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Prioritizing sub-watersheds flooding intensity for structural Damaging Flood control and managing

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Abstract

Nowadays multicriteria decision making (MCDM) methods are a useful tool for investigating natural resources and to address problems related to hydro systems. The goal of this research was to assess the Daliri Standardization Method (DSM) to prioritize and make selections for application to MCDM. And to compare the DSM method with the Utility Additive (UTA) method. The (DSM) method, unlike the (UTA) method, lines up choices without incorporating a decision-maker. Moreover, by conditioned weights, linear or exponential functions, the choices partial additive function is formulated in the Lingo program and finally, the total additive function is used to make priorities among the choices. In this study, 47 sub-watersheds in eastern Khurasan province were evaluated according to 25-year return periods for flood, lag time and fatal-cost damage. Results of the (DSM) method were accompanied by all multi-component goals in sub-basins based on real data. The utility function of each method was compared with data relating to the Kan river northwest of Tehran, and comparison showed that 80 percent of the results were the same, so the DSM method can be considered as more logical and sensible than the UTA method. This evaluation was made without consideration of site variation, so it can be used effectively in watershed flood management to prevent investment in low priority sub-basins.

***Keywords*:** Damaging Flood; DSM; Utility Function

1. Introduction

"Watershed management means sustainable control or regulate of system by structural operations or management operations, regarding to knowing involved components in the system and mutual feedback between them, under condition of satisfying economic, social and political considerations" Daliri *et al.* (2009a,b). MCDM is a useful tool for watershed management as can increase parts of a system along with some components and present various effective criteria in its feedback. Therefore the use of mathematical logic Multi Criteria Decision Making (MCDM) is essential in order to optimize watershed management. Furthermore, MCDM presents a cost effective approach to watershed management, as the method does not require extensive field survey. Furthermore, in most cases only some parts of a basin would be under effective watershed management and flood control. Ghaemi *et al.* (1984) evaluated flood potential for the Karkheh River Basin in terms of specific flood, using physiographic characteristics of precipitation (snow and rain) and vegetation rather than multi criteria decision-making methods. Another study by Mirzapoor *et al.* (1984) determined flood intensity of the Saghezchay watershed using environmental resources. The above-mentioned methods

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considered only mathematical flow rate or hydrological debit. These methods were therefore less efficient as some other methods such as MCDM in prioritizing for flood intensity. Analysis by mathematical logic has had wide application in the fields of engineering and management from the 1980s. Such methods have also been applied to Metro Network Design (Roy *et al*, 1986), Comprehensive Watershed Management (Duckstein and Oprivoic, 1980), Water Resources Compressive System Planning (Benedini, 1988) and Water Resources Management (Stewart and Scott, 1995). The method is flexibile enables communication with a decision maker and includes the recommendations of researchers in the field (Jacquet *et al*, 1987), the UTA method is a commonly applied MCDM method. Kholghi (1997) used the UTA method for integrated management of groundwater and surface water. This involved calculations for amounts of groundwater storage and river infiltration and applied the effects of each exploitation on surface water with consideration of the social and economic issues of each item as a criterion. Results showed, that not only consideration of engineering issues, but also weights of non-numerical rating criteria were important in decision-making and natural systems' management. Kholghi (2008) used the UTA method for planning wastewater systems and wastewater treatment. The research concluded that if system management includes expert opinion then application of the results obtained from selective prioritization are more effective. In theory, the UTA compares the numerical values of each choice; this method of prioritizing choices was first presented by Lagrez and Siskos (1982). It has been suggested that using the UTA method in multi-objective planning gives better results than single objective planning. However, in this method and similar methods, the weight of non-numerical criteria in each region is very important (Kholghi, 1997).

The main objective of this research was to evaluate ability of the DSM to prioritize sub-basins according to mathematical logic for each watershed operation and construct a model for flood control on a low budget. The DSM method was first introduced and confirmed in the third International Conference on Water Resources Management in Iran for flood damage in terms of structural and non-structural operation management (Daliri *et al*, 2008). In this regard, in order to evaluate the DSM method, it was compared and evaluated one time in 47 sub-basins north of Neyshabour (Khurasan province) with local realities and then a second evaluation was made using information from the approved method (UTA) in sub-basins of the Kan River located in North West of Tehran.

2. Material and methods

2.1. Study area

A. The region North of Neyshabour covers an area of 2432 square kilometers and was located in Razavi-Khorasan province. The geographical location of the area was 58º 21' to 59 º 28' E and 35º 59' to 36º 40' N with average precipitation at 340 mm in the region north of Neyshabour City. Important flood rivers from east to west were those of: 1- Dizabad River 2- Garineh River 3- Dorud 4- Kharo 5- Buzhan 6- Rood 7- Faroob Rooman 8- Baroo 9- Andar Ab or Kalmaroos. This relatively large area with multiple outputs consisted of 47 study units that each covered between 21 to 104 square kilometers (Table 1). In the region north of Neyshabour, after flood damage in 1987, in the valley of Buzhan (unit 13) which in addition to substantial financial losses resulted in human casualties (around 100 people). Other floods in other rivers of this region also resulted in financial losses to farms and gardens close to rivers. According to reports, annual financial losses resulting from flooding in the north of Neyshabour region were estimated at more than 146×10^7 I.R. Rials, based on data from the period prior to 2000 (Daliri, 2003).

B. Kan River: After several flood events near Tehran city in the years 1987 and 1988, extensive studies have been done on ways to control high turbid flooding in the watersheds of Garmabdareh, Darband and Kan during recent years. The Kan River Basin was used in this research, to evaluate flood intensity in sub-basins and their role in flood intensity. In this case, 19 sub-basins were chosen with a minimum area of 0.9 km^2 and a maximum of 131.9 km^2. Characteristics of The Kan River basin and results of the confirmed UTA method are shown in Table 2 as the basis of the approach (Kholghi, 2002).

2.2. Theory of Prioritizing

The watershed to the north of Neyshabour was used in multi criteria decision making (MCDM) for prioritizing sub-basins of the region north of

Neyshabour in terms of watershed operation, structural control and flood management.

Evaluation by MCDM requires effective and suitable criteria for surveying specified choices, to obtain the effect of each choice on criteria by calculations or as a mathematical model as a number for conversion to partial value function. In the final stage, prioritizing is made from calculations of total value function for each choice. There were 3 total approaches for prioritizing:

Table 1. Choice and criteria in region north of Neyshabour

Choice N	Study unit No.	Area km ^{2}	q25 $m^3/s/km^2$	Lt Hour	Df 0-100
1	1_1	69.9	0.492	0.97	15
2	1_2	33.6	0.877	0.82	0
3	1_3	47.0	0.731	0.87	5
4	1_4	66.1	0.539	1.17	50
5	1_5	62.7	0.517	1.25	15
6	1_6	58.9	0.620	0.88	33
7	1_7	80.0	0.677	1.19	15
8	1_8	33.1	0.550	1.00	0
9	1_9	40.1	0.471	1.18	0
10	1_10	59.5	0.279	1.22	0
11	1_11	48.7	0.591	1.00	0
12	1_12	72.4	0.296	0.80	0
13	2_1	67.6	1.058	1.54	49
14	2_2	104.3	1.355	1.08	10
15	2_3	41.6	0.603	0.67	49
16	2_4	60.3	0.442	1.01	10
17	3	53.0	0.224	1.37	20
18	4	72.2	0.590	1.54	10
19	5	77.5	0.357	1.07	0
20	6	93.4	0.590	1.09	35
21	7	27.3	0.370	0.99	0
22	8	34.2	0.931	0.61	0
23	9_1	77.7	1.827	0.72	30
24	9_2	80.9	0.960	0.88	30
25	10	64.6	0.590	0.97	0
26	11	61.8	0.590	0.90	0
27	12	66.1	0.590	1.00	20
28	13	33.6	2.360	0.38	100
29	14	49.6	0.590	0.77	10
30	15	59.1	0.590	0.52	0
31	16	25.7	0.590	0.50	15
32	17_1	34.7	2.247	0.47	40
33	17_2	51.2	2.322	0.48	0
34	17_3	22.9	0.967	0.43	0
35	18	37.1	0.590	0.54	0
36	19	28.7	2.556	0.35	25
37	20	33.5	0.589	0.73	15
38	21	56.8	1.102	0.56	15
39	22	28.1	0.590	0.54	15
40	23	67.7	0.590	0.68	0
41	24	28.8	1.126	0.42	0
42	25	37.4	0.558	0.80	0
43	26	44.6	0.590	0.97	0
44	27	31.0	0.762	0.82	0
45	28	33.1	0.590	0.64	0
46	29	21.3	0.506	0.53	0
47	30	53.0	0.591	0.49	0

q25: specific flood (25-year), Lt: lag time, df: score of flood damage

1- Distance from ideal point: agreed methods are defined according to distance between ideal point and considered choice (Zeleny, 1982).

2- Omission method: in this method choices are compared, then one of them is omitted and the others remain for the next stage, (Roy, 1978, 1985) and (Roy *et al*, 1986).

3- Methods based on calculating value function and prioritizing according to evaluations of value function (Keeney and Raiffa, 1976), (Lagreze and Siskos, 1982). Each of the above-mentioned techniques has a specific method and as such each is suited to different types of problems. The above-mentioned techniques consist of several methods for application to specific problems. The first and second groups prioritize automatically without consideration of a decision maker, while the third consideration seeks to establish superior priorities by using interference of a manager and administrator. This flexibility is the most suitable for the decision-making process for problems relating to natural resources, as such it presents a suitable method for prioritizing watersheds of the sub-basins located in the north of Neyshabour region and Kan River in Tehran.

There are two methods in the third group. But in both methods, the decision maker in the process is asked constantly to determine which of these choices is preferred. In the first method, choices are chosen randomly by the decision maker and probabilistic binomial function. While in the UTA method the decision maker is more free than the other method in the first selection and superior prioritization, and even in the first setting what is more logical in his mind.

Table 2. Data and Prioritizing results in Kan River with UTA* method as base approach

Study unit No.	q25 $m^3/s/km^2$	Lt Hour	df 0-100	$f_I(g_I)$ (0-1)	Priority
K3	5.9	0.44	90	0.91	1
K1	5.13	0.90	100	0.89	2
T1	4.30	1.13	90	0.82	3
C2	3.27	0.72	85	0.81	4
C'1	2.4	0.95	93	0.76	5
KO2	3.36	1.30	80	0.76	6
S'5	1.37	1.12	97	0.68	7
SO2	9.10	12.20	30	0.62	8
C3	2.63	1.02	40	0.59	9
CO2	1.23	2.10	70	0.51	10
CO1	1.56	1.74	50	0.5	11
R2	2.69	0.92	0	0.48	12
S'2	2.54	0.54	20	0.47	13
SO1	2.03	1.60	30	0.45	14
S5	0.83	1.07	20	0.45	15
So4	1.18	2.75	60	0.32	16
KO4	1.40	2.55	40	0.32	17
SO3	1.29	2.50	35	0.30	18
RO1	1.62	1.38	10	0.24	19

*The same weight for lag time (Lt), specific flood (q25) and more weight to damaging floods(df), f(g): value of function

UTA Method

In UTA method, partial value functions, is added to by this method as follows:

$$U(g_1, g_2, .. g_n) = \sum u_i(g_i)$$

In which u, g, I are value function, choices and criteria respectively. In this method, evaluation scores are variable between 0 to 1, as in $G_i = [g_i*, g_i*]$ i.e. $g_i* = 0$ is the worst priority and $g_i* = 1$ is the best priority. Multi part linear programming is used to determine value partial function. As, if $g_i(a)$ be numerical amount of reaction choice on criterion I, between g_{ij} and g_{ij+1}, value function $u_I(g_i(a))$, would be linear compound of $u_i(g_{ij})$ and $u_i(g_{ij+1})$, (Figure 1).

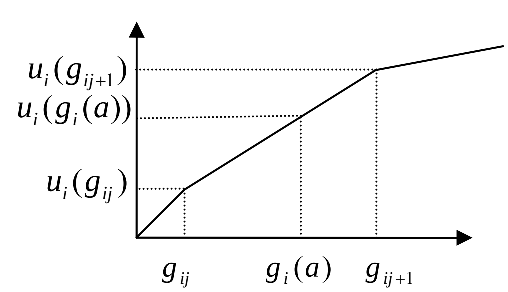

Fig. 1. Partial value functions In UTA method

Therefore, partial value function is determined by having early superior choice, which is chosen by a manager So, linear programming is used for optimizing the following linear model:

$$(g(a)) = u_1(g_1(a)) + u_2(g_2(a)) + ... + u_n(g_n(a))$$

Objective function in this linear programming, is minimizing between early chosen choices (purpose) and total value function (answer), as if choices made by the manager are illogical and out of the decision making space, then the method would reflex immediately and prioritizing would be done regardless of person's choices.

DSM method

DSM method, which is classified in the third group, involves sensitivity as the first stage of the process i.e. suitable selection of criterion. Criteria must be chosen according to type in relation to prioritiziing in an objective such as a watershed, range management, erosion and controlling sediment of the dam depository to supply a viewed objective. Therefore, if the presented results are illogical from the decision maker's point of view then modifying is required in selection of criteria, the amount, or weight of criteria. In the DSM method, partial value functions would be added as follows:

$$F(g_1, g_2, ..g_n) = \sum f_I(g_I) \equiv [0,1] \qquad (1)$$

In that, f, g, I respectively are partial value functions, choice and numerical criteria or non-numerical criteria. When superior priority be with the amount of related maximum optimal figure of above function is as follows:

$$\text{MAX } f = \sum_{j=1}^{n}\sum_{i=1}^{n} \alpha_i g_{ij}$$

If partial value function is shown with the p sign, it is possible to calculate its linear amount by the following equation in the DSM method:

$$P_{ni} = D_i \alpha_i \qquad I = 1,2,.... \qquad (2)$$

Which:

p_{ni}: Partial value function of choice n for numerical criteria i

α_i: Criterion weighting coefficient if the following linkage is always true:

$$Unit = \sum_{i=1}^{I} \alpha_i \qquad (3)$$

MCDM methods have various ways of choosing weight coefficient and offering choices in various levels in order to settle disputes related to beneficiaries and stockholders that can be applied to the DSM method. In the present research, criteria weight was valued according to the research objectives.

In linkage 3:

I= number of numerical and non-numerical

D_i: Dimensionless ratio of standardization, which by substitution of its equivalent, equation 2 was changed to equation 4:

$$p_{ni} = (\frac{s(x)}{s_i'})\alpha_i \qquad (4)$$

There:

s(x): evaluation score function or standardization line equation for numerical criteria was gained from nonlinear equations or the following equation:

$$s(x) = Ax_i + B \qquad (5)$$

A: gradient of the amounts for domain limit of numerical criteria with unit determination coefficient

B: y-coordinate of standardization line

Xi: numerical amount of intended criteria

In the DSM method, unlike UTA in which the evaluation score is between 0 to 1, the evaluation scores can specify amounts for natural desirable maximum, but minimum amounts for numerical standards would always be 1. In mathematical terms, it is as the following:

$$\{x \in N | s_i = x \prec s_i' \Rightarrow x = 1\}$$

Such that in $s(x) = [s_i, s_i']$ minimize amounts (s_i) and maximize (s_i') it is possible to choose between the two closed amounts of [1,100]. The distance shown above was chosen in this study.

Methodology

In order to calculate values of partial function for non-numerical criteria such as social, spiritual and financial and damage to life (if there is no possibility for consideration then financial and life damages were taken in numerical form) firstly, sub-basins must be classified by local visits in the region and consultation with citizens, various experts and collecting statistics and information about damages, according to the following logic or suitable professional logic domains:

Type of damage	s(x) (Evaluation score of non-numerical criteria)
Spiritual- Casualties	50-100
Casualties -financial	30-50
Financial	0-30

It is obvious that if there is information on flood damage it must be prepared according to analysis of frequency damage-flood curves, and then annual damage for numerical standard indexing is calculated. The amounts of evaluation score maximum in cases of non-numerical criteria must be equal to the maximum amount in numerical criteria. But its minimum amount would always be chosen as 0.

$$s(x) = [s_i, s_i'] \qquad \{s_i = 0, s_i'\}$$

The above classification would be changed according to necessity in the region and experts' point view. Calculations of the partial value function for non-numerical criteria are the same as for numerical criteria. Finally, the amount of total value function would be calculated from equation 1. This amount would be obtained in an open distance of 0 and 1, in which a higher amount shows the superior priority of sub-basins in a region to perform operations of related criteria such as watershed management, flood management and sediment control. In order to use the DSM method, after reviewing various specifications which were raised for flood intensity in the region north of Neyshabour, the following criteria were considered for prioritization of flood intensity and to select top choices. Obviously, choices on number and type of criteria might be variable according to a particular area:

A- The amount of specific flood with 25-year return period (q_{25})

Flood discharge was calculated for 47 of the regions units from statistics on hydrometery stations (8 cases), calibration of the precipitation-runoff model in control points and model implementation in other the watershed hydro systems in lumped form for the inputs. The above equations for the region north of Neyshabour hydrological modeling system were determined by the algorithm HEC-HMS and SCS-CN method (Table 1). CN values were calculated according to the method cited in Daliri (2001) and Daliri et al, (2011).

B- Lag time of basin (L_t), in which factors such as length of main channel, roughness coefficient, center of gravity and slope of main channel are effective. Lag time is very effective in flood wave velocity, and a lower evaluation leads to higher probability of devastating floods. So, its value was determined in relation to flood focus time and return period (Table 1).

C- Casualties financial damages resulted from flood (d_f) (Table 1).

If spiritual and social damages are intended, or in cases in which it is not possible to analyze the flood damage frequency curve for conversion to numerical values, then the following steps need to be taken to transform nonnumeric criteria into numeric criteria:

Firstly information is gathered from a local visit and financial damages are evaluated and recorded as a numerical value; information on agricultural land, village, water resources, livestock, gardens, buildings, casualties, for 30 sensitive critical points, then the sub-basin is divided into 3 groups and given a score on the following scale; 1- without damage or financial damage (nos. 0 to 30), 2- casualties financial damage (nos. 30 to 50.), 3- spiritual casualties damage (nos. 50 to 100) and then assessed relative to each other. After asking questions from residents and information gathered from field visits along with consultation with resident experts for determining criteria compensation, evaluations were made as follows; 0 was considered for 23 units of region, and for other units values of 5 to 100 were considered.

Regarding 3 criteria as A, B, C, according to Table 1 for each choice, figures subject to partial and overall value functions, based on (1) to (5), calculations were made by the DSM for equal weight of specific flood and more lag time and weight of damage standard (50%) for prioritization of flood of units in the region north of Neyshabour. Results of the UTA method for prioritizing (Table 2) flood intensity of 19 sub-basin of Kan River were used in order to confirm results of DSM by the UTA method. Weighting coefficient in the UTA method and the Kan region located in the North West of Tehran consisted of equal weights for lag time criteria and specific flood and more weight for damage was determined and the Kan River sub-basins were prioritized. Finally, prioritizing for the Kan River catchment flood control operation was done by the DSM method for equal circumstances consisting of 3 equal criteria, similar to the UTA method, weighting coefficient of 3 cases as 1, 2, 3 with more weight for damage respectively as 50%, 40% and 35% and equal weighting of the two other criteria, for analyses of result sensitivity of the two methods.

3. Results

Prioritizing calculations were made for the sub-basin of north of Neyshabour by the DSM method for the mentioned situations and results are demonstrated in Table 3. In this method, regarding priority in weighting coefficient (here more weight for damage), if amounts of damage in these two rivers were equal, then their rating would be determined by comparing the minor values of other criteria (here as lag time and specific flood) in linear form. Results shown in Table 3 suggest that in order to perform effective flood operations, structural or non-structural, performance must start from units 13, 17-1, 19, 9-1 and 2-3 as the first five suggested choices made by the DSM method. Information from local reviews and consultation with resident experts, it was found that the mentioned units were considered as the top priorities of the region in terms of erosion and sediment and flood damage. This conformity was calculated for acceptable rating of the other lower level priorities. By looking closely at Tables 1 and 3, it is clear that although more weight was given to damage criteria, sub-basin 19 was assigned with damage percentage of 25%, lag time as 0.35 hour and specific flood as 2.5 cubic meters per second on the square kilometers, as such it was higher than sub-basin 2-3 with damage percentage of 49%, lag time as 0.67 and specific flood as 0.6. This is logical. Because just one criteria in a multi criteria decision making (MCDM) problem, would not be appropriate to determine the top priority appropriately. Another consideration of the results from Table 3 is that the first 11 priorities of the DSM method were placed steadily in up of kenic line (upstream) and the final priority such as units 1-10, 4, 1-9 under kenic line and were placed in lowland areas. So flood control in this area must be started by a combination of watershed management involving implementation of check dams and time of concentration engineering methods from upstream according to priorities of the DSM method. It should also be noted that around 70% of prioritized units were rated from 12 to 44 in various points of the basin. So, operations in basin or watershed management were not just focused on upstream and tributaries. So watershed integrated management based on of dumbbell-shaped basin in the most comprehensive natural resources management. Prioritized results for the Kan River 19 sub-basin flood intensity are presented in Table 4 by the UTA and DSM methods. Results of analyses of these 2 mentioned methods demonstrate that relative adaptation percent of choices prioritization is acceptable to each other. As maximum amounts in both classes, for all cases were equal to 80%. Nevertheless, around 20% of choices for sub-basins So4, Ko4, So2, R2 had evaluations for completely different priorities. In this regard, analyzing the data evaluations on effective in flood choices intensity (Table 2), according to the following reasons, it can be said that results of the DSM method were more reasonable than those produced by the UTA method. Therefore, flood amount magnitude or wave speed afflux (more damage probability) with more or less weighting than damage criteria can determine choice priority superiority, only under conditions of relative reasonable values for criteria can be more effective than damage criteria amounts or other criterion. Calculations of relative logical criteria were different according to the method applied and resulted in difference in the final results, even under equal situations. With this explanation and analysis of R2 choice, crude amounts and regarding weighting criterion involving damage percentage as zero, lag time as 0.92 hours, specific flood as 2.69 cubic meters per second to square kilometers, against criterion amounts of choices So4 and Ko4 respectively, consisted of 40% and 60% damage, lag time as 2.75 and 2.55% and specific flood as 1.18 and1.14, thus it was determined that it was more logical that R2 choice in lower priority rather than similar choices as So4 and Ko4. Also, So2 sub-basin with 30% damage, 12.2 hours lag time and 9.1 cubic meters per second per square kilometer, it was not logical to be prioritized in a higher rating than So4 and Ko4 choices or similar sub-basins. Since passing such cataclysm in So2 unit can lead to damages and lower probability destruction than smaller but more destructive floods in the two other sub-basins. However, in the DSM method, sub-basin So2 was ranked between similar sub-basins as So4 and Ko4, when the damage criterion weighting coefficient decreased from 50% to 35%. So, in a suitable method, which has enough flexibility and sensitivity, by changing the standard weighting, choices must be placed in different classes. Considering results of Table 4 for various cases in the DSM method, it is clear that above method showed suitable and more appropriate sensitivity to change weighting of the decision maker and the director's comments provided better result than the UTA method for crude data, criteria, and real local conditions. Generally, it should be noted, specifically in situations where there are many criteria, criteria weighting would be one key element affecting the results, which requires careful decision making and consideration by an expert. This testimonial has been reported in Kholghi (2002).

Table 3. Prioritizing of flooding intensity by using DSM method in Neyshabour region

Study unit No.	$f_I(g_I)$ (0-1)	Priority	Study unit No.	$f_I(g_I)$ (0-1)	Priority
29	0.245	25	13	0.971	1
28	0.232	26	17_1	0.641	2
1_1	0.228	27	19	0.623	3
1_2	0.225	28	9_1	0.495	4
1_3	0.223	29	2_3	0.471	5
23	0.223	30	17_2	0.447	6
27	0.212	31	21	0.376	7
1_7	0.201	32	9_2	0.371	8
25	0.195	33	1_4	0.365	9
2_4	0.189	34	1_6	0.350	10
11	0.177	35	2_1	0.338	11
1_5	0.172	36	16	0.334	12
1_12	0.167	37	24	0.333	13
26	0.163	38	22	0.327	14
10	0.162	39	17_3	0.314	15
1_11	0.157	40	6	0.312	16
1_8	0.151	41	20	0.288	17
3	0.140	42	8	0.273	18
7	0.135	43	2_2	0.270	19
5	0.117	44	30	0.262	20
1_9	0.106	45	15	0.257	21
4	0.095	46	12	0.256	22
1_10	0.077	47	14	0.254	23
			18	0.252	24

Table 4. Prioritization of Kan River Sub-basins based on UTA and DSM methods for various weighting states

State 3 DSM method		State 2DSM method		state 1 DSM method		Datum approach UTA method		priority
FI(gI) (0-1)	Study unit Code	FI(gI) (0-1)	Study unit code	FI(gI) (0-1)	Study unit code	FI(gI) (0-1)	Study unit code	
0.840	K3	0.846	K1	0.871	K1	0.91	K3	1
0.833	K1	0.845	K3	0.854	K3	0.89	K1	2
0.759	T1	0.770	T1	0.792	T1	0.82	T1	3
0.713	C2	0.724	C2	0.754	C’1	0.81	C2	4
0.701	C’1	0.718	C’1	0.745	C2	0.76	C’1	5
0.683	KO2	0.693	S’5	0.739	S'5	0.76	KO2	6
0.670	S'5	0.692	KO2	0.710	KO2	0.68	S'5	7
0.543	CO2	0.555	CO2	0.580	CO2	0.62	SO2	8
0.522	C3	0.513	C3	0.514	SO4	0.59	C3	9
0.496	CO1	0.497	SO4	0.497	CO1	0.51	CO2	10
0.489	SO4	0.496	CO1	0.494	C3	0.5	CO1	11
0.462	S'2	0.442	S'2	0.425	KO4	0.48	R2	12
0.448	SO1	0.437	SO1	0.414	SO1	0.47	S'2	13
0.433	SO2	0.430	KO4	0.402	SO2	0.45	SO1	14
0.432	KO4	0.423	SO2	0.401	S'2	0.45	S5	15
0.412	SO3	0.407	SO3	0.398	SO3	0.33	SO4	16
0.387	R2	0.367	S5	0.339	S5	0.32	KO4	17
0.381	S5	0.358	R2	0.306	RO1	0.30	SO3	18
0.368	RO1	0.348	RO1	0.298	R2	0.24	RO1	19

State 1: The same weight for lag time and specific flood and more weight to damage: 50%
State 2: The same weight for lag time and specific flood and more weight to damage: 40%
State 3: The same weight for lag time and specific flood and more weight to damage: 35%

4. Conclusion

Comparison of results from both methods determined that the DSM method, which used data, from was more effective than UTA. The UTA method needs programming for optimization of objective functions. The UTA method had previously been applied to the Kan River (kholghi, 2002).

-MCDM techniques are an important tool for water and watershed management and planning for prioritization in flood structural control because considering just one criterion provides results biased towards the one criterion.

-The proposed DSM method can prioritize flood intensity in urban areas and rural watersheds; it can also be applied to management in other fields such as range management, erosion and sediment control and synthesis studies. Considering this, it is important that more than one standardization line equation is used for criteria regarding critical points and extreme points.

-It is recommended that the DSM method be evaluated for Sediment Delivery Ratio (SDR) of river basin areas of a station for efficiency in spatial distribution total sediment. In this case, effective criteria must be considered.

-Non-linear solution of DSM method is possible if a responsible expert knows that it is essential for criterion or specific criteria. In this case, it is possible to use the criterion weighting coefficient for considered thresholds in conditional forms in equation 4.

-Results of each method must be assessed and confirmed by the manager. "If manager be a professional expert, the obtained results and the chosen priorities would have more enforcement to implement" (Kholghi, 2002).

-Watershed management is no only software that focuses on tributaries or small channel and forest or human life. Watershed management, namely sustainable integrated management under Dumbbell-shaped watershed boundary and its environment in high real comprehensive perception of water resources.

-Any flood control technique in a catchment area according to prioritization results, must be done in accordance with its contemporary concerns.

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