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D.T1.3.1 Technical Training Manual on Urban Circular Water Management for Municipalities

fbr, Association for Rainwater Harvesting and Water Utilisation

MODULE 5: DECISION-MAKING TOOL

- Why an economic study to assess rainwater management measures?
- Non-monetary assessment
- Monetary assessment
- Comparison of 3 variants for the selection of a rainwater management measure (Worksheet 1 – 6)
- Presentation of results
- Conclusions

ECONOMIC STUDY

Background

- In the field of rainwater management there exist different measuers and solutions which are diffiult to compare at a first glance. We should ask ourselves:
- Which measures/solutions come into question?
- Which measure/solution is environmentally compatible and economically viable?
- Which non-monetary criteria are relevant for the selected measure?
- Many decisions for or against a rainwater management concept never undergo a transparent evaluation process
- Operating costs and non-monetary aspects are usually undervalued in comparison to investment costs
- The share of the water costs within the overall operating costs have been continuously increasing
- To reach a viable economical decision, it is necessary to consider and assess different possible solutions and alternatives with respect to their **costs** and **benefits**

ECONOMIC STUDY

When should the economic study be conducted?

As early as possible, usually during the pre-planning stage

Who conducts the economic study?

Engineers, planners, architects within the scope of the planning contract

Recommended approach for the economic study

- Define and set goals in advance
- Compare different variants with similar benefits
- Consider both **monetary** (cost factor) and **non-monetary** goals (benefits)
- Whether monetary and non-monetary goals should be weighted equally (50%:50%) is the decision of the client/contracting authority

NON-MONETARY GOALS

1. Non-monetary goals (set by client/contracting authority)

Can be defined as ecological/environmental or social goals related to project:

e.g. maximal rainwater retention, savings in drinking water, promoting biodiversity, improving local microclimate, water and soil protection, local employment, environmental education, …

- Which goals should be included in the assessment?
- How should the non-monetary goals be weighted?

→ Assessement based on the **benefit analysis** **method**.

„BENEFIT ANALYSIS“ METHOD

- A flexible target system
- Allows adjustment to a large number of special requirements
- Allows a direct camparability of the different alternatives
- Identifies the non-monetary benefits and provides a basis for the weighing and decision process
- Disadvantage: additional time requirement
- Uncertainities: main difficulty lies in the subjectivity of weighting

MONETARY GOALS

2. Monetary goals:

- Set the period under review (e.g. 30 years)
- Interest and price development (is given or recommended)
- Temporal assessment of expenses and revenues (performed by planer)

➡ Calculations based on the **Net Present Value (NPV)** method

➡ **Monetary and non-monetary goals should be equally evaluated!**

„NET PRESENT VALUE (NPV)“ METHOD

- Is a dynamic method which takes into account the temporal variations in costs and expenditures
- A simple mathematical tool which allows an easy interpretability, since the net present value is expressed in monetary units (absolute result)
- Disadvantage: Due to the simple calculation and interpretability, there is a risk of using the results uncommented
- Uncertainities: the calculated interest rate, which is based on a subjective assumption and anticipated future payment flows

WORKSHEET 1:

Non-monetary assessment based on the benefit analysis

Comparison of Variants for rainwater management measures			
Object:			
1	1. Non-monetary project goals		
2	**Urban ecological goals**	Weighting [%]	**Partial criteria**
3	RW Retention on site	20	The amount of rainwater remaining on site is roughly estimated and automatically evaluated based on the planning data
4	Improvement of the micro-climate through evaporation	5	The amount of rainwater which is evaporated on site is roughly estimated and automatically evaluated based on the planning data
5	Careful use of water resources	20	The amount of rainwater which is reused as service water on site is roughly estimated and automatically evaluated based on the planning data
6	Soil protection/ land use	10	Land use is not restricted by rainwater management
			No acumulation of pollutants in the soil
7	Pollutant retention and water quality of receiving water bodies	10	No heavy metals input from roof surfaces
			Abandon using fertilisers for green roofs
			Retention measures for rainwater runoffs from traffic surfaces
8	Social sustainability	5	Acceptance by resident
			Comfort
			Safety (maintenance / monitoring)
			Employment
9	Visualisation of the water cycle/educational sustainability	30	Use of water becomes visible
			Drinking water and service water consumption are shown
			Precipitation data is shown
			Information on system
10		**100%**	

WORKSHEET 2:

Collection of property data (here only an extract)

- Property is in a water protection area?
- Connection to existing sewer or direct discharge possible?
- Soil data:
  - Highest groundwater level?
  - Permeability?
  - Contaminated sites?
  - Market value?

- Data on all drainage surfaces within the planning area?

- Data on property use:
  - Number of persons?
  - Water demand?
  - Water prices (drinking water, wastewater, rainwater fees)?

WORKSHEET 3:

Site assessment – Variants pre-selection

- Estimation of the yearly amount of rainwater generated
- Estimation of the service water demand (indoors, outdoors)
- Estimation of the possibilities of evaporation (green roofs, open water bodies, open spaces, facade greening)
- Estimation of the possibilities of rainwater infiltration (data: origin, k_f-value, groundwater level, contaminated sites, approval required under the exemption regulation?)

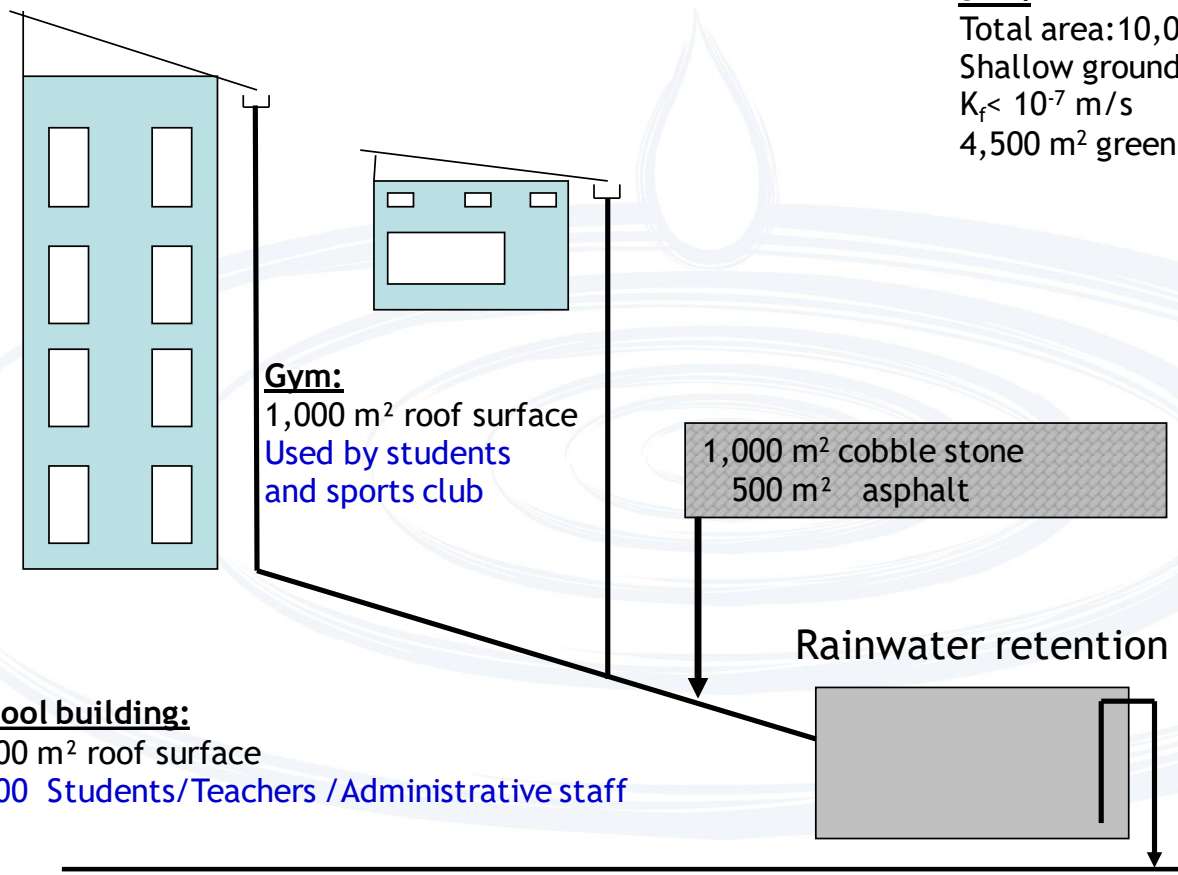
Selecting the site-specific variants for rainwater management

- Exclude (de-select) variants which do not apply (e.g. direct discharge is not possible due to abscence of a nearby water body or infiltarion due to a high groundwater table)
- Select the site-specific variants for a closer assessment
  Example:
- **Variant 1**: Throttled discharge into combined sewer
  Variant 2: Green roofs and throttled discharge into combined sewer
  Variant 3: Green roofs, rainwater harvesting, no discharge into combined sewer

VARIANT 1

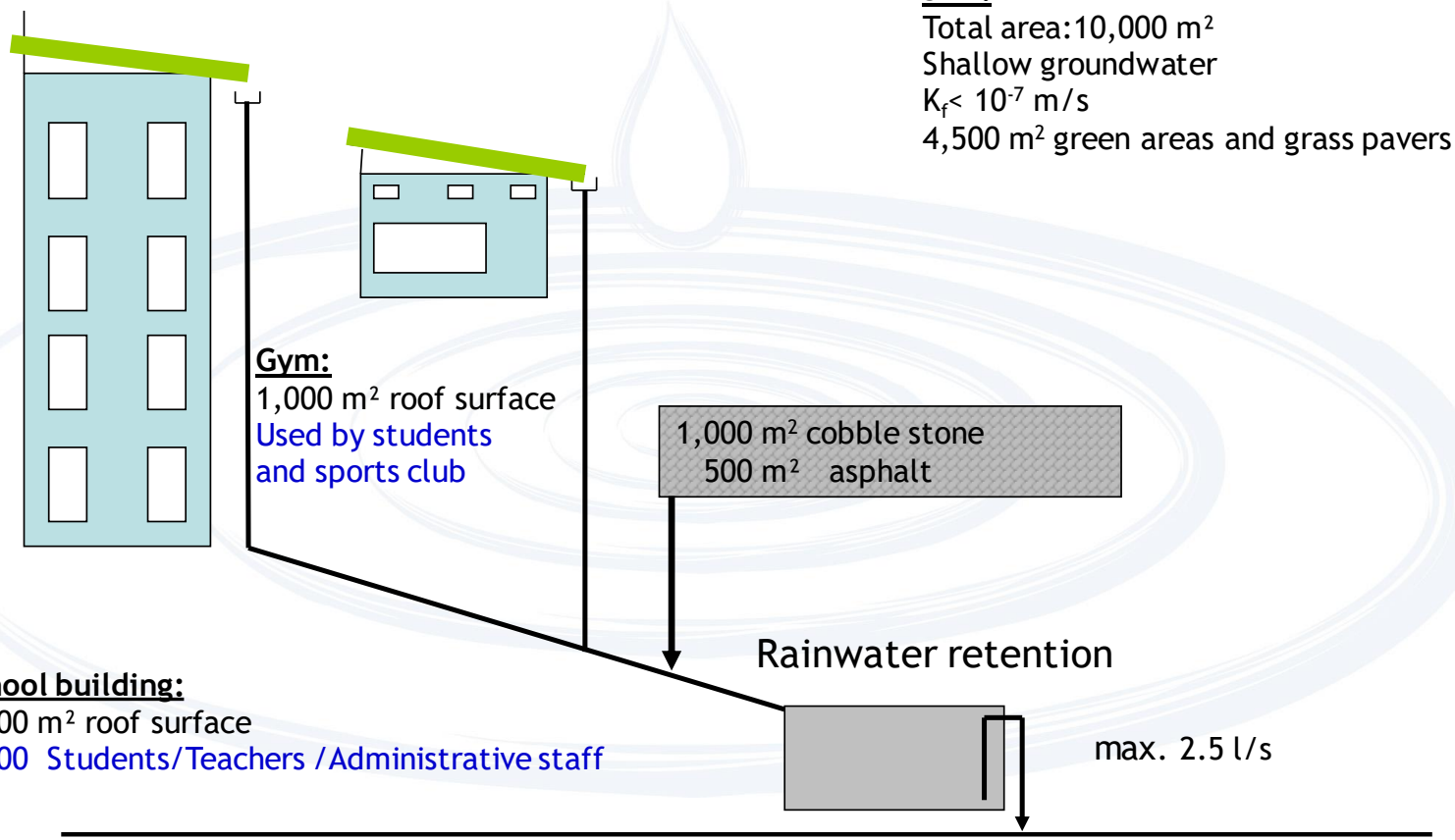
Variant 1: „Throttled discharge only“

Site:
Total area:10,000 m²
Shallow groundwater
$K_f < 10^{-7}$ m/s
4,500 m² green areas and grass pavers



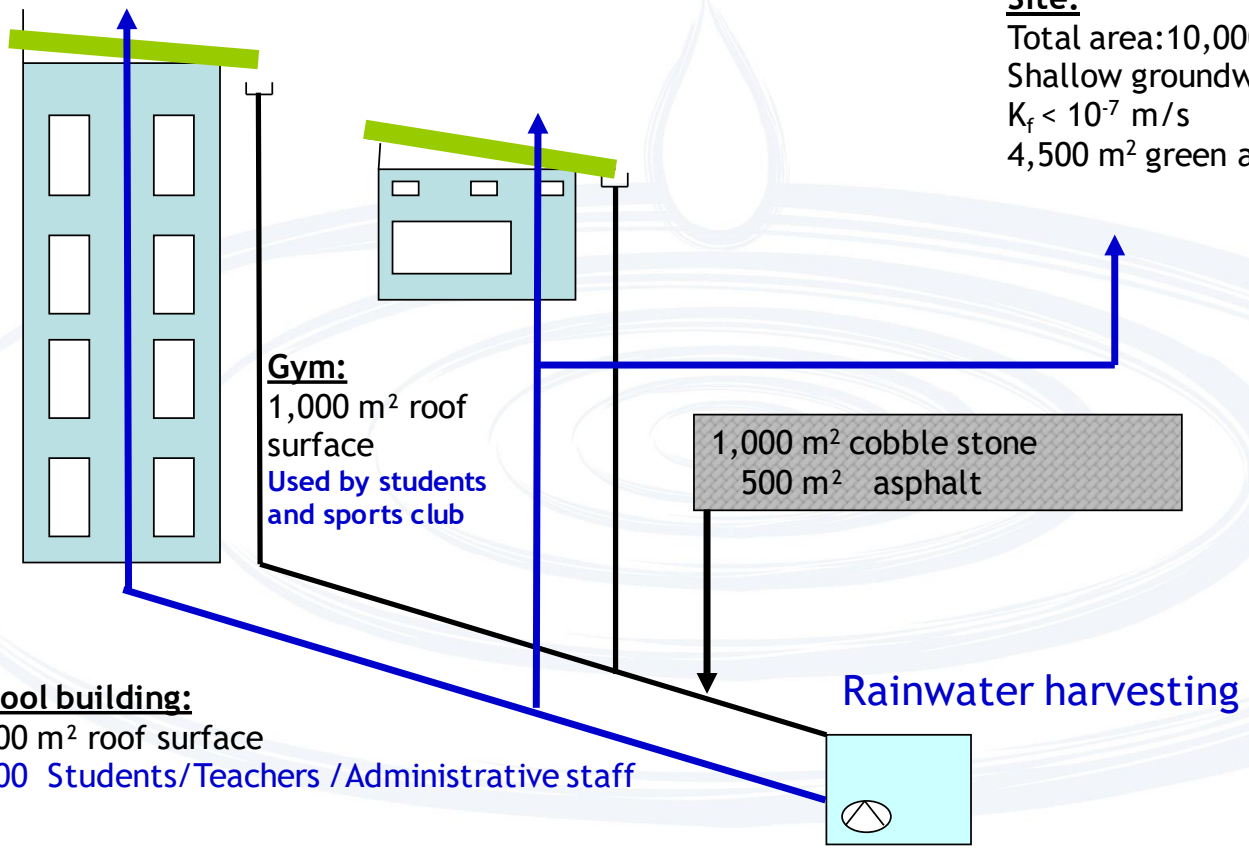
Variant 2: "Green roofs and throttled discharge"

Site:
Total area:10,000 m²
Shallow groundwater
$K_f < 10^{-7}$ m/s
4,500 m² green areas and grass pavers



VARIANT 3

Variant 3: „Green roofs with rainwater harvesting and no connection to sewer“



Site:
Total area:10,000 m²
Shallow groundwater
$K_f < 10^{-7}$ m/s
4,500 m² green areas and grass pavers

WORKSHEET 4:

Assessement of the single variants

- Rough estimation of the yearly amount of rainwater which evaporates, infiltrates or is reused as service water, or discharged unused into sewer

- **Costs estimation:**
  - Production costs
  - Maintenance and inspection costs
  - Energy costs
  - Fees
  - Savings/revenues
  - Reinvestment costs

- **Calculation of the total project costs for each single variant (monetary assessment)**

Monetary assessment (based on the NPV method)

Defining the framework conditions:

- Period under review: e.g. 30 years
- Interest rate used (For example: interest rate for 10 years of Federal bonds plus a substantial interest rate of 0.2 % (source: daily press) plus an additional interest rate for energy and water prices of, for example, 2%

Approach

- Collection of one-time revenues and expenses
- Collection of the current revenues and expenses
- All revenues and expenses are calculated separately taking into account the time factor and projected to the present time (present value)

MONETARY ASSESSMENT

Monetary assessment (based on the NPV method)

Interest rate used: 5%

Discount factor = 1/(1+p/100)n; Present value = Fair value x Discount factor

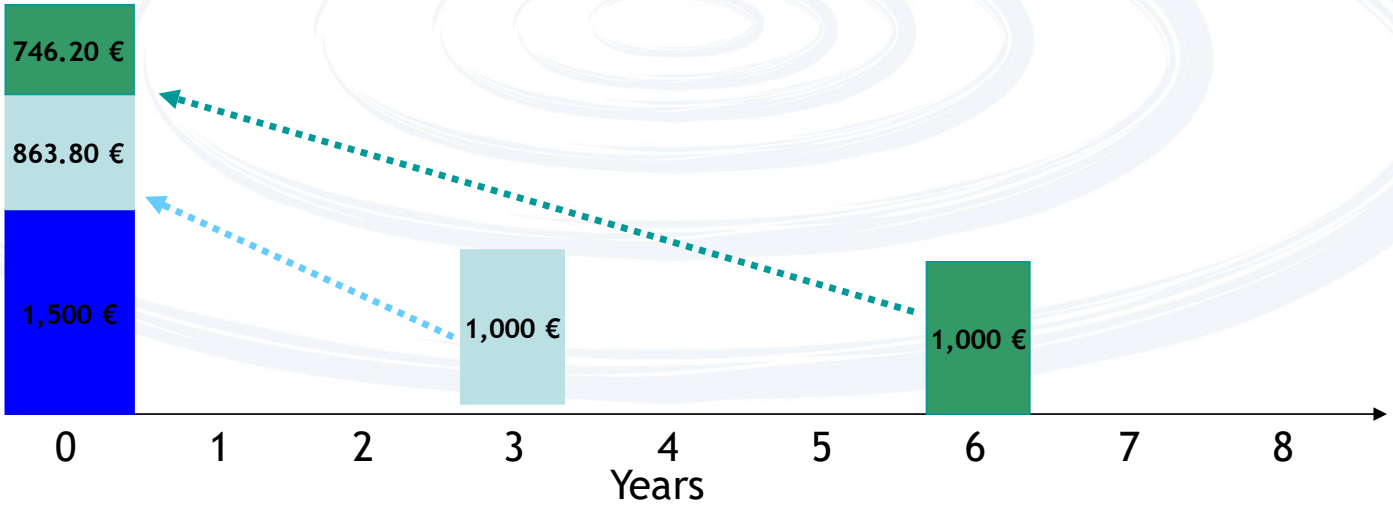
Investment at time zero is: 1,500.00 €

plus follow-up costs:

in 3 years 1,000 € x 0.8638 = 863.80 €

in 6 years 1,000 € x 0.7462 = 746.20 €

Total project costs: **3,110.00 €**



WORKSHEET 5:

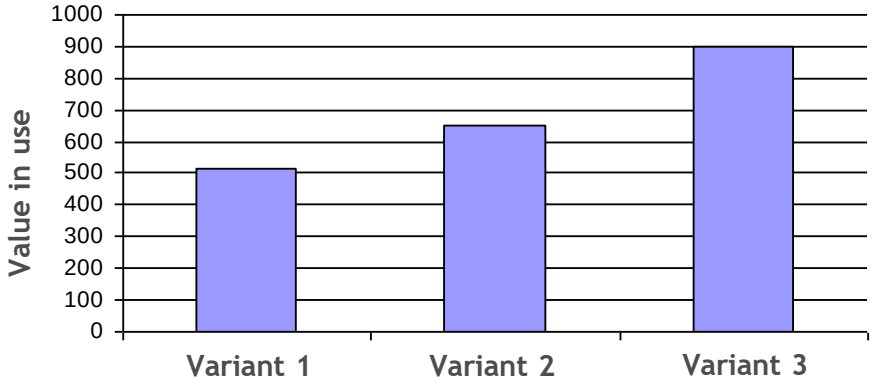
Non-monetary assessment (benefit analysis)

353	Non-monetary assessment based on the benefit analysis							
355	**Assessment criteria**	Weighting [%]	**Variant 1**		**Variant 2**		**Variant 3**	
356			Points	Part worth	Points	Part worth	Points	Part worth
357	Rainwater retention on site	20	**2.63**	53	**6.73**	135	**10**	200
358	Improvement of the micro-climate through evaporation	5	**1.4**	7	**5.36**	27	**5.36**	27
359	Careful use of water resources	20	**0**	0	**0**	0	**3.94**	79
360	Soil protection/Area use	10	**4**	40	**10**	100	**10**	100
361	Pollutant retention and water quality of receiving water bodies	10	**6.66**	67	**8.33**	83	**10**	100
362	Social sustainability	5	**7.5**	38	**8.75**	44	**8.75**	44
363	Visualisation of the water cycle/educational sustainability	30	**8.75**	263	**8.75**	263	**10**	300
364	**Σ Value in use**	**100%**		**517**		**651**		**900**

WORKSHEET 6:

Presentation of results

Non-monetary assessment



Monetary assessment

Variant	Investment costs [€]	Running costs [€]	Reinvestment [€]	Total project costs [€]
Variant 1 Throttled discharge into sew er	88,000	224,102.42	1,939.63	314,042.05
Variant 2 Throttled discharge and green roofs	100,500	170,229.43	1,939.63	272,669.07
Variant 3 Green roofs and rainw ater harvesting, no sew er connection	121,700	5,612.46	24,256.69	151,569.15

If necessary, conduct a susceptibility testing!

Decision-making (here on a purely mathematical basis)

Provided that non-monetary and monetary goals are equally assessed (50%:50%)

	Non-monetary assessment		Monetary assessment		Overall assessment
	%	Assessment points	€	Assessment points	
Variant 1	57	5.7	314,042.05	4.8	**10.5**
Variant 2	72	7.2	272,669.07	5.6	**12.8**
Variant 3	100	10	151,569.15	10	**20.0**

Decision:
Variant 1, with the lowest investment costs has the highest total project costs and the lowest score for the non-monetary assessment. It comes off worst in the total assessment.
Therefore, the choice is in favour of Variant 3.

CONCLUSIONS

Why is it beneficial to conduct an econmic study to select a rainwater management measure?

- With continuously increasing operating costs, one should not solely look at the investment costs of a project
- Due to the wide diversity of measures and technologies for rainwater management and the diferent site conditions, a generalised assessment of a single measure is usually not possible
- An economic study makes an optimised use of funds possible

CONCLUSIONS

The presented economic study (only an example):

- Does not take the decision away from any person, it rather helps in taking a decision
- It contributes to making decisions more transparent and resilient

Who benefits from the economic study?

- The client obtains better planning results, which would take more into account the follow-up costs, revenues and their timely onset
- The planer usually achieves higher planning fees with increasing investment costs