Decision Support System for Distribution of Assistance for Fishermen with Analytical Hierarchy Process

Prind Triajeng Pungkasanti[1] and Surya[2]

[1] *Information System Program, Faculty of Information technology and Communication, Semarang University, Indonesia*

[2] *Information System Program, Faculty of Information technology and Communication, Semarang University, Indonesia*

Abstract – Sei Kapitan (Kapitan River) is a village located in Kumai District, West Kotawaringin Regency, Central Kalimantan Province with a population density of 5,660 inhabitants. 25% from 5,660 people work as fishermen so do fishermen in this village). The government has provided assistance for fishermen to reduce poverty, but it isn't in the right target. The government only provides assistance without providing standard data and criteria to determine the beneficiaries. While from the village, they chose beneficiaries based on meetings with village officials, there will be many factors recommended at the meeting. Therefore they need system that can determine and conduct the assistance to fishermen who are entitled to receive support, it is the AHP (Analytical Hierarchy Process) method. By using the system development method, called *prototypes*, and criteria for fisheries ownership every month, types of fisheries, ship, and fishing gear ownership can be detected. This method was chosen because it can select the best alternative from several alternatives. The final result of this system is an alternative decision making that is interesting in determining the beneficiary fishermen. The future hope is that the results of decision making will be right on target and the system can be operated online.

Index Terms — *Analytical Hierarchy Process (AHP), Fishermen's Assistance, Decision Support Systems.*

1. Introduction

Sei Kapitan is a village located in the District of Kumai, West Kotawaringin Regency, Central Kalimantan Province with a population density of 5,660 people. 25% from 5,660 people work as fishermen, like other fishermen, most of them are poor. The government has given attention to the fishing community in Sei Kapitan. The government through the Ministry of Maritime Affairs and Fisheries (KKP) of the Republic of Indonesia has issued assistance programs to fishing communities. The government has provided assistance to fishermen to reduce poverty, but it is still not on target. The government only provides support to fishermen in Sei Kapitan without data and standard criteria in determining who is entitled to receive these assistance. Whereas from the village determines who the recipients of assistance are by conducting village management meetings. But despite having carried out village management meetings, the decisions taken were still not on target because there were subjective factors appear at the gathering.

Even though the government has provided assistance to fishermen, it is still not efficient in distributing the support. Therefore the society needs a decision support system that can help it in carrying out the selection of fishermen effectively and on target. Analytical Hierarchy Process (AHP) is a method of comprehensive decision making by calculating qualitative and quantitative matters in determining the best alternatives from existing alternatives. There are 4 criteria used in decision support systems using AHP method, they are per month fishermen's income, types of fishermen, ship and fishing gear ownership. With the existence of a decision support system using the AHP method, it can solve problems in the distribution of aid and the selection of beneficiary fishermen, so that it becomes right targeted.

2. Research Method

This study aims to produce a decision support system that uses the prototype system development method. This method is suitable for developing the device that will be developed for future. All changes can occur when a prototype is formed to fulfil user's necessity and at the moment that allows developers to understand user's needs better [8]. The description of the prototype method is found in Figure 1 below:

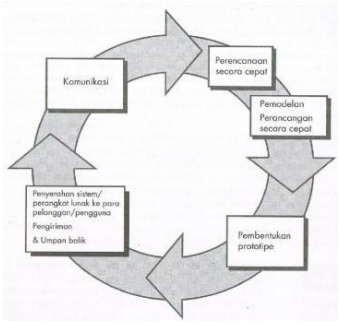

Figure 1. Prototype Method

The understanding of the stages in the prototype method in Figure 1 above is as follows:

a. Communication

The prototype method starts with communication between software developers and users or end users of the software that will be created later. Here the researcher met with the inhabitant of Sei Kapitan Mr. Mulkan to define the system to be created and retrieve some fisherman's data which will be used by the system.

b. (Quick Planning) Quick planning at this stage is to devise the prototype as soon as possible. The researcher is contriving a database that will be used on the system later.

c. Rapid Modeling

At this stage a design model will be made from software and used by the user or end user. At this stage the researcher will make the UML (Unified Modelling Language) and design the user interface (UI).

d. Prototype designing

After the design modelling phase is completed, the next step is to design a prototype of the software. At this stage the researcher makes a prototype of the system. Making this prototype uses procedural programming techniques, PHP programming languages and uses MySQL as its database.

e. (Submission of Systems / Software)

After the prototype is completed, the next prototype will be submitted to the user or end user. Next they will do certain evaluations of the prototype that has been made. If the system prototype is still less than the expected, the researcher will repair it until the user or administrative village is satisfied with the prototype.

3. Result and Discussion

3.1 (Analytical Hierarchy Process (AHP) Method)

Analytical Hierarchy Process (AHP) is a decision support model developed by Thomas L. Saaty. Analytical Hierarchy Process (AHP) is a general theory of measurement that is used to determine the scale of a ratio both from discrete and continuous pairing comparisons. The steps in using AHP to choose fishermen are:

1) To Create a hierarchical structure

The description of the hierarchical structure is shown in Figure 2 below.

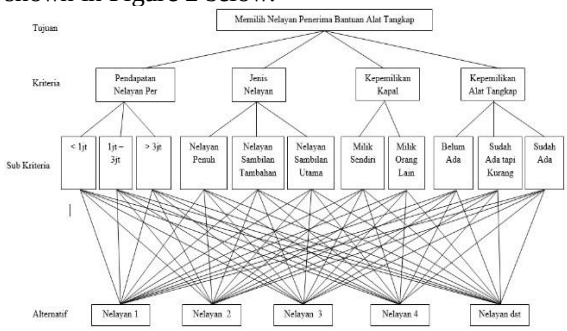

Figure 2. Hierarchy structure

Figure 2 above is a picture of a hierarchical structure to determine beneficiary fishermen or alternatives.

2) Determine criteria data, sub criteria and alternatives.

The criteria and sub-criteria data are:

1. K1 is per month fishermen's income with sub-criteria (C1 is <1 million, C2 is 1 - 3 million, and C3 is> 3 million>
2. K2 is a type of fisherman with sub-criteria (D1 is full fisherman, D2 is an additional part-time fisherman, and D3 is a major part-time fisherman)
3. K3 is Ship owner with sub-criteria (E1 is the owner and E2 belongs to someone else)
4. K4 is fishing gear owner with sub-criteria (F1 missing, F2 exists but deficient and F3 exists)

While alternative or fishermen data which is used in this study are residents who work as fishermen in Sei Kapitan namely:

1) A1 is Triyanto
2) A2 is Selamat Budi S
3) A3 is Badrin
4) A4 is Eko Prasetyo
5) Muhammad Arifin

3) Perform Criteria Calculation

At this stage, pairwise comparisons of each of the predetermined criteria will be carried out. There are several steps to calculate the criteria, namely, making criteria value matrix, making row addition matrix, and calculating the consistency ratio, calculating λ max, CI, and CR. To make a paired comparison the criteria can be seen in Table 1 below.

Table 1. Pairwise Comparison Criteria

	K1	K2	K3	K4
K1	1	3	5	5
K2	0,333	1	4	3
K3	0,2	0,25	2	2
K4	0,2	0,333	0,5	1
Total	1,733	4,583	10,5	11

Table 1 above will get results from the value of comparison. Then proceed with making a matrix of criteria values in Table 2 below.

Tabel 2. Criteria Value Matrix

	K1	K2	K3	K4	K5	K6
K1	0,576	0,654	0,476	2,162	2,162	0,540
K2	0,192	0,218	0,380	1,064	1,064	0,266
K3	0,115	0,054	0,181	0,446	0,446	0,111
K4	0,115	0,072	0,090	0,326	0,326	0,081

From Table 2 above, you will get the criteria and priority values of the criteria. Next is calculating the consistency ratio in Table 3.

Table 3 Calculates the Consistency Ratio

	Amount in Row	Priority	Results
K1	2,306	0,541	4,265
K2	1,138	0,266	4,278
K3	0,450	0,112	4,024
K4	0,334	0,082	4,094
Total			16,662

From Table 3 above the number of lines, criteria and results of the criteria are obtained. Next is to process of calculating λ max, CI, and CR of the criteria.

λ max = number of consistency ratio results / n
= 16,662 / 4
= 4,165

CI = (λ max-n) / n-1
= (4,165-4) / 4-1
= 0,0055

CR = CI / IR
= 0,0055 / 0.9
= 0,0613

CR values smaller than 0.1 can be interpreted as pairwise comparisons are consistent.

a) Perform calculation of sub criteria

The researcher will do the same calculation as the calculation of the criteria but the sub criteria of each criterion that has been predetermined and also have a replacement code for each sub-criteria, while the calculation of sub-criteria is as follows:

1) Sub Criteria for Monthly Income or K1
To make comparison of the sub criteria for monthly fishermen income, it can be seen in Table 4 below.

Table 4. Comparison of Sub Criteria for Monthly Income

	C1	C2	C3
C1	1,000	3,000	5,000
C2	0,333	1,000	2,000
C3	0,200	0,500	1,000
Total	1,533	4,500	8,000

From Table 4 above the comparison value is obtained, then proceed by making a sub-criteria value matrix such as Table 5 below.

Table 5. Sub Value Matrix for Monthly Revenue Criteria

	C1	C2	C3	Total
C1	0,652	0,667	0,625	1,943
C2	0,217	0,222	0,250	0,689
C3	0,130	0,111	0,125	0,367
λ max				
CI				
CR				

From Table 5 above, you will get a sub-criteria value matrix, λ max, CI, and CR per month income for fishermen.

2) Fisherman Criteria or K2 Sub Criteria To get the value from the fisherman sub-criteria type is to do a comparison of the sub criteria for fishermen types such as Table 6 below.

Table 6. Comparison of Fisherman Type Criteria Sub

	D1	D2	D3
D1	1	3	4
D2	0,333	1	2
D3	0,25	0,5	1
Total	1,583	4,5	7

From Table 6 above the comparison value is obtained, then proceed by making a sub-criteria value matrix such as Table 7 below.

Table 7. Sub Value Matrix of Fisherman Type Criteria

	D1	D2	D3	Amount in Row	Priority
D1	0,632	0,667	0,571	1,870	0,623
D2	0,211	0,222	0,286	0,718	0,239
D3	0,158	0,111	0,143	0,412	0,137
λ max					3,018
CI					0,009
CR					0,016

From Table 7 above will get a sub-criteria value matrix, λ max, CI, and CR types of fishermen.

3) Sub Criteria for vessel Ownership or K3

To obtain the value of sub vessel ownership criteria is to do comparison such as Table 8 below.

Table 8. Comparison of vessel Ownership Sub Criteria

	E1	E2
E1	1	0,5
E2	2	1
Total	3	1,5

From Table 8 above the comparison value is obtained, then proceed by making a sub-criteria value matrix such as Table 9 below.

Table 9. Sub Value Matrix of vessel Ownership Criteria

	E1	E2	Amount	Priority
E1	0,333	0,333	0,666	0,333
E2	0,667	0,667	1,334	0,667
λ max				2
CI				0
CR				0

From Table 9 above will get a sub-criteria value matrix, λ max, CI, and CR vessel ownership.

4. Sub Criteria for Ownership of Fishing Gear K4

To obtain the value of sub criteria of vessel ownership is to compare such like table 10 below.

Table 10. Comparison of Fishing Gear Ownership Criteria Sub

	F1	F2	F3
F1	1,000	2,000	3,000
F2	0,500	1,000	2,000
F3	0,333	0,500	1,000
Total	1,833	3,500	6,000

From Table 10 above the comparison value is obtained, then proceed by making a sub-criteria value matrix such as Table 11 below.

Table 11. Sub Value Matrix of Vessel Ownership Criteria

	F1	F2	F3	Amount	Priority
F1	0,545	0,571	0,500	1,671	0,539
F2	0,273	0,286	0,333	0,892	0,297
F3	0,182	0,143	0,166	0,491	0,164
λ max					3,009
CI					0,005
CR					0,008

From Table 11 above will get a sub-criteria value matrix, λ max, CI, and CR ownership of fishing gear.

b) To Input Candidate Values

The next process is to input candidate values as shown in Table 12 below.

Table 12. Candidate Scores

	K1	K2	K3	K4
A1	C1	D1	E1	F2
A2	C3	D1	E1	F3
A3	C2	D2	E2	F1
A4	C3	D3	E2	F2
A5	C3	D3	E2	F1

Table 12 will insert the value of the criteria, sub-criteria and alternatives from the previous process.

c) Make a Decision Matrix

At this stage the decision result matrix will be made as shown in Table 13 below.

Tabel 13. Result Matrix

Criteria	K1	K2	K3	K4
Priority	0,541	0,266	0,112	0,082
Sub Criteria	C1	D1	E1	F1
	0,647	0,623	0,330	0,538
	C2	D2	E2	F2
	0,229	0,239	0,667	0,297
	C3	D3		F3
	0,122	0,137		0,163

From Table 13 above, the results of the priority criteria and sub criteria were calculated previously. After that, it is followed by inserting value of the fishermen or the alternatives that have been determined as shown in Table 14 below.

Tabel 14. Value of Fishermen

	K1	K2	K3	K4	Total
A1	0,350	0,165	0,037	0,024	0,577
A2	0,066	0,165	0,037	0,013	0,282
A3	0,124	0,063	0,074	0,444	0,306
A4	0,066	0,036	0,074	0,024	0,201
A5	0,066	0,036	0,074	0,044	0,221

The value from table 14 above is obtained from the value of each fisherman based on criteria and sub-criteria and then summed according to its alternatives.

d) Perform the Ranking

After all the processes are completed, at this stage they will do ranking phase of each fisherman or a summed alternative such as in Table 15 below

Tabel 15. Ranking

Name	Total	Ranking
A1	0,577	1
A3	0,306	2
A2	0,282	3
A5	0,221	4
A4	0,201	5

Table 15 above to ranking the alternative fishermen. Where the highest value is reserved the right than the low value or the highest ranking.

3.2 Display of Program Pages

a. Dashboard Page
The dashboard page is the main page, see Figure 3 below.

Figure 3. Dashboard

Display The Dashboard page see Figure 3 above is the main page which contains menus that can be used on the system.

b. Project Criteria Page
The project criteria page is a page for criteria such as Figure 4 below.

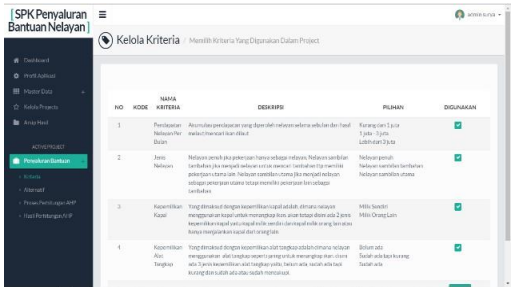

Figure 4. Project Criteria Page

The criteria project page see Figure 4 is used to select the criteria that will be used in the project from the master data criteria.

c. Alternative Project Page
Alternative project pages are used for fisherman data or criteria such as Figure 5 below.

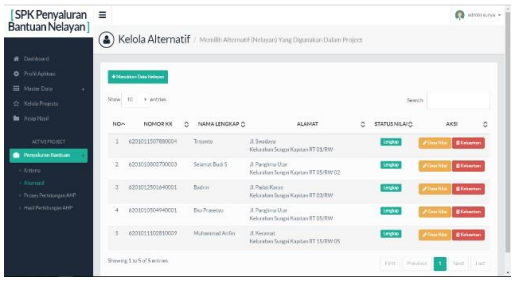

Figure 5. Alternative Project page

The alternative project page like Figure 5 above is used to select fishermen who will be used in the project from the fisherman data master.

d. AHP Calculation Process Page Display
The calculation process page is to perform calculations such as Figure 6 below.

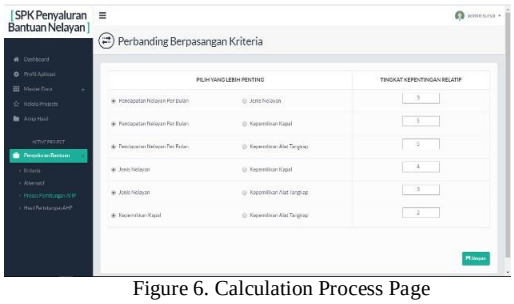

Figure 6. Calculation Process Page

The AHP calculation process page see Figure 6 above is used to insert the comparison value and perform the calculation process from the criteria to the sub criteria.

e. Display of AHP Calculation Results
The calculation page to display the results of calculations such as Figure 7 below.

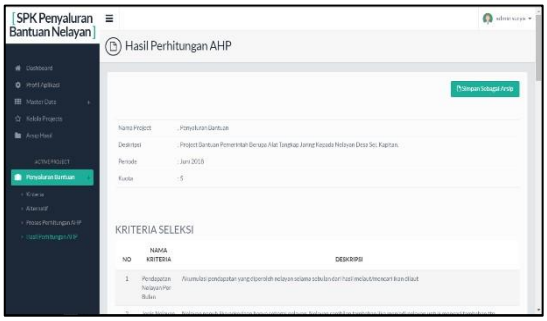

Figure 7. AHP Calculation Results Page

The page view of the calculation process, see Figure 7 is used to display the results of the calculation process of criteria and sub criteria.

f. Report View
The report page is used to print reports like the following Figure 8.

Figure 8. Report Views

The appearance of the report page, see Figure 8 above is to print reports from the calculation of criteria and sub criteria along with the ranking of the beneficiary fishermen.

4. Conclusions and Suggestions

4.1 Conclusions

The conclusions are obtained that this system can choose fishermen who has the right to receive assistance by ranking from the highest ranks entitled to receive support and by this system the distribution of aid becomes more targeted to fishermen who need it.

4.2 Suggestions

The suggestion for this system still has no data backup feature so that in the future it can be added. This system is also still operated offline, but it can be an online system in the future.

REFERENCES

[1] Nofriansyah, Dicky. 2014. *Konsep Data Mining VS Sistem Pendukukung Keputusan.* Deepublish: Yogyakarta.

[2] Pratiwi, Heny. 2016. *Buku Ajar Sistem Pendukung Keputusan.* deepublish: Yogyakarta

[3] Arnawa, I Ketut, I B Purnama, dan Gede Mekse Korri Arisena. 2016. *Dampak Bantuan Sarana Perikanan Tangkap Terhadap Peningkatan Pendapatan Nelayan di Kabupaten Gianyar Provinsi Bali.* Jurnal Manajemen Agribisnis Vol. 4, No. 1, Mei 2016 ISSN: 2355-0759, Halaman 47.

[4] Satzinger, John W., Jackson, Robert B., Burd, Stephen D. 2012. *System Analysis and Design in a Changing World Sixth Edition.* Course Technology, New York.

[5] Rosa, A.S. M. Shalahuddin. 2014. *Rekayasa Perangkat Lunak Terstruktur dan Berorientasi Objek. Bandung: Informatika. [6] Fathansyah, (2015).* Basi Data Revisi Kedua. Informatika: Bandung.

[6] Hidayatullah, Priyanto., dan Jauhari Khairul Kawistara. 2014. *Pemrograman Web.* Informatika: Bandung.

[7] Pressman, Roger S. 2012. Rekayasa Perangkat Lunak Edisi 7 Buku 1. Andi: Yogyakarta.