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DEVELOPMENT OF A GEOGRAPHIC INFORMATION SYSTEM FOR ASSESSMENT OF SUITABLE AREAS FOR RUNOFF IRRIGATION

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Executive Summary

The main goal of the current project is to estimate the most favorable conditions for developing runoff irrigation which will result in increased grape yield and to develop the Geographic Information System for the assessment of the most suitable areas for runoff agriculture The specific objectives for the third year of the present research were to

1) To proceed the runoff harvesting experiments and data processing of these experiments
2) To calibrate the runoff-rainfall model KINEMAT for the experimental sites
3) To test the hydrologic similarity of the Sanzar and the Parkent sites
4) To collect data meteorological data for the period of 1975-1997 for development of the model of vineyard water consumption

In 1998 the runoff harvesting experiments were proceeded at 3 runoff plots in the experimental site in Bakhmazarsai river basin in the Bakhmal District of the Djizak Region (about 250 km south from Tashkent) Total rainfall and runoff volume, as well as intensity of these parameters were measured

Experimental data collected on the runoff plots were used for runoff-rainfall model calibration In the model the runoff plot was presented as a plane with a set of physical parameters (soil roughness, rainfall interception, depression storage capacity, soil moisture and porosity, hydraulic conductivity) and input data (rainfall) The model parameters were calibrated for one particular storm

Two experimental areas were chosen instead of one at the initial stages of the project The first one is situated in the region under research - the basin of the Sanzar river in the Bahmal District of the Djizak region (about 250 km south from Tashkent), and the second is situated in the basin of Parkentsai river (about 70 km east from Tashkent) The reason of it was the significant amount of meteorological, soils and geomorphologic data The experimental runoff harvesting initiated at the Parkentsai was interrupted in 1997 due to safety reasons Since we had only historical (1965-1970) rainfall-runoff data for the second area, we decided to continue runoff harvesting experiment only in Sanzar region

Vineyard irrigation experiment was an important component of our project We intended to determine the water consumption enabling the maximum yields But as a result of the local deteriorating conditions the irrigation experiment had not been carried out in 1997-98, and will not be carried out next year In order to overcome this serious limitation we decided to analyze available data of vineyard production and water consumption at Kolkhoz level for 1975-1997 The meteorological data for decade and month were collected They include the following parameters air temperature, relative air humidity, wind speed, atmospheric precipitation, number of the sunshine hours These data will be used for the development of the model of vineyard water consumption

Dr L Poberezhsky (Uzbekistan) visited Israel in February-March 1998, and November-December 1998 for discussions, reporting and further work coordination

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Section I

A Research Objectives

The main objectives of the third year of research were
1 To proceed the runoff harvesting experiments and data processing of these experiments
2 To calibrate the runoff-rainfall model KINEMAT for the experimental sites
3 To test the hydrologic similarity of the Sanzar and the Parkent sites
4 To collect data meteorological data for the period of 1975-1997 for development of the model of vineyard water consumption

B Research Accomplishments

B 1 *Runoff harvesting experiment*

In 1998 the runoff harvesting experiments were proceeded at 3 runoff plots in the experimental site in Bakhmazarsai river basin in the Bakhmal District of the Djizak Region (about 250 km south from Tashkent) In addition to the measurements of total rainfall and runoff amount (by 18 events), the intensity of these parameters were measured for 9 events Intensity of the rainfall and runoff was measured as total amount during each five minutes (in daylight time) Processed data on field experiments are presented in Annex 1

B 2 To calibrate the runoff-rainfall model for the experimental sites

Experimental data collected at the runoff plots were used for runoff-rainfall model calibration The runoff plot was presented in the model as a plane with a set of physical parameters and input data (rainfall) The model parameters were calibrated for one particular storm 4 04 98 The storm duration was 45 min The measured rainfall amount was 4 9 mm The storm had one peak Model was calibrated with time step of 5 minutes The observed total discharge was 0 21 mm while the model value was 0 19

The calibrating process during which parameters were assigned to characterize the area included two major aspects the flow configuration of the runoff and elaboration of the physical parameters Only matching between two types of variables revealed the final calibrated model that fitted better of the observed hydrographs

Soil roughness Initial values for roughness were obtained from literature sources adapted to specific local soil characteristics The final specific value was then slightly modified during the calibration procedure within the range recommended in literature

Rainfall interception Data on rainfall interception by different types of vegetation are appended in Annex 2

Depression storage capacity RECS parameter is the average effective depth of water flowing through the micro-depressions over the slopes This parameter affects directly the rate of overland flow that continues to contribute to the stream channel after the

rainstorm is over (delayed discharge) In our model, since we dealt with colluvial hill slopes, this parameter was not necessary and attempts to introduce it during calibration stage showed very little and non-significant results In practice, its effect was carried out the parameters that control infiltration and length of the overland flow

Soil moisture and porosity Soil moisture in the model is presented as relative to saturation which is the relation between volumetric soil water content and maximum water capacity The maximum water content is measured as percent of porosity For the calibration procedure, the maximum soil water content was 95% of the total porosity Temporal and spatial data collected on soil moisture may serve only an indicator for the real soil moisture prevailing for the specific rain showers that produce the runoff As already mentioned, the model accept soil moisture as percent of porosity, however, during the event the porosity changes sufficiently as soil crust is formed Porosity values measured in undistributed soil over the experimental sites varied from 44% to 54%

In spite of runoff presenting as a sheet flow, in reality it was observed that hillslope overland flows concentrate into small streams Runoff concentrating in small streams increases infiltration along the streambed After the rain ceased, soil moisture decreases due to percolation and evaporation Subsurface gravimetric percolation under the crust drains toward the lower hillslope into the streams increasing the moisture content in streambeds Therefore, in-between rains, streambeds are relatively wet that the colluvial hillslopes due to higher storage and water capillary movement towards surface As a result, effective soil moisture for such modeling conditions is most likely the soil moisture as measured in small streambed

Hydraulic conductivity In the model, hydraulic conductivity values are used as for homogeneous soil

B 3 To test the hydrologic similarity of the Sanzar and the Parkent sites

Two experimental areas were chosen instead of one at the initial stages of the project The first one is situated in the region under research - the basin of the Sanzar river in the Bahmal District of the Djizak region (about 250 km south from Tashkent), and the second one is situated in the basin of Parkentsai river (about 70 km east from Tashkent)

The reason to chose the second area was a great amount of detailed data on meteorological parameters, soils and geomorphology It was assumed then that these two areas could be considered as analogs To test the similarity of these two sites the geographic and geomorphologic characteristics were analyzed The following features were included in the scope of the analyses

- mezo- and micro-relief
- climate
- elevation
- aspect

The experimental runoff harvesting initiated at the Parkentsai were interrupted in 1997 due to safety reasons Since we had only historical (1965-70) rainfall and runoff

information and could not confirm it by the data of the present study, it was decided to concentrate all experimental efforts at the Sanzar River Basin Additionally to the existing small runoff plots (within the area of ~100 m^2), the watershed with a total area about 1 km^2 was chosen for further additional runoff experiment in order to obtain rainfall-runoff information in larger scale This additional experimental watershed is situated in the middle part of Bakhmazarsai River Basin near the exit of the river to the plain on the level between 1685 and 1290 m MSL (1 5 km to the south from the Mugal village)

B 4 To collect meteorological data for the period of 1975-1997

Vineyard irrigation experiment was an important component of our project We intended to determine the water consumption enabling the maximum yields This total amount of water would be then the target volume of runoff to be collected and thus allow the optimization of the watershed in terms of grape production As described in our previous annual report this trial could not be carried out in 1998 As a result of the local conditions the Uzbekistan partners will not be able to carry out irrigation experiment in the future

In order to overcome this serious limitation we decided to analyze available data of vineyard production and water consumption at Kolkhoz level for 1975- 1997 The major part of data has already been collected and is now being analyzed The Uzbekistan team is presently collecting the remaining data Concurrently the relevant meteorological data is being collected as well The latter will be used to estimate the potential evapotranspiration by the Penman method (ETP) We will be able to correlate the yield with the ratio of applied water/ETP

The data on water consumption is not the water actually used by vineyard but the amount of water supplied to the Kolkhoz, which means that conveyance losses are included in our figures Undoubtedly this will affect the results of our model and the distribution of runoff generating and receiving areas

The meteorological data for decade and month were collected on the following parameters air temperature, relative air humidity, wind speed, atmospheric precipitation, number of the sunshine hours These data will be used for the development of the model of vineyard water consumption

C Scientific Impact of Collaboration

The Israeli Principal Investigators developed the trials which had to be carried out in the target area They also provided equipment for experiments, computer program packages and scientific literature for the Uzbek team

The methodology of all experiments in the target country is developed by Israeli PIs with participation of the Uzbek partner

Dr Pobereshsky is responsible for collecting data and carrying out of routine observations in the experimental area

D Description of Project Impact

During three years collaboration with Israeli group the Uzbek team members gained experience in runoff harvesting techniques application, computer technology of data proceeding, using of GIS software and hardware (digitizing device)

E Strengthening of the Developing Country Institution

The Uzbek team was provided with necessary equipment and computer programs for creating of GIS based models as well as rainfall-runoff models All equipment and programs were installed in Tashkent

F Future work

The plan for the forth year of the project includes the additional field runoff experiment, development of the model of vineyard water consumption, completing of GIS development

Section II

A Managerial Issues

As it was mentioned above, the main problem remains that the vineyard irrigation experiment cannot be carried out

B Budget

No changes

C Special Concerns

None

D Collaboration, Travel, Training and Publications

Dr L Poberezhsky (Uzbekistan) visited Israel in February-March 1998, and November-December 1998 for discussions, reporting about the field experiments, and coordination of the future plans

E Request for A I D or BOSTID Actions

The no-cost extension of the project was requested by the Principal Investigators in October 1998, and the positive answer was received

Annex 1

Results of the field experiment in Bakhmazarsai River Basin, 1998

Plot 1

Date	Rainfall, mm	Runoff, mm	Runoff Coefficient
28 3 98	4 7	0 17	0 036
3 4 98	9 1	0 485	0 053
4 4 98	4 9	0 211	0 043
8 4 98	17 1	1 088	0 063
10 4 98	7 2	0 221	0 031
11 4 98	5 1	0 214	0 042
15 4 98	34 3	0 691	0 02
16 4 98	19 8	0 139	0 007
19 4 98	27 4	1 097	0 4
21 4 98	47 5	1 513	0 032
30 4 98	3 9	0 119	0 03
5 5 98	7 9	0 65	0 082
6 5 98	18	1 095	0 06
8 5 98	13 5	0 27	0 02
15 5 98	38 3	1 78	0 046
16 5 98	6 9	0 32	0 046
26 5 98	11	0 211	0 019
11 6 98	3 8	0 117	0 031

Plot 2

Date	Rainfall, mm	Runoff, mm	Runoff Coefficient
28 3 98	4 7	0 32	0 068
3 4 98	9 1	0 6	0 066
4 4 98	4 9	0 275	0 056
8 4 98	17 1	0 9	0 053
10 4 98	7 2	0 205	0 028
11 4 98	5 1	0 211	0 041
15 4 98	34 3	0 799	0 023
16 4 98	19 8	0 209	0 01
19 4 98	27 4	1 29	0 047
21 4 98	47 5	1 69	0 036
30 4 98	3 9	0 13	0 033
5 5 98	7 9	0 8	0 101
6 5 98	18	1 16	0 064
8 5 98	13 5	0 38	0 028
15 5 98	38 3	1 865	0 049
16 5 98	6 9	0 445	0 064
26 5 98	11	0 325	0 029
11 6 98	3 8	0 119	0 031

Plot 3

Date	Rainfall, mm	Runoff, mm	Runoff Coefficient
28 3 98	4 7	0 27	0 057
3 4 98	9 1	0 52	0 057
4 4 98	4 9	0 2	0 041
8 4 98	17 1	1 111	0 065
10 4 98	7 2	0 2	0 028
11 4 98	5 1	0 2	0 039
15 4 98	34 3	0 75	0 022
16 4 98	19 8	0 22	0 011
19 4 98	27 4	1 1	0 04
21 4 98	47 5	1 5	0 032
30 4 98	3 9	0 12	0 031
5 5 98	7 9	0 7	0 089
6 5 98	18	1 118	0 062
8 5 98	13 5	0 3	0 022
15 5 98	38 3	1 87	0 049
16 5 98	6 9	0 4	0 058
26 5 98	11	0 2	0 018
11 6 98	3 8	0 12	0 032

Rainfall-runoff intensity, Bakhmazarsai runoff plots, 1998

Plot 1

Date	Time		Rainfall		Runoff	
	hour	min	mm	mm/min	mm	runoff coef
4 4 98	9	35	0 2	0 04	0	
		40	0 1	0 02	0	
		45	0 1	0 02	0	
		50	0 8	0 16	0 01	0 012
		55	1 4	0 28	0 06	0 043
	10	0	1 6	0 32	0 11	0 069
		5	0 4	0 08	0 03	0 075
		10	0 1	0 02	0	
		15	0 1	0 02	0	
		20	0 1	0 02	0	
8 4 98	11	5	0 2	0 04	0	
		10	0 1	0 02	0	
		15	1 4	0 28	0 05	0 036
		20	1 4	0 28	0 08	0 06
		25	2 9	0 58	0 28	0 096
		30	1 4	0 28	0 45	0 336
		35	0 5	0 1	0 09	0 18
		40	0 3	0 06	0 03	0 1
		45	0 1	0 02	0 03	0 3
		50	0 3	0 06	0	
		55	0 5	0 1	0 01	0 02
	12	0	0 9	0 18	0 02	0 022
		5	1 9	0 38	0 09	0 047
		10	3 2	0 64	0 25	0 078
		15	0 5	0 1	0 03	0 06
		20	0 3	0 06	0 01	0 033
		25	0 3	0 06	0 01	0 033
		30	0 1	0 02	0	
		35	0 8	0 16	0 02	0 025
		40	0 1	0 02	0	
11 4 98	12	50	0 1	0 02	0	
		55	0 4	0 08	0 02	0 05
	13	0	2 2	0 44	0 29	0 132
		5	1 3	0 26	0 09	0 069
		10	0 3	0 06	0 02	0 067
		15	0 6	0 12	0 03	0 05
		20	0 1	0 02	0	
		25	0 1	0 02	0	
15 4 98	10	50	0		0	
		55	1 2	0 24	0 08	0 067
	11	0	2 9	0 58	0 38	0 131
		5	5 7	1 14	0 81	0 142
		10	4	0 8	0 8	0 2
		15	1 8	0 36	0 39	0 216
		20	0 8	0 16	0 06	0 075
		25	1 9	0 38	0 19	0 1
		30	6 9	1 38	1 5	0 217
		35	7 8	1 56	1 9	0 244
		40	1	0 2	0 11	0 11
		45	0 2	0 04	0 01	0 05
		50	0 1	0 02	0	

Rainfall-runoff intensity, Bakhmazarsai runoff plots, 1998

Plot 1

Date	Time		Rainfall		Runoff	
	hour	min	mm	mm/min	mm	runoff coef
16 4 98	16	20	0 1	0 02	0	
		25	1 1	0 22	0 05	0 045
		30	2 8	0 56	0 21	0 075
		35	3	0 6	0 35	0 117
		40	4 9	0 98	1 03	0 21
		45	2 7	0 54	0 6	0 222
		50	2	0 4	0 38	0 19
		55	1 8	0 36	0 21	0 116
	17	0	0 7	0 14	0 03	0 043
		5	0 5	0 1	0 01	0 02
		10	0 2	0 04	0	
19 4 98	8	40	0 1	0 02	0	
		45	1 9	0 38	0 12	0 063
		50	3 5	0 7	0 95	0 271
		55	4 1	0 82	1 05	0 256
	9	0	3 8	0 76	0 9	0 237
		5	2 1	0 42	0 32	0 152
		10	0 4	0 08	0 03	0 075
		15	0 1	0 02	0	
		20	0 1	0 02	0	
		25	0 1	0 02	0	
		30	2 3	0 46	0 15	0 065
		35	3 8	0 76	0 8	0 21
		40	4 9	0 98	1 21	0 246
		45	0 1	0 02	0 01	0 1
		50	0 1	0 02	0	
21 4 98	7	10	0 1	0 02	0	
		15	0 8	0 16	0 03	0 037
		20	3 8	0 76	0 21	0 055
		25	5 4	1 08	1 15	0 213
		30	0 8	0 16	0 07	0 088
		35	0 6	0 12	0 03	0 05
		40	0 4	0 08	0 02	0 05
		45	2 6	0 52	0 17	0 065
		50	7	1 4	1 65	0 236
		55	8 2	1 64	2 61	0 318
	8	0	7 8	1 56	2 9	0 372
		5	4	0 8	1 05	0 262
		10	3	0 6	0 4	0 133
		15	2 6	0 52	0 25	0 096
		20	0 2	0 04	0 01	0 05
		25	0 1	0 02	0	
		30	0 1	0 02	0	

Rainfall-runoff intensity, Bakhmazarsai runoff plots, 1998

Plot 1

Date	Time		Rainfall		Runoff	
	hour	min	mm	mm/min	mm	runoff coef
5 5 98	7	55	0 1	0 02	0	
	8	0	0 1	0 02	0	
		5	0 1	0 02	0	
		10	0 4	0 08	0 02	0 05
		15	1 9	0 38	0 12	0 063
		20	2 8	0 56	0 2	0 071
		25	1 5	0 3	0 09	0 06
		30	0 5	0 1	0 02	0 04
		35	0 3	0 06	0 01	0 03
		40	0 1	0 02	0	
		45	0 1	0 02	0	
15 5 98	13	20	0 01	0 02	0	
		25	0 01	0 02	0	
		30	0 3	0 06	0 01	0 033
		35	0 8	0 16	0 03	0 038
		40	2 8	0 56	0 19	0 068
		45	5 5	1 1	1 25	0 227
		50	8	1 6	2 25	0 281
		55	6 6	1 32	1 51	0 228
	14	0	5	1	1 02	0 204
		5	0 9	0 18	0 08	0 088
		10	0 1	0 02	0	
		15	0 1	0 02	0	
		20	3 4	0 68	0 15	0 044
		25	2 9	0 58	0 13	0 045
		30	1 4	0 28	0 08	0 057
		35	0 1	0 02	0	
		40	0 1	0 02	0	
		45	0 1	0 02	0	

Annex 2

Interception of atmospheric precipitation by the crown of walnut

Date	Rain-gauges readings, mm				Interception	
	No 1	No 2	Average	No 3	Absolute,mm	Relative, %
1	2	3	4	5	6	7
20 IV 97	7 8	7 9	7 8	8 4	0 6	7 1
23 IV 97	16 7	16 9	16 8	17 3	0 5	2 9
24 IV 97	15 6	16	15 8	16 1	0 3	1 9
25 IV 97	2 9	3 0	3 0	3 2	0 2	6 2
2 V 97	4 1	4 3	4 2	5	0 8	16
3 V 97	20 5	20 6	20 6	21	0 4	1 9
5 V 97	3 9	4 4	4 2	5	0 8	16
9 V 97	0 8	1 0	0 9	1 9	1 0	52 6
13 V 97	32 4	33 0	32 7	34 9	2 2	6 3
14 V 97	12 2	12 4	12 3	13 4	1 1	8 2
17 V 97	1 6	2 0	1 8	3 0	1 2	40
19 V 97	9 4	9 5	9 4	11 5	2 1	18 2
20 V 97	4 8	5 0	4 9	6 2	1 3	21
27 V 97	2 2	2 2	2 2	3 4	1 2	35 3
2 VI 97	5 7	5 6	5 6	7 2	1 6	22 2
7 VI 97	1 6	1 8	1 7	3 0	1 3	43 3
9 VI 97	6 1	6 1	6 1	7 1	1 0	14 1
16 VI 97	0 8	1 0	0 9	1 8	0 9	50
17 VI 97	7 9	8 0	8 0	9 9	1 9	19 2
18 VI 97	38 8	39 8	39 3	40 2	0 9	2 2
19 VI 97	4 2	4 6	4 4	4 6	0 2	4 3
20 VI 97	23 1	23 5	23 3	25 7	2 4	9 3
23 VI 97	18 0	18 8	18 4	20 4	2 0	9 8
27 VI 97	4 9	5 0	5 0	6 2	1 2	19 3
28 VI 97	5 3	5 5	5 4	6 7	1 3	19 4
1 VII 97	2 4	2 8	2 6	3 6	1 0	27 8
2 VII 97	1 0	1 2	1 1	2 4	1 3	54 2
7 VII 97	4 0	4 2	4 1	5 3	1 2	22 6
13 VII 97	6 1	6 5	6 3	8 4	2 1	25
14 VII 97	7 3	7 9	7 6	8 4	0 8	9 5
15 VII 97	3 3	3 3	3 3	4 6	1 3	28 2
16 VII 97	10 0	10 4	10 2	11 3	1 1	9 7
19 VII 97	9 5	9 6	9 6	10 8	1 2	11 1
27 VII 97	24 0	25 2	24 6	27	2 4	8 9
28 VII 97	9 6	9 8	9 7	10 7	1 0	9 3
30 VII 97	2 8	3 0	2 9	4 2	1 3	30 9
31 VII 97	2 0	2 6	2 3	3 8	1 5	39 5
1 VIII 97	1 4	1 6	1 5	2 7	1 2	44 4
5 VIII 97	0 0	0 0	0 0	0 2	0 2	100
9 VIII 97	0 0	0 0	0 0	0 2	0 2	100
10 VIII 97	0 6	0 6	0 6	1 8	1 2	66 7
25 VIII 97	0 0	0 0	0 0	1 0	1 0	100
26 VIII 97	0 0	0 0	0 0	0 7	0 7	100
29 VIII 97	5 9	6 1	6 0	7 1	1 1	15 5
3 IX 97	3 9	4 3	4 1	5 2	1 1	21 1
14 IX 97	3 0	3 1	3 0	4 0	1 0	25
29 IX 97	0 0	0 0	0 0	0 6	0 6	100
30 IX 97	1 1	1 1	1 1	2 2	1 1	50
Total	349 2	361 2	355 3	409 3	54 0	

Annex 2

Interception of atmospheric precipitation by the crown of *Juniperus seravchanica* Kom

Date	Rain-gauges readings,mm					Interception, mm					
	No 1	No 2	No 3	No 4	No 5	No 1	No 2	No 3	No 4	Average	
										abs ,mm	rel , %
1	2	3	4	5	6	7	8	9	10	11	12
Separately growing tree											
5 IV 97	0 9	1 6	2 3	5 5		4 6	3 9	3 2		3 9	7 1
7 IV 97	1 7	2 5	2 9	5 9		4 2	3 4	3 0		3 5	59 3
9 IV 97	0 0	0 0	0 0	0 3		0 3	0 3	0 3		0 3	100
14 IV 97	25 0	26 4	26 9	30 0		5 0	3 6	3 1		3 9	13 0
15 IV 97	0 0	0 0	0 0	0 1		0 1	0 1	0 1		0 1	100
16 IV 97	1 2	1 5	1 9	4 9		3 7	3 4	3 0		3 3	67 9
21 IV 97	0 0	0 0	0 0	0 2		0 2	0 2	0 2		0 2	100
22 IV 97	11 6	11 8	12 3	15 6		4 0	3 8	3 3		3 7	23 7
23 IV 97	4 1	4 6	4 8	7 9		3 8	3 3	3 1		3 4	43 0
24 IV 97	5 5	6 1	6 5	9 7		4 2	3 6	3 2		3 7	38 1
6 V 97	22 1	22 8	23 8	26 8		4 7	4 0	3 0		3 9	14 5
20 V 97	6 1	6 7	7 0	10 1		4 0	3 4	3 1		3 5	34 6
26 V 97	0 0	0 0	0 0	1 1		1 1	1 1	1 1		1 1	100
12 VI 97	0 0	0 0	0 0	1 2		1 2	1 2	1 2		1 2	100
21 VI 97	0 0	0 0	0 0	3 0		3 0	3 0	3 0		3 0	100
2 VII 97	23 4	24 2	24 0	27 4		4 0	3 2	3 0		3 4	12 4
8 VII 97	0 0	0 0	0 0	0 2		0 2	0 2	0 2		0 2	100
9 VII 97	0 0	0 0	0 0	1 4		1 4	1 4	1 4		1 4	100
Total	101 6	108 2	112 4	151 3		49 7	43 1	38 5		43 7	
Average						4 2	3 6	3 1		3 6	
The tree in the grove											
16 IV 97	0 0	0 0	0 0	0 0	2 8	2 8	2 8	2 8	2 8	2 8	100
22 IV 97	10 5	11 4	12 5	12 5	15 5	5 0	4 1	3 0	3 0	3 8	2 4
23 IV 97	17 1	17 2	18 8	19 0	21 9	4 8	4 7	3 1	2 9	3 9	2 0
24 IV 97	11 0	10 9	12 9	12 8	15 9	4 9	5 0	3 0	3 1	4 0	2 5
6 V 97	24 7	25 1	26 1	26 1	29 1	4 4	4 0	3 0	3 0	3 6	1 2
20 V 97	7 3	7 2	8 4	8 5	11 5	4 2	4 3	3 1	3 0	3 5	30 0
26 V 97	0 0	0 0	0 0	0 0	1 0	1 0	1 0	1 0	1 0	1 0	100
12 VI 97	0 0	0 0	0 0	0 0	1 1	1 1	1 1	1 1	1 1	1 1	100
13 VI 97	0 0	0 0	0 0	0 0	1 0	1 0	1 0	1 0	1 0	1 0	100
21 VI 97	0 0	0 0	0 0	0 0	3 0	3 0	3 0	3 0	3 0	3 0	100
2 VII 97	8 5	9 5	10 3	10 6	13 5	5 0	4 0	3 2	2 9	3 8	28 0
8 VII 97	0 0	0 0	0 0	0 0	0 6	0 6	0 6	0 6	0 6	0 6	100
9 VII 97	0 0	0 0	0 0	0 0	2 1	2 1	2 1	2 1	2 1	2 1	100
Total	79 1	81 3	89 0	89 5	119 0	39 9	37 7	30 0	29 5	34 2	
Average						4 7	4 3	3 1	3 0	3 8	

Annex 2

Interception of atmospheric precipitation by grassy vegetation
in the phase of spiking-florescence

Vegetation species	Interception of precipitation with amount, mm												
	0 5		1 0		3 0		5 0		10 0		20 0		Average
	mm	%	mm	%	mm	%	mm	%	mm	%	mm	%	abs mm
Astragalus arenarius	0 5	100	0 7	70	0 8	27	0 6	12	0 7	7	0 7	3	0 7
Artemisia vulagris L	0 3	60	0 5	50	0 4	13	0 3	6	0 4	4	0 5	2	0 4
Artemisia absinthium L	0 5	100	0 4	40	0 6	20	0 4	8	0 6	6	0 5	2	0 5
Artemisia sieversiana	0 3	60	0 3	30	0 4	13	0 2	4	0 3	3	0 3	1	0 3
Prangos pabularia Linde	0 5	100	0 9	90	1 1	37	0 9	18	1 1	11	1 0	5	1 0
Vicia unijuda A Br	0 3	60	0 4	40	0 4	13	0 2	4	0 3	3	0 3	1	0 3
Triticum	0 5	100	0 4	40	0 6	20	0 4	8	0 6	6	0 5	2	0 5
Distamnus albus L	0 1	20	0 1	10	0 2	7	0 1	2	0 1	1	0 2	1	0 1
Zindelofia	0 5	100	0 5	50	0 7	23	0 6	12	0 6	6	0 6	3	0 6