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Family Program Policy Projection Planning And Transmigration Against Population Of Sukolilo District With A Dynamic Simulation Approach Based On Vensim Software

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ABSTRACT

Sukolilo sub-district is a densely populated sub-district, the city government provides a policy to reduce the population so that the density in Sukolilo sub-district can be reduced. So this study aims to determine a dynamic system simulation model using several scenarios and policies in order to get a population that is not excessive. In this study, Vensim software was used to verify and validate the population system data of the Sukolilo sub-district. In the Vensim software, data processing is carried out and causal loop diagrams and simulation outputs are obtained, so that results such as the significant influence of transmigration in the Sukolilo sub-district, transmigration and family planning programs can reduce the population up to 80% of the total population in early 2022 to 2027 , but there are still limitations of limitations such as environmental, economic, and social factors. Thus the results of this study can be used to make policy plans in order to reduce the population in order to avoid overcrowding.

Keywords: Policy, Dynamic System, Population, Vensim.

1 Introduction

The development of this world is accompanied by an increase in population, because the number of population is always increasing or rising, some countries or cities have a major problem, namely overcoming population density. All countries issue policies to be able to reduce population density, of course without reducing effectiveness and still maintaining the quality of the country. One of the efforts to reduce or inhibit the rate of population growth is the family planning policy, with the family planning policy, residents are required not to have more than 2 children. Population growth in Indonesia is increasing every year, which is a very popular problem. Population growth that is not properly controlled will affect various aspects of economic and social life, especially improving the quality of life or the quality of the population in terms of human resources, provision of budgets, health facilities, education , and food availability. This condition is a big problem for Indonesia as a country with the fourth largest population after China, India and the United States. Based on data from the Central Statistics Agency (BPS) that the population of Indonesia from 1980 to 2010 has increased, from 147,490,298 people in 1980 it continued to increase to 237,641,326 people in 2010 and it is also estimated that Indonesia's population reached 271 million in in 2020. With this in mind, we need a way to predict population growth in the coming years using modeling in mathematics (Ahmad, 2019).

System dynamics is defined as a field for understanding how things change over time. System dynamic is a method that can describe the process, behavior, and complexity of the system. This dynamic system methodology has been and is being developed since it was first introduced by Jay W. Forester in the 1950s as a method of solving complex problems that arise due to causal dependencies of various variables in the system. The dynamic system is focused on determining policies and how these policies determine the behavior of problems that can be modeled using a dynamic system. Special software for dynamic systems are widely available such as *Dynamo* . Simile, Powersim, Vensim, I-think and others (Rahayu et al., 2018). The characteristics of the system in the dynamic system model are that there is a change in the behavior of the system over time (dynamic) and there is a feedback relationship to the entities in the system. The purpose of system modeling is to predict and determine a policy based on the system model. The system dynamic method has been widely used by researchers in modeling production

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systems in companies to address complex production system problems. Several studies use dynamic systems to determine strategic policies in companies. Dynamic system modeling needs to be used to avoid making unqualified policy decisions. The dynamic system model has variable behavior and it is possible that the feedback scheme will provide a more complex flow of information (Karima et al., 2022).

Like other models, the dynamic system model is also a representation of a real-life system that can be used to study system behavior under different test conditions. Basically, dynamic system modeling aims to recognize, understand, and study structures, policies, and *delays* in decisions or actions that can affect the system (Zubaidah et al., 2022). The increase in population as a result of the increase in the number of births and in-migration to the villages around the buffer zone has become the dominant factor in the conversion of forests into settlements and cultivation areas. Sukolilo sub-district is a densely populated sub-district, the city government provides policies to reduce the population so that density in the Sukolilo sub-district can be reduced. So this study aims to determine a dynamic system simulation model using several scenarios and policies in order to get a population that is not excessive. In this study Vensim *software was used* to verify and validate population system data in Sukolilo sub-district. In the Vensim software, data processing is carried out and *a causal loop diagram is obtained* and the simulation output is obtained.

2 Literature Review

Definition of Simulation

The word simulation comes from a foreign language (English), namely to *simulate* which means imitating, while the word *simulation* which is translated into Indonesian with simulation has an artificial meaning or an attempt to imitate, i.e. imitating a real system (*real system*) which is the object of study in order to find answers over the problem of the system (Andika, et al 2018). Simulation is used before a system is built, to reduce the possibility of failure, to eliminate unexpected bottlenecks, and to optimize system performance. So that simulation can be defined as a program built with a mathematical model based on the original system (Pariyadi and Fitaloka, 2017).

Dynamic simulation

The application of dynamic system modeling in the field of information systems is to help information systems managers see system requirements, design and build quality information systems, increase the success of information systems project development, increase customer satisfaction and add business value. Besides that, dynamic systems can also explain the effects of information systems in managing complex businesses (Dewi & Suryani, 2018)

Vensim Software

Vensim PLE (*Personal Learning Edition*) is a configuration designed to create dynamic system simulation models from causal loop diagrams as well as stock and flow diagrams. Vensim is a tool for visualizing models that have been made so that dynamic system models can be simulated, analyzed and optimized. In the initial view of vensim, you will see a worksheet where words will be typed on the sheet that describe the existing system (which is a form of a pre-designed model), where these words will be connected using the available arrows. After giving the arrows, the next step is to provide the information provided by the equation editor, which is used to complete the simulation model that has been made. (Irna & Yudha, 2021).

Policy Concept and Policy Implementation

Public policy according to Dye (1987) is defined as "Whatever governments chooses to do or not to do". Public policy is what the government chooses to do or not do (Saraswaty, 2018). In the policy system there are three elements, namely (a) policy stakeholders, (b) policy actors (policy contents), and (c) the policy environment (policy environment). Based on this theory, it can be concluded that a policy is made by the government to achieve certain goals in which there are actors involved in overcoming problems that arise from their environment. (Budget, 2014). Meanwhile what is meant by policy implementation is the process of interaction between goal setting and action to achieve goals (Pressman and Wildavsky, 1984). Slightly different understanding conveyed by P. Sabatier & Mazmanian that policy implementation is understanding about programs that are enforced or formulated when they occur or have occurred, such as events or activities when they occur after formulating policies to have a certain impact on society or events. Furthermore, according to Wahab, quoted by Subianto (2020: 55) the policy implementation function can provide a relationship that directs policy goals or objectives in realizing an end result of policies that have been formulated by the government, because the implementation function includes forwarding

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what policies are in policy science with known as the "Policy Delivery System" (policy forwarding delivery system) which includes ways or means that have been designed and directed to realize the desired goals and objectives. Further stated by Pressman and Wildavsky (1984) that the implementation of this policy will fail or succeed depending on the interrelationships between the various organizations and departments at the local level involved in the implementation. Therefore cooperation, coordination, and control play a very important role. In other words, a collaborative approach between the actors involved can be recommended to overcome relationship bottlenecks in the implementation chain (Bowen.1982).

3 Research Methodology

The data collection method used is to use secondary data, namely historical data from the Central Bureau of Statistics for the City of Surabaya. The data needed is *real data* from the population of Sukolilo District. Furthermore, the method used in solving this problem is to use a dynamic simulation method. The simulation is carried out using Vensim *software* , because it makes it easier to design and evaluate the results of the model design that is made. Production simulation uses Vensim software as a tool in carrying out this research.

1 Results And Discussion

Data collection

Data collection is an activity carried out in research to collect information. This data will be *input* at the data processing stage. The data collection method was carried out using secondary data, namely historical data obtained from the internet and previous research. The following is the data needed to be able to support the research.

Table 4.1 Data Collection

	Year		
	2019	2020	2021
Migration of Residents	950	859	1,116
Number of Active Family Planning Participants	352	301	410
Number of Births	1,268	2,031	4,418
Number of Deaths	754	881	1,582

Model Conceptualization

The conceptual model for dynamic systems consists of causal loop diagrams and stock flow diagrams. Before making a stock flow diagram conceptual model, a causal loop diagram needs to be made to see the causal relationship between each variable that affects the system.

Casual Loop Diagrams

Causal *loop diagrams* are useful for photographing the interrelationships between variables in a system. There are two types of feedback in *the causal loop diagram* , namely positive feedback (+) and negative feedback (-). Positive feedback indicates that a variable causes an increase in other variables, while *negative* feedback if a variable results in a reduction in other variables.

Stock Flow Diagrams

The *stock flow diagram* depicts the variables that affect the dynamics of changes *in load factor* . Making *a stock flow diagram* of the population model in Sukolilo District which will later be reduced by the existence of family planning program policies and the transmigration program.

Model Formulation

The formulation of the mathematical model is carried out by incorporating the interrelationships between variables into a mathematical equation. The following is the model formulation that will be simulated:

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Table 4.2 Model Formulation

No	*Variables*	*type*	*Equation*
1	Total Population Resident Subdistrict Sukolilo	Levels	(Influx Rate-Moving Rate- Mortality Rate)* (Family Planning Use Rate)/Population Reduction Rate*Transmigrant Program Participant Rate/100
2	Effectiveness Subtraction Population Resident	Levels	(Birth Reduction Rate+Transmigrant Rate per Year)* Percentage of Decreasing Population*1500/Level Population Reduction
3	Program Transmigration	Levels	Transmigrant Program Member Level *Level Transmigrants per year
4	Number of KB Program Users	Levels	((Success KB Rate- Failed KB Rate)* 100)*Level KB users/Birth Reduction Rate*100
5	Level KB user	Rate	(KB Implants + birth control pills + birth control injection) * 100
6	Death Rate	auxiliary	Health Level*80

Model Simulation

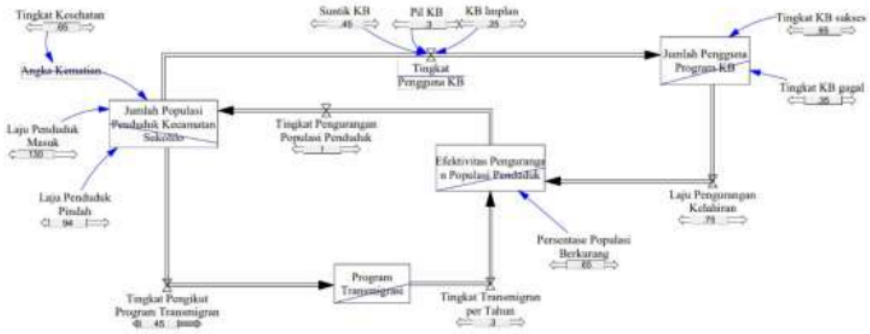
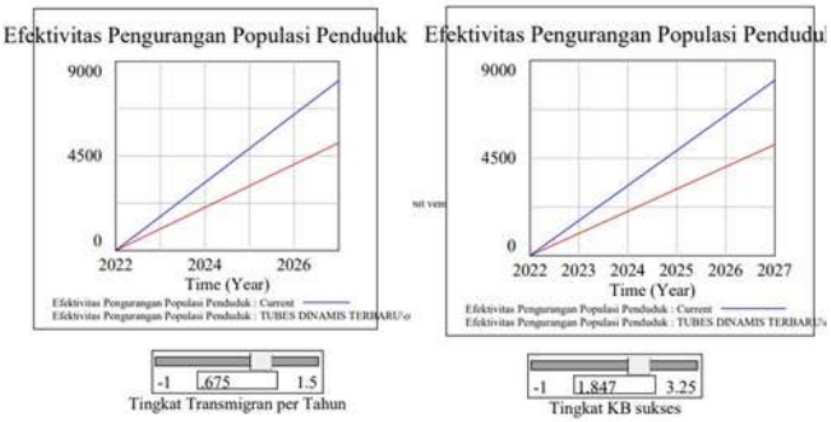


Figure 4.1 Model Simulation Using Vensim *Software*



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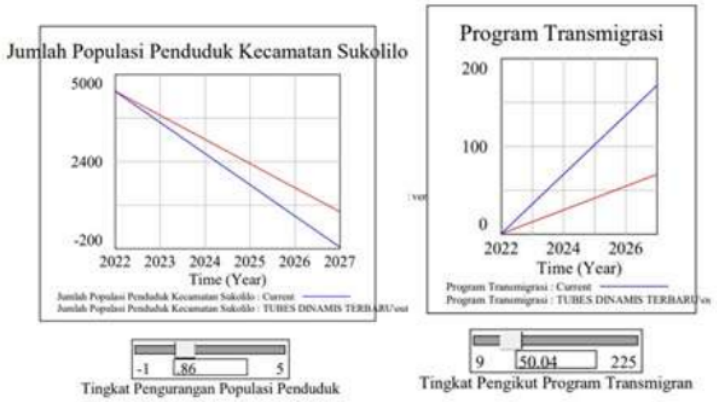

Figure 4.2 Population Model Simulation Results

Notes
Efektivitas Pengurangan Populasi Penduduk = The Effectiveness of Population Reduction
Jumlah Populasi Penduduk Kecamatan Sukolilo = Total Population of Sukolilo District
Program Transmigrasi = Total Population of Sukolilo District
Tingkat Transmigran pertahun = Transmigrant rate per year
Tingkat KB Sukses = Transmigrant rate per year
Tingkat Pengurangan Populasi penduduk = Resident Population Reduction Rate
Tingkat Pengikut program transmigran = Transmigrant Program Follower Level

Model Verification

Figure 4.3 Model Verification

From the results of the verification test using the Vensim *software* , the model and units of all variables are appropriate (OK) so that it can be stated that the population dynamic system simulation model has been verified.

Model Validation

Table 4.3 *Real Data* and Simulation Result Data

Year	Simulation Result Data
2022	4,500
2023	3,780
2024	3,060
2025	2,340
2026	1,620
2027	900

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Descriptive Statistics

	Mean	Std. Deviation	N
Data_Real	2815.00	1322.074	6
Data_Simulasi	2700.00	1346.997	6

Correlations

		Data_Real	Data_Simulasi
Data_Real	Pearson Correlation	1	.999**
	Sig. (2-tailed)		.000
	N	6	6
Data_Simulasi	Pearson Correlation	.999**	1
	Sig. (2-tailed)	.000	
	N	6	6

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 4.4 Model Validation using SPSS *Software*

From the results of model validation using SPSS software as a statistical test, it can be seen in Figure 4.6 above that it shows that a Pearson Correlation value of 0.999 is obtained. Where the value of P (0.999) ≥ α (0.05) then H0 is accepted. That is, there is no significant difference between the real output and the output of the simulation results obtained so that it can be said that the model can be declared *valid* .

G. Policy Scenario Analysis

1. Before the KB and Transmigration policy (Scenario 1)

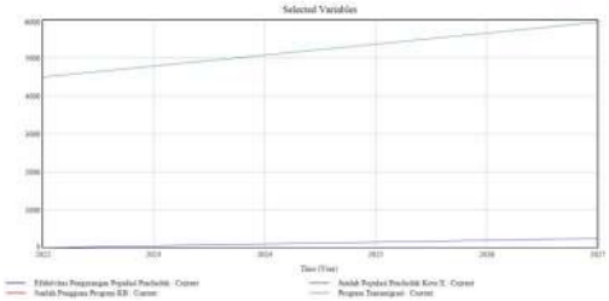

Figure 4.5 Population Graph of Scenario 1

Table

Time (Year)	2022	2023	2024	2025	2026	2027
Selected Variables Runs:	Current					
Jumlah Pengguna Program KB	0	0	0	0	0	0
Jumlah Populasi Penduduk Kota X	4500	4790	5080	5370	5660	5950
Program Transmigrasi	0	0	0	0	0	0

Notes:
Jumlah Pengguna Program KB = Number of KB Program Users
Jumlah Populasi penduduk Kota X = Total Population of City X
Program Trasnmigrasi = Transmigration Program

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Figure 4.6 Population *Pad Table Scenario 1*

From the results of *scenario* 1 above, it can be seen that the total population from 2022 to 2027 continues to experience a significant increase. From a population of 4,500 in 2022 to 5,950 in 2027. If prevention of population increase is not immediately pursued, it is feared that it will have an impact on other sectors of society and will also have an impact on environmental damage, diminishing land, and rising unemployment. more increasing.

2. After the KB policy and before the Transmigration policy (Scenario 2)

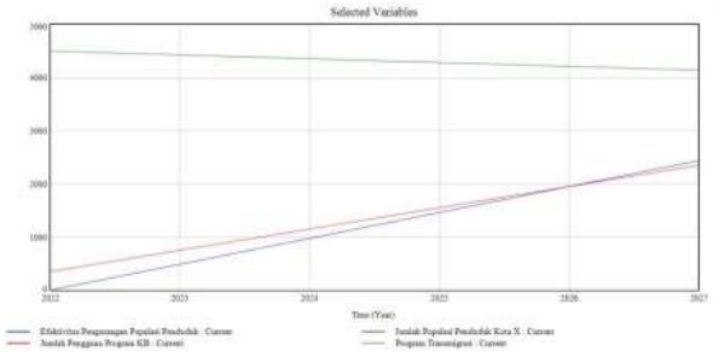

Figure 4.7 Population Graph of Scenario 2

Table

Time (Year)	2022	2023	2024	2025	2026	2027
Selected Variables Runs:	Current					
Efektivitas Pengurangan Populasi Penduduk		488.2	975.7	1463.2	1950.7	2438.2
Jumlah Pengguna Program KB	351	751	1151	1551	1951	2351
Jumlah Populasi Penduduk Kota X	4500	4428	4356	4284	4212	4140
Program Transmigrasi	0	0	0	0	0	0

Notes:
Efektivitas Penngurangan Populasi Penduduk = Effectiveness of Population Reduction
Jumlah Pengguna Program KB = Number of KB Program Users
Jumlah Populasi Penduduk Kota X = Total Population of City X Residents
Program Transmigrasi = Transmiration Program

Figure 4.8 Population *Pad Table Scenario 2*

From the results of *the scenario* 2 graph above, it can be seen that the total population from 2022 to 2027 has decreased from year to year. From a population of 4500 in 2022 to 4140 in 2027. This can also be seen in the effectiveness of population reduction which is increasing from year to year. This indicates that reducing the population with the existence of a family planning program policy is effective in reducing the population of the Sukolilo District.

3. After the Transmigration policy and before the Family Planning policy (Scenario 3)

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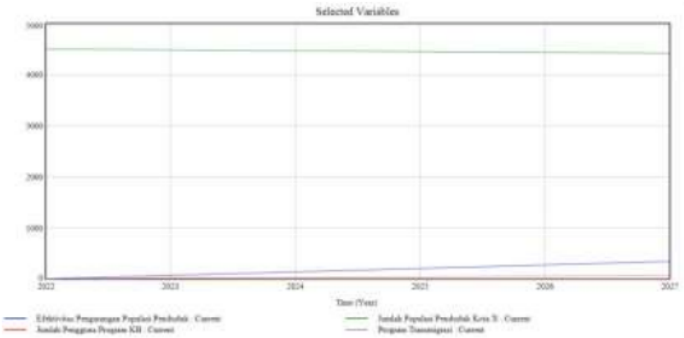

Figure 4.9 Population Graph of Scenario 3

Table

Time (Year)	2022	2023	2024	2025	2026	2027
Selected Variables Runs:	Current					
Efektivitas Pengurangan Populasi Penduduk		68.95	137.2	205.45	273.7	341.95
Jumlah Pengguna Program KB	0	0	0	0	0	0
Jumlah Populasi Penduduk Kota X	4500	4484	4468	4452	4436	4420
Program Transmigrasi	0.55	14.05	27.55	41.05	54.55	68.05

Notes:
Efektivitas Pengurangan Populasi Penduduk = Effectiveness of Reducing Population
Jumlah Pengguna Program KB = Number of KB Program Users
Jumlah Populasi Penduduk Kota X = Total Population of City X Residents
Program Transmigrasi = Transmigration Program

Figure 4.10 Population *Pad Table Scenario 3*

From the results of *scenario* 3 above, it can be seen that the total population from 2022 to 2027 has decreased from year to year. From a population of 4500 in 2022 to 4420 in 2027. This can also be seen in the effectiveness of population reduction which is increasing from year to year. This indicates that reducing the population with the existence of an effective transmigration program policy to reduce the population of the Sukolilo District.

4. After the Family Planning and Transmigration policies are in place (Scenario 4)

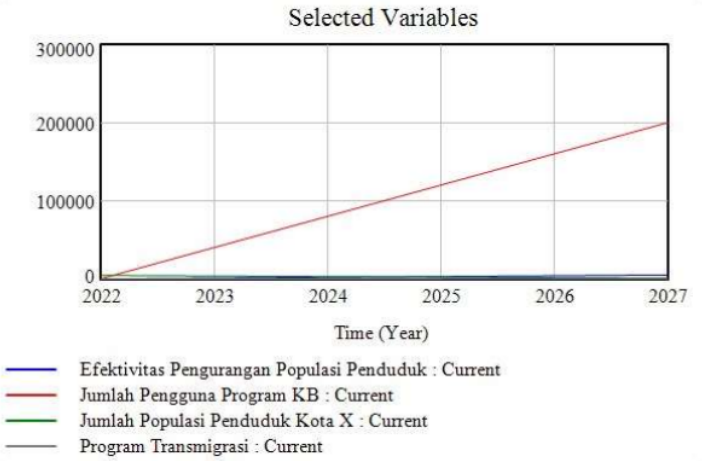

Figure 4.11 Population Graph of Scenario 4

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Table

Time (Year)	2022	2023	2024	2025	2026	2027
Selected Variables Runs:	Current					
Efektivitas Pengurangan Populasi Penduduk		1024.45	2048.2	3071.95	4095.7	5119.45
Jumlah Pengguna Program KB	351	40351	80351	120351	160351	200351
Jumlah Populasi Penduduk Kota X	4500	3780	3060	2340	1620	900
Program Transmigrasi	0.55	135.55	270.55	405.55	540.55	675.55

Notes:
Efektivitas Pengurangan Populasi Penduduk = The Effectiveness of Population Reduction
Jumlah Pengguna Program KB = Number of KB Program Users
Jumlah Populasi Penduduk Kota X = Total Population of City X Residents
Program Transmigrasi = Transmigration Program

Figure 4.12 Population *Pad Table Scenario 4*

From the results of *scenario* 4 above, it can be seen that the total population from 2022 to 2027 has decreased significantly from year to year. From a population of 4500 in 2022 to 900 in 2027. This can also be seen in the effectiveness of population reduction which is increasing from year to year. This indicates that reducing the population with the existence of family planning program policies and transmigration programs is effective in reducing the population of Sukolilo District.

4 Discussion

Of the four scenarios that have been simulated, scenario 4, namely after the family planning program policy and the transmigration program, is the best scenario among the three existing scenarios. This is because scenario 4 has the most significant population reduction effectiveness compared to scenarios 1, 2 or 3. In scenario 4 the final results are obtained for the total population of Sukolilo District for 2022, 2023, 2024, 2025 2026 and 2027 respectively -respectively 4500; 3780; 3060; 2340; 1620 and 900. The existence of family planning program policies and the Transmigration program can reduce the population of Sukolilo District by 80% from 2022 or when the dynamic simulation starts.

Based on the simulation results, especially the results of scenario 4, it is projected that the Family Planning Program (KB) as a government policy intervention can be projected up to 202t to have been able to reduce the population. The policy regarding this family planning program is carried out through the use of contraception to reduce maternal mortality through two mechanisms: (1) reducing births, and (2) reducing high risk pregnancies (https://repository.binawan.ac.id/) The legal basis for family planning policies refers to Law of the Republic of Indonesia Number 36 of 2009 concerning Health, article 78 which states that the family planning service program regulates the pregnancies of couples of childbearing age in order to build healthy and intelligent next generations. Law Number 52 of 2009 concerning Population Development and Family Development which states that family planning policies are implemented to assist prospective or married couples in making decisions and realizing reproductive rights in a responsible manner. The government is responsible for ensuring the provision of safe and quality family planning services according to professional and ethical standards, which are sustainable, and can reach and be affordable to the community. The family planning program does not prohibit but regulates that pregnancy occurs only when the mother is ready physically, mentally and socially. In order for the success of this family planning program which is estimated in the future in the City of Surabaya to be optimized, the Surabaya City Government needs to strengthen it in the form of good cooperation, coordination and control (Pressman & Wildavsky.1984) between institutions, namely the Family Planning Program Institution led by the BKKBN and the Ministry of Health in collaboration and coordinating with many parties including the Surabaya City Government itself, related sectors/partners, and the private sector, including the community.

Furthermore, regarding the Transmigration Policy, it is also necessary to think about and plan for strengthening in the future for the Surabaya City Government in an effort to equalize population distribution between regions. Based on Law Number 15 of 1997 concerning Transmigration as amended by Law Number 29 of 2009 concerning Amendments to Law Number 15 of 1997 concerning Transmigration, the transmigration implementation policy is directed at the development and development of areas that have links with the surrounding areas to form one regional economic development system. Besides considering transmigration policies that are possible to do. The Surabaya City Government also needs to see empirically that Suabaya City is a densely populated Metropolis city

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after Jakarta. Regional development through transmigration for the Surabaya City Government deserves to be considered, so that through this transmigration activity the arrangement of population distribution, which is harmonious and balanced according to the carrying capacity of nature and the carrying capacity of the environment, and the arrangement of social, economic and cultural life systems can be realized in the life of real.

5 Conclusion

The conclusions in this study are as follows:

From the results of the dynamic simulation model design that has been obtained, it can be concluded that the scenario with the existence of the family planning program policy and the Transmigration program in an effort to reduce the population in Sukolilo District has a significant effect. The existence of family planning program policies and transmigration programs can reduce the population by up to 80% of the total initial population in 2022 to 2027.

In order to succeed in reducing the population in Sukolilo District in particular and the City of Surabaya in general, through this KB and Transmigration program it is necessary to strengthen policies while increasing cooperation between organizations and institutions as well as with community groups with an interest in future policy implementation.

The results of this study still have limitations that need to be considered, including the absence of environmental factors, economic factors, social factors that accompany the design model made. Therefore, the suggestion for further research is to add to these factors such as environmental, economic, social factors which will have a significant effect later on the results of the population model created.

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