# A Solution to the Sunni and Shia Conflict
# in Sampang Madura Using a Dynamic Game Theory

**Muhammad Wakhid Musthofa**
Universitas Islam Negeri Sunan Kalijaga Yogyakarta, Indonesia
Email: muhammad.musthofa@uin-suka.ac.id


**Mohamad Yusup**
Universitas Islam Negeri Sunan Kalijaga Yogyakarta Sunan Kalijaga Yogyakarta, Indonesia
Email: sabil09aya11@gmail.com

**Abstract:** *The conflict between Sunni and the Shia community in Nangkernang hamlet, Karang Gayam village, Omben district and Gading Laok hamlet, Blu'uran village, Karang Penang district, Sampang has been going on since 1990s. The Shia community is still forced to live in the Puspa Agro flats in Jemundo Sidoarjo. The problem that has not been resolved is that the Shiite community wants to return to their hometown but the Sunnis still insist on refusing them. This study tried to find a solution to the problem using a dynamic game theory approach. Researcher constructed a dynamic game based on Prisoner's Dilemma model which represented the situation of conflict between Shia and Sunni communities. The resulting model then was simulated in order to offer a solution that government could execute to end the conflict and repatriate the Shia community to their hometown. Based on the game simulation, it is recommended that the repatriation of the Shia community from Jemundo Sidoarjo will only be safe if at least 80% of Sunnis accept the Shia community.*
*Keywords: Shia-Sunni conflict, dynamic game, prisoner's dilemma*

**Abstrak:** *Konflik antara warga Sunni dengan Komunitas Syiah di Dusun Nangkernang Desa Karang Gayam Kecamatan Omben dan Dusun Gading Laok Desa Blu'uran Kecamatan Karang Penang Kabupaten Sampang telah berlangsung sejak tahun 1990-an dan hingga kini belumlah usai. Akibat dari konflik tersebut hingga kini komunitas Syiah masih terpaksa (dipaksa) tinggal di rusunawa Puspa Agro Jemundo Kabupaten Sidoarjo. Permasalahan yang hingga hari ini belum terselesaikan adalah komunitas Syiah menginginkan untuk kembali ke kampung halamannya sementara warga Sunni di kampung halaman masih tetap bersikeras untuk menolak kepulangan mereka. Penelitian ini mencoba mencari solusi dari masalah tersebut dengan menggunakan pendekatan teori permainan dinamis. Dalam penelitian ini akan dikonstruksikan model permainan dinamis Prisoner's Dilemma yang merepresentasikan situasi konflik antara komunitas Syiah dan Sunni. Hasil pemodelan kemudian disimulasikan dalam rangka menawarkan solusi yang dapat dilakukan oleh aparat pemerintah untuk mengakhiri konflik dan memulangkan komunitas Syiah ke kampung halamannya. Berdasarkan simulasi model permainan direkomendasikan pemulangan*

*komunitas Syiah dari rusunawa Jemundo Sidoarjo hanya akan aman dilakukan jika minimal 80% warga Sunni dalam posisi mau menerima kembali keberadaan mereka.*
***Kata Kunci**: konflik Syiah-Sunni, permainan dinamis, prisoner's dilemma.*

## INTRODUCTION

Indonesia is known as a multicultural country with multiethnic, multiracial, multicultural and multireligious. In this situation, a harmonious inter-religious relationship is very essential. Unfortunately, the facts show that many conflicts of religious background are still common in Indonesia, especially over this past three decades. Starting from the conflict led to riots in Situbondo and Tasikmalaya in 1996, a series of religious conflicts were being continue. The last incident of intolerance is the dissolution of pre-Christmas church services on December 6, 2016 in Bandung.

One of the internal religious conflicts that has not ended until now is the conflict between Sunni and Shia community in Nangkernang hamlet of Karang Gayam village of Omben District and Gading Laok hamlet of Blu'uran village of Karang Penang district of Sampang regency in Madura. The conflict began in the early 1990s, and reached its peak in 2011 and 2012 when Sunnis burned down Shia community homes that led to their expelling from their hometowns in 2013. Starting from that year they were forced to live in the Puspa Agro flats in Jemundo Sidoarjo regency to this day. The problem that has not been resolved to this day is that the Shia community wants to return to their hometown while the Sunnis in their hometown still insist on refusing them. Even their body was refused burial in their hometown cemetery.

Many alternatives to resolve the Sunni-Shia conflict have been done. One of them is offered by Munawwaroh who offers expending the pie, repayment,

mediation, negotiation and communication as a solution to the conflict[1]. Hazim offers three stages of conflict resolution, namely de-escalation of conflict, problem solving approach, and peace building[2]. Ida and Dyson expressed the need for a forum of communication and dialogue initiated by Sunni and Shiia communities which is spearheaded by neutral clerics[3]. Meanwhile, Pamungkas proposed reconciliation by strengthening the implementation of human rights fulfillment as a solution to the conflict[4]. Unfortunately, the implementation of the various solution offered above has not been able to reconcile between these two conflicting parties up to now.

This research attempts to offer another alternative approach as a solution to the Sunni-Shia conflict in Sampang using a dynamic game theory. Dynamic game is a part of mathematical science that studies a competitive situation between two or more parties that involved in a conflict of interest with each other.[5][6]. The updated data collection of the conditions of the Sunni-Shia conflict in Sampang was conducted in March - May 2021. The obtained data is used to construct a game model that corresponds to conflict situations. The results were formulated into several recommendations that could be used by the government to reconcile the conflict and repatriate the Shia community to their hometowns.

[1] Mundiroh Lailatul Munawaroh, "Penyelesaian Konflik Sunni – Syiah Di Sampang Madura" (UIN Sunan Kalijaga, 2014).

[2] Hazim Hazim, "Dampak Sosial Dan Psikososial Bagi Pengungsi Pasca Konflik Antara Sunni - Syiah Di Sampang Madura," *Psikologia : Jurnal Psikologi* 3, no. 1 (March 22, 2016): 01–17, https://doi.org/10.21070/PSIKOLOGIA.V3I1.107.

[3] Rachmah Ida and Laurentius Dyson, "Konflik Sunni-Syiah Dan Dampaknya Terhadap Komunikasi Intra-Religius Pada Komunitas Di Sampang-Madura," *Masyarakat, Kebudayaan Dan Politik* 28, no. 1 (January 1, 2015): 33–49, https://doi.org/10.20473/MKP.V28I12015.33-49.

[4] Cahyo Pamungkas, "MENCARI BENTUK REKONSILIASI INTRA-AGAMA: Analisis Terhadap Pengungsi Syiah Sampang Dan Ahmadiyah Mataram," *Epistemé: Jurnal Pengembangan Ilmu Keislaman* 13, no. 1 (June 5, 2018): 113–47, https://doi.org/10.21274/EPIS.2018.13.1.113-147.

[5] J C Engwerda, *Linear Quadratic Dynamic Optimization and Differential Games* (West Sussex: John Wiley & Sons, 2005).

[6] A Haurie, J Krawczyk, and G Zaccour, *Games and Dynamic Games*, vol. 1 (Singapore: World Scientific Publishing Company, 2012).

**METHOD**

This study took the method of model combination as a research approach. Furthermore, among the form of model combination research methods, the method that corresponds to this study is sequential exploratory research method. This method combines sequentially between qualitative and quantitative research. The first stage uses qualitative research where continues by using quantitative research in the next stage.

However, quantification is not using the statistical method approach but using a dynamic game theory approach then the research paradigm is adjusted to the stages of dynamic game formulation which is relatively different from the quantification stages of statistical data analysis.

The research phase consists of two stages: the first stage is a qualitative research in the form of tracing the chronology of the Shia-Sunni conflict, and second stage is the quantitative research using a dynamic game theory approach. In this stage, the qualitative data that has been identified in the previous stage is converted into a dynamic game equation and analyzed the interpretation of game solutions in order to solve the addressed problems.

**RESULTS AND DISCUSSION**

**Highlights of Conflict Chronology**

A violent conflict is not an independent event but rather the result of a previous series of events that led to the violence. Similarly, the conflict between Shiites and Sunnis in Sampang. The conflict that led to the burning and expulsion of the Shia community from their hometown did not happen suddenly, but there was a series of previous events.

This conflict started from a conflict between two kyai who still have a kinship, they are Abuya Ali Karrar Sinhaji and Kiai Makmun in the early 1990s[7]. At that time, Kyai Makmun was interested to study Shia theories that were very different from the *ahlus sunnah* embraced by Kyai Karrar and the Muslim community of Madura. So, when Kiai Makmun sent his two children, Tajul Muluk and Roisul Hukama, to Shia Boarding School of YAPI in Bangil, Kiai Karrar asked him to refuse the two children from that boarding school. Tajul was eventually repatriated from YAPI and continued to study at Ma'had Maliki in Saudi Arabia. But, in Mecca Tajul used more of his time to study Shia teachings under guidance Muhammad Liwa' Mahdi, a Shia from Qatif in Saudi Arabia who is also a student at King Abdul Aziz University[8].

The conflict continued when Tajul Muluk returned from Mecca and began to introduce the Shia to the villagers in Karang Gayam and Blu'uran village, Omben district, Sampang regency in 1999 by establishing Pesantren Misbahul Huda[9]. Tajul Muluk's da'wah was received by the community until in 2004 there were 50 heads of families who joined the Tajul community. In 2011, the member has increased to 150 heads of families. Starting in 2004, Tajul sent the children of his community to Islamic boarding school of Shia foundation network in East Java to learn Shia teachings more[10].

However, Tajul's da'wah which is much contrary to the teachings of kyai in Sampang, and which is accompanied by Tajul's attitude that is often demeaning, insulting, and blaming the learnings and policies of the Sampang kyai. The increase of Tajul followers also has an impact on the reduction of the followers of some kiai in Sampang. The kyai called Tajul because he did not want to attend meetings held by MWC NU of Omben and Karang Penang. The Tajul's

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[7] Muhammad Afdillah, *Dari Masjid Ke Panggung Politik Melacak Akar-Akar Kekerasan Agama Antara Komunitas Sunni Dan Syiah Di Sampang, Jawa Timur* (Yogyakarta: Center for Religious dan Cross Culture Studies, 2016).

[8] Wahyudi Akmaliah, "Kekerasan Dan Pengusiran Atas Nama Agama Pasca Rejim Orde Baru: Studi Kasus Konflik Syiah Sampang," *MAARIF* 10, no. 2 (2015): 222–42.

[9] Achmad Maududi, "Perlindungan Hukum Terhadap Pengikut Aliran Syiah Di Sampang Madura," *Al-Daulah: Jurnal Hukum Dan Perundangan Islam* 4, no. 2 (2014): 243–60.

[10] Hodari, "Gerakan Politik Syiah-Sunni Di Desa Karang Gayam Dan Desa Blu'uran Sampang Madura," *Jurnal Review Politik* 5, no. 2 (2015): 232–53.

policy that concentrating the Prophet's birthday event in his mosque, which was previously held in people's homes, has also made the incomes of some kyai reduced drastically due to the lack of birthday of prophet Muhamad event held by them. They keep themselves from confronting vulgarly because they still respect to their grandfather Kyai Makmun and Kyai Ahmad.

In 2006 Kyai Makmun passed away. After that, the kyai and villagers began to dare to confront more vulgarly with Tajul Muluk. When Tajul Muluk held a birthday prophet Muhamad event at his home, as well as commemorating the 40th anniversary of his father's death, villagers flocked to Tajul's house. The villagers asked Tajul to stop his event because villagers suspected Tajul would invite 12 Shia experts from Kuwait. But the demonstration did not lead to anarchism because it was successfully prevented by the police. This event is an embryo of the courage of villagers to confront physically with Tajul Muluk and his followers[11].

In 2008, there was an agreement between Tajul Muluk and NU's administrator also MUI Sampang[12]. At the urging of the kyai, Tajul Muluk is willing to stop all his da'wah activities, because it is considered heretical and unsettling for the lives of the people of Karang Gayam village. But Tajul broke his promise. He still spread Shia teachings both secretly and openly.

On April 4, 2011 Tajul Muluk held a birthday Prophet's Muahamd event with the cover of IJABI by presenting Shia experts. The villagers block the venue. Armed with machetes, truncheons, and other weapons, they confronted the Tajul's followers who wanted to attend the event. The villagers judged that Tajul Muluk

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[11] Mujtahidin, Mahmud, and Mohammad Edy Nurtamam, "Peran Nilai Budaya Dalam Membentuk Perspektif Toleran Dan Intoleran Di Madura: Studi Kasus Konflik Sunni-Syiah Di Desa Karanggayam Kecamatan Omben Kabupaten Sampang – Madura," *Jurnal Pamator* 10, no. 2 (2017): 122–27.

[12] Ahmad Zainul Hamdi, "Klaim Religious Authority Dalam Konflik Sunni-Syi'i Sampang Madura," *ISLAMICA* 6, no. 2 (2012): 215–31.

had violated the agreement he had made together with NU and MUI Sampang in 2008. Finally, Tajul complied the villagers' demands to stop the event. To avoid a worse physical conflict, starting on April 16, 2011 the authorities relocated Tajul Muluk to Malang, in the village where his wife came from[13].

Although has been relocated, the villagers see Tajul returning to his village for various reasons, such as visiting his wife or on pilgrimage to his father's grave almost every day. Finally on December 17, 2011, the villagers burned down the house of one of the Tajul followers who allegedly became his hideout during his stay in Sampang. The arson continued on December 29, 2011 when Sunni villagers in Sampang lost their patience and burned down four houses and one mosque belonging to the Shia leader in Karang Gayam village. There are no casualties in this conflict, and the Shia were evacuated to Sampang Sports Hall[14].

The biggest process of the conflict occurred on December 26, 2012, which led to the burning of homes and the expulsion of Shia followers. This event began with a conflict between Umi Hani Tajul's sister and the village teenagers who were hooking on the road. That conflict extended so make obstruction of Shia who happened to be taking their children back to Shia boarding schools in East Java.[15]. After successfully confronting them, villagers moved to Nangkernang hamlet around Tajul's house. A debate was inevitable until there was a brawl. In fact, Shia community had prepared some weaponry to confront Sunnis. 3,000 Sunnis began arriving and storming down Shia homes. The attack left two people dead, 10 injured, and 37 homes burned, including Tajul Muluk's[16].

After the attack, the Shia community of approximately 278 followers was evacuated in Wijaya sport hall at Sampang regency. They consisted of 144 people, 98 children, and 36 babies. They have stayed in the sport hall for 6 months. Furthermore, on June 20, 2013 after doing *istigasah*, thousands of villagers went

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[13] Afdillah, *Dari Masjid Ke Panggung Politik Melacak Akar-Akar Kekerasan Agama Antara Komunitas Sunni Dan Syiah Di Sampang, Jawa Timur.*

[14] Affaf Mujahidah, "Eksistensi Civic Engagement Dan Elite Integration Dalam Konflik Sunni-Syiah Di Sampang," *Religió: Jurnal Studi Agama-Agama* 5, no. 2 (2015): 139–66.

[15] Abd Aziz and Matnin, "Jurnalis Dalam Tinjauan Sosial Ekonomi Politik Pada Konflik Sunni-Syiah Di Kabupaten Sampang," *Kabilah* 3, no. 2 (2018): 223–40.

[16] Afdillah, *Dari Masjid Ke Panggung Politik Melacak Akar-Akar Kekerasan Agama Antara Komunitas Sunni Dan Syiah Di Sampang, Jawa Timur.*

to Wijaya sport hall. They ornate and force the refugees to immediately get out and leave from the sport hall. Iklil Milal, Tajul Muluk's younger brother who became a spokesman for the Shia community, was not strong enough with the pressure from the villagers until he fell unconscious. This made the Shia community who initially insisted on not wanting to move, resigned to be moved from the sport hall. Next, using the bus facilitated by the police and security forces of the Sampang district government they were transferred to Jemundo flats in Sidoarjo in that same day. They live there in full of limitations[17].

Up to this day they still inhabit the Jemundo flats. On November 5, 2020 Tajul Muluk and about 270 of his followers declared a return to the teachings of *ahlus sunnah wal jamaah*. Facilitated by the regent of Sampang they are dressed in the office of Sampang regency. They hope that after returning to Sunni, the Karang Gayam villagers will accept them. To this day, however, most villagers still refuse their presence[18]. Based on the chronology of the above conflict, the conflict between Tajul Muluk and his followers and Sunni villagers in Karang Gayam village can be divided into three periods: 1). Period of physical confrontation, 2006 - 2012, 2). Period of exile, 2013 - 2020, 3). Post-*baiat* to Sunni period, 2021 – current.

**The Game Model of Sunni Shia Conflict in Sampang**

The conflict between Shiites and Sunnis in Sampang can be modeled using a dynamic game theory. In this game setting, the players are Shia and Sunnis community who are in conflict. Based on the conflict events described in the

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[17] Abdul Rozak, "Perlindungan Hak Atas Pendidikan Bagi Pengungsi Internal: Studi Kasus Pendidikan Anak Korban Kekerasan Terhadap Warga Syiah Sampang," *Jurist-Diction* 2, no. 6 (2019): 1887–1908.

[18] Interview with Mahdi Salim, a member of Team Lima from Karang Gayam village on April 1, 2021.

previous section, there are generally two basic strategies carried out by the players, that are strategy of confrontation and strategy of cooperation. The objective in this game is that each player wants to maintain the existence of the teachings of Islam that they believe in, that are Shia and Sunni.

Based on the construction of the game, the dynamic game model that suitable to represent the conflict between Shiites and Sunnis in Sampang is a prisoner's dilemma (PD) game model presented with graphs[19]. This section will lay out the basic model of prisoner's dilemma and use it to describe the conflict between Shiites and Sunnis in Sampang in three time periods, in accordance with the character of the conflict that occurred.

**The Basic Model of Prisoner's Dilemma**

The prisoner's dilemma game model is a type of game that describes a conflict of interest between two parties. Each player can choose to play one of the two opposing strategies, which each strategy will have different consequences. The goal of each player is to choose one of two available strategies, which will give him a maximum profit. In this paper, researcher refer our game model to Luo game model (2011) with some modifications in order to be able to represent the conflict between Tajul Muluk and his followers with Sunnis in Sampang. Here are some definitions related to the prisoner's dilemma game model.

**Definition 1.** Undirected Graph

Undirected Graph $G$ is an ordered pair of $G = (V, E)$, where $V = \{v_1, v_2, ..., v_n\}$ is a set of $n$ vertices, and $E \subseteq V \times V$ is a set of edges. A two vertices $v_i$ and $v_j$ is said to be a neighbor if $(v_i, v_j) \in E$, that is if there is an edge that connects between $v_i$ and $v_j$. The set $N_i = \{v_j \mid (v_i, v_j) \in E\}$ is a set of all neighbors of $v_i$. The notation $|N_i|$ defines the degree of $v_i$. We define $N_i^+ = N_i \cup \{v_i\}$[20].

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[19] Dockner E. et al., *Differential Games in Economic and Management Science* (Cambridge: Cambridge University Press, 2000).

[20] Kenneth Rosen, *Discrete Mathematics and Its Applications*, 8th ed. (New York: Mc Graw Hill, 2018).

**Definition 2.** Prisoner's Dilemma (PD) Game

Prisoner's dilemma (PD) is a two-player game with each player having two strategies available: cooperation (C) and confrontation (D).[21]. The payoff value (revenue) of each selected game strategy is given by the following table:

**Table 1.** The payoff value in prisoner's dilemma game

|   | C | D |
|---|---|---|
| C | $\sigma_1, \sigma_2$ | $a_1, b_2$ |
| D | $b_1, a_2$ | $\delta_1, \delta_2$ |

The index 1 corresponds to the row players, and the index 2 corresponds to the column players. The values $b_i, \sigma_i, \delta_i, a_i$, $i = 1, 2$ in the payoff matrix must meet to the following inequality

$$b_i > \sigma_i > \delta_i > a_i, \ i = 1, 2.$$

Based on the constraints on the above parameters, it can be seen that regardless of whether one player chooses a strategy of cooperation or confrontation, a better strategy for the other player is always confrontation. This is because $b_i$ is the biggest payoff value in this game. However, if both players choose a confrontation strategy, then the payoff they receive will be smaller than if both choose a cooperation strategy. This is where the dilemma arises.

Next, for repeated PD games, there are additional constrains that $2\sigma > a + b_i$, $i = 1, 2$.

**Definition 3.** PD Game in Graphs

A PD game in a graph is a repetitive game with *n* existing players forming the vertices of the graph and the game takes place in two phases: (i) the phase of the game playing, and (ii) the strategy update phase[22].

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[21] James R Situmorang, "Penggunaan Game Theory Dalam Ilmu Sosial," *Jurnal Administrasi Bisnis* 11, no. 2 (2015): 160 – 172.

Furthermore, in this paper we mean the PD games in a graph is limited to PD games with fixed graphs and with synchronized strategy update models. This PD game is a recurring game with each iteration in the game takes place in two phases:

a) The phase of the game playing. In this phase the players play the PD game along with all the other players with a certain strategy and then each player calculates the total payoff they have earned.

b) Strategy update phase. In this phase all players compare the earned payoffs to all of their friends (including the payoff themselves) and choose a strategy from other players that provide the highest payoff for the next iteration. In other words, the rule of updating players' strategy is to mimic the strategy of other players who give the highest payoff.

Next, each player will be grouped based on the character he has. This grouping will also be the basis in determining the rules of the game, both in the phase of the game playing, and the strategy update phase.

## Construction of a Game Model for the Shia-Sunni Conflict

This section constructed a prisoner's dilemma (PD) based on game model to represent the conflict between Tajul Muluk and his Shia community with Sunnis in Sampang. The population in this PD game is divided into two groups, namely Shia groups and Sunni groups. Each group consists of many individuals who are referred to as players. The interaction between players and each other is modeled on a graph, with the vertices on the graph represent the player and the edges on the graph represent the interaction between players.

Because the population in this PD game consists of two different religious groups, there are two different types of vertices in the graph. In this PD game context, a cooperation strategy (C) means the desire of the player to reconcile or compromise with the other group. And a confrontation strategy (D) means the

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[22] Lingzhi Luo, Nilanjan Chakraborty, and Katia Sycara, "An Evolutionary Game-Theoretic Model for Ethno-Religious Conflicts between Two Groups," *Comput Math Organ Theory* 17, no. 1 (2011): 379–401.

desire of the player to remain in conflict with the other group. Furthermore, the strategy D can be used to measure the tension between these two conflicting groups.

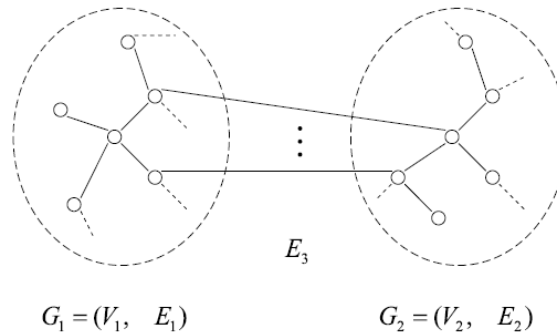### The Construction of Graph Network in the Game

The undirected graph $G = (V, E)$ is used to represent the players of Shia and Sunni groups and the interaction between them, with the set $V$ is expressed by $V = \{v_i \mid i = 1, 2, ..., n\}$. The notation $n_1$ states the total number of players in the Sunni group and $n_2$ states the total number of players in the Shia group, where $n = n_1 + n_2$ stating the total number of players. Next, the graph $G$ is constructed in two steps as follows:

a) Construct the graphs $G_1 = (V_1, E_1)$ and $G_2 = (V_2, E_2)$ for each group separately, were $|V_1| = n_1$ and $|V_2| = n_2$.

b) Construct the set of edges $E_3 \subseteq V_1 \times V_2$ such that each player in that one group is connected to at least one player in the other group. The average number of edges connecting a player from one group to another is $k$[23]. The number $k$ can be viewed as a parameter that states the degree of connectedness between two groups.

Whitin this construction, we obtain a graph $G = (V, E)$, with $V = V_1 \cup V_2$ and $E = E_1 \cup E_2 \cup E_3$. This graph $G$ can be described in Figure 1. below.

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[23] The number $k$ states the average of how much a player from one group relates to a player from the other group.

**Figure 1.** Network structure of graph $G$

According to the construction of graph $G$, each player $i$ on graph $G$ has two types of a neighborhood:

a)  Neighborhood of players of its own type, $NS_i = \left\{ v_j \middle| \left( v_i, v_j \right) \in E_1 \cup E_2 \right\}$, $i = 1, 2, ..., n$.

b)  Neighborhood of players of the other group's type, $ND_i = \left\{ v_j \middle| \left( v_i, v_j \right) \in E_3 \right\}$, $i = 1, 2, ..., n$.

**Phases in each Round of the Game**

The PD games take place in several rounds (iterations) with each round consisting of a phase of game playing and a phase of strategy update. In this game, it is assumed that the structure of the $G$ network is fixed and the strategy update is synchronized.

In the phase of the game playing, each player plays a PD game with other players who come from different groups. So, in this case every player uses $ND_i$ as the game playing neighborhood.

Defined $s_i(t)$ is the strategy of player $i$ on the $t^{th}$ round, with the value $s_i(t) = 0$ stating the cooperation strategy (C) and $s_i(t) = 1$ stating the confrontation strategy (D). It is assumed that in each round each player plays the same strategy as all players in his game playing neighborhood. The aggregate payoff of player $i$ on the $t^{th}$ round is notated by $p_i(t)$ which is counting by

summing the individual payoffs to be earned from playing with the players in $ND_i$

$$p_i(t) = \sum_{j:v_j \in ND_i} \sigma\left(1 - s_i(t)\right)\left(1 - s_j(t)\right) + \delta s_i(t) s_j(t). \qquad (1)$$

In the strategy update phase, each player $i$ mimics the strategy of another player with the highest payoff value in the previous iteration, thus forming a set $C_i^+ = C_i \cup \{v_i\}$, with $C_i$ is a strategy update neighborhood. In this paper it is assumed that each player updates his strategy based on the payoff value of his neighboring players who come from his group, that is $C_i = NS_i$. If there is more than one player who has the highest payoff value then a player will randomly choose one of the players with the highest payoff and then imitate his strategy. Thus, the strategy update for player $i$ can be expressed as

$$s_i(t) = s_j(t-1), \text{ where } j = \arg\max_{k \in C_i^+}\left(p_k(t-1)\right). \qquad (2)$$

Next, we define the strategy vectors $S(t) = \left[s_1(t), ..., s_n(t)\right]$ and the payoff aggregate vectors $P(t) = \left[p_1(t), ..., p_n(t)\right]$ for all $n$ players on $t^{\text{th}}$ iteration. The initial strategy vector $S(1)$ is chosen at random so that the probability of the player's initial strategy is the cooperation strategy is expressed by $f_c$. This number states the initial proportion of cooperation strategies. Evolution of the strategy vectors $S(t)$ and the payoff vectors $P(t)$ are presented by Figure 2 below.
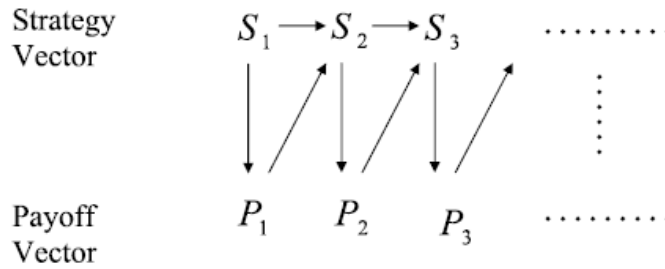
**Figure 2.** Evolution of strategy vectors $S(t)$ and payoff vectors $P(t)$

The arrow in Figure 2 states the dependency relation of these variables.

## Game Playing and Strategy Update Neighborhood

The game playing neighborhood for each player in the phase of the game playing is $ND_i$, i.e. players are in the neighboring who come from different groups. Intuitively, this means that the desired conflict occurs between players from different groups rather than in the same group. Next, in the strategy update phase, the strategy update neighborhood is $NS_i$. This gives the assumption that a player is more concerned with the information and opinions of players who come from his group rather than those from another group.

The difference in the use of the concept of neighborhood for the phase of the game playing and phase of strategy update is intended in order to emphasize that in this game there are two types of players in different graphs, which aims to emphasize the strategy of confrontation between two groups compared to the strategy of cooperation.

## The Measure of Conflict Potential

The measure of potential conflict between two groups is measured by considering interactions between players. This measure is expressed in strategy pairs of the interaction of two players which come from different groups in a steady state condition. In this game, the $D-D$ strategy (two players from two different groups chooses to play the confrontation strategy) between Shia and Sunni groups is chosen as a measure of the conflict potential, which is stated by the following equation

$$f_{dd} = \frac{\sum\limits_{(v_i, v_j) \in E_3} s_i \cdot s_j}{|E_3|} . \tag{3}$$

**Applying the Case of the Sunni Shia Conflict in Sampang**

This section applied the PD game model that was constructed in the previous section to the case of conflict between Shia and Sunni in Sampang Madura. In this game, Sunnis as player 1, Shia as player 2. Each player has two strategic options: cooperation (C) and confrontation (D).

The game in this conflict can be modeled with a PD game presented with graphs $G = (V, E)$, with $V = \{V_1, V_2\}$ where $V_1$ states the set of conflicting Sunni villagers, with, $|V_1| = 3000$ and $V_2$ states the set of conflicting Shia communities, with $|V_2| = 270$. A set $E$ is presented as $E = \{E_1, E_2, E_3\}$, where $E_1$ states an internal interaction between Sunnis, $E_2$ states an internal interaction between Shias, and $E_3$ states the interactions between Sunnis and Shias. The number of lines on $E_1$ and $E_2$ are raised randomly with the Matlab program.

Next, a program based on Matlab will be created to simulate the dynamics of conflict between Shia and Sunni. Some aspects that will be simulated are the dynamics of the strategies chosen by the two conflicting groups, the types of strategy of both groups at the steady state condition, and the predictions of future conflict dynamics.

Before simulating the game, in the first step we will estimate the involved parameters in the game. We explain this in the following section.

**Parameter Estimation**

The PD game with graph that represents cases of conflict between Shiites and Sunnis in Sampang Madura in this article has several parameters, they are:

a) The parameters contained in the payoff matrix, that are $\sigma_1, \sigma_2, \delta_1, \delta_2, a_1, a_2, b_1$, and $b_2$. Parameter $a_1$ is the payoff value that player 1 will get if he/she uses strategy C and player 2 uses strategy D. Conversely, $a_2$ is the payoff value that player 2 will get if he/she uses strategy C and player 1 uses strategy D. Because the focus of analysis on this game is the choice of the final strategy of each player whether strategy C or D, then the parameters $a_1$ and $a_2$ do not really affect the game. So, for simplicity we take $a_1, a_2 = 0$.

Parameter $\sigma_1$ is the payoff value that will be obtained by player 1 and the parameter $\sigma_2$ is the payoff value that will be obtained by player 2 if both players use strategy C. Next, the parameter $\delta_1$ is the payoff value that will be obtained by player 1 and the parameter $\delta_2$ is the payoff value that will be obtained by player 2 if both players use strategy D. In this Shia-Sunni conflict, the parameters $\delta_1$ and $\delta_2$ will not change the outcome of the game significantly, as long as the values of $\delta_1$ and $\delta_2$ are much smaller than $\sigma_1$ and $\sigma_2$.

The other parameters are $b_1$ and $b_2$. The parameter $b_1$ states the payoff to be earned by players in Sunni groups when a player in the Shiite group takes a cooperation strategy. Based on the results of[24], players in smaller groups have more incentive for confrontation than those in larger groups. So, the value of $b$ for players in a smaller group (in this case is the Shia group) is greater than the value of $b$ for players in the larger group (in this case is the Sunni group), that is for $n_1 > n_2$ then $b_1 < b_2$. Because of the

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[24] M Lumsden, "The Cyprus Conflict as a Prisoner's Dilemma Game," *J Confl Resolut* 17, no. 1 (1973): 7–32.

values of player's strategy $s_i(t)$ are 0 or 1, then the value of $b_1$ and $b_2$ do not affect the payoff values of the game.

b) Number of players in each group. According to the information gathered at the location of the conflict and from some literature, it is known that the number of Sunni villagers in Karang Gayam who are involved in the conflict is stated with $n_1 = |V_1| = 3000$, while the number of Shia communities in Karang Gayam and Blu'uran is stated with $n_2 = |V_2| = 270$.

c) The initial proportion of the cooperation strategy ($f_c$), which states the proportion of players on both groups who initially choose the cooperation strategy. This proportion can be used as a data on the magnitude of the level of hostility that occurs between the two warring groups. In this conflict, the values of $f_c$ in the game will differ at each conflict period, adjusting to the level conflict escalation. The smallest value of $f_c$ lies in the conflict period 2006 - 2013, and in the next period the value will increase.

d) The degree of connectedness between the two groups, denoted with $k$, which states the average player in the Shia group interacts with how many players in the Sunni group, or vice versa. In contrast with $f_c$, the values of $k$ also differ in each conflict period, but the largest value of $k$ lied in the conflict period 2006 -2013, and in the next period the value will decrease.

## Period of Conflict 2006 - 2012

This period was the culmination of the conflict between Sunni villagers and the Shia community in Karang Gayam village. In this period, both the initial proportion of cooperation ($f_c$) and the degree of connectedness between Sunni and Shia ($k$) groups had the highest number compared to the next two periods.

Based on field observations and information from several sources, in this first period this we set the values $f_c = 0,1$ and $k = 10$. The value of $f_c = 0,1$ means only 10% of all players from both Sunni and Shia communities choose to play cooperation strategies, while the other 90% choose to confront. While the value of $k = 10$ means that during the conflict, on average, every Sunni interacts with 10 Shiites and vice versa. Next, we set the value $\delta = 0,5$ and $\sigma = 0,4$ that indicates the perception of the players that choosing a confrontation strategy is more profitable compared to the cooperation strategy.

The construction of the game graph in this period is presented by Figure 3 below. The blue line states the internal interactions of Sunnis, the color green expresses the internal interaction of the Shia community, the black color states the player who chooses the confrontation strategy and the red color states the player who chooses the cooperation strategy.
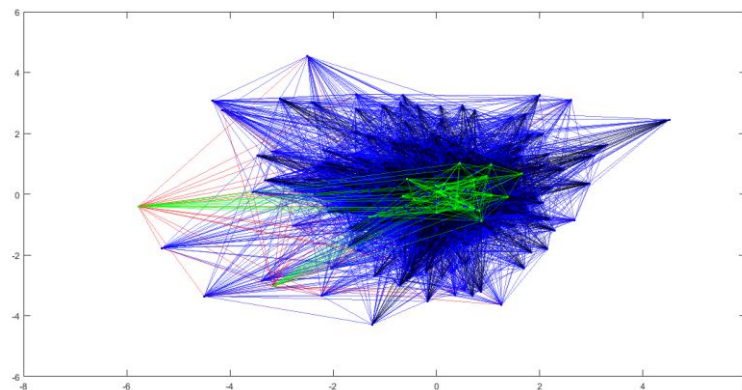


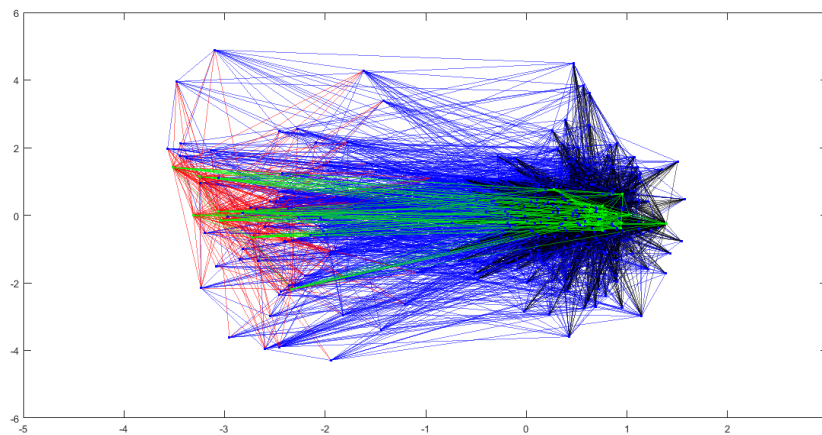**Figure 3.** The initial condition of the game in the period 2006 - 2012

The above parameters are then inputted into Matlab. The result says that the game ends in one iteration, and at the end of the game all players use a confrontation strategy. This result is in accordance with the conditions of conflict between Sunnis and Shiites in the period 2006 to 2012, where the two conflicting groups remained in a conflict until the end of 2012. At that time, the Shia community was expelled from his homeland and relocated to Puspa Agro flats in Jemundo Sidoarjo East Java, which is about 100 km from Sampang regency. On

the other hand, the Sunnis hold a grudge against the Shia community even though they have been far from their villages.

**Conflict Period 2013 - 2020**

The conflict between Sunni villagers and the Shia community in Karang Gayam village of Sampang regency in this period began to decline. This is because these two parties have been separated with a considerable distance. The Shiite community are in Sidoarjo, while Sunnis remain in Karang Gayam village. The interaction between the two parties has diminished, as has the internal interaction on each community. Nevertheless, both of these two parties still hold grudges and deep heart wounds. In this period the majority of the two conflicting parties still choose the strategy of confrontation. It is estimated that only 25% of players choose a cooperation strategy.

Mathematically, the change of data of conflict condition in this period will lead to the change of parameters involved in the game. Because the interaction between players was decreased, the value of parameter $k$ dropped to 8, and the parameter $f_c$ rose to 0.25. While the parameters $\delta$ and $\sigma$ are fixed, because the player's perception of the strategy options is still in same, that is the confrontation strategy is more profitable compared to the cooperation strategy. The construction of the game graph in this period is presented by Figure 4 below.

**Figure 4.** Initial condition of the game in the period 2013 - 2020

Inputting all of the above parameters in the program, then the result also says that the game ends in one iteration, and at the end of the game all players use a confrontation strategy. This result is also in accordance with the conditions of conflict between Sunni and Shia villagers in the period 2013 to 2020, where the two conflicting parties remain in a conflict although they were not interacting each other directly. Each of them still holds a grudge against each other for the physical confrontation that ever occurred between them.

## Period of Post-conflict in 2020

This period describes the current state of conflict. Based on the current conflict conditions, in this period we will predict conflict situations in the future through a game simulation based on the assumptions in the current game parameters. Using this prediction, it is expected that the best recommendations can be purposed regarding with the conflicts between Sunnis and the Shia community.

First, we will predict the future conflict situation based on the total number of Sunni and Shia communities choosing a cooperative strategy currently (initial proportion of cooperation/ $f_c$ ). In this simulation, the value of parameter $f_c$ will be changed, while the values of the other parameters are fixed at $k = 7$, $\delta = 0,46$, and $\sigma = 0,45$.

With the values of these parameters, for $f_c$ those moves from 0.5 to 0.8 we obtained the results of the simulation in Table 2 below. The parameter $f_{dd}(i)$ on the table states the proportion of players choosing a confrontation strategy in $i^{th}$ iteration.

**Table 2.** The proportion value of players who choose a confrontation strategy

| $f_c$ | $f_{dd}(1)$ | $f_{dd}(2)$ | $f_{dd}(3)$ | $f_{dd}(4)$ | Description |
|---|---|---|---|---|---|
| 0,5 | 0,4771 | 0,6514 | 0,8471 | 0,9144 | The game ends in conflict and at the end of the game there are 280 players who choose a cooperation strategy. |
| 0,6 | 0,07 | - | - | - | The game ends in peace and at the end of the game there are 229 players who choose a confrontation strategy. |
| 0,7 | 0,0061 | - | - | - | The game ends in peace and at the end of the game there are 20 players who choose a confrontation strategy. |
| 0,8 | 0 | - | - | - | The game ends in peace and at the end of the game all players agree to use a cooperation strategy. |

Converting the proportions in Table 2 into numbers, then the total number of players (Shias and Sunnis) who choose the strategy of confrontation in each iteration is presented in Table 3 below.

**Table 3.** Total number of players who choose confrontation strategies

| $f_c$ | $f_{dd}(1)$ | $f_{dd}(2)$ | $f_{dd}(3)$ | $f_{dd}(4)$ | Description |
|---|---|---|---|---|---|
| 0,5 | 1.560 | 2.130 | 2.770 | 2.990 | The game ends in conflict and at the end of the game there are 280 players who choose a cooperation strategy. |
| 0,6 | 229 | - | - | - | The game ends in peace and at the end of the game there are 229 players who choose a confrontation strategy. |
| 0,7 | 20 | - | - | - | The game ends in peace and at the end of the game there are 20 players who choose a confrontation strategy. |
| 0,8 | 0 | - | - | - | The game ends in peace and at the end of the game all players agree to |

| | | | | | use a cooperation strategy. |
|---|---|---|---|---|---|

According to the Table 3 above, it is known that if at this time the number of Sunnis and Shia communities who choose the strategy of cooperation (wants to make a peace) is 50% (or a number of 1,635 people) then it is predicted that the conflict will end in a confrontation, where Sunnis and Shia communities who are choosing a strategy of confrontation at the end of the conflict is 2,990 people and who are choosing a cooperation strategy is only 280 people.

Next, if the number of Sunnis and Shia communities who choose the cooperation strategy is 60% (or a total of 1,962 people) then it is predicted that the conflict will end in peace, where Sunnis and Shia communities who are choosing a strategy of confrontation at the end of the conflict is only 229 people, while the rest are choosing a cooperation strategy. Similarly, if the parameter $f_c$ is greater than 0.6 then it is predicted that the conflict will end in peace. However, although ending in peace, but there are still a small percentage of citizens, around 20 people, who choose to confront if $f_c = 0,7$. All the villagers were agreed to make a peace (choose a cooperation strategy) when $f_c = 0,8$. In this condition, none of the villagers chose to confront.

Thus, the repatriation of Shia communities to their hometowns in Sampang regency will only be safe if the number of Sunnis who choose a cooperation strategy is at least 80% of the total population. This is because if the number of Sunnis who choose the cooperation strategy is 80%, then it is predicted that the conflict will end in peace without leaving a single villager who insists on staying confronted.

Besides $f_c$, the game parameters that determine how the conflict conditions will end are the parameter $\delta$ and $\sigma$. These parameters are an incentive (advantage/benefit) for players to their selection of cooperation and confrontation strategies. In the previous simulation the difference of the value of $\delta$ and $\sigma$ was made very small, which is 0.01, in order to show that the two parameters did not affect the game significantly. To see the role of these two parameters in the

conflict between Sunnis and Shias, we will conduct some simulations by setting parameter $f_c = 0,5$ and $k = 6$, while parameter $\delta$ and $\sigma$ were changed. The results of the simulation are presented in Table 4 below.

**Table 4.** Conflicts Simulation with the Varying Values of $\delta$ and $\sigma$

| $\delta$ | $\sigma$ | Difference between $\delta$ and $\sigma$ | $f_{dd}(1)$ | Description |
|---|---|---|---|---|
| 2 | 1 | 1 | 0.9235 | The conflict ended with 3,019 villagers choosing a confrontation strategy and 251 villagers choosing a cooperative strategy. |
| 0,5 | 0,4 | 0,1 | 0.7095 | The conflict ended with 2,320 villagers choosing a confrontation strategy and 950 villagers choosing a cooperative strategy. |
| 0,5 | 0,45 | 0,05 | 0.4893 | The conflict ended with 1,600 villagers choosing a confrontation strategy and 1,670 villagers choosing a cooperative strategy. |
| 0,5 | 0,475 | 0,025 | 0.6055 | The conflict ended with 1,970 villagers choosing a confrontation strategy and 1,300 villagers choosing a cooperative strategy. |

According to table 4, it can be concluded that the smaller the distance between the parameters $\delta$ and $\sigma$, the total number of players who choose confrontation and cooperation strategies will be more balanced. In this condition the strength of both parties will also be balanced until the end of the game. So that, the conflict between the two parties will remain continue. Thus, one of the efforts in order to accelerate the resolution of the conflict between Sunnis and Shiites is to minimize the difference between parameters $\delta$ and $\sigma$. In this case because $\sigma$ is an incentive for players if choosing a cooperation strategy, then this value must be enlarged. Increasing the value of $\sigma$ could be efforted by providing

persuasion to the villagers so that they will choose a cooperative strategy. In its application, this can be done with a sociological approach in the form of providing counseling and awareness to Sunnis in order to accept the existence of the Shia community. Theological approaches can also be done using a spiritual mental development through the existing forums of study.

Lastly, the simulations are performed by varying the average number of interactions a player with other players in his group. Interaction between players in Sunni groups is symbolized by $k_1$, while interaction between players in Shia groups is symbolized by $k_2$. The other parameters are fixed to the values $f_c = 0,5$, $\delta = 0,46$, and $\sigma = 0,45$. The simulation results are summarized in Table 5 below.

**Table 5.** Table 5. Conflict Simulation with varying values of $k_1$ and $k_2$

| $k_1$ | $k_2$ | Difference between $k_1$ and $k_2$ | $f_{dd}(1)$ | $f_{dd}(2)$ | Description |
|-------|-------|-------------------------------------|-------------|-------------|-------------|
| 10 | 5 | 5 | 0.5505 | 0.9939 | The game ends in conflict |
| 10 | 6 | 4 | 0.6024 | - | The game ends in conflict |
| 10 | 7 | 3 | 0.4587 | 0.0031 | The game ends in peace |
| 10 | 8 | 2 | 0.4220 | 0.0183 | The game ends in peace |
| 10 | 9 | 1 | 0.4006 | 0.0092 | The game ends in peace |

The Table 5 informs that the smaller the difference between the values of $k_1$ and $k_2$, the more it will guarantee the game ends in peace. In order to assure that the difference between the values of $k_1$ and $k_2$ in the game is small, then we have to enlarge the value of $k_2$. This means to increase the average interaction between players in Shia groups that will result in increasing their solidity, so that the game will end in peace. Thus, one of the efforts in order to accelerate the resolution of the conflict between Sunnis and Shiites is to minimize the difference between the values of $k_1$ and $k_2$ or increase the value of $k_2$.

## CONCLUSION

Prisoner's Dilemma (PD) dynamic game model can be used to represent conflict between Sunni villagers and Shia communities in Karang Gayam village of Omben district of Sampang regency. Through the PD game, research have conducted some simulations that result some suggestions that can be done in order to accelerate the peace between the two parties. One of the suggestions is by enlarging the parameter of $\delta$, so that the difference between the parameters $\delta$ and $\sigma$ becomes small. This suggestion is done by fostering the Sunnis in order to accept the presence of the Shia community. The next suggestion is to increase the value of $k_2$ by increasing the average interaction between players in Shia groups which results in increasing their solidity. However, although both suggestions have been done, the repatriation of the Shia community from Jemundo flats in Sidoarjo will only be safe if at least 80% of Sunnis are in a position to accept their presence again.

The PD game model in this research still views the influence of a player to the other players in the same weight. In fact, there are types of players who has more weight influence to the other players. One of them are the leaders of community and kyai. Therefore, it is recommended that the game model accommodates players who have a greater weight of influence than the other players in the next research.

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