REPORTS FROM TESTING THE STATIC METHOD TO ASSESS CUMULATIVE EF-FECT OF N(S)WRM (PILOT ACTION)

D.T2.2.2

Pilot Catchment Nagykunsági

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1. INTRODUCTION

The purpose of developing the StaticTool method and the computer application StaticTool.xlsm is to enable the estimation of the effects of the implementation of a program of natural, small water retention measures (PoNSWRM) in a simplified way, which does not require the time-consuming and costly development of de-tailed models, hydrological or / and hydraulic, of the analysed catchment. This estimate is a grading, based on expert knowledge and is used to compare variants of the NSWRM program.

The potential effects of individual NSWR measures may be different, depending on the climatic and physio-graphic conditions (e.g. slopes, ground permeability) of the analysed area, so the method parameters should be adapted to local conditions (climate type, landscape type). The StaticTool method thus consists of two parts:

- *developing method parameters for local conditions,*

- *estimation of the effects of activities planned under the Natural Small Water Retention Program.*

The StaticTool method assumes that the expected effect of the PoNSWRM is to improve catchment retention properties, which is understood as increasing low flows (LowQ), reducing high flows (HighQ) and / or limit-ing the load of pollutants yielded from the catchment area (Qual). This effect depends on the planned measures, in particular: i) their type and ii) the level of intensity. The measures included in the StaticTool method are summarized in the local catalogue of measures. For each measure, an intensity criterion is for-mulated, and threshold values are defined that correspond to the characteristic intensity levels (low, medi-um, high). Each measure is also assigned the expected improvement of retention properties of the SPU, ex-pressed on a point scale (0-5 points). The greatest improvement that can be achieved (maximum points for a given measure) corresponds to the implementation of the measure with maximum intensity. For lower inten-sity levels, the assigned grades are proportional to the level of intensity of planned measure. Hence, devel-oping parameters of the StaticTool method means defining a set of functions that make grade assessment dependent on the type of planned measures and their intensity for each measure from the local catalogue.

The StaticTool method and the StaticTool.xlsm application were developed as part of the pro-ject FramWat, Work Package T2 (Effectiveness of the Natural Small Water Retention Measure), activity A.T2.2 (Developing the GIS based method to assess cumulative effect of N(S)WRM at the river basin scale), deliverable D.T2.2.1 (Static method to assess cumulative effect of N(S)WRM in the river basins). A detailed description of the methodology is in a separate file created by the author of the program. This report presents the results of testing the static method (StaticTool.xlsm) to assess cumulative effect of N(S)WRM for the Pilot Catchment Nagykunsági.

2. DESCRIPTION OF INPUT DATA PREPARATION

In the first step, during working with the StaticTool program, it was necessary to specify/se-lect the N(S)WRM type, for which calculations will be carried out for expert variant and vari-ant of local preferences. The table below (Tab. 1) shows the types of measures implemented in the program in individual variants (all reported measures in the expert and local variants).

Selection of measures for StaticTool was carried out by using Concept Plan D.T2.3.1. Location and measure type was chosen by an interdisciplinary team of experts with experience in the planning and implementation of small retention measures.

Aggregated measures:

Aggregated measures include a group of measures whose implementation in a similar way improves the retention properties of the catchment area, and assessment of the effects of individual activities, without detailed field or model studies at the current level of knowledge, is not possible.

Code	Sector	Measures (NWRM/NSWRM)	Measures for testing Static method	Description
A01	Agriculture	Meadows and pastures	A01	Poor quality arable and high risk of pluvial flood. (ha)
A02		Buffer strips and hedges	A02	Planned next to state owned canal system without existing buffer strips or forest. (km)
A06		No till agriculture	WRAL	Good quality arable land and easily cultivated soil type. (ha)
A07		Low till agriculture		
A08		Green cover		Good arable without other agricultural measures (ha)
A15		Deep plowing (removing the plow's sole)	A15	Good quality arable and high risk of pluvial flood. (ha)
N02	Hydro-morphology	Wetland restoration and management	N02	Water supply of onetime streams and wetlands (ha)
N07		Reconnection of oxbow lakes and similar features	N07	Reconnection and water supply of oxbows in the pilot area. (km)
F01	Forestry	Forest riparian buffers	F01	Same as A02. Buffer strips and forest buffer in the opposite side (km)
D01	Drainage	Regulated outflow from drainage systems	BPDA	Regularly inundated area by pluvial flood in meadow and pasture areas. (ha)
D02		Water damming in ditches, wires with constant crest (valleys)		Water storage in existing canal system (km)
D03		Active water management on a drainage system (river valleys)		Extending impact area of water supply increasing (ha)
D04		Construction of micro reservoirs on ditches		Development of new reservoirs
D07		Construction of reservoirs on outflows from drainage systems		Development of existing irrigation water reservoirs.

Table 1. Selected measures and aggregated measures

For each measure the intensity criteria and the threshold values for characteristic intensity levels were defined. According to the assumptions of the StaticTool method, the expected improvement in the catchment retention properties depends on the type and level of intensity of planned measures. Three levels of measures' intensity were distinguished: low, medium and high. They correspond to three levels of the expected improvement in the catchment retention properties (e.g. small, average and large). Four threshold values were used: T0 – no action, Tlow – the boundary between low and medium intensity, Thigh – the limit between medium and high intensity and Tmax, which corresponds to the maximum (hypothetically) possible intensity of measure. There were determined expert assessments of the impact of aggregated measures on three elements of the catchment retention properties (low flows, high flows and erosion), with maximum intensity of measures' application. There was needed to formulate a general assessment of measures (3 above-mentioned elements together) and defining effect coefficients for lower than maximum intensity of measures. The tables below show the parameters used for calculationsThe assessment of the impact of aggregated measures on three elements of the catchment retention properties (6-grade scale was adopted, 0 - 5, where 0 means no positive impact on the retention of the catchment area, and 5 – very high positive impact) – expert variant. (Table 2)

No	Code	Aggregated measure name	Low flows	High flows	Qual Erosion	AVG
1	A01	Meadows and pastures	0	3	2	1,67
2	A02	Buffer strips and hedges	1	1	3	1,67
3	WRAL	WRAL - best practices for Water Retention in Agricultural Lands	2	1	1	1,33
4	A13	Mulching/fertilization	2	3	0	1,67
5	A15	Deep plowing (removing the plow's sole)	2	3	2	2,33
6	F01	Forest riparian buffers	1	1	3	1,67
7	N02	Wetland restoration and management	2	1	0	1,00
8	N07	Reconnection of oxbow lakes and similar features	2	2	0	1,33

Table 2. The impact of aggregated measures

No	Meas-ure ID	Aggregated English	Intensity thresholds				Grade max	Grade thresholds [%]				Grade values			
			T0	Tlow	Thigh	Tmax		E%0	E%low	E%high	E%max	E0	Elow	Ehigh	Emax
1	A01	Meadows and pastures	0	0,05	0,20	0,74	3	0	25	65	100	0	0,75	1,95	3,00
2	A02	Buffer strips and hedges	0	0,10	0,20	1,50	3	0	30	70	100	0	0,90	2,10	3,00
3	WRAL	WRAL - best practices for Water Reten-tion in Agri-cultural Lands	0	0,30	0,55	0,74	3	0	25	65	100	0	0,75	1,95	3,00
4	A13	Mulch-ing/fertiliza-tion	0	0,02	0,15	0,74	3	0	10	60	100	0	0,30	1,80	3,00
5	A15	Deep plow-ing	0	0,02	0,30	0,74	3	0	25	65	100	0	0,75	1,95	3,00
6	F01	Forest ripar-ian buffers	0	0,30	0,50	1,50	3	0	30	50	100	0	0,90	1,50	3,00
7	N02	Wetland res-toration and management	0	0,00	0,05	0,07	2	0	20	55	100	0	0,40	1,10	2,00
8	N07	Reconnec-tion of ox-bow lakes and similar features	0	0,01	0,30	0,50	3	0	10	65	100	0	0,30	1,95	3,00
9	BPDA	BPDA - Best practices on drained areas	0	0,05	0,30	1,00	4	0	15	55	100	0	0,60	2,20	4,00

Table 3. List of parameters for measures in Expert 2. variant.

3. MODIFICATIONS TO THE STATICTOOLS.XLSX TOOL PARAMETERS

The precondition of using the tool is defining the measures intensity and determining the thresholds values (low, medium, high).

This work requires a team of experts with appropriate knowledge in the field of water management and agriculture.

In Middle-Tisza district the expert team was made up of members of the Directorate and the delegate from the National Chamber or Agriculture as the Associated partner in FramWat project.

The expert group reviewed the preliminary proposal and the final version was made after a detailed consultation.

Expert assessment of NWRM impact on catchment retention properties – for maximum intensity level values see the table below (Table 4.)

Abbreviations in the table:

LowQ: Increasing low flows.

HighQ: Reducing high flows.

Qual: Limiting the load of generated pollution

Code	Measures (NWRM/NSWRM)	Initial valuea Impact on (0-5):			Accepted values			
		Low flows	High flows	Qual	Low flows	High flows	Qual	AVG
A01	Meadows and pastures	0	5	2	0	3	2	1,667
A02	Buffer strips and hedges	1	1	3	1	1	3	1,667
WRAL	WRAL - best practices for Water Retention in Agricul-tural Lands	2	1	1	2	1	1	1,333
A13	Mulching/fertilization	2	4	0	2	3	0	1,667
A15	Deep plowing	2	4	2	2	3	2	2,333
F01	Forest riparian buffers	1	1	3	1	1	3	1,667
N02	Wetland restoration and management	2	1	0	1	1	0	1
N07	Reconnection of oxbow lakes and similar features	2	2	0	1	1	0	1
BPDA	BPDA - Best practices on drained areas	3	4	2	3	4	2	3

Table 4. The initial and the accepted impact assessment results

4. DESCRIPTION OF RESULTS

4.1 For the Expert 1. variant

The final results of the assessment were obtained from the StaticAssessment tab (Tab. 5). This tab contains a table with the cumulative assessment for the entire catchment and partial assessments for each group of measures and for each SPU.

The results show that the highest impact on the final grade had A01 Meadow and pasture (26,49), A15 Deep plowing (22,58), and Best practices on drained areas (BPDA = 20.99)

In order to assess a single SPU while taking into account the size of the catchment area, additional calculations were made according to the following equation SPUgrades * F_SPU / Σ F_SPU. The results are shown in Table 5.

The greatest impact on the final assessment had SPU 7 which are characterized by a large catchment area however the SPU rating which does not take into account the area shows different results: the highest rating was obtained by SPU 6.

The final rating for the catchment depends largely on the size of the SPUs.

The overall rating for this option is 7,05.

Number of measures	9			Grading of the Program of Small Water Retention Measures									Catchment grade for current variant	
Number of SPUs	28		Measure No.	1	2	3	4	5	6	7	8	9	7,05	SPU grades *F_SPU/ Sum_F_ SPU
Grade for a measure (total by SPUs):				26,49	15,03	12,62	14,38	22,58	7,82	7,72	8,50	20,99		
No.	SPU Id	SPU name	Measure Id by User	A01	A02	WRAL	A13	A15	F01	N02	N07	BPDA	SPU grades	
			F_SPU [km²]	km2/km2	km/km2	km2/km2	km2/km2	km2/km2	km/km	ha/ha	km/km2	km2/km2		
1	SPU_01	Tiszaboői	59,14	1,31	1,09	0,35	0,31	0,97	0,55	0,55		0,12	5,26	0,10
2	SPU_02	Mirhó-Gyólcsi	94,78	2,72	0,70	0,16	1,02	1,54	0,31	0,57		1,26	8,28	0,26
3	SPU_03	Ledencei	9,29	0,00		0,98	0,00	0,01		0,91		0,16	2,07	0,01
4	SPU_04	Tólaposi	21,25	0,44		0,42	0,10	0,30				0,35	1,62	0,01
5	SPU_05	Örményes II.	19,59	1,64		1,23	0,33	1,03		0,43		0,00	4,67	0,03
6	SPU_06	Karcagi	203,21	3,25	2,10	0,39	2,03	2,01	0,93			3,06	13,77	0,94
7	SPU_07	Villogói	338,78	2,55	1,97	0,54	2,01	2,00	0,92	0,40		0,92	11,32	1,29
8	SPU_08	Kakati	413,98	1,63	1,60	0,77	0,21	0,67	0,91	0,40		0,79	6,99	0,98
9	SPU_09	Mezőtúr-Halásztelki	158,38	1,20	1,23	0,62	0,57	1,33	0,40		0,94	1,16	7,45	0,40
10	SPU_10	Mezőtúr-Álomzugi	61,50	3,32	0,70	0,63	1,12	1,58	0,35	0,55		3,09	11,33	0,23
11	SPU_11	Örvényabádi	253,81	2,57	1,19	0,18	0,99	1,52	0,70	0,45	0,45	1,05	9,11	0,78
12	SPU_12	Mesterszállás-Bartapuszt	249,53	0,29	1,47	1,85	0,86	1,47	0,74	0,52	0,37	1,33	8,90	0,75
13	SPU_13	Szenttamási	130,77	0,92		0,74	1,17	1,61		0,47		0,00	4,91	0,22
14	SPU_14	Örményes I.	19,16	0,10		0,65	1,05	1,55		0,53			3,88	0,03
15	SPU_15	Túrkevei-Kiserdei	112,56	1,31		0,10	0,79	1,43		0,46	0,60	0,43	5,12	0,19
16	SPU_16	Rákóczifalva-Szandai	24,20	0,00		0,21						0,00	0,21	0,00
17	SPU_17	Alcsi-Tenyő-Kengyeli	137,44	0,12		0,41	0,11	0,35			0,89	0,00	1,87	0,09
18	SPU_18	Fegyvernek-Büdöséri	81,07	0,05		0,15	0,06	0,18				2,76	3,21	0,09
19	SPU_19	Szajoli	111,03	0,12	0,87	0,07	0,14	0,44	1,21	0,49	1,40	2,53	7,25	0,27
20	SPU_20	Óballai	20,10	0,18		0,05	0,00	0,00		0,53		0,01	0,77	0,01
21	SPU_21	Németéri	57,44	1,33	2,11	0,29	1,19	1,62	0,78			0,29	7,60	0,15
22	SPU_22	Kungyalu I.	72,82	0,06		0,35	0,22	0,70		0,46		0,02	1,80	0,04
23	SPU_23	Cibakházi	88,31	0,01		0,18					1,40	1,44	3,02	0,09
24	SPU_24	Tőkefoki	99,57	0,05		0,10	0,03	0,11			0,94	0,01	1,25	0,04
25	SPU_25	Tóközei	41,46	0,03		0,61	0,00	0,00				0,16	0,81	0,01
26	SPU_26	Tiszaugi	19,87	0,04		0,12					1,50	0,04	1,70	0,01
27	SPU_27	Kungyalu II.	33,32			0,38	0,05	0,16					0,59	0,01
28	SPU_28	Tiszakürti	32,66	1,27		0,08					0,03	0,00	1,38	0,02

Table 5. Assessment of the effectiveness of the Expert 1. variant

4.2 For the Expert 2. variant

In variant 1. the intensity of planned measures comes from the Concept plan, so the assessment was carried out with the highest possible intensity even if in some opinion this is not reasonable.

In expert 2. variant we reduced the agricultural measures rates, so that is more reasonable under the current farming conditions.

In this version, as expected the overall rating is lower: 4,17. But still the A01 Meadow and pasture brought the highest impact (15,03), because this measure intensity and assumed impacts are still high. The reason is that if we use this kind of measure, the amount of water that has to be drained significantly less than arable cultivation condition.

Number of measures	9			Grading of the Program of Small Water Retention Measures										Catchment grade for current variant	
Number of SPUs	28		Measure No.	1	2	3	4	5	6	7	8	9		**4,17**	SPU grades *F_SPU/ Sum_F_SPU
		Grade for a measure (total by SPUs):		7,34	15,03	8,13	8,33	10,38	7,82	7,72	8,50	11,79			
No.	SPU Id	SPU name	Measure Id by User	A01	A02	WRAL	A13	A15	F01	N02	N07	BPDA		SPU grades	
			F_SPU [km²]	km2/km2	km/km2	km2/km2	km2/km2	km2/km2	km/km	ha/ha	km2/km2	km2/km2			
1	SPU_01	Tiszabői	59,14	0,51	1,09	0,35	0,23	0,32	0,55	0,55		0,10		**3,70**	0,07
2	SPU_02	Mirhó-Gyólcsi	94,78	0,81	0,70	0,16	0,77	0,75	0,31	0,57		1,01		**5,09**	0,16
3	SPU_03	Ledencei	9,29	0,00		0,98	0,00	0,01		0,91		0,13		**2,03**	0,01
4	SPU_04	Tólaposi	21,25	0,26		0,42	0,07	0,18				0,28		**1,22**	0,01
5	SPU_05	Örményes II.	19,59	0,42		1,23	0,25	0,62		0,43		0,00		**2,95**	0,02
6	SPU_06	Karcagi	203,21	0,74	2,10	0,18	0,65	0,77	0,93			0,93		**6,30**	0,43
7	SPU_07	Villogói	338,78	0,38	1,97	0,18	0,59	0,82	0,92	0,40		0,50		**5,76**	0,66
8	SPU_08	Kakati	413,98	0,43	1,60	0,10	0,16	0,18	0,91	0,40		0,37		**4,16**	0,58
9	SPU_09	Mezőtúr-Halásztelki	158,38	0,28	1,23	0,16	0,43	0,36	0,40		0,94	1,31		**5,11**	0,27
10	SPU_10	Mezőtúr-Álomzugi	61,50	1,00	0,70	0,35	0,53	0,80	0,35	0,55		1,58		**5,85**	0,12
11	SPU_11	Örvényabádi	253,81	0,82	1,19	0,18	0,74	0,76	0,70	0,45	0,45	0,75		**6,05**	0,52
12	SPU_12	Mesterszállás-Bartapuszt	249,53	0,17	1,47	0,22	0,65	0,78	0,74	0,52	0,37	0,68		**5,59**	0,47
13	SPU_13	Szenttamási	130,77	0,34		0,17	0,53	0,78		0,47		0,00		**2,30**	0,10
14	SPU_14	Örményes I.	19,16	0,07		0,65	0,78	0,78		0,53				**2,81**	0,02
15	SPU_15	Túrkevei-Kiserdei	112,56	0,33		0,10	0,59	0,67		0,46	0,60	0,35		**3,09**	0,12
16	SPU_16	Rákóczifalva-Szandai	24,20	0,00		0,21						0,00		**0,21**	0,00
17	SPU_17	Alcsi-Tenyő-Kengyeli	137,44	0,04		0,37	0,08	0,21			0,89	0,00		**1,59**	0,07
18	SPU_18	Fegyvernek-Büdöséri	81,07	0,05		0,15	0,04	0,11				1,49		**1,85**	0,05
19	SPU_19	Szajoli	111,03	0,07	0,87	0,07	0,10	0,26	1,21	0,49	1,40	1,16		**5,63**	0,21
20	SPU_20	Óballai	20,10	0,09		0,05	0,00	0,00		0,53		0,01		**0,69**	0,00
21	SPU_21	Németéri	57,44	0,39	2,11	0,29	0,89	0,81	0,78			0,23		**5,51**	0,11
22	SPU_22	Kungyalu I.	72,82	0,03		0,31	0,17	0,26		0,46		0,01		**1,24**	0,03
23	SPU_23	Cibakházi	88,31	0,00		0,18					1,40	0,72		**2,30**	0,07
24	SPU_24	Tőkefoki	99,57	0,03		0,10	0,03	0,06			0,94	0,01		**1,17**	0,04
25	SPU_25	Tóközei	41,46	0,02		0,61	0,00	0,00				0,13		**0,76**	0,01
26	SPU_26	Tiszaugi	19,87	0,02		0,12					1,50	0,03		**1,67**	0,01
27	SPU_27	Kungyalu II.	33,32			0,19	0,04	0,10						**0,32**	0,00
28	SPU_28	Tiszakürti	32,66			0,04					0,03	0,01		**0,08**	0,00

Table 6. Assessment of the effectiveness of the Expert 2. variant

4.3 Comparison of variants

The differences between the two variants static tool results are not significant, because mainly some agricultural measure intensity and thresholds values were changed, the types of measures remains.

Compared the results with valorisation map from FroGis (General needs of water retention) it can be concluded that these variants can reduce the need for water retention in particularly sensitive areas. Two exception are 64c, 64b, 63c, 62d SPU's, but these are smaller catchment where the planned agricultural measure intensity was smaller.
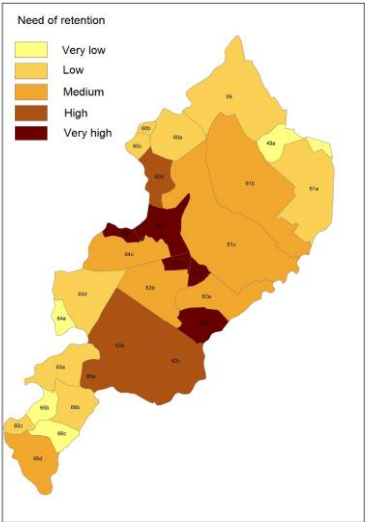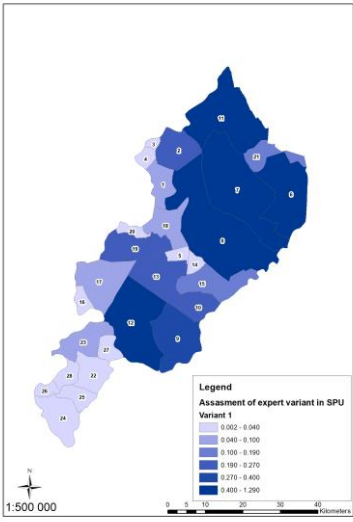

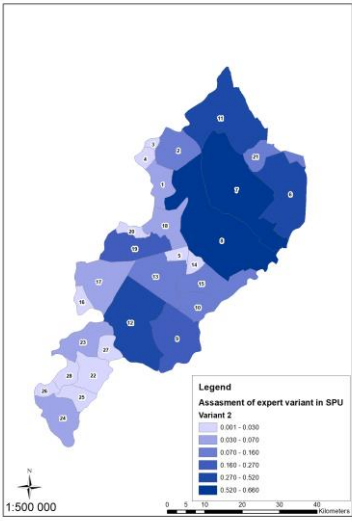| Figure 1 Valorisation result | Figure 2 StaticTool result Expert 1. version | Figure 3. StaticTool result Expert 2. version |

5. CONCLUSIONS

- The final rating value is highly influenced by the SPU surface area, so larger number of SPUs with the same surface area produces better results. However it would be difficult to divide the river basin even more.

- This tool is suitable for comparing variants, because there is no difficulty in interpreting the final scores,

- When comparing variants, use the same SPU layer so that the results correspond with each other,

- It is recommended to compare the effectiveness assessment map with the map of needs and possibilities of small water retention development, because than it is possible to additionally assess whether measures are planned where they are needed,

- StaticTool.xlsm is a good solution to enable the estimation of the effects of the implementation of a program of natural, small water retention measures (PoNSWRM) in a simplified way, which does not require the time-consuming and costly development of detailed hydrological or/and hydraulic models of the analysed area (catchment).

6. REFERENCES

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