

1	Introduction.....	5
1.1	Challenges for the management of water resources.....	7
1.2	Project goals.....	8
1.3	Areas of investigation.....	9
2	Description of the models.....	11
2.1	The TRACE Model.....	13
2.1.1	Geometry.....	13
2.1.2	Numerical solution.....	14
2.1.3	Boundary conditions.....	14
2.1.4	Soil hydraulic properties.....	15
2.1.5	The plant module SUCROS.....	16
2.2	The GROWA Model.....	20
2.2.1	Plane unpaved sites with deep water tables.....	20
2.2.2	High relief terrains.....	22
2.2.3	Groundwater-affected sites.....	23
2.2.4	Urban regions.....	25
2.2.5	Deriving the groundwater recharge.....	27
2.2.6	Determining the BFI values from gauge data.....	27
2.2.7	Identification of runoff-effective site conditions.....	29
2.2.8	Attribution of area-differentiated BFI values.....	31
3	Data preparation and regionalization.....	35
3.1	Microscale.....	37
3.1.1	Material and Methods.....	37
3.1.2	Results.....	40
3.2	Macroscale.....	45
3.2.1	Climatic data bases.....	46
3.2.2	Landcover data.....	51
3.2.3	Soil data.....	55
3.2.4	Hydrogeological data base.....	66
3.2.5	Topographic data.....	71
3.2.6	Discharge data.....	74

4	Model results.....	77
4.1	Microscale	79
4.2	Macroscale.....	81
4.2.1	<i>Actual evapotranspiration.....</i>	83
4.2.2	<i>Total runoff.....</i>	86
4.2.3	<i>Groundwater recharge</i>	88
4.2.4	<i>Direct runoff.....</i>	91
4.2.5	<i>Predominating runoff components</i>	94
5	Model Validation	97
5.1	Microscale	99
5.1.1	<i>Measurements and model input</i>	99
5.1.2	<i>Lysimeter experiment</i>	101
5.1.3	<i>Field experiment.....</i>	105
5.2	Macroscale.....	106
5.2.1	<i>Total runoff.....</i>	110
5.2.2	<i>Groundwater recharge and direct runoff.....</i>	111
5.3	Analysis of scale effects	114
5.3.1	<i>Procedure.....</i>	114
5.3.2	<i>Results</i>	115
6	Disaggregation of nutrient balances.....	121
6.1	Introduction and Objectives	123
6.2	Database.....	123
6.3	Image Processing.....	124
6.3.1	<i>Preprocessing</i>	124
6.3.2	<i>Classification</i>	126
6.3.3	<i>Accuracy assessment and classification results.....</i>	131
6.3.4	<i>Disaggregation</i>	135
6.4	Conclusion.....	138
7	Summary	141
8	References	147