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A CASE-STUDY IN MULTI-PROJECT PLANNING WITH UTILITY-BASED TRADE-OFF ANALYSIS.

Dr.W.H.van den Toorn*

Summary

This paper presents a method for multi-project planning under the following conditions:
- ex-ante preferences between objectives are unknown
- resources are involved the availability of which rests with political choice rather than technical inventory. The ex-ante preferences between these resources are unknown.

The method consists of two major components. The first component is called "elementary utility analysis". Its ultimate result is comprehensively-based values which for each project in the project set represent the relative efficiency at which aggregate resource use is converted into aggregate objective satisfaction. The second component concerns a procedure in the course of which alternative efficient project baskets are determined that are feasible both technically and politically, based on inter-objective cum inter-resource trade-offs and their political appreciation. The decision maker's ultimate choice will be between these baskets, with others added iteratively if so desired by the decision maker.
The method grew out of the author's work as an economic advisor with the Harvard Institute for International Development (1976-1980), and became part of wider research on development planning theory and methods later (Van den Toorn-1984).

1. Introduction

Over the last decade or so it is increasingly recognized that decision methods based on ex-ante preferences with respect to the objectives collide with real life decision making. After all,

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*
wetenschappelijk hoofdmedewerker van
de vakgroep Ontwikkelingskunde,
Technische Hogeschool Twente,
Postbus 217, 7500 AE-Enschede

decision makers are unable"...to know what they want prior to knowing what they can have" (Loucks 1975, p.224). In his analysis why this is so, Van den Toorn (1984,chapter 4) points out that the establishment of meaningful and precise ex-ante preferences on the part of the decision maker is politially impracticable and technically unfeasible. This is not limited to the objectives, but equally applies to the establishment of ex-ante availability of scarce resources, i.e. for these resources the availability of which is a matter of decision or choice rather than technical inventory. The existing literature on these problems does little concern itself with this latter aspect. The methods or models reported rather exclusively concern the objectives side (e.g. Hartog,Nijkamp and Spronk 1980; Nijkamp and Spronk 1978; Keeney and Raiffa 1976; Loucks 1975; MacCrimmon 1973).

This paper presents a method called "utility-based trade-off analysis" (UTA), a method developed originally to select projects and programmes for the Kenyan agricultural five-year plan.

The paper reads as follows. Descriptory notes on UTA are given in section 2.1. The algorithm is presented in section 2.2. The Kenyan agricultural five-year plan 1979-1983 exercise is presented as a case study in the remaining sections.

2. The method

2.1. Description

The problem that UTA is concerned with can be summarized as follows:

> to enable a decision maker to reach rational choice in a multi-dimensional surface which in principle would represent the possibilities for efficient objective satisfaction transformation across the full reach of the decision maker's potential political preferences on both the objectives and the politically dimensioned scarce resources.

To solve this problem, UTA applies an interactive procedure between the decision maker and the analyst. The procedure and contents of each step are presented schematically in diagram 1, with further details in diagrams 2 and 3. A description is given below:

1. After the "basic appraisals" of bloc 3 representing professional assessment of project performance, the method starts off with what has been called "elementary utility computation". This is an activity undertaken by the analyst. The final result (bloc 4.5) is a number of alternative project ranking orders each point of which is Pareto-efficient. These ranking orders are based on relative project performance, aggregated for multiple objectives and multiple scarce resources in accordance with the limited number of extreme weight sets for relative objective importance (bloc 5) and relative resource scarcity (bloc 6). The use, initially, of "extreme weight sets" will be further discussed at the end of this description.
2. Each ranking order is completed by adding at each point the corresponding cumulative performance under each individual objective and scarce resource (bloc 7.1).
3. The decision maker is invited to assess each separate ranking order and select the point he thinks he would opt for if no other choice was open to him (bloc 7.2). This point on any given ranking order represents both a performance package and a corresponding underlying "project basket" or "programme". It is at the same time a point on the multi-dimensional transformation surface.
4. Once the decision maker has decided on "programme size" in each alternative ranking order, the analyst will proceed by preparing a table which contains the information concerning the performance and trade-off packages that correspond with the programmes elected by the decision maker (blocs 7.3 and 7.4).
5. The decision maker is asked either to decide on one of these packages and inherent programmes (bloc 8) or to indicate one or more intervals between packages where he would request more detailed analysis (bloc 9). In the former case, the exercise would have come to an end. In the latter case, the analyst would formulate alternative weight sets, compute additional ranking orders, invite the decision maker to select additional "programmes", and present additional alternative performance packages and corresponding trade-off information. If after several iterations

DIAGRAM 1 UTA: PROCEDURE

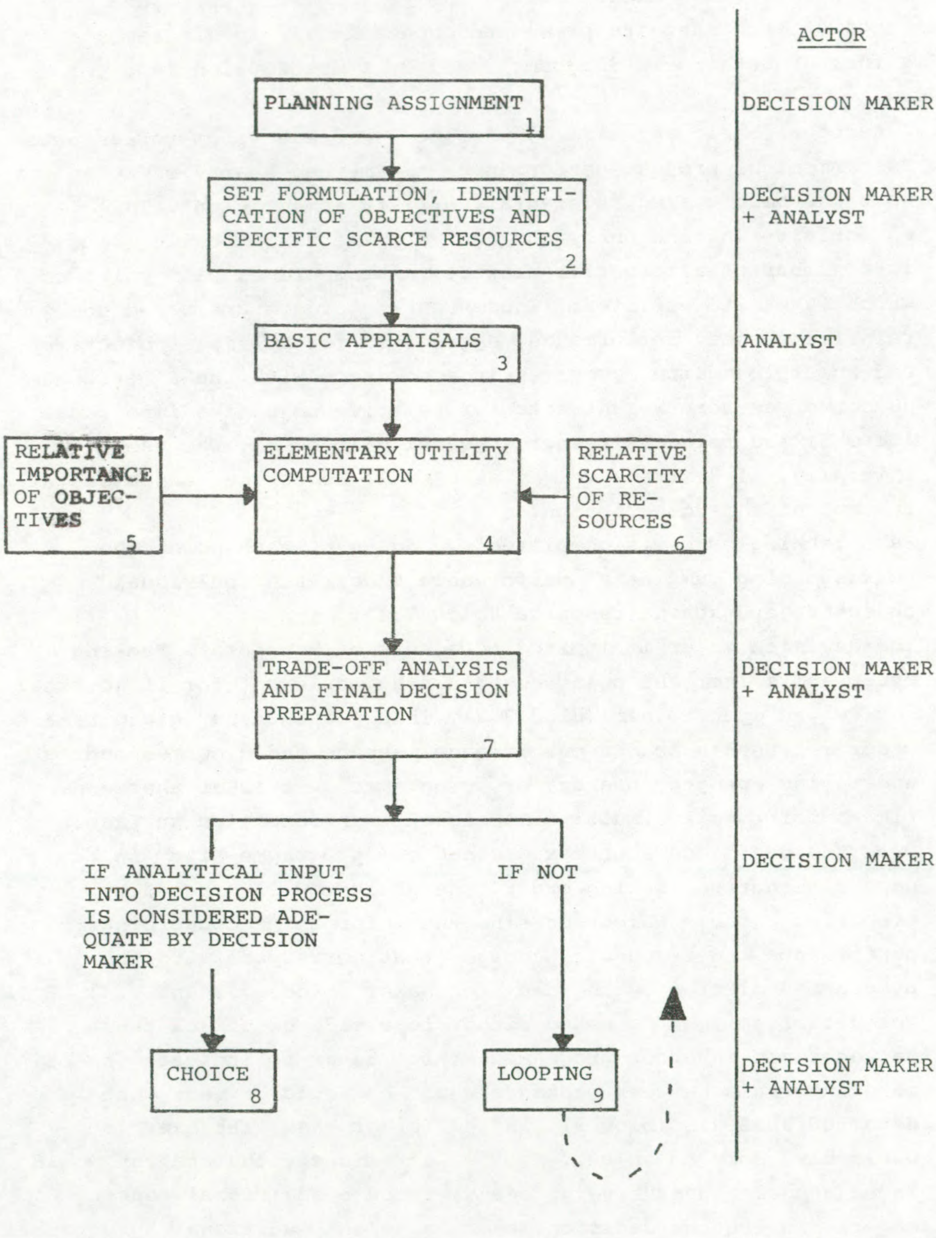


DIAGRAM 2 DETAILS OF ELEMENTARY UTILITY COMPUTATION

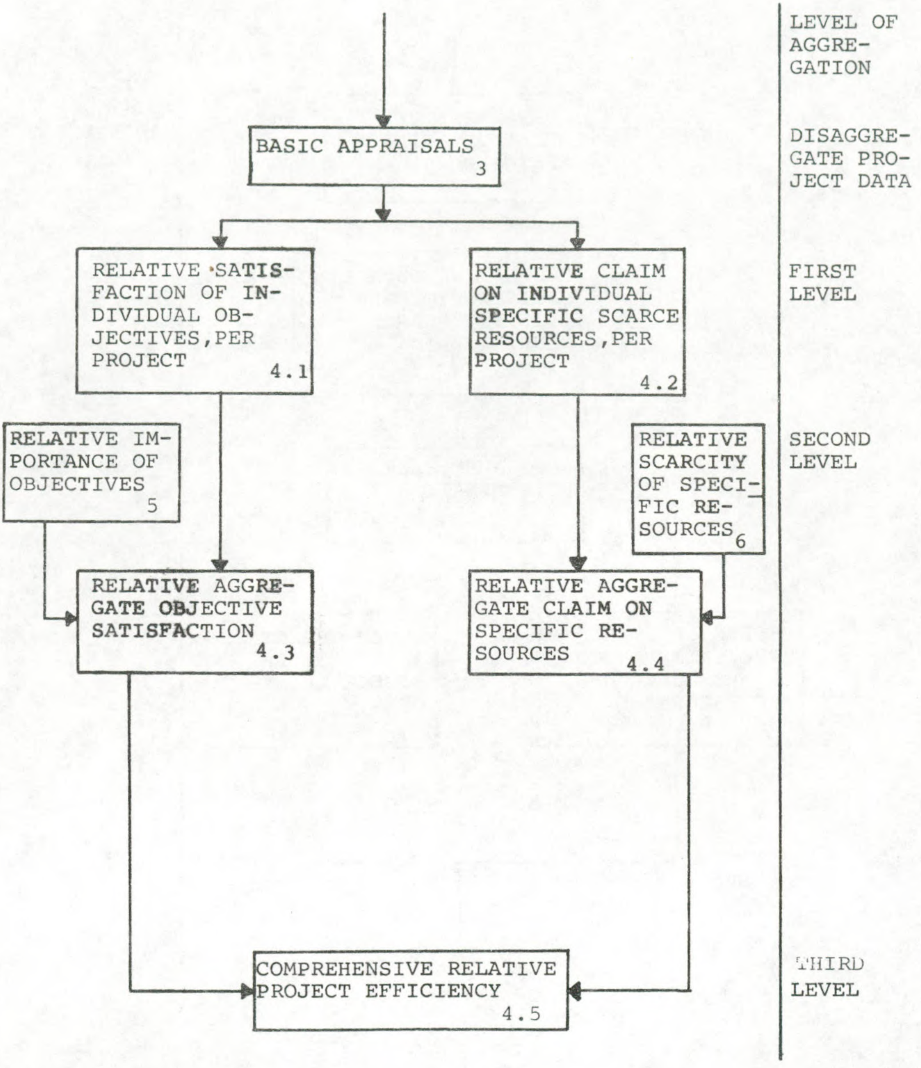
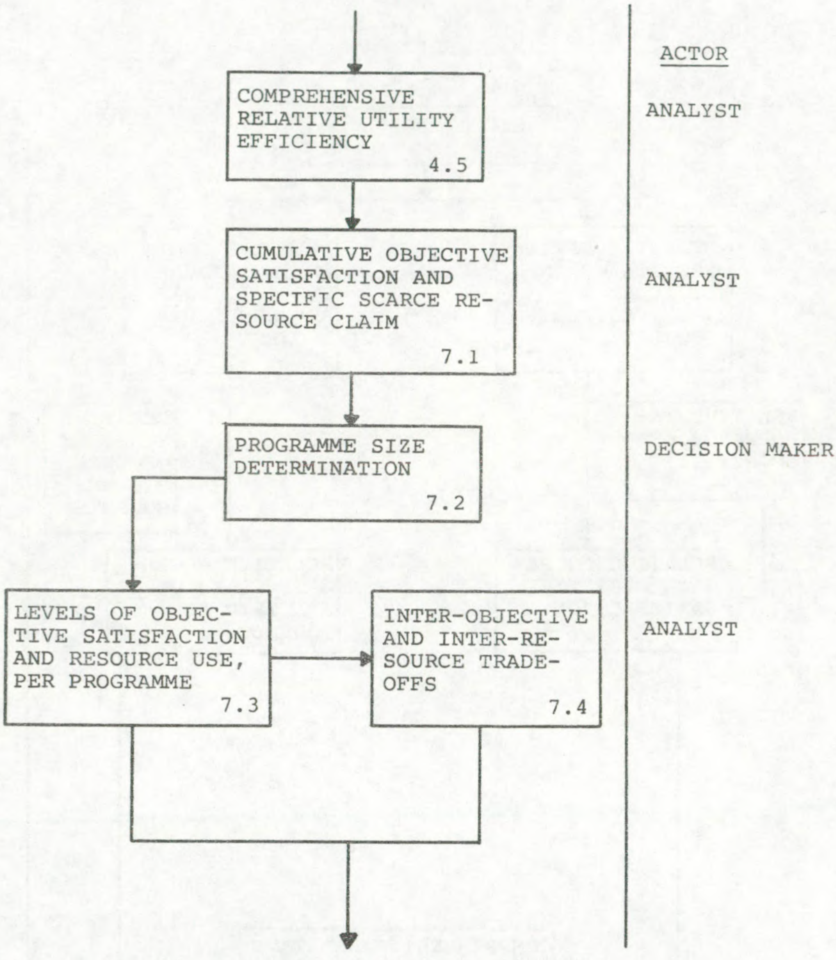


DIAGRAM 3 DETAILS OF TRADE-OFF ANALYSIS AND FINAL DECISION PREPARATION



in this manner the decision maker is still not satisfied, the exercise could loop back to areas other than alternative weight sets. Amongst these, "programme size" determination (bloc 7.2, point 3 above) features eminently. If, e.g., objective satisfaction is judged by the decision maker to reach too low a level, he may wel be prepared to stress his political credit in order to raise the availability of critical resources. A re-consideration of "programme size" would then be a logical loop-back area.

Before concluding this description, the issue of the procedure starting off with "extreme" weight sets as raised under point 1 above should be discussed in some more detail.
This issue is not a matter of principle but rather one of practice. The problem as stated at the beginning of this section refers to the "full reach of the decisionmaker's potential political preferences on both the objectives and the politically dimensioned resources". As argued in Van den Toorn (1984, chapter 4), in the absence of the decision maker's ex-ante preferences, any ex-ante curtailment of the multi-dimensional transformation surface would be a political act on the part of the analyst. Apart from being vulnerable to an accusation of un-mandated behaviour, the analyst would be open to professional criticism as well as he should not reduce information generation without knowing the trade-offs involved. On these grounds, "extreme" weight sets must be included in the exercise. To apply these extreme sets to start off the procedure would have the practical usefulness of an early establishment of the boundaries of the multi-dimensional transformation surface. These boundaries once known would act as a logical point of departure in the process of narrowing down the area of particular interest to the decision maker.

2.2. The algorithm of the elementary utility computation.

The algorithm used in UTA to conduct the elementary utility computation and produce the values in according with which the alternative ranking orders are established is given below, together with a glossary of the symbols:

$$\phi^p = \frac{o^p{}_i}{o_i^{p\text{-max}}} \qquad (1)$$

$$R_j^p = \frac{r^p{}_j}{r_j{}^{p\text{-max}}} \qquad (2)$$

$$U_v^p = \sum_{i=1}^{m} \phi_i^p * a_{vi} \qquad (3)$$

$$D^p{}_w = \sum_{j=1}^{n} R_j^p * b_{wj} \qquad (4)$$

$$C_{vw}^p = \frac{U_v^p}{D_w^p} \qquad (5)$$

in which:

ϕ_i^p = relative satisfaction of objective i by project p, $p = 1 \ldots q$ and $i = 1 \ldots m$

o_i^p = absolute satisfaction of objective i by project p

o_i^p- max = highest o_i^p-value found in $p = 1 \ldots q$

R_j^p = relative use of resource j by project p, $j = 1 \ldots n$

r_j^p = absolute use of resource j by project p

r_j^p- max = highest r_j^p-value found in $p = 1 \ldots q$

U_v^p = relative utility of project p under alternative objective weight set v, $v = 1 \ldots y$

a_{vi}= relative importance coefficient for objective i under alternative weight set v

D_w^p = relative dis-utility of project p under alternative scarce resource weight set w, $w = 1 \ldots z$

b_{wj}= relative scarcity coefficient for specific resource j under alternative weight set w

C_{vw}^p= relative comprehensive efficiency at which project p converts aggregate resource use into aggregate objective satisfaction under alternative weight sets v on the objectives and w on the scarce resources.

3. Case study: Kenyan agricultural five-year plan 1979-1983

3.1. The problem.

To prepare the agricultural five-year plan 1979-1983, the Planning Division of the Ministry of Agriculture, Kenya, appointed 13 working groups. Each group was instructed to examine a particular agricultural sub-sector with a view to generate proposals for development under the five-year plan in the sub-sector concerned. No initial conditions were set regarding budget, manpower availability, and availability of other resources. Once all the proposals would be in, a steering committee consisting of the 13 working group coordinators and chaired by the Head of the Planning Division would review them and proceed to prepare the agricultural plan.

In a concerted effort between the Ministries of Finance and Agriculture it had agreed that proposals would be screened in terms of their contribution to three development objectives:
- national-economic growth
- employment generation
- poverty alleviation.

The Ministry of Agriculture's critically scarce resources were considered to be:
- skilled planning and implementation manpower above a certain qualification level
- interministerial cooperation in implementation.

The working groups generated a very large number of development proposals which for the purpose of further analysis and appraisal could be contracted into sixty-two.
This case study demonstrates UTA for only a selection of fifteen proposals. Of necessity, as a result, the policy decisions with respect to "programme size determination" as reported here cannot but be fictitions.

3.2. Basic appraisals.

When the analysis of the proposals started, most of them appeared to lack appraisal beyond an intuitive notion that the project concerned would serve the national objectives. In these conditions, the analyst decided to interview each proposer, while using an unified and highly formalized format of criteria. The criteria were the following:

- economic growth (EC)

a project would score in accordance with a combination of quantitative output and unit value, with net output expressed per beneficiary household, scores would be High, Medium, Low with numerical values 4,2,1 respectively. The latter reflects an attempt by the ministry to gear choice to high performance.

- employment generation (EM)

A project would score in accordance with the estimated percentage-wise increase it would yield in terms of labour absorption per beneficiary household. Scores would be High if more than 40%, Medium if between 20% and 40%, Low if less than 20%, with numerical values again being 4,2,1 respectively.

- poverty alleviation (PO)

A project would score in accordance with the estimated initial income level in beneficiary households: High if less than shs 2000/yr, Medium if between shs 2000 and shs 4000, Low if more than shs 4000, with numerical values again being 4,2,1 respectively.

- planning and implementation manpower (MP)

A project would score in terms of incremental man-years required during project operation.

- inter-ministerial cooperation (IM)

A project would score in terms of project funds to be spent on the project by agencies outside the Ministry of Agriculture.

The criteria related to objective satisfaction are indices per beneficiary household, whereas those related to the scarce resources are in absolute terms. To relate project benefits to project costs, therefore,"project size" indicators were estimated representing the number of beneficiary households, at a ratio of approximately one point per 2.500 beneficiary households.

The numerical appreciation 4,2,1 of "High,Medium,Low respectively would be subjected to sensitivity testing which,however,is not reported in this paper.

Table 1, below, presents the "basic appraisals" for the fifteen selected projects, in line with the above criteria.

Table 1 Project performance

Project	No.of beneficiaries	Objectives EC	EM	PO	scarce resources MP	IM
2 Tick control	12.0	2.0	1.0	1.5	60.0	7.0
4 Veterinary services	1.0	1.0	1.0	1.0	10.0	0.1
5 Foot & mouth disease control	12.0	3.0	1.0	1.5	200.0	0.7
19 Wheat research	1.0	1.0	1.0	1.0	15.0	0.1
34 Passion fruit research	1.0	2.0	1.0	2.0	8.0	0.1
40 Coffee rehabilitation	12.0	2.0	3.0	1.0	75.0	4.0
41 Tobacco development	7.0	4.0	4.0	3.0	450.0	0.3
44 Large-scale irrigation devt.	7.0	3.0	2.0	2.0	500.0	50.0
52 Mixed group farm subdivision	12.0	4.0	4.0	2.0	465.0	0.5
53 Integrated agricultural devt.4	12.0	2.0	3.0	2.0	150.0	1.0
54 Other integrated projects	7.0	2.0	3.0	2.0	100.0	1.0
55 Tractor hire service	9.5	1.5	1.5	1.0	135.0	0.2
56 Soil improvement	20.0	1.5	1.5	2.0	630.0	4.0
57 Small-scale irrigation devt.	4.0	1.5	3.0	2.0	120.0	4.0
58 Agricultural Finance Corporation	7.0	2.0	2.0	1.5	80.0	0.3

3.3 Initial set of alternative ranking orders.

To compute the C^{p}_{vw}-values of equation (5) from the basic appraisal data, it is necessary first to formulate the starting badge of the alternative weight sets. In line with the discussion of section 2.1, this starting badge contains the "extreme" positions. They are presented in table 2, below.

Table 2 Initial weight sets (a_{vi}, b_{wj})

Objective	Weight sets a v=1	2	3	4
EC,i=1	1.00	-	-	,333
EM,2	-	1.00	-	,333
PO,3	-	-	1.00	,334

scarce resource	weight sets b W=1	2
MP,j=1	.50	.75
IM,2	.50	.25

Weight sets b_{wj}, as the table shows, are formulated while ignoring the practical rule to start off with the "extreme" sets. This represents operational judgement at the time the exercise was undertaken, in retrospect something difficult really to justify.

Applying the algorithm of section 2.2 to the "basic appraisals" of table 1 and the initial weight sets of table 2 yields the C^p_{vw}-values as presented in table 3, below.

Table 3. Relative comprehensive project efficiencies (C^p_{vw}-values)

Project rank	Alternative b_w weight set	Alternative a_v weight set 1		2		3		4	
		Project	C^p-value	Project	C^p-value	Project	C^p-value	Project	C^p-value
1	1	34	5.250	40	7.500	34	6.250	40	5.170
2		40	5.000	53	5.814	53	4.654	53	4.783
3		5	4.518	54	4.867	58	3.925	58	4.209
4		58	4.358	58	4.358	59	3.889	54	4.000
5		2	4.237	55	2.734	2	3.814	2	3.390
6		53	3.876	52	2.674	40	3.000	5	2.911
7		54	3.244	34	2.625	4	2.778	34	2.750
8		55	2.734	4	2.333	5	2.711	55	2.550
9		52	2.674	2	2.119	55	2.183	4	2.444
10		4	2.333	57	1.838	19	1.923	52	2.318
11		41	1.619	41	1.619	56	1.856	19	1.692
12		19	1.615	19	1.615	52	1.604	41	1.567
13		56	1.157	5	1.506	57	1.471	57	1.412
14		57	.919	56	1.157	41	1.458	56	1.389
15		44	.488	44	.326	44	.390	44	.401
1	2	2	4.717	40	6.881	34	5.000	40	4.743
2		40	4.587	53	4.076	2	4.245	34	3.800
3		34	4.200	54	3.532	53	3.261	2	3.774
4		5	3.099	58	3.010	54	2.823	53	3.353
5		58	3.010	2	2.358	40	2.752	58	2.907
6		53	2.717	34	2.100	58	2.711	54	2.903
7		54	2.355	55	1.840	4	1.923	5	1.996
8		55	1.840	52	1.799	5	1.860	55	1.716
9		52	1.799	4	1.615	55	1.469	4	1.692
10		4	1.615	57	1.534	19	1.316	52	1.559
11		41	1.334	19	1.105	56	1.299	57	1.178
12		19	1.105	41	1.086	57	1.227	19	1.158
13		56	.812	5	1.033	52	1.079	41	1.050
14		57	.767	56	.812	41	.978	56	.974
15		44	.518	44	.345	44	.414	44	.426

3.4 Programme size determination

To enable the decision maker to determine "programme size" (bloc 7.2 of diagram 3, point 3 of section 2.1), the synthetic C^{p}_{vw}-values are replaced by cumulative project performance. This is presented in tables 4 and 5 for w=1 and w=2 respectively.

Table 4 Cumulative project performance- w=1

Project ranking	Project performance: Bene-ficia-ries (1000)	EC	EM	PO	MP	IM	Project ranking	Project performance: Bene-ficia-ries (1000)	EC	EM	PO	MP	IM
		v=1, w=1							v=2, w=1				
34	1	2	1	2	8	.1	40	12	24	36	12	75	4.0
40	13	26	37	14	83	4.1	53	24	48	72	36	225	5.0
5	25	62	49	32	283	4.8	54	31	62	93	50	325	6.0
58	32	76	63	43	363	5.1	58	38	76	107	61	415	6.3
2	44	100	75	61	423	12.1	55	48	90	121	71	540	6.5
53	56	129	111	85	573	13.1	52	60	138	169	95	1005	7.0
54	63	138	132	99	673	14.1	34	61	140	170	97	1013	7.1
55	73	152	146	109	808	14.3	4	62	141	171	98	1023	7.2
52	85	200	194	133	1273	14.8	2	74	165	183	116	1083	14.2
4	86	201	195	134	1283	14.9	57	78	171	195	124	1203	18.2
41	93	229	223	155	1733	15.2	41	85	199	223	145	1653	18.5
19	94	230	224	156	1748	15.3	19	86	200	224	146	1668	18.6
56	114	260	254	196	2378	19.3	5	98	236	236	164	1868	19.3
57	118	266	266	204	2498	23.3	56	118	266	266	204	2498	23.3
44	125	287	280	218	2998	73.3	44	125	287	280	218	2998	73.3
		v=3, w=1							v=4, w=1				
34	1	2	1	2	8	.1	40	12	24	36	12	75	4.0
53	13	26	37	26	158	1.1	53	24	48	72	36	225	5.0
58	20	40	51	37	238	1.4	58	31	62	86	47	305	5.3
54	27	54	72	51	338	2.4	54	38	76	107	61	405	6.3
2	39	78	84	69	398	9.4	52	50	100	119	79	465	13.3
40	51	102	120	81	473	13.4	5	62	136	131	97	665	14.0
4	52	103	121	82	483	13.5	34	63	138	132	99	673	14.1
5	64	139	133	100	683	14.2	55	73	152	146	109	808	14.3
55	74	153	147	110	818	14.4	4	74	153	147	110	818	14.4
19	75	154	148	111	833	14.5	52	86	201	195	134	1283	14.9
56	95	184	178	151	1463	18.5	19	87	202	196	135	1298	15.0
52	107	232	226	175	1928	19.0	41	94	230	224	156	1748	15.3
57	111	238	238	183	2048	23.0	57	98	236	236	164	1868	19.3
41	118	266	266	204	2494	23.3	56	118	266	266	204	2498	23.3
44	125	287	280	218	2998	73.3	44	125	287	280	218	2998	73.3

Table 5 Cumulative project performance- w=2

Project ranking	Project performance: Beneficiaries (1000)	EC	EM	PO	MP	IM	Project ranking	Project performance: Beneficiaries (1000)	EC	EM	PO	MP	IM
	v=1, w=2							v=2, w=2					
2	12	24	12	18	60	7.0	40	12	24	36	12	75	4.0
40	24	48	48	30	135	11.0	53	24	48	72	36	225	5.0
34	25	50	49	32	143	11.1	54	31	62	93	50	325	6.0
5	37	86	61	50	343	11.8	58	38	76	107	61	405	6.3
58	44	100	75	61	423	12.1	2	50	100	119	79	465	13.3
53	56	124	111	85	573	13.1	34	51	102	120	81	473	13.4
54	63	138	132	99	673	14.1	55	61	116	134	91	608	13.6
55	73	152	146	109	808	14.3	52	73	164	182	115	1073	14.1
52	85	200	194	133	1273	14.8	4	74	165	183	116	1083	14.2
4	86	201	195	134	1283	14.9	57	78	171	195	124	1203	18.2
41	93	229	223	155	1733	15.2	19	79	172	196	125	1218	18.3
19	94	230	224	156	1748	15.3	41	86	200	224	146	1668	18.6
56	114	260	254	196	2378	19.3	5	98	236	236	164	1868	19.3
57	118	266	266	204	2498	23.3	56	118	266	266	204	2498	23.3
44	125	287	280	218	2998	73.3	44	125	287	280	218	2998	73.3
	v=3, w=2							v=4, w=2					
34	1	2	1	2	8	.1	40	12	24	36	12	75	4.0
2	13	26	13	20	68	7.1	34	13	26	37	14	83	4.1
53	25	50	49	44	218	8.1	2	25	50	49	32	143	11.1
54	32	64	70	58	318	9.1	53	37	74	85	56	293	12.1
40	44	88	106	70	393	13.1	58	44	88	99	67	373	12.4
58	51	102	120	81	473	13.4	54	51	102	120	81	473	13.4
4	52	103	121	82	483	13.5	5	63	138	132	99	673	14.1
5	64	139	133	100	683	14.2	55	73	152	146	109	808	14.3
55	74	153	147	110	818	14.4	4	74	153	147	110	818	14.4
19	75	154	148	111	833	14.5	52	86	201	195	134	1283	14.9
56	95	184	178	151	1463	18.5	57	90	207	207	142	1403	18.9
57	99	190	190	159	1583	22.5	19	91	208	208	143	1418	19.0
52	111	238	238	183	2048	23.0	41	98	236	236	164	1868	19.3
41	118	266	266	204	2498	23.3	56	118	266	266	204	2498	23.3
44	125	287	280	218	2998	73.3	44	125	287	280	218	2998	73.3

In his assessment of the information presented in tables 4 and 5, the decision maker will pay attention particularly to discontinuities in cumulative project performance. In addition, he will consider what he thinks might be politically interesting levels and composition of objective satisfaction, in combination with an assessment of political credit and effort required to secure certain levels and composition of the package of politically dimensioned scarce resources. Suppose that these considerations lead him to select "programme size" as indicated by the arrows in tables 4 and 5, and spelled out in table 6 below.

Table 6 Programme size determination.

weight sets combination	Programme (= project package)
a_1 b_1	34,40,5,58,2,53,54,55
a_2 b_1	40,53,54,58,55,52,34,4
a_3 b_1	34,53,58,54,2,40,4,5,55,19
a_4 b_1	40,53,58,54,2,5,34,55,4
a_1 b_2	2,40,34,5,58,53,54,55
a_2 b_2	40,53,54,58,2,34,55
a_3 b_2	34,2,53,54,40,58,4,5,55,19
a_4 b_2	40,34,2,53,58,54,5,55,4

Disregarding slight differences in sequence, programmes a_1b_1 and a_1 b_2 appear to be identical and so are programmes a_3b_1 and a_3b_2, and a_4b_1 and a_4b_2.

3.5. Choice of programme, iterations

Table 7, below, summarizes the performance data of the programmes selected by the decision maker. To enhance the insight into the trade-offs involved, the performance data is presented in both absolute and relative terms, with the relative level having $a_4b_1 = a_4b_2$ as its point of reference.

Table 7 Performance data for selected programmes.

Package	Beneficiaries (1000)	EC	EM	PO	MP	IM
$a_1b_1=a_1b_2$						
-absolute	73	152	146	109	808	14.3
-relative	98.7%	99.4%	99.3%	99.1%	98.8%	99.3%
a_2b_1						
-absolute	62	141	171	98	1023	7.2
-relative	83.8%	92.2%	116.3%	89.1%	125.1%	50.0%
$a_3b_1=a_3b_2$						
-absolute	75	154	148	111	833	14.5
-relative	101.4%	100.7%	100.7%	100.9%	101.8%	100.7%
$a_4b_1=a_4b_2$						
-absolute	74	153	147	110	818	14.4
-relative	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
a_2b_2						
-absolute	61	116	134	91	608	13.6
-relative	82.4%	75.8%	91.2%	82.7%	74.3%	94.4%

Project packages $a_1b_1 = a_1b_2$, $a_3b_1 = a_3b_1$, and $a_4b_1 = a_4b_1$ are so close as far as performance is concerned that for practical purposes they can be taken not to differ. On the remaining three packages that do significantly differ - a_2b_1, $a_4b_1 (= a_1b_1 = a_2b_1 = a_3b_1 = a_4b_2)$, and a_2b_2 - the following observations can be made:

- particularly attractive performance in the three packages:
  in a_2b_1: EM, IM
  in a_4b_1: beneficiaries, EC, PO
  in a_2b_2: MP.
- considering a_2b_2, the resource use package is such that MP could be allowed to increase while IM is not far from becoming rather unattractive. At the same time, the objective satisfaction package has little distinctively interesting aspects if compared to the other two project packages.
- it would seem to be of interest to investigate whether a project package could be found such that:
  MP is lowered relative to package a_2b_1
  IM is lowered relative to package a_4b_1
  EM is increased relative to package a_2b_1, without losing too much in terms of EC and PO.

On these grounds, the "area" between weight set combinations a_2b_1 and a_4b_1 is worth examining in greater detail through more narrowly-spaced alternative weight set combinations, in a first go by more narrowly-spaced alternative a_v weight sets. The following additional a_v weight sets could be explored:

Objective	Alternative a_v weight sets			
	already explored		additional	
	v=1	4	5	6
EC	1.00	.333	.25	.15
EM	-	.333	.50	.70
PO	-	.334	.25	.15

Working out the additional alternative objective functions would:
- yield two additional project ranking orders
- require the decision maker to determine "size of programme" for these two additional ranking orders
- summarize the additional performance information as done in table 7
- require the decision maker either to choose or, in concerted effort with the analyst, to formulate additional iterations.

If after these additional runs the decision maker would still be unsatisfied, he might wish to reconsider "programme size" and go back to tables 4 and 5 plus the information gathered during the iteration runs. He might, e.g., reconsider his initial decision under a_4b_1 not to select a programme up to and including project 52.

In the actual study, the approach was somewhat cruder than the one demonstrated above. Particularly the involvement of the ultimate decision maker, i.e. the minister, was slight. Owing to the structure and procedures of the burocracy in the Ministry of Agriculture, the Head of the Planning Division was able to exercise considerable "pre-screening" power. The minister was left with minimal choice, as becomes a burocracy worth its salt.

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