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Decision Support System

# Application of the Weighted Sum Model Method in Determining the Location of Family Planning Counseling at the North Sumatera BKKBN

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**A B S T R A C T**

To determine the location of Family Planning Counseling automatically, this research developed a web-based decision support system using the Weighted Sum Model (WSM) method with PHP programming and a MySql database. This system uses several variables as decision support indicators such as the number of couples of childbearing age, number of contraceptive users, location accessibility, costs, number of family cards, number of family planning participants, number of children and education, with 33 alternative regencies/cities in Sumatera Utara region. Based on the analysis carried out, the results of the top 5 alternatives are regencies/cities, namely Deli Serdang (127851), Medan (103020), Langkat (67047), Simalungun (53025), and Asahan (48598). So it can be concluded that this research achieved the results expected by the BKKBN.

## INTRODUCTION

The National Population and Family Planning Agency (BKKBN) is a Non-Ministerial Government Institution that is under and responsible to the President through the Minister of Health. BKKBN carries out government duties in the field of population control and family planning. The National Population and Family Planning Agency (BKKBN) developed a program called Family Planning (KB). Family Planning (KB) is one of the government's efforts to control the rate of population growth and form quality families. The population density that occurs in Indonesia is a problem that requires special attention from the Indonesian government. Increasing family resilience and welfare can be traced through various indicators that reflect the implementation of the eight family functions. This is stated in Government Regulation Number 87 of 2014 concerning Population Development and Family Development, Family Planning and Family Information Systems. Expansion of family planning services is one of the efforts to reduce the very high birth and death rates due to pregnancy experienced by women caused by various factors. Therefore, with the existence of a family planning program for the community to create a prosperous society, especially for mothers and children and to control population growth in accordance with the Norm of a Small, Happy and Prosperous Family (NKKBS) [1,2,3].

According to the laws and regulations issued by the government, counseling is an activity of delivering information and education about population programs, family planning, and family development in order to improve the knowledge, attitudes, and behavior of individuals, families, and communities [4,5,6]. Indonesia has many areas that require family planning counseling, especially remote areas. However, in making decisions on location selection, it is still done based

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on the results of deliberations so that assessments are inefficient and data processing is still done manually. Data processing through the system can provide strong analysis and provide access to various information faster and more structured. By utilizing IT wisely, information systems can help in making more focused, efficient and structured decisions in prioritizing the most strategic locations to determine the location of family planning counseling [7,8,9].

Determining the location of Family Planning counseling requires several supporting parameters or variables such as the number of fertile couples, the number of contraceptive users, location accessibility, costs, the number of KB participants, the number of KK, the number of children and education. From several variables measured, they are selected using appropriate and precise methods so that the selection of this location can provide more accurate results. So a decision support system is needed using the Weighted Sum Model Method.

According to the Weighted Sum Model is the most well-known method in multi-criteria simple decision making to evaluate a number of alternatives in terms of a number of decision criteria. As revealed in previous research [10,11,12]. The Weighted Sum model method can be used as a decision support system model for providing KIP assistance to students with test results reaching a value of 86% so that optimal results are obtained in providing decision recommendations to the school. Thus, it can be concluded that in determining the location of Family Planning counseling, it can provide recommendations for the right location for the North Sumatra BKKBN.

## METHOD

### *Data Collection Techniques*

This data collection is carried out to obtain information and data needed in the study. The methods used in data collection are as follows:

1. Observation
   According to [13,14], Observation is a data collection technique that involves various factors in its implementation. Observation is divided into two categories, namely participant observation and non-participant observation. In participant observation, researchers are directly involved in the subject or object being observed. While in non-participant observation, researchers do not participate or are directly involved in the subject or object being studied. At this stage, the author observes directly in the field the problems experienced by the BKKBN.
2. Interview
   According to [15], Interview is a data collection technique where researchers conduct direct questions and answers with sources. Interviews are divided into two types, namely structured and unstructured interviews. In structured interviews, researchers have prepared a list of questions systematically. While in unstructured interviews, researchers only prepare important points from the problems they want to explore from the sources. At this stage, the author communicates directly with related parties, namely BKKBN, in order to obtain variables or parameters as a reference in determining the location of Family Planning counseling.
3. Literature Study
   According to [16], Literature Study is a data collection method where researchers are not directly involved with the subject or object of research. Researchers will answer research questions by collecting various documents such as books, journals, papers or the internet to then be used as analysis materials. At this stage, the author searches for and studies supporting data such as books, journals or internet sources that discuss decision support systems, weighted scoring model methods and family planning counseling.

### *System Analysis*

At this stage, the author will conduct a system needs analysis that is applied as a decision-making tool in determining the location of family planning counseling in order to obtain precise and accurate results by calculating the website-based weighted sum model method. This system will evaluate several criteria that will be assessed such as the number of fertile couples, the number of contraceptive users, location accessibility, costs, number of KB participants, number of family cards, number of children and jobs with different alternative areas. Each data will be input by the admin into the website platform, then each value will be multiplied by the criteria weight, then it will provide ranking results in the form of recommendations for priority areas for the implementation of family planning counseling.

The criteria used in the decision support system for determining the location of Family Planning counseling are as follows:

1. Criteria and Weight
   a. Number of Fertile Couples
      Fertile Couples (PUS) are married couples whose wives are between 15 and 49 years old. The criteria for the Number of Fertile Couples are seen based on the number of PUS in the Regency/City area.
   b. Number of Contraceptive Device Users
      Contraceptive devices are devices used to prevent or delay pregnancy. Both men and women must use contraception if they are sexually active. The criteria for the Number of Contraceptive Device Users are seen based on the number of contraceptive devices used in each Regency/City area.
   c. Location Accessibility
      Location accessibility is seen based on how far the location is in each area.
   d. Cost
      Cost is seen based on the budget allocated for family planning counseling in each Regency/City.
   e. Number of Family Planning Participants
      Family planning acceptor participants are members of the community who participate in the family planning movement by using contraceptives. The number of Family Planning Participants is seen based on those who have used family planning in each Regency/City area.
   f. Number of Family Cards (KK)
      The number of updated KK in each Regency/City
   g. Number of Children
      The number of children is seen based on the number of children born alive in each family in the Regency/City.
   h. Education
      Education is seen based on the last educational qualification, namely Not graduated from Elementary School, Graduated from Elementary School, Graduated from Junior High School, Graduated from High School and Graduated from College/Academic.
2. Criteria Data Explanation
   This criteria data explanation is a description of the criteria that will be used to explain this research process.
3. Alternative Criteria
   The alternatives used in this study are 33 districts or cities

***Process Flowchart***

To get recommendations that match the available data and build the model desired by the user, it is necessary to design the application flow using a flowchart. This flowchart will make it easier to get the right recommendation results.

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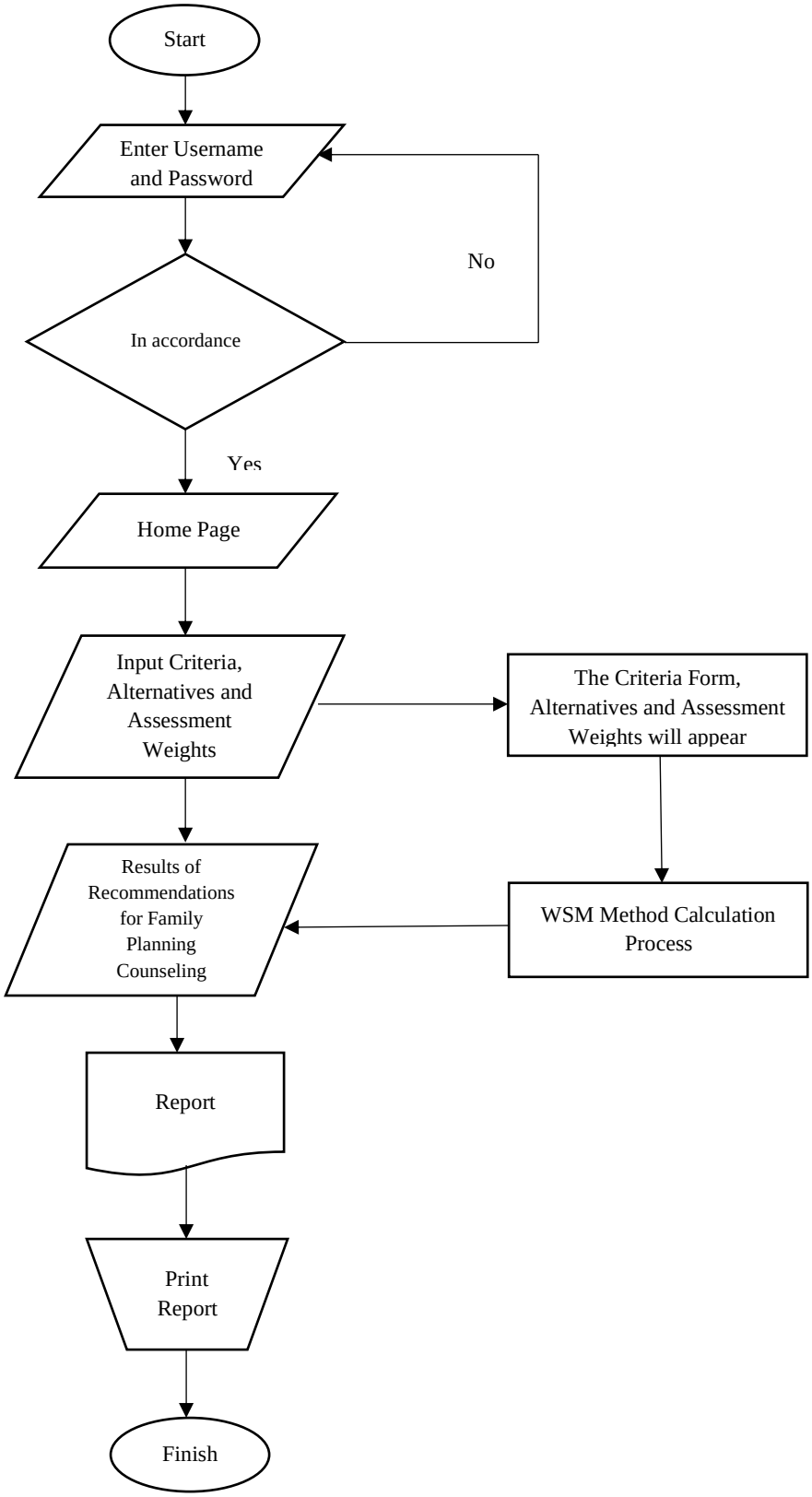


Figure 1. System Flowchart

Figure 1. explains the process flow in the system to be built. The admin will log in by entering a username and Start Input Username and PasswordAccordingMain PageYesNoInput Criteria, Alternatives and Assessment WeightsResults of KB Extension Location RecommendationsReportPrint ReportDoneDisplay Form Criteria, Alternatives, Assessment WeightsWSM Method Calculation Process password, if the data matches, it will display the main page. After that, carry out the calculation process of the decision support system using the weighted sum model method with several steps. Then it will display the recommendation results from several locations in the form of a printable report.

## RESULTS AND DISCUSSION

### *Old System Analysis*

To conduct counseling, the BKKBN must first hold a deliberation. In this case, the BKKBN will collect data and information by involving various related parties. In the deliberation, the BKKBN will identify priority areas that have urgent needs for family planning counseling.

### *New System Analysis*

The system designed in this study is a decision support system using the weighted sum model method to determine priority locations for Family Planning Counseling. This system has two users, namely admin and user. The admin is tasked with managing officer data, on the other hand, officers can access the recommendation results provided by the system. The way this system works is by inputting criteria and alternative data as decision support variables so that the system can be processed for calculations, which will provide recommendations for the right location for the North Sumatra BKKBN.

### *WM-Score Method Calculation Process*

Carry out calculations, multiply the criteria weight value with alternative data for each criterion using the equation Xij = R1 * Wj.

With weight:
w = (0.25+0.15+0.1+0.05+0.1 +0.1+0.2+0.05 )=1

Then add up each result of the multiplication of the criteria, as follows:

A01 = (0.25*62.678) + (0.15*28.864) + (0.1*302) + (0.05*3) + (0.1*29.134) + (0.1*23.333) + (0.2*24.069) + (0.05*4)
= 15.669,5 + 4.329,6 + 30.2 + 0.15 + 2.913,4 + 2.333,3 + 4.813,8 + 0.2
= 30.090

A02 = (0,25*10.459) + (0,15*48.964) + (0,1*181) + (0,05*3) + (0,1*49.427) + (0,1*24.507) + (0,2*39.011) + (0,05*4)
= 26.039,75 + 7.344,6 + 18,1 + 0,15 + 4.942,7 + 2.450,7 + 7.802,2 + 0,2
= 48.598

A03 = (0,25*112.116) + (0,15*50.738) + (0,1*144) + (0,05*5) + (0,1*51.194) + (0,1*26.054) + (0,2*48.226) + (0,05*4)
= 28.029 + 7.610,7 + 14,4 + 0,25 + 5.119,4 + 2.605,4 + 9.645,2 + 0,2
= 53.025

A04v = (0,25*33.036) + (0,15*11.531) + (0,1*177) + (0,05*3) + (0,1*11.615) + (0,1*13.491) + (0,2*18.462) + (0,05*4)
= 8.259 + 1.729,65 + 17,7 + 0,15 + 1.161,5 + 1.349,1 + 3.692,4 + 0,2
= 16.210

A05 = (0,25*47.843) + (0,15*20.734) + (0,1*104) + (0,05*3) + (0,1*20.941) + (0,1*16.970) + (0,2*19.335) + (0,05*4)
= 11.960,75 + 3.110,1 + 10,4 + 0,15 + 2.094,1 + 1.697 + 3.867 + 0,2
= 22.740

A06 = (0,25*276.772) + (0,15*130.122) + (0,1*28) + (0,05*5) + (0,1*130.945) + (0,1*80.938) + (0,2*89.742) + (0,05*4)
= 69.193 + 19.518,3 + 2,8 + 0,25 + 13.094,5 + 8.093,8 + 17.948,4 + 0,2
= 127.851

A07 = (0,25*144.923) + (0,15*75.632) + (0,1*72) + (0,05*4) + (0,1*76.165) + (0,1*21.954) + (0,2*48.260) + (0,05*4)
= 36.230,75 + 11.344,8 + 7,2 + 0,2 + 7.616,5 + 2.195,4 + 9.652 + 0,2
= 67.047

A08 = (0,25*35.004) + (0,15*7.854) + (0,1*144) + (0,05*5) + (0,1*7.941) + (0,1*7.449) + (0,2*18.809) + (0,05*1)
= 8.751 + 1.178,1 + 14,4 + 0,25 + 794,1 + 744,9 + 3.761,8 + 0,05
= 15.245

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A09 = (0,25*13.662) + (0,15*4.768) + (0,1*220) + (0,05*3) + (0,1*4.825) + (0,1*10.456) + (0,2*8.204) + (0,05*4)
= 3.415,5 + 715,2 + 22 + 0,15 + 482,5 + 1.045,6 + 1.640,8 + 0,2
= 7.322

A010 = (0,25*92.621) + (0,15*47.528) + (0,1*97) + (0,05*4) + (0,1*47.949) + (0,1*21.639) + (0,2*33.299) + (0,05*4)
= 23.155,25 + 7.129,2 + 9,7 + 0,2 + 4.794,9 + 2.163,9 + 6.659,8 + 0,2
= 43.913

A011 = (0,25*59.374) + (0,15*27.670) + (0,1*133) + (0,05*3) + (0,1*27.882) + (0,1*21.451) + (0,2*23.461) + (0,05*2)
= 14.843,5 + 4.150,5 + 13,3 + 0,15 + 2.788,2 + 2.145,1 + 4.692,2 + 0,1
= 28.633

A012 = (0,25*41.087) + (0,15*15.863) + (0,1*460) + (0,05*4) + (0,1*16.128) + (0,1*19.318) + (0,2*17.669) + (0,05*2)
= 10.271,75 + 2.379,45 + 46 + 0,2 + 1.612,8 + 1.931,8 + 3.533,8 + 0,1
= 19.776

A013 = (0,25*32.550) + (0,15*14.450) + (0,1*393) + (0,05*4) + (0,1*14.676) + (0,1*9.275) + (0,2*15.920) + (0,05*4)
= 8.137,5 + 2.167,5 + 39,3 + 0,2 + 1.467,6 + 927,5 + 3.1784 + 0,2
= 15.924

A014 = (0,25*40.248) + (0,15*19.532) + (0,1*349) + (0,05*2) + (0,1*19.690) + (0,1*34.622) + (0,2*15.957) + (0,05*4)
= 10.062 + 2.929,8 + 34,9 + 0,1 + 1.969 + 3.462,2 + 3.191,4 + 0,2
= 21.650

A015 = (0,25*51.763) + (0,15*26.293) + (0,1*259) + (0,05*2) + (0,1*26.572) + (0,1*31.786) + (0,2*21.009) + (0,05*4)
= 12.940,75 + 3.943,95 + 25,9 + 0,1 + 2.657,2 + 31.78,6 + 42.01,8 + 0,2
= 26.949

A016 = (0,25*10.304) + (0,15*4.912) + (0,1*353) + (0,05*2) + (0,1*4.949) + (0,1*17.222) + (0,2*4.824) + (0,05*4)
= 2.576 + 736,8 + 35,3 + 0,1 + 494,9 + 1.722,2 + 964,8 + 0,2
= 6.530

A017 = (0,25*22.492) + (0,15*12.601) + (0,1*178) + (0,05*2) + (0,1*12.695) + (0,1*32.628) + (0,2*9.719) + (0,05*4)
= 5.623 + 1.890,15 + 17,8 + 0,1 + 1.269,5 + 3.262,8 + 1.943,8 + 0,2
= 14.007

A018 = (0,25*28.130) + (0,15*14.039) + (0,1*135) + (0,05*2) + (0,1*14.130) + (0,1*31.598) + (0,2*11.166) + (0,05*4)
= 7.032,5 + 2.105,85 + 13,5 + 0,1 + 1.413 + 3.159,8 + 2.233,2 + 0,2
= 15.958

A019 = (0,25*21.990) + (0,15*12.087) + (0,1*89) + (0,05*3) + (0,1*12.181) + (0,1*22.367) + (0,2*7.493) + (0,05*4)
= 5.497,5 + 1.813,05 + 8,9 + 0,15 + 1.218,1 + 2.236,7 + 1.498,6 + 0,2
= 12.273

A020 = (0,25*227.062) + (0,15*91.353) + (0,1*4,8) + (0,05*5) + (0,1*91.857) + (0,1*92.577) + (0,2*70.534) + (0,05*4)
= 56.765,5 + 13.702,95 + 0,48 + 0,25 + 9.185,7 + 9.257,7 + 14.106,8 + 0,2
= 103.020

A021 = (0,25*21.359) + (0,15*7.979) + (0,1*246) + (0,05*3) + (0,1*8.061) + (0,1*10.257) + (0,2*13.627) + (0,05*4)
= 5.339,75 + 1.196,85 + 24,6 + 0,15 + 806,1 + 1.025,7 +2.725,4 + 0,2
= 11.119

A022 = (0,25*54.610) + (0,15*22.647) + (0,1*568) + (0,05*3) + (0,1*22.953) + (0,1*17.402) + (0,2*26.235) + (0,05*2)
= 13.652,5 + 3.397,05 + 56,8 + 0,15 + 2.295,3 + 1.740,2 + 5.247 + 0,1
= 26.389

A023 = (0,25*15.877) + (0,15*5.504) + (0,1*305) + (0,05*5) + (0,1*5.552) + (0,1*5.468) + (0,2*10.149) + (0,05*1)
= 3.969,25 + 825,6 + 30,5 + 0,25 + 555,2 + 546,8 + 2.029,8 + 0,05
= 7.957

A024 = (0,25*10.049) + (0,15*3.513) + (0,1*320) + (0,05*5) + (0,1*3.547) + (0,1*7.328) + (0,2*6.063) + (0,05*1)
= 2.512,25 + 526,95 + 32 + 0,25 + 354,7 + 732,8 + 1.212,6 + 0,05
= 5.372

A025 = (0,25*16.347) + (0,15*5.865) + (0,1*294) + (0,05*5) + (0,1*5.921) + (0,1*6.923) + (0,2*10.057) + (0,05*1)
= 4.086,75 + 879,75 + 29,4 + 0,25 + 592,1 + 692,3 + 2.011,4 + 0,05
= 8.292

A026 = (0,25*6.159) + (0,15*2.804) + (0,1*199) + (0,05*2) + (0,1*2.836) + (0,1*6.086) + (0,2*3.737) + (0,05*4)
= 1.539,75 + 420,6 + 19,9 + 0,1 + 283,3 + 608,6 + 747,4 + 0,2
= 3.620

A027 = (0,25*37.880) + (0,15*19.385) + (0,1*362) + (0,05*3) + (0,1*19.583) + (0,1*12.628) + (0,2*17.676) + (0,05*4)
= 9.470 + 2.907,75 + 36,2 + 0,15 + 1.958,3 + 1.262,8 + 3.535,2 + 0,2
= 19.171

A028 = (0,25*40.427) + (0,15*15.443) + (0,1*358) + (0,05*3) + (0,1*15.684) + (0,1*9.157) + (0,2*21.562) + (0,05*4)
= 10.106,75 + 2.316,45 + 35,8 + 0,15 + 1.568,4 + 915,7 + 4.312,4 + 0,2
= 19.256

A029 = (0,25*33.464) + (0,15*12.705) + (0,1*293) + (0,05*3) + (0,1*12.868) + (0,1*13.098) + (0,2*19.512) + (0,05*4)
= 8.366 + 1.905,75 + 29,3 + 0,15 + 1.286,8 + 1.309,8 + 3.902,4 + 0,2
= 16.800

A030 = (0,25*22.010) + (0,15*8.156) + (0,1*260) + (0,05*3) + (0,1*8.249) + (0,1*9.896) + (0,2*12.332) + (0,05*4)
= 5.502,5 + 1.223,4 + 26 + 0,15 + 842,9 + 989,6 +2.466,4 + 0,2
= 11.033

A031 = (0,25*37.467) + (0,15*23.492) + (0,1*26) + (0,05*3) + (0,1*23.641) + (0,1*38.061) + (0,2*10.753) + (0,05*4)
= 9.366,75 + 3.523,8 + 2,6 + 0,15 + 2.364,1 + 3.806,1 + 2.150,6 +0,2
= 21.214

A032 = (0,25*17.297) + (0,15*6.549) + (0,1*286) + (0,05*3) + (0,1*6.578) + (0,1*19.446) + (0,2*8.958) + (0,05*4)
= 4.324,25 + 982,35 +28,6 + 0,15 + 657,8 + 1.944,6 + 1.791,6 + 0,2
= 9.730

A033 = (0,25*26.704) + (0,15*12.503) + (0,1*396) + (0,05*3) + (0,1*12.589) + (0,1*51.185) + (0,2*11.224) + (0,05*4)
= 6.676 + 1.875,45 + 39,6 + 0,15 + 1.258,9 + 5.118,5 + 2.244,8 + 0,2
= 17.214

The next step is to rank each alternative to determine the priority location decision for the North Sumatra BKKBN KB Extension Service.

So from the calculations above, the best alternative decision results are in the regencies/cities, namely Deli Serdang (127,851), Medan (103,020), Langkat (67,047), Simalungun (53,025), and Asahan (48,598).

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## CONCLUSION

Based on research in the application of the Weighted Sum Model (WSM) method for a decision support system for determining the location of family planning counseling at the North Sumatra BKKBN, the following conclusions can be drawn: The design of the decision support system in this study can be implemented in the form of a website that produces calculations in accordance with manual calculations using the Weighted Sum Model method. With the implementation of this decision support system, it can help and facilitate the BKKBN in making decisions to determine the location of family planning counseling automatically based on the data that has been inputted. In building a web-based decision support system, development tools such as XAMPP are used as a local web server, sublime text as a text editor, a database for data storage, and a browser to display website pages. Based on the results of system testing using the Blackbox Testing technique, the system built provides valid and functional results. This approach ensures that each menu on the system can function properly and correctly, so that users can rely on the system in decision making.

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