are the contribution rate for microtakaful as a cash inflow to the microtakaful system, the mortality rates that will affect the tabarru fund (the fund that is used as a reserve for the death benefit claims), and the new participants' rate to ensure the growth of the whole system. The value of the funds involved is measured in Malaysian Ringgit (RM). Despite variations in participants' ages and their associated mortality risks, this model adopts a single contribution rate to ensure simplicity in purchase, ease of comprehension, and standardized risk categorization (Abdul Ghani et al., 2021; Fikri et al., 2022; Maulida & Slamet Rusydiana, 2023). One of the important activities in identifying key problems is the data collection process. The data and information were secondary data collected from various sources and institutions to develop the structure of the model. The summary of important data collected can be referred to in Table 1.

Table 1

Data and Information Collected for the Model

Data/Information	Details	Sources	Year
Mortality Rates	Mortality rate by age group	Life Insurance Association Malaysia (LIAM)	2018
Investment rates	Assumptions on investment rates required for Tabarru Fund	Bank Negara Malaysia (BNM)	2018
Participants and populations	The growth rate of the population in Selangor	Department of Statistics Malaysia (DOSM)	2020

Step 2: Formulation of Dynamics Hypothesis

Causal Loop Diagram (CLD) is one of the tools that can be used to visualize the relationship of each variable. The dynamic hypothesis of impact in changes from each component (variable) in the system will be represented in the symbols in the CLD. The main function of CLD is to illustrate the connection between components (variables) involved in the microtakaful system. Note that the symbol (+) shows the variables moving in the same direction (both increasing or decreasing), and (-) shows the variables moving in different directions. Figure 1 depicts the final CLD developed for the microtakaful system, which is managed and provided by Zakat and Waqf institutions. In CLD, balancing loops indicate processes that preserve equilibrium, whereas reinforcement loops reflect processes that amplify or increase a system's behavior over time.

Participants of the microtakaful scheme will be the poor in the population, who will be identified by the Zakat institutions. Their microtakaful contribution rate will be sponsored by Zakat institutions. On the other hand, waqf institutions will be the ones that will manage those contributions because the functions of waqf funds enable the operator to use the funds to be invested in the future. These funds need to be invested for the fund to grow, which should result in a lower contribution rate needed to provide microtakaful benefits.

To create a functional and problem-oriented model, the scope and limits of the variable must be explicitly defined. The scope can be categorized into endogenous, exogenous, and excluded factors (Grösser, 2005). Table 3 presents the list of variables incorporated in the model. Endogenous variables can be referred to as dependent variables or responsive variables, where the values are determined in the model. Exogenous variables are the variables that influence the endogenous variable, and the values are determined outside the model. Note that exogenous variables can also be referred to as independent or causal variables (Bureš, 2017). All of these factors' interactions can be used to establish explanations for behavior, determine patterns that emerge, and investigate changes in behavior after they have altered (Gao et al., 2002). Other elements that are not specified in the model are considered outside the model's boundary.

Table 2

Transformed Rainfall Data Model Boundary Chart

Endogenous variable			**Exogenous variable**	**Excluded Parameters**
Participants	Tabarru rate	Management expenses	Population	Macroeconomic indicators
Zakat fund	Tabarru fund	Management fund	Economic performance	Management expenses such as salary, rent, reinsurance, or retakaful
Investment returns	Mortality rate		Age of participants	
Contribution	Claim		Contingency rate	Marketing or awareness of participants

These exogenous variables are important to formulate insightful models. The current information regarding the initial population of Selangor and their expected age as the indicator for the age of participants is the important exogenous variable in the model. The data for this variable is obtained from the Department of Statistics Malaysia (DOSM). Another variable, economic performance, indicates the performance of the state from various macroeconomic indicators. These assumptions may influence other endogenous variables. Finally, a contingency rate is often obtained from the regulations, which can be referred to as Central Bank of Malaysia (BNM) guidelines. Hence, the model might reflect the same behavior as the industry.

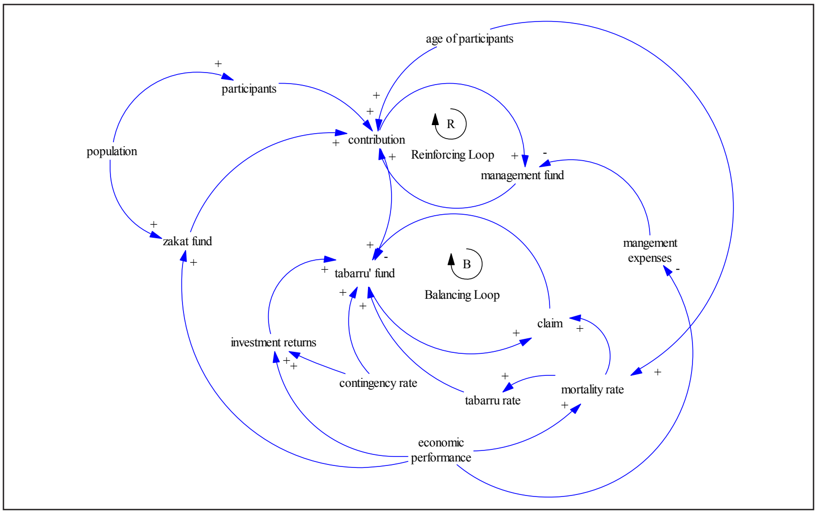
It is important to limit the number of exogenous variables to focus on the behavior of endogenous variables (Gao et al., 2002). Therefore, the excluded variables are the variables that might indirectly influence exogenous variables such as macroeconomic indicators (inflation rate, gross domestic product, unemployment rate) and details on management expenses (salary, rent, reinsurance, or retakaful). Another excluded variable is the marketing influence or the awareness that may influence the number of participants for microtakaful. This variable is excluded as the target is to have all eligible participants participate in the model, as the assumptions from the population.

In the proposed CLD, three distinct funds are envisaged for inclusion: the Contribution Fund, the Management Fund, and the Tabarru Fund, each serving a distinct purpose. The participant's contribution amount is calculated based on the waqf management expenses and the tabarru amount. This tabarru amount is subsequently subtracted from the Contribution Fund and transferred to the Tabarru Fund. Any surplus that may arise from efficient waqf management will be returned to the Contribution Fund. Consequently, this arrangement establishes a reinforcing loop between the Contribution Fund and the Management Fund. This is consistent with the takaful model, which adopted the Wakala and Waqf model, as mentioned in (Wahab et al., 2007).

The tabarru fund, which accumulates from tabarru deduction, will be used to pay out claims when due. The calculation of the tabarru deduction relies on mortality and investment assumptions. This tabarru deduction is computed using a formulation and principles akin to those employed in determining the net premium in a life insurance policy (Arofah et al., 2019; Ismail, 2013; Saputra et al., 2016). A balancing loop exists between the claim and the tabarru fund, in which the claim made will reduce the accumulated value in the fund. In contrast, an increase in expected claims will increase the tabarru amount, increasing the tabarru fund. The CLD represents major variables involved in the model, which include mortality, claims, investment, and management funds.

Figure 2

CLD of Microtakaful System Provided by Zakat and Waqf

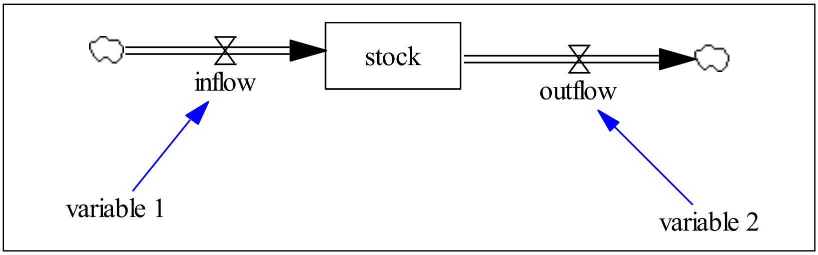


Step 3: Formulation of Simulation Model

CLD is suitable for illustrating the interrelationship of components. However, the equation and units for each connection are not shown in this visualization (Celi et al., 2020). Therefore, another diagram called a Stock and Flow Diagram (SFD), is useful for including the equations and units of each variable that need to be developed. In SFD, the stock (level) serves as an accumulation of a particular quantity or state variable. At the same time, the arrow signifies the flow, depicting the rate at which additions or subtractions occur within the stock over time, thus illustrating the dynamic interactions and feedback loops within the system. The core elements of SFD are formed by stocks and arrows, enabling dynamic systems to be visually modeled and simulated, demonstrating how variables accumulate and change over time in response to various influences and interactions, as illustrated in Figure 3.

Figure 3

Illustration of Stock and Flow Diagram



The SFD is a fundamental representation within the SDM framework, which is widely employed for studying dynamic systems. In this diagram, stocks represent accumulations of quantities, such as water in a reservoir or capital in an economy. They embody the notion of a level, essentially a storehouse of a particular entity. Inflow rate pertains to the rate at which a certain variable is added to the stock. In contrast, the outflow rate denotes the rate at which the variable is removed from the stock. These rates are typically expressed in units per unit of time. Variables, also known as factors, are components of the system that influence the behavior of stocks and flow. These can encompass a broad spectrum of elements, ranging from physical entities to abstract concepts like economic variables. Note that arrows in the diagram signify the direction and magnitude of the flow of a variable between stocks, reflecting the causal relationships that govern the dynamics of the system. They are essential for depicting the interactions and interdependencies within the modeled system. Overall, the SFD provides a visual and conceptual framework for comprehending the dynamic behavior of complex systems over time.

The formulations in SFD were mainly derived from relationships and connections of variables in the previously developed CLD. However, a few more variables have been added to SFD to make the model more realistic and logical. The SFD developed in this paper is separated into two parts: cash management for microtakaful and participants in microtakaful. Figure 4 illustrates the SFD for the cash management of microtakaful, and Figure 5 illustrates the SFD for the participants in microtakaful.

For the cash management of microtakaful, the SFD consists of three stocks, which are the contribution fund, management fund, and tabarru fund (see Figure 4). The contribution fund functions as a fund that receives contribution payments from participants before it deducts and transfers some of the amounts to the tabarru fund and management fund. The tabarru fund will function as the fund needed to pay off the claims of the participants when they are due. Finally, the management fund will cover all costs associated with maintaining the entire system. The outflow from the contribution fund to the management fund is called the wakalah fee, which represents the fee needed for the management to act as a representative (wakil) to the participants.

Figure 4

SFD for Funds in Microtakaful Model

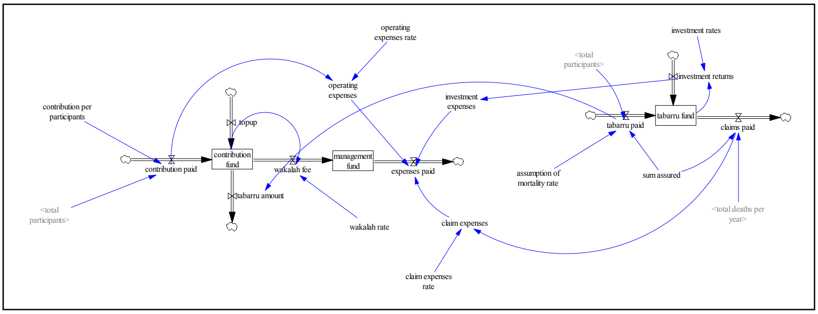
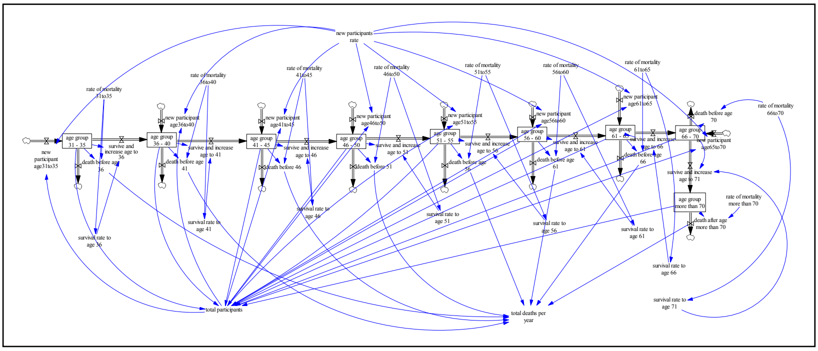


Figure 5

SFD For Different Age Groups of Participants



For the participants of microtakaful, there are nine stocks, which represent the number of participants in each age group, as shown in

Figure 3. The youngest group of participants are aged between 31 and 35, and the oldest group of participants are aged more than 70. The deaths of the participants of each group will follow the table of mortality from Malaysian Assured Lives from 2011 to 2015, produced by Life Insurance Association Malaysia (LIAM) (LIAM, 2018). Due to the data limitations, the mortality rates published by LIAM in 2018 will be utilized as a reference point since mortality rates for the low-income group have not been established yet. The selected mortality rates for each age group used in the model can be referred to Table 3. Each member of the participants in each group's individual age is assumed to be uniformly distributed in age, with the members of the highest age in the group surviving to the next age group based on the survival rate (1 mortality rate) for each group.

Table 3

Rates of Mortality for Each Age Group (LIAM, 2018)

Age Group	Rates of Mortality
31 – 35	0.00091
36 – 40	0.00115
41 – 45	0.00166
45 – 50	0.00242
50 – 55	0.00382
56 – 60	0.00549
61 – 65	0.00920
66 – 70	0.01575
More than 70	0.08274

For participants aged over 70, the highest mortality rate within the age range from 71 to 100 is utilized to ensure prudence in estimating the number of deaths in the model.

This part of SFD is important to estimate and simulate the number of participants who are going to contribute to the microtakaful scheme and the number of deaths of the participants in order to estimate the claim amount needed to be paid. Every year, new participants will enter the system, and it is assumed to be only 0.8% each year.

The variables in the SFD model are linked to the model's equations. The equations for some of the important variables are shown in Equations 1 until 13 below.

Assumption of mortality rate = 0.013682, Units: 1/Year (1)

Claim expenses = claims paid * claim expenses rate, Units: RM/Year (2)

Claims paid = total deaths per year * sum assured, Units: RM/Year (3)

Contribution fund = $\int_0^{\infty}$(contribution paid + topup − tabarru amount − wakalah fee, 0), Units: RM (4)

Contribution paid = contribution per participant * total participants, Units: RM/Year (5)

Expenses paid = claim expenses + investment expenses + operating expenses, Units: RM/Year (6)

Investment returns = IF THEN ELSE (tabarru fund<0, 0 , tabarru fund*investment rates), Units: RM/Year (7)

Management fund = $\int_0^{\infty}$(wakalah fee − expenses paid, 0), Units: RM (8)

Operating expenses = contribution paid*operating expenses rate, Units: RM/Year (9)

Management fund = $\int_0^{\infty}$(wakalah fee − expenses paid, 0), claims paid, 0), Units: RM (10)

Tabarru paid = total participants * sum assured * assumption of mortality rate, Units: RM/Year (11)

Total deaths per year = death before age 36 + death before age 41 + death before 46 + death before 51 + death before age 56 + death before age 61 + death before age 66 + death after age more than 70, Units: people/Year (12)

Total participants = “age group 31 - 35" + "age group 36 - 40" + "age group 41 - 45" + "age group 46 - 50" + "age group 51 - 55" + "age group 56 - 60"+"age group 61 - 65" + "age group 66 - 70" + age group more than 70, Units: people (13)

Assumption of new participants rate = 0.008. Units: 1/Year (14)

The assumption of mortality rate (Equation 1) used in determining tabarru rate is calculated using the average mortality rate for each group from 30 to 35 to 96 to 100, which is adopted from flat tabarru approaches throughout the years of all ages (Ismail, 2013). The new participant’s rate (Equation 14) is set to be 0.8% every year according to the population growth rate of Selangor obtained from DOSM (Hamid, 2020). As a start, the initial number of participants in each stock is set to be 100 participants. As for the management side of the microtafakul model, the variables of each rate that may influence the funds involved are operating expenses rate, claim expenses rate, and investment rate. The “0” in parenthesis after the Contribution Fund

(Equation 4), Management Fund (Equation 8), and Tabarru Fund (Equation 10) indicates that the initial values for each variable are set to zero.

Operating expense rates are determined from the contribution rate, where the purpose is to cover all costs arising from issuing the microtakaful protection. Correspondingly, it will be deducted from the management fund through the expenses paid. The claim expense rate is determined from the total claim paid, which covers all costs in settling the claims when due. The investment rate in the model is the minimum investment rate required for the tabarru fund. The tabarru fund needs to be invested to ensure the growth of the funds over time. The rates are set to be 4%, which is the pessimistic scenario in the Guidelines on Dynamic Solvency Testing from BNM (Bank Negara Malaysia, 2018).

The initial assumptions or the baseline of the model need to be set and used as the base of comparison between other results. Table 4 below contains the assumptions and brief explanations of the assumptions used.

Table 4

Baseline Inputs of the Model

No.	Variables	Value	Unit	Particulars
1.	Contribution per participants	150	RM/ people/ year	This is an annual contribution a participant needs to pay to enter the microtakaful scheme.
2.	Wakalah rate	20%	1/year	This is the rate of the admin fee charge so that the management can represent the participants (wakil).
3.	Operating expenses	5%	RM/year	This is the operating expenses rate per year based on the contribution.
4.	Claim expenses rate	5%	Dmnl	This is the rate of expenses that will be used to manage every claim that occurs and be charged from the total benefits paid.

(continued)

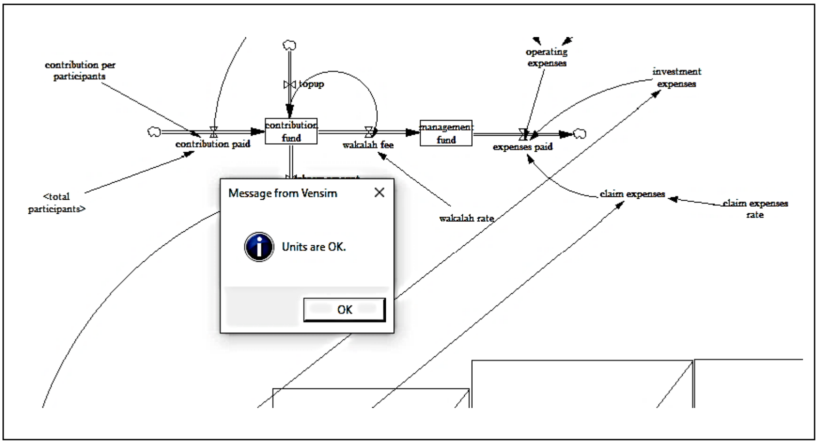
No.	Variables	Value	Unit	Particulars
5.	Sum Assured	RM 5,000	RM/ people	This is the amount given as a death benefit to the participants.
6.	Investment rates	4%	1/year	The rate of investment of the tabarru fund per year.
7.	Assumption of mortality rate	1.3682%	1/year	This is the average mortality rate from age 30 to 85.
8.	Age group (30 to 35 to more than 70)	100	people	Number of people in each age group in the model.
9.	New participants rate	0.8%	1/year	The rate of increment for new participants is every year.

Step 4: Model Testing

All SFD models must go through a validation process to verify the formulation used. One of the validation processes is called structure validation, which uses dimensional unit checking. This process will determine whether the unit used is consistent with the other components, which will also determine the final formulation of the model. Vensim Software, which is also used to design both CLD and SFD, can be used to execute this process. The signal in Figure 4 indicates that the model has passed unit checking.

Figure 6

Indication of Unit Check for SFD Model



Step 5: Scenario Analysis

The results of the analysis are divided into two main components: baseline analysis and intervention analysis. The baseline analysis provided insights into the initial state of the system. In contrast, the intervention analysis is divided into three specific aspects: the changes in the new participant rate, the changes in the assumptions of mortality rate, and the changes in contributions per participant. Note that these results are pivotal in understanding the dynamics of the microtakaful system and its responsiveness to different variables and interventions. Summary of the analysis type and their description is summarized in Table 5.

Table 5

Description of the Scenario Analysis

<table>
<tr><th colspan="2">Analysis Type</th><th>Description</th></tr>
<tr><td colspan="2">Baseline Analysis</td><td>Insights into the initial system state</td></tr>
<tr><td rowspan="3">Intervention Analysis</td><td>Changes in New Participants Rate</td><td>Impact of altering the rate of new participants</td></tr>
<tr><td>Changes in Assumptions in Mortality Rate</td><td>Effects of modifying assumptions in mortality rates</td></tr>
<tr><td>Changes in Contribution per Participants</td><td>Consequences of adjusting contributions per participant</td></tr>
</table>

RESULTS AND DISCUSSION

This section presents the significant impact of the changes in important variables, which will affect the value of the funds involved. To remain sustainable, those funds need to be increased over time to accommodate new participants and claims when due.

Baseline Analysis Results

The results of analysis from the baseline inputs of the model can be illustrated in Figures 7, 8, and 9.

Figure 7

Projected Cash Flows of Fund in Microtakaful Model

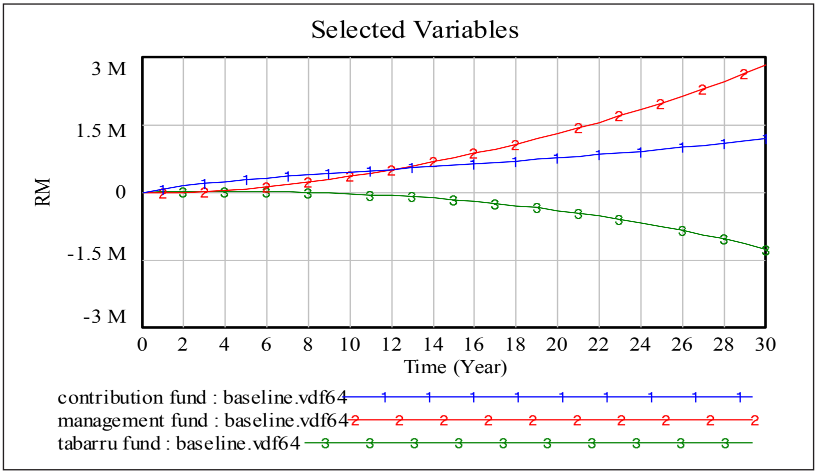


Figure 8

Projected Number of Participants

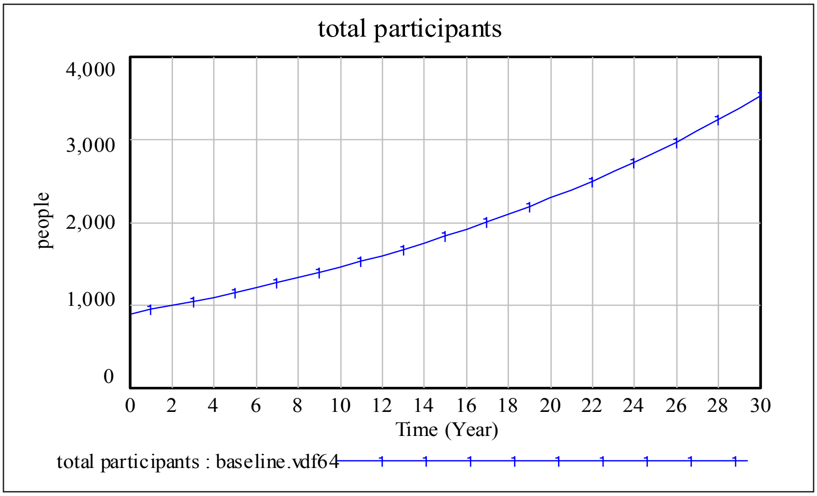
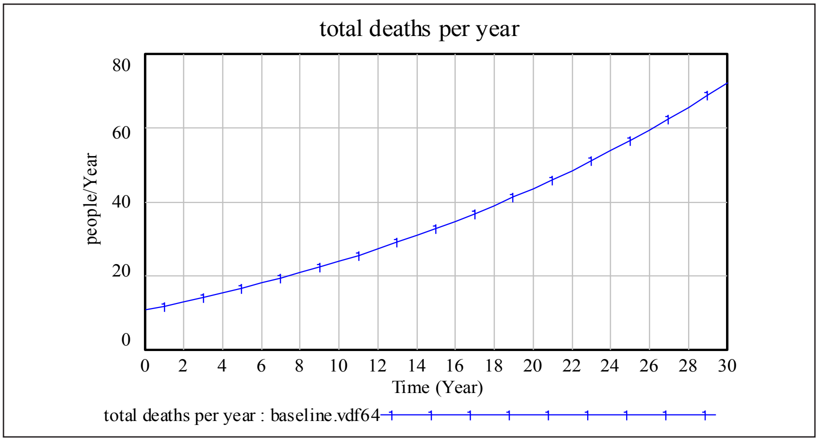


Figure 9

Projected Number of Deaths



The results from Figure 7 demonstrated that the baseline inputs were able to maintain the contribution fund and management fund to be above 0 at all times. However, the value of the tabarru fund will be less than 0. These results indicate that the inputs used in the initial setup are unable to sustain the microtakaful system. Therefore, in order to sustain the system, changes must be made to the inputs.

Figures 8 and 9 depict the number of participants and the number of deaths among the participants over time; with 100 initial participants in each group, the number of participants will keep increasing over time with a 0.8% increment rate for all age groups. This determines that the growing number of deaths over time is due to the survivors of the participants from younger age groups to older age groups, as well as the increasing number of participants every year.

Intervention Analysis Results

Key changes in the variables from the baseline inputs were discussed in this section. The baseline inputs were taken from the data collected except for the contribution per participant, where this contribution is an assumption used for payment per year.

The changes in the variables were determined based on the changes in cash flows for each fund. The main objective is to determine the optimum rate or price (contribution) that can help provide microtakaful benefits that can be sustained in the long term. The summary of the changes made in the analysis can be referred to Table 6.

Table 6

Changes in Values of Variables for Intervention Analysis

Variables	Baseline	Scenario 1	Scenario 2	Scenario 3
Contribution per participants	RM 150	RM 150	RM150	RM100 to RM140
New participants rate	0.8%	0.9% to 1.5%	0.8%	0.8%
Assumptions of mortality rates	1.3682%	1.3682%	1.5% to 2.0%	2.0%

The first analysis (Scenario 1) is the comparison of changes in the new participant's rate to all age groups. New participants are important as they will continue to contribute to the system's cash flows. The rates used in this analysis are 0.8%, 0.9%, 1%, and 1.5%, of which the changes in these rates towards the funds are illustrated in Figures 10, 11, and 12.

Figure 10

Changes in New Participants Rate (NPR) in Contribution Fund

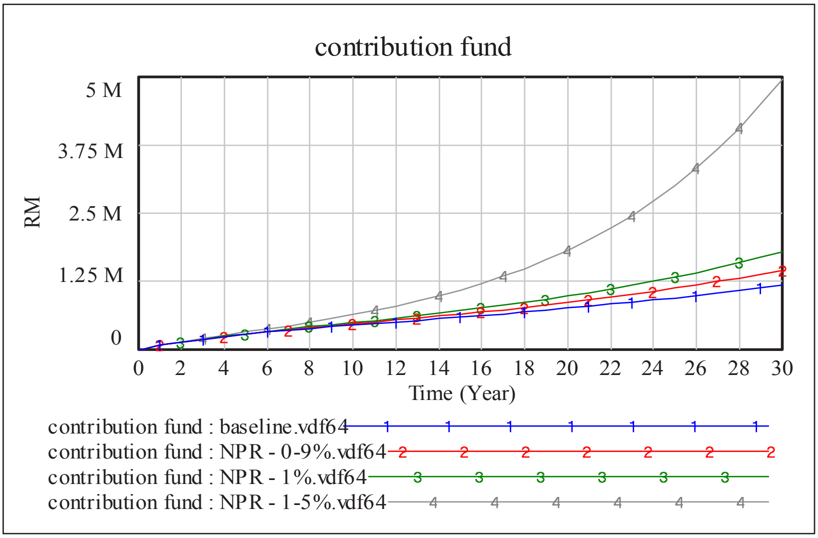


Figure 11

Changes in New Participants Rate (NPR) in Contribution Fund

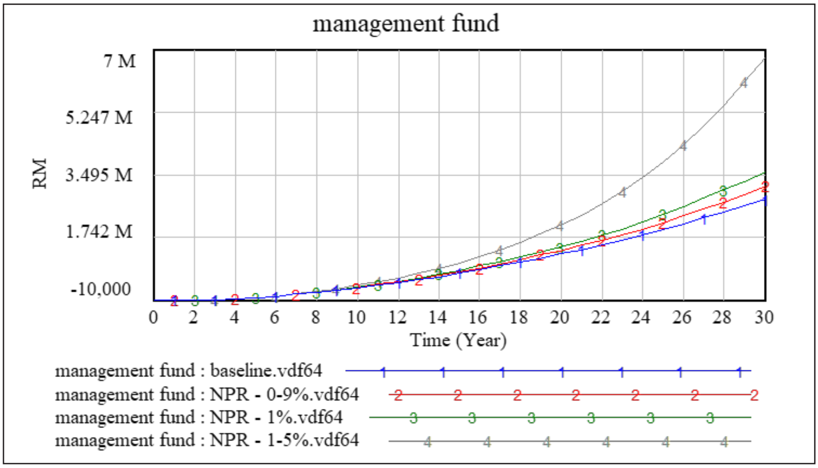
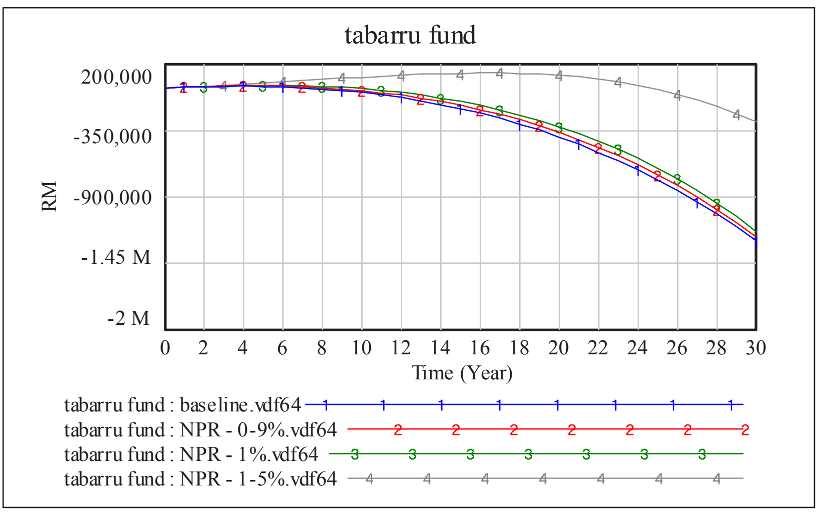


Figure 12

Changes in New Participants Rate (NPR) in Tabarru Fund



The results indicate massive improvement in the fund movement with an increment rate of 1.5% for the new participants. However, there will still be negative fund value for the tabarru fund over the years. The value of the tabarru fund from this scenario indicates that more new participants will increase the cash inflow to the contribution fund and result in more cash outflow in the tabarru fund from the claim made by the participants. Other than that, a high surplus in both the contribution fund and management fund should be used to fulfill the obligation of the tabarru fund. Figure 10 portrays that the new participant's rate should be more (1.5%) than the assumption of mortality rate (1.3682%) used in determining the tabarru paid into the tabarru fund.

The next analysis in Scenario 2 will reset the new participant's rate to the initial 0.8%. Nevertheless, it will change the assumed mortality rate used in the model. The rate of 0.8% is used as a realistic growth rate for participants. The rate of assumptions of mortality rate is set to be from the range of 1.3682% to 2.0%. The results are illustrated in Figures 13, 14, and 15.

Figure 13

Changes in Assumption of Mortality Rate (MR) in Contribution Fund

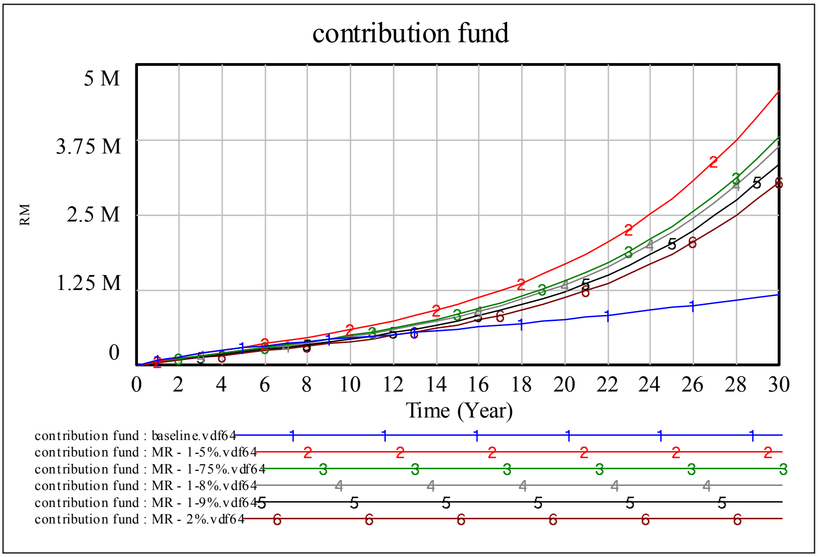


Figure 14

Changes in Assumption of Mortality Rate (MR) in Management Fund

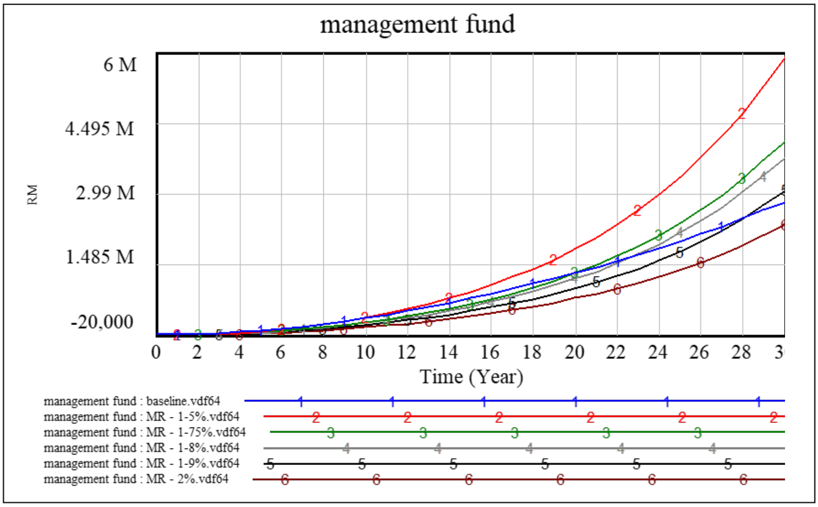
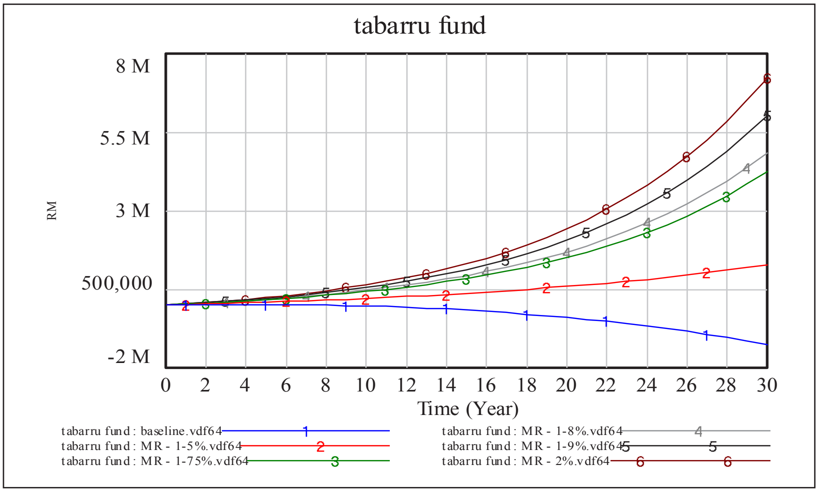


Figure 15

Changes in Assumption of Mortality Rate (MR) in Tabarru Fund



With the changes in the assumption of mortality rates, both contribution funds and management funds show a drop in the fund value. However, they are still going to increase over time. These changes help to maintain the tabarru fund to be more than zero and increase over time. The higher the assumptions of mortality rate for the deduction to the tabarru fund indicates the prudency in managing the risk of death of the participants. Consequently, the model's findings indicate that the mortality rates used to determine tabarru deductions exceed the optimal rate of 1.5341% calculated through mathematical equations (Ismail, 2013). The analysis determines that using rates below 2.0% leads to the tabarru fund maintaining a value below zero for an extended period. The purpose of this model is not to ensure profitability in providing microtakaful benefits. Therefore, the surplus and the increase in value for the contribution fund and management fund can be reduced by changing the contribution per participant. The next analysis in Scenario 3 will demonstrate the results of the funds involved due to the changes in contribution per participant. This analysis will use 2.0% to assume the mortality rate. The tabarru fund will not be affected as the inflow only assumes the assumption of mortality rate, which indicates that no matter the changes in the contribution rate, the main priority will be to make the tabarru fund always sufficient to pay out the claims when due. The results of the analysis from the changes in contribution per participant can be examined in Figures 16 and 17.

Figure 16

Changes in Contribution per Participants in Contribution Fund

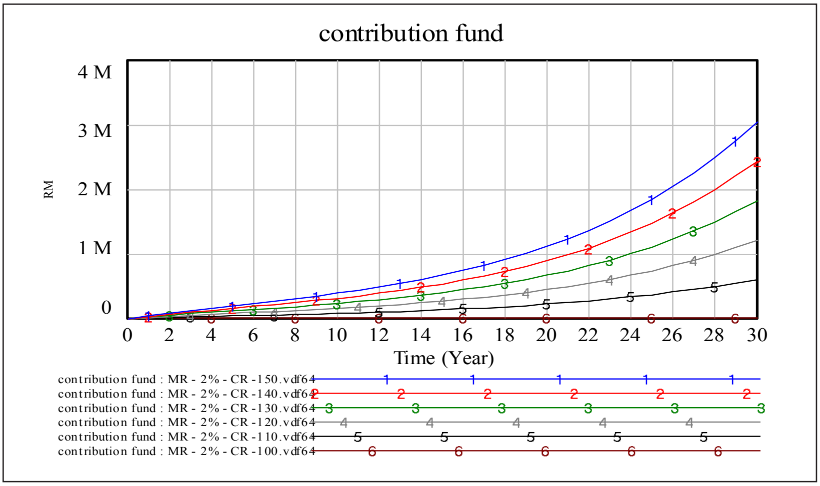
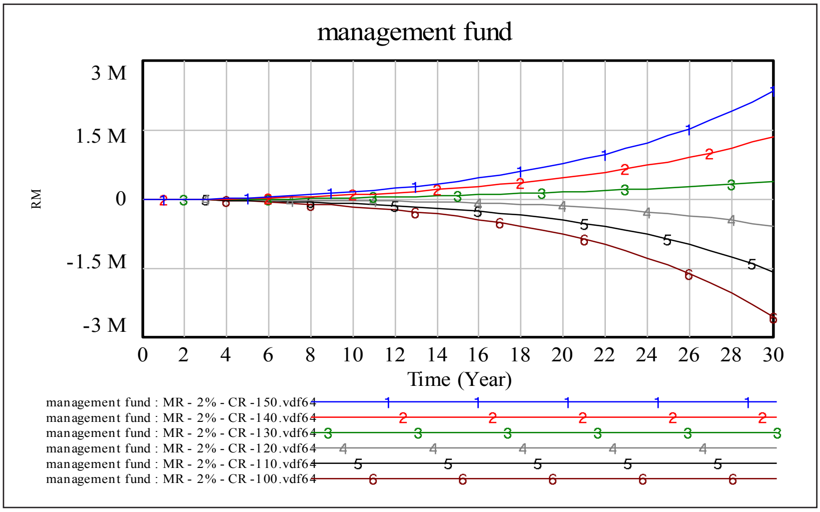


Figure 17

Changes in Contribution per Participants in Management Fund



The results indicate that the minimum amount for the contribution fund to be more than zero at all times is RM100 per year. However, to maintain the management fund, which is intended to cover all expenses, the contribution must be at least RM130 per year.

Based on the model's findings, the recommended annual contribution for microtakaful is RM130. This is less than the RM420 that urban poor individuals are willing to contribute, yet slightly higher than the RM120 considered by the rural poor (Rom & Rahman, 2012). Additionally, this recommended amount is more affordable than existing microtakaful products in the market, which range from RM180 to RM600 per year (Rapi et al., 2022).

CONCLUSION

In the scope of microtakaful, existing studies mostly emphasize aspects such as modeling, regulatory frameworks, and market demands. However, one critical factor that has received relatively limited attention pertains to the sustainability of implemented microtakaful systems. This research stands as a notable departure from the conventional landscape, as it endeavors to develop microtakaful products without seeking profitability by integrating the function of zakat and waqf, aligning with the principles of financial inclusivity and social welfare.

The model of microtakaful system proposed solely depends on the contribution from the participants, which zakat institutions and other funds required will be managed by waqf institutions. However, there are many variables or components that may affect the sustainability of all the funds involved. All the results in the analyses done in this paper show the important variables that need to be considered in determining the policy or contract of the microtakaful. Hence, it is important to ensure sustainability in all funds so that the obligations towards the participants can be met when due. Specifically, our research underscores the importance of carefully adjusting contribution rates to achieve financial stability, managing mortality rates to ensure long-term viability, and fostering strategies to encourage new participants. Furthermore, the recognition of complex feedback loops among these variables highlights the need for adaptive and holistic policy frameworks. In this way, our research serves as a valuable resource for policymakers and stakeholders seeking to promote the growth and resilience of microtakaful systems, ultimately contributing to the broader goal of financial inclusion and social protection.

This research, while designed to offer simple and understandable contracts to participants by employing a single contribution rate and a consistent sum assured assumed to be funded by zakat institutions, acknowledges several areas for future investigation and improvement. In cases where zakat institutions can only partially cover the required contribution, it becomes crucial to determine the optimal participant rate, particularly for the asnaf group. Further inquiries are needed to ascertain the appropriate sum assured that can effectively support dependents. Additionally, potential extensions of the model include exploring the interplay between microtakaful contributions and other financial assistance programs offered by zakat funds, enhancing the model's applicability and impact. Therefore, addressing data limitations related to real death numbers and specific mortality rates for the poor will be essential for future research to refine and substantiate these findings.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper and that the funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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