Technical Cooperation between
Germany and Afghanistan

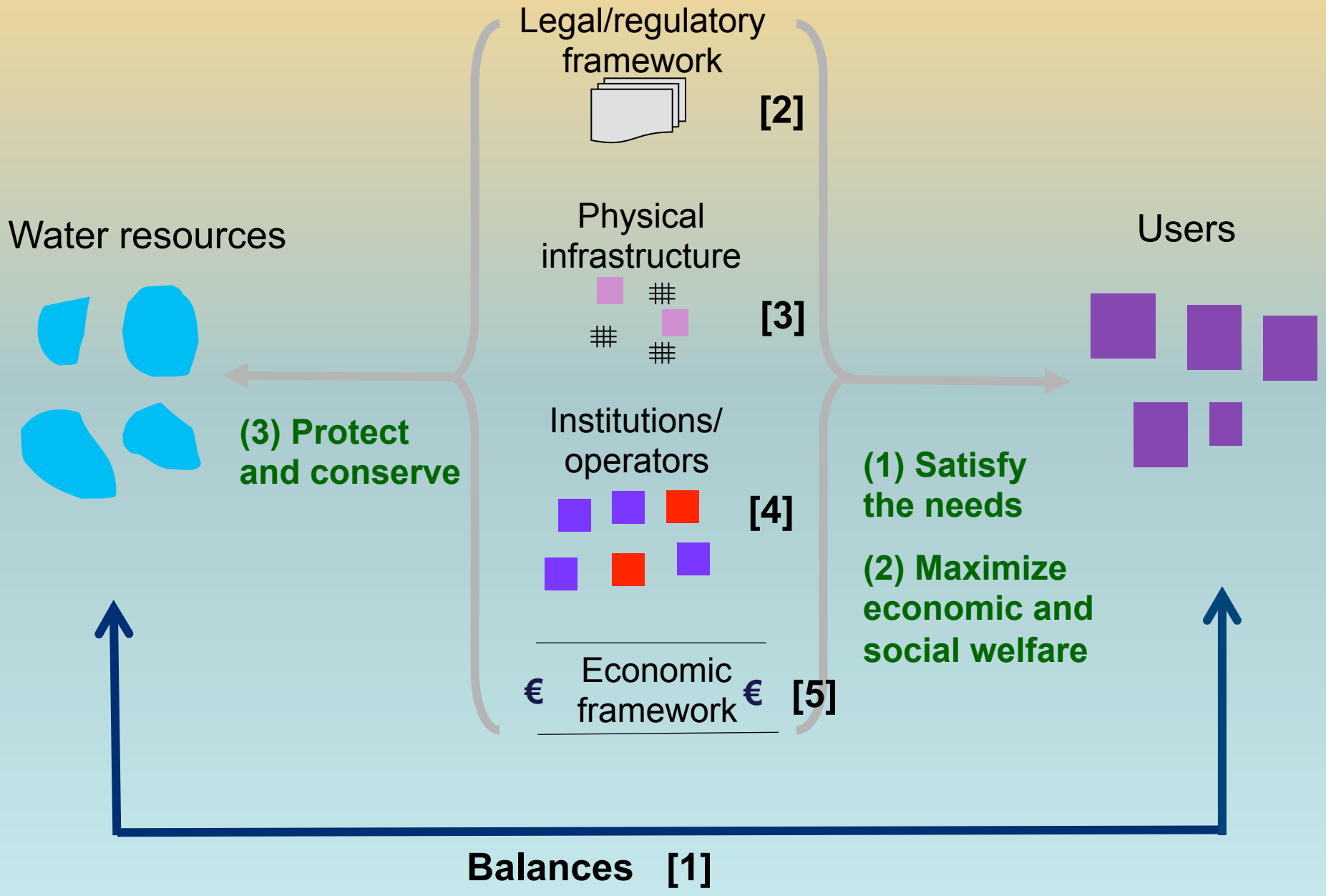
National Water Master Plan (NWMP)

Water Balances, Demand Scenarios and Long-term Investment Framework

Kabul, December 2013

Integrated Water Resources Management (IWRM) and National Water Master Plan (NWMP)

IWRM – a system view



The framework of IWRM

- ***Fundamental objectives:***
  (1) Cover the needs of the different user groups in quantity and quality (***rational utilisation***);
  (2) Maximize ***economic and social welfare***;
  (3) Assure the long term (quantitative and qualitative) protection of water resources (***sustainability***).

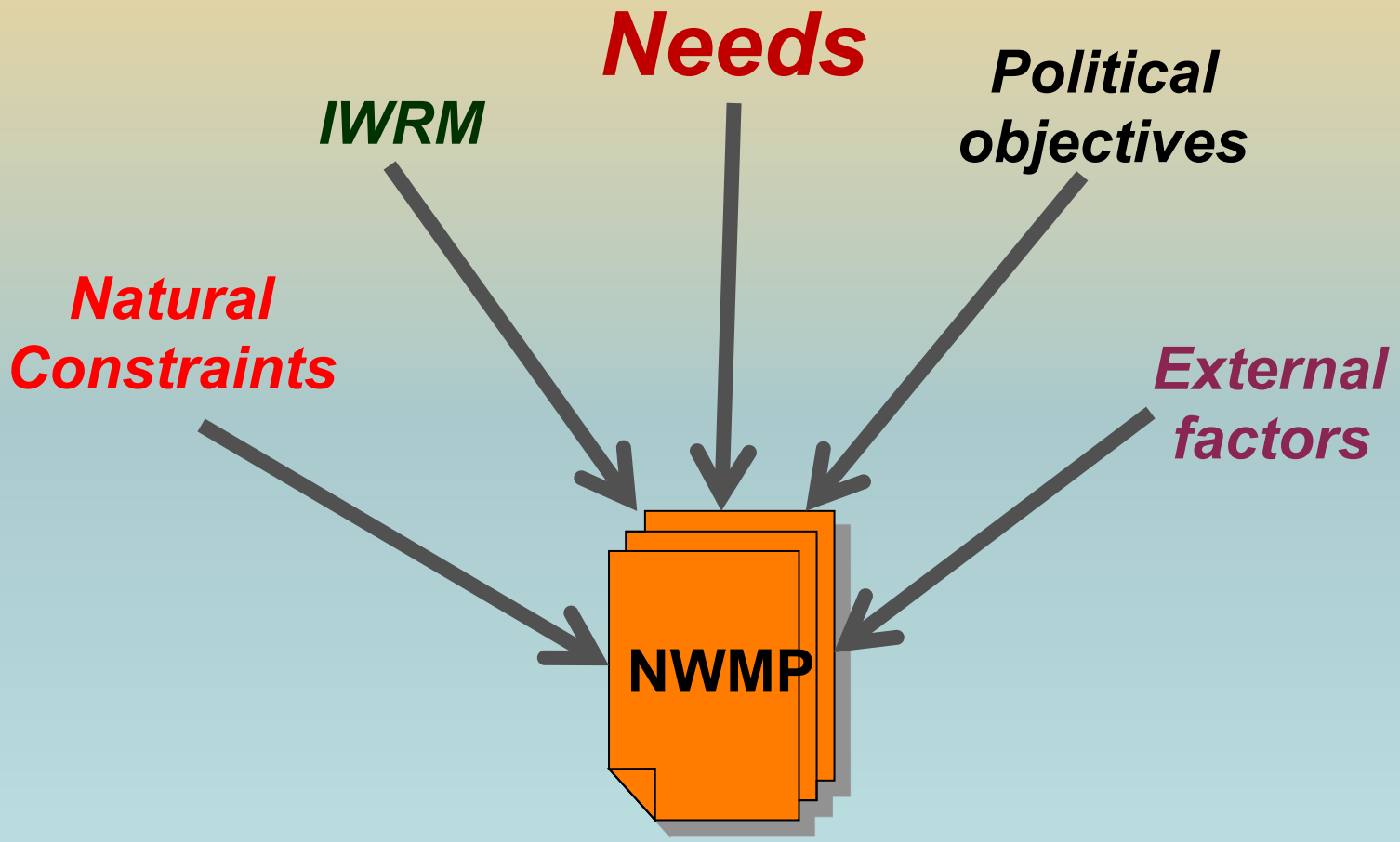
- ***Natural constraints:***
  - Scarcity of water resources and fluctuation in time;
  - Unequal geographic distribution of water resources.

- ***External factors:***
  - Land use planning;
  - Economic policy;
  - Environmental imperatives;
  - Fluctuation of financial resources.
  - …..

What is a National Water Master Plan?

- A National Water Master Plan (NWMP) defines the **strategic (long term) planning framework** for the development of the water sector **according to IWRM goals**. “National” means that the plan covers the territory of Afghanistan.
- **NWMP is the result of institutionalised procedures** with regard to data collection and management, project planning, implementation, monitoring, political arbitration, etc.

NWMP – conceptual view



What has to be done?

Content of National Water Master Plan (1)

NWMP defines ***"what has to be done"*** for the development of the water sector; it is based on and defined by:

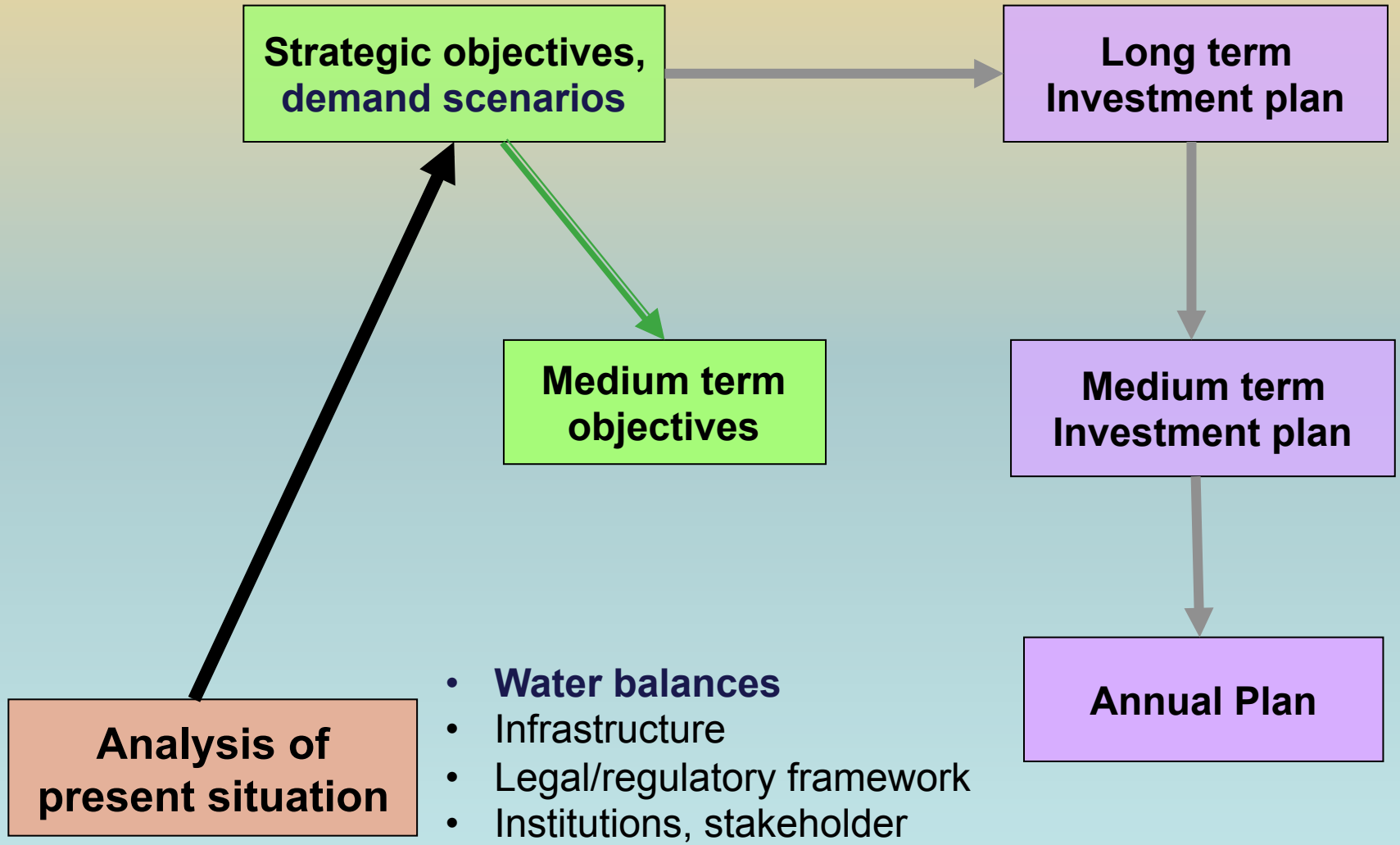
- User needs;
- IWRM principles;
- Political objectives;
- Natural constraints;
- External factors.

Content of National Water Master Plan (2)

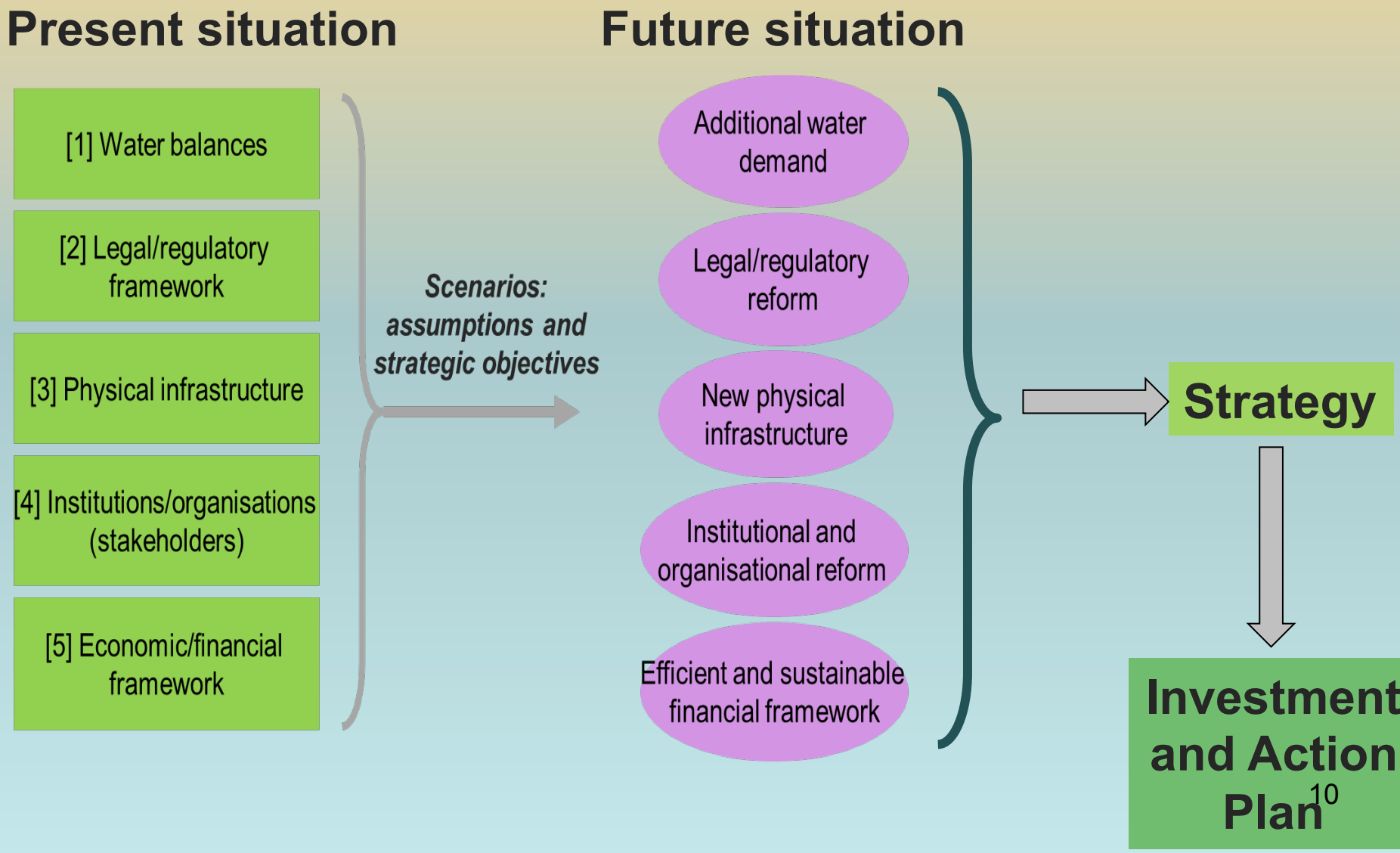
- Comprehensive **assessment** of the present situation in the water sector in Afghanistan, with regard to:
  - Legal/regulatory framework;
  - Water resources balances;
  - Status of water supply and protection infrastructure, service delivery;
  - Institutional and organisational framework;
  - Economic framework.

- **Long term development strategy** for the water sector (What has to be done?):
  - Policies and reform programs;
  - Investment plans, action plans.

NWMP – planning from the future to the present

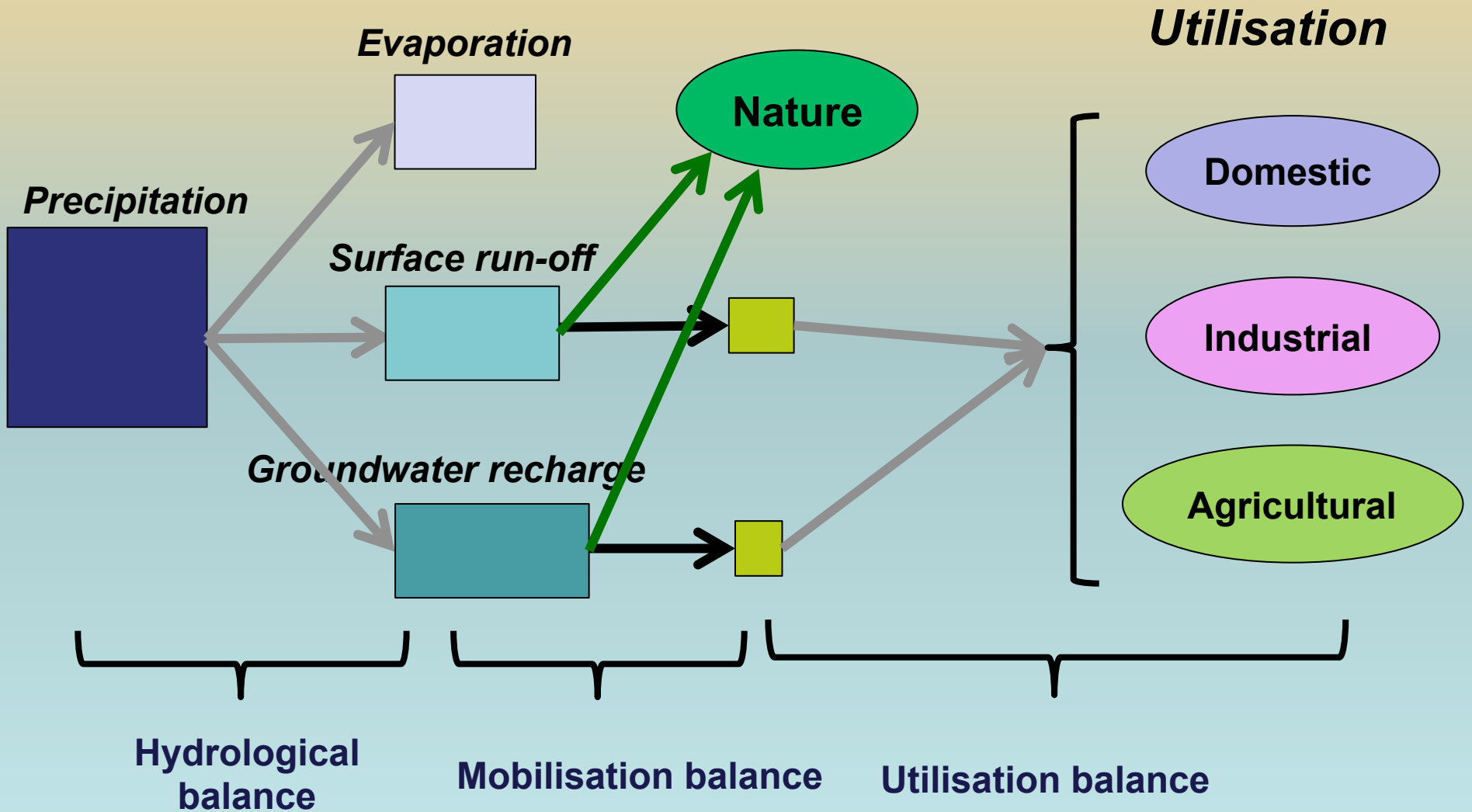


Structure of NWMP



Water Balances

Chain of water balances



Chain of water balances – explanation (1)

- Precipitation is transformed into three components: evaporation, surface run-off and groundwater recharge. This transformation is described in the ***hydrological balance***.
- Surface run-off and the groundwater recharge components are ***available (potentially usable) water resources for use***.

Chain of water balances – explanation (2)

- One part of the potentially available resources covers the “demand of nature”, another part is mobilised for end-use (“demand of man”) as described in the second balance, the ***mobilisation balance***.
- The ***utilisation balance*** shows how the mobilised resources are directed towards the three global user categories: domestic, industrial and agricultural.

Annual precipitation by basin (long term average)

No	Basin	Area (km^2)	Average annual precipitation (mm)	Total precipitation (MCM/a)
1	Kabul	108,441	356	38,590
2	Helmand	202,006	171	34,476
3	Amu	101,659	515	52,371
4	North	78,099	270	21,106
5	Harirod	162,659	210	34,155
Total		**652,864**	**277**	**180,698**

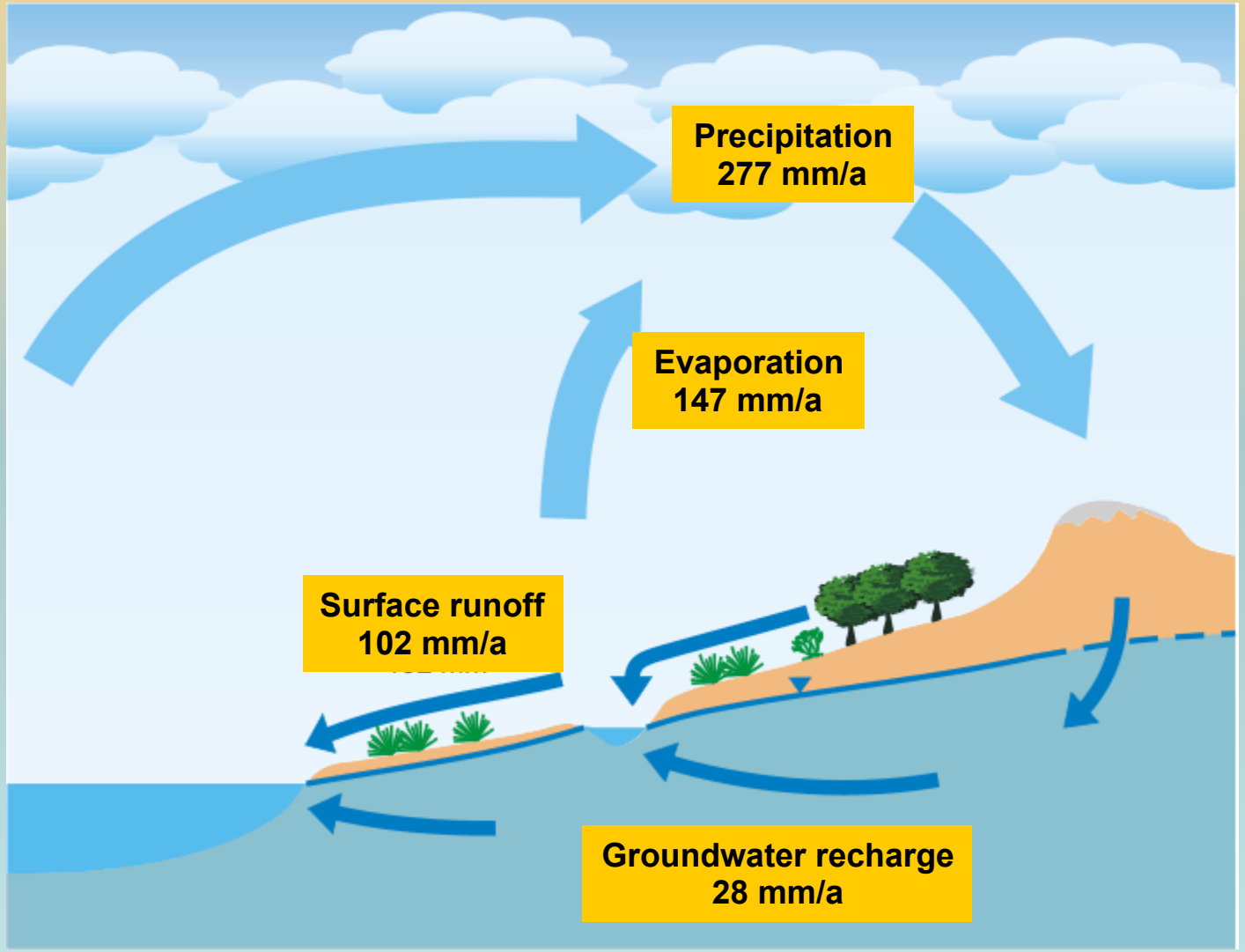
Hydrological balance of Afghanistan (1)

- Long term average values (in billion m^3/a)

  [Surface of Afghanistan: 652,864 km^2]

Precipitation:	**180**	
Evaporation:	95	(53%)
Surface run-off:	67	(37%)
Groundwater recharge:	18	(10%)
Potentially usable resources:	**85**	

Hydrological balance of Afghanistan (2)



Available (potentially usable) resources by basin

No	Basin	Precipitation (MCM/a)	Avalaible resources (MCM/a)	Population 2010 ('000)	Population 2040 ('000)	Avail. res. per person 2010 (m^3/a)	Avail. res. per person 2040 (m^3/a)
1	Kabul	38,590	18,137	10,920	20,369	1,661	890
2	Helmand	34,476	16,204	3,189	5,950	5,080	2,724
3	Amu	52,371	24,614	4,010	7,480	6,138	3,291
4	North	21,106	9,920	3,540	6,603	2,803	1,502
5	Harirod	34,155	16,053	3,329	6,211	4,822	2,585
Total		**180,698**	**84,928**	**24,988**	**46,612**	**3,399**	**1,822**

Demand of nature and demand of man

- Due to technical and other limitations, only a part of the potentially usable resources can be used to cover the:
  - Environmental needs;
  - Domestic needs (residential, commercial, institutional);
  - Agricultural needs (irrigation);
  - Industrial and mining needs (big industries).
- The first category describes the ***„demand of nature“***, the other three categories the ***„demand of man“*** requiring a mobilisation infrastructure.

Safely usable resources

- The resources that can be (technically) mobilised for the demand of man after the demand of nature has been covered are referred to as ***safely usable resources***.
- It is estimated that 70 % of the potentially usable resources are safely usable to domestic, agricultural and industrial use.

Water use in Afghanistan in 2010

(in million m^3/a)

- **Potentially usable resources:** **84,928**
- **Safely usable resources:** **60,000** (70%)

  (taking into consideration environmental demand and technical limitations)
- **Water use:** **27,565**
  - Domestic use: 641
  - Agriculture (irrigation): 26,837
  - Industry and mining: 87

Macro and micro level of balances analysis

- Balances analysis from the national point of view offers a macro view with a high level of aggregation.
- Geographic differences in rainfall, geological background, population and economic activity lead to a wide spectrum of balances on the local (micro) level.
- Balances analysis on the national level has to be complemented by balances analysis on basin, sub-basin and province level.

Water Demand Scenarios

Scenarios of future water demand

- Scenarios estimate the future water demand; they are prepared for a given user group and region, based on assumptions with regard to:
  - Long-term availability of water resources;
  - Financial framework of water sector operations;
  - Evolution and trend of two exogenous variables, namely population growth and economic growth;
  - Consumption patterns;
  - Strategic objectives set by the political level.

*A scenario always reflects **external constraints, technical trends and political will.***

Example of data frame: Domestic urban water demand - scenario 3

Demand area:	**Northern basin DU3**
Base year:	**2010**

	Year						
	2010	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Population (in thousand) نفوس به هزار	722	801	889	986	1,094	1,214	1,347
- Population served by house connections (%) نفوس که از نلهای خانگی استفاده میکنند	33	38	43	48	53	58	63
- Population served by public standpipes (%) نفوس که از نل های ایستاده عامه استفاده میکنند	10	10	10	10	10	10	10
- Population served by house wells (%) نفوس که از چاه های خانگی استفاده میکنند	30	27	23	20	17	13	10
- Population served by water vendors (%) نفوس که توسط کمپنی های فروشنده آب مستفید میشوند	27	25	24	22	20	19	17
Net domestic per capita consumption (l/c/d) مصرف خالص آب برای هر نفر در روز به اساس لیتر							
- Household connection نلهای خانگی	37	37	37	37	37	37	37
- Public standpipes پیپ های ایستاده عمومی	20	20	20	20	20	20	20
- House wells چاه های خانگی	35	35	35	35	35	35	35
- Water vendors آب های فروشنده	15	15	15	15	15	15	15
Total net domestic consumption (MCM/a) مجموعی مصرف آب به اساس میلیون متر مکعب در سال	**8**	**9**	**10**	**11**	**12**	**14**	**15**
Physical losses (%) ضایعات فزیکی	30	27	23	20	17	13	10
Volume of water produced (MCM/a) مقدار تولید آب به میلیون متر مکعب در سال	**11**	**12**	**12**	**13**	**15**	**16**	**17**
by source: به اساس منبع							
- Surface water(MCM/a) آبهای سطحی به میلیون متر مکعب	0	0	0	0	0	0	0
- *Groundwater(MCM/a)*	11	12	12	13	15	16	17

Example of data frame: Domestic rural water demand - scenario 2

Demand area: **Northern basin DR2**

Base year: **2010**

	Year						
	2010	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Population (in thousand)	2,818	3,126	3,468	3,848	4,270	4,737	5,256
Population with access to water points (%)	30	40	50	60	70	80	90
Population without access to water points (%)	70	60	50	40	30	20	10
Net domestic per capita consumption (l/c/d)							
- with access to water points	30	37	44	51	58	65	72
- without access to water points	25	32	39	46	53	60	67
Total net domestic consumption (MCM/a)	**27**	**39**	**53**	**69**	**88**	**111**	**137**
Physical losses (%)	20	20	20	20	20	20	20
Volume of water produced (MCM/a)	**34**	**48**	**66**	**86**	**110**	**138**	**171**
by source:							
- Surface water(MCM/a)	17	24	33	43	55	69	86
- *Groundwater(MCM/a)*	17	24	33	43	55	69	86

Example of data frame: Industrial water demand - scenario 3

Demand area:	Northern basin Ind3
Base year:	2010
Economic growth:	4 % per year

	Year						
	2010	2015	2020	2025	2030	2035	2040
Gross industrial water production (MCM/a) مجموع تولید ناخالص آب صنعتی بر اساس میلیون مترمکعب در سال	5	7	10	14	14	14	14
by source: بر اساس منبع							
- Surface water(MCM/a) آبهای سطحی بر میلیون متر مکعب	1	1	1	2	2	2	2
- Groundwater(MCM/a) آبهای زیر زمینی بر میلیون مترمکعب	5	6	8	12	12	12	12

Example of data frame: Agricultural water demand - scenario 4

Demand area: Northern basin Agr4

Base year: 2010

	Year						
	2010	2015	2020	2025	2030	2035	2040
Irrigation area (in thousand hectar) سطح آبیاری (به هزار هکتار)	575	665	755	845	934	1,024	1,114
- Canals کانال	561	651	741	830	920	1,010	1,100
- Karez (qanat) کرز	1	1	1	1	1	1	1
- Springs چشمه	12	12	12	12	12	12	12
- Wells چاه	1	1	1	1	1	1	1
Net water consumption of crops (m³/ha/a) (سال/ هکتار/متر مکعب) مصرف آب برای حاصلات							
- Canals کانال	9,000	8,800	8,600	8,400	8,200	8,100	8,000
- Karez (qanat) کرز	9,000	8,800	8,600	8,400	8,200	8,100	8,000
- Springs چشمه	9,000	8,800	8,600	8,400	8,200	8,100	8,000
- Wells چاه	9,000	9,000	9,000	9,000	9,000	9,000	9,000
Total net water consumption (MCM/a) مجموع مصرف خالص آب بر اساس میلیون متر مکعب درسال	**5,175**	**5,851**	**6,491**	**7,095**	**7,663**	**8,297**	**8,913**
Physical losses (%) ضایعات فیزیکی	20	20	20	20	20	20	20
Total water mobilisation (MCM/a) مجموع آبهای جذب شده بر اساس میلیون متر مکعب در سال	**6,469**	**7,314**	**8,114**	**8,868**	**9,578**	**10,371**	**11,142**
by source: بر اساس منبع							
- Surface water(MCM/a) آبهای سطحی بر میلیون متر مکعب	6311	7159	7962	8720	9433	10228	11000
- *Groundwater(MCM/a)*	158	155	151	148	145	143	142

Investment scenarios

Investment for future water mobilisation

- Water demand scenarios estimate the additional amount of water that has to be mobilised for the satisfaction of future water demand.
- This allows to estimate future investments for the needed infrastructure for the mobilisation of the additional water.
- Investments are calculated by applying unit costs per m^3.

Investment needs: Domestic urban water demand - scenario 3

Demand area:	**Northern basin DU3**

Investment water mobilisation:	**353 AF/m³**
Investment losses reduction:	**177 AF/m³**
Investment network extension:	**37247 AF/person**
Rehabilitation:	**35 AF/m³**

	Year/Period							
	2010	**2011-15**	**2016-20**	**2021-25**	**2026-30**	**2031-35**	**2036-40**	**Total**
Add. volume of water produced at end of period (MCM/a)	**0**	**0.8**	**0.9**	**1.0**	**1.1**	**1.2**	**1.3**	**6.3**
Add. population served by house connections ('000)	0	66.1	77.7	91.0	106.4	124.1	144.3	610
Urban water supply infrastructure investments								
- Investment water mobilisation (million AF)	0	285	314	346	382	420	462	2,209
- Investment losses reduction (million AF)	0	27	34	42	50	61	73	287
- Investment network extension (million AF)	0	2,460	2,893	3,391	3,964	4,621	5,374	22,703
- Rehabilitation (million AF)		381	410	441	476	514	556	2,777
Total investment (million AF)		**3,154**	**3,651**	**4,220**	**4,871**	**5,615**	**6,465**	**27,977**

Investment needs: Domestic urban water demand - scenario 3

Investment 2011-15 for urban water supply (million AF, constant 2010 and current prices)

Demand area: Northern basin DU3

Annual inflation rate: 8 %

	Year					
	2011	2012	2013	2014	2015	Total
Investment in constant 2010-prices (million AF)	631	631	631	631	631	**3,154**
Investment in current prices (million AF)	681	736	795	858	927	**3,996**

Investment needs: Agricultural water demand - scenario 3

Demand area: **Northern basin Agr3**

New infrastructure investment:	**101,352 AF/ha**
Upgrading investment:	**19,424 AF/ha**
Rehabilitation investment:	**3,885 AF/ha**

	Year/Period						
	2010	**2011-15**	**2016-20**	**2021-25**	**2026-30**	**2031-35**	**2036-40**
Additional irrigation area to be equipped (in thousand ha)	0	15	15	15	15	15	15
Irrigation area to be rehabilitated (in thousand ha)	0	575	590	605	620	634	649
Irrigation infrastructure investments							
- New infrastructure investment (million AF)	0	1,053	1,053	1,053	1,053	1,053	1,053
- Upgrading of existing irrigation infrastructure (million AF)		86	86	86	86	86	86
- Rehabilitation investment (million AF)	0	2,234	2,292	2,349	2,407	2,464	2,522
Total irrigation infrastructure investment (million AF)		**3,373**	**3,431**	**3,488**	**3,546**	**3,604**	**3,661**

Investment for wastewater management and sanitation

- Investment tables for wastewater management and sanitation are built on the same pattern as those for water mobilisation. Investments are calculated by applying ***unit costs per person***.
- ***Three technical approaches*** are distinguished:
  - Centralised wastewater management in urban areas;
  - Decentralised wastewater management in urban areas;
  - Sanitation package (including several measures) in rural areas.

Investment needs: Urban wastewater management - scenario 2

Investment centralised UWWM:	**9,936 AF/person**
Investment decentralised UWWI	**5,700 AF/person**

	Year/Period							
	2010	**2011-15**	**2016-20**	**2021-25**	**2026-30**	**2031-35**	**2036-40**	**Total**
Add. pop. covered by centralised UWWM (1000 at end of period)	0	40.8	49.7	60.0	72.0	85.9	101.9	**410**
Add. pop. covered by decentralised UWWM (1000 at end of period)	0	80.9	98.5	119.0	142.9	170.5	202.5	**814**
Add. pop. covered by UWWM (1000 at end of period)	0	**121.7**	**148.2**	**179.1**	**214.9**	**256.4**	**304.4**	**1,225**
Urban WWM infrastructure investments								
- Investment centralised UWWM (million AF)	0	406	494	596	715	853	1,013	**4,077**
- Investment decentralised UWWM (million AF)	0	461	562	679	814	972	1,154	**4,642**
Total UWWM investment (million AF)	0	**867**	**1,055**	**1,275**	**1,530**	**1,825**	**2,167**	**8,718**

Investment needs: Rural sanitation - scenario 2

Demand area: Northern basin San rur2

Base year: 2010

	Year						
	2010	2015	2020	2025	2030	2035	2040
Population (in thousand)رازه ب سفن	2,818	3,126	3,468	3,848	4,270	4,737	5,256
Population with access to sanitation (%)	5	20	35	50	65	80	95

Investment sanitation: 2,975 AF/person

	Year/Period							
	2010	2011-15	2016-20	2021-25	2026-30	2031-35	2036-40	Total
Add. pop. with sanitation (1000 at end of period)	0	484.3	588.7	710.1	851.1	1,014.4	1,203.3	**4,852**
Investment sanitation (million AF)	**0**	**1,441**	**1,752**	**2,113**	**2,532**	**3,018**	**3,580**	**14,437**

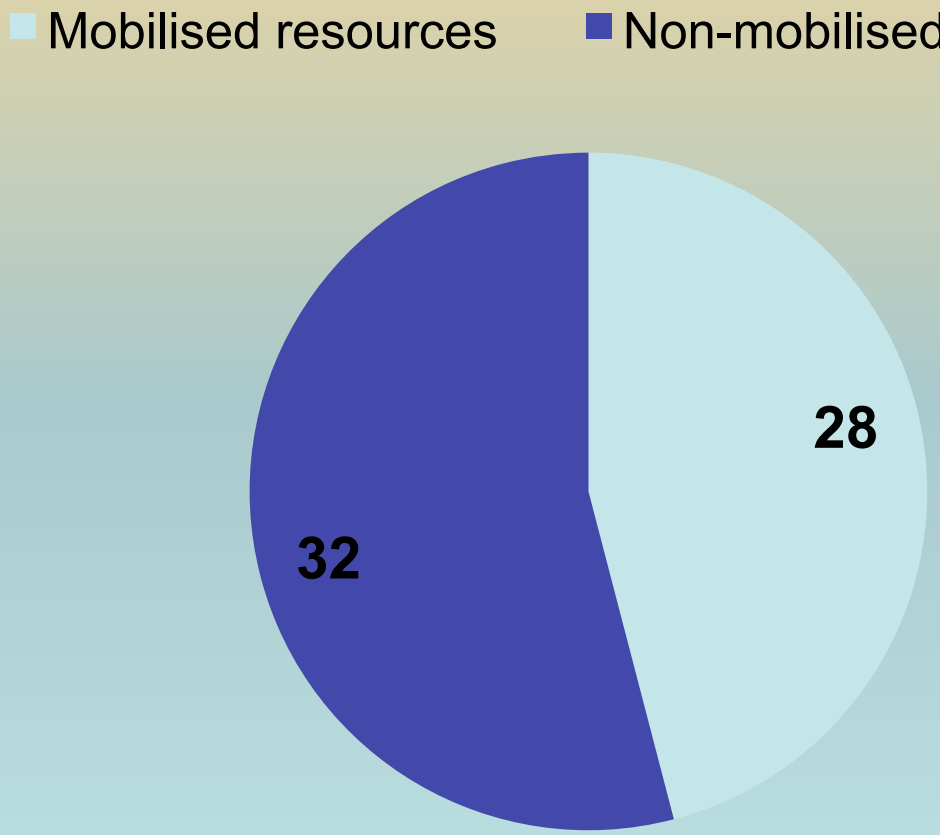
Selected result tables

Population figures 2010 - 2040 (in thousand)

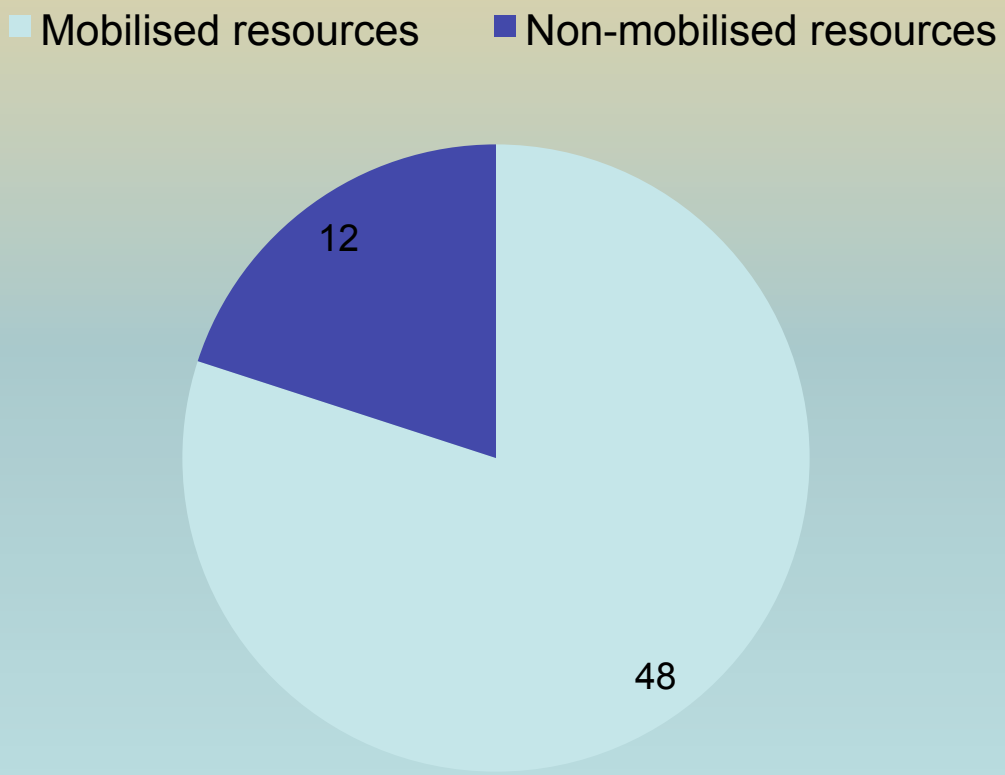
Basin	Year						
	2010	*2015*	*2020*	*2025*	*2030*	*2035*	*2040*
Northern basin	3,540	3,927	4,357	4,834	5,364	5,951	6,603
Amu Darya basin	4,010	4,449	4,936	5,477	6,077	6,742	7,480
Harirod basin	3,329	3,694	4,098	4,547	5,045	5,598	6,211
Helmand basin	3,189	3,539	3,926	4,356	4,833	5,362	5,950
Kabul basin	10,920	12,115	13,442	14,914	16,547	18,359	20,369
Afghanistan	**24,988**	**27,724**	**30,760**	**34,128**	**37,865**	**42,012**	**46,612**

Scenario	Total water demand in Afghanistan (MCM/a)						
	Year						
	2010	***2015***	***2020***	***2025***	***2030***	***2035***	***2040***
Total1: Dom urban1 + Dom rural1 + Ind1 + Agr1	**27,565**	27,654	27,755	27,869	27,999	28,147	28,315
Total2: Dom urban2 + Dom rural2 + Ind2 + Agr2	27,565	29,387	31,261	32,855	35,113	37,087	39,111
Total3: Dom urban3 + Dom rural2 + Ind3 + Agr3	27,565	28,744	29,897	31,020	32,027	33,378	34,728
Total4: Dom urban3 + Dom rural2 + Ind3 + Agr4	27,565	31,444	34,973	38,175	40,990	44,032	**47,885**

Afghanistan - Water Budget 2010 (BCM/a)

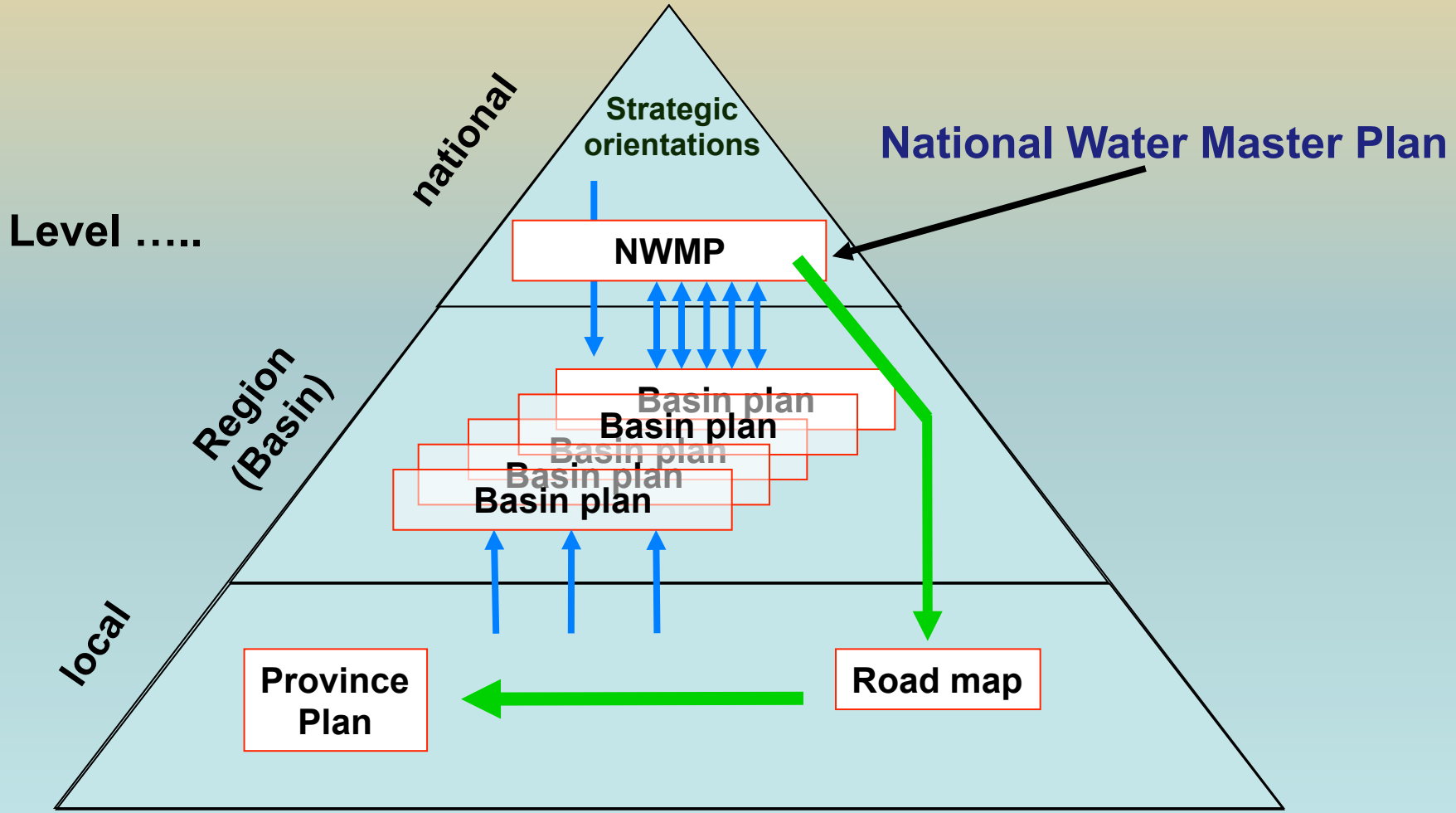


Afghanistan - Water Budget 2040 (BCM/a); scenario 4



Interrelation between National Water Master Plan and River Basin Master Plan

National Water Master Plan (NWMP) and River Basin Master Plans (RBMP)



Integration of NWMP and RBMP (1)

- NWMP, RBMP and provincial plans are elements of ***one integrated planning process*** in the water sector.
- The planning process starts with strategic (and methodological) orientations defined on the national level.
- The strategic orientations are „handed down“ to River Basin Agencies, provinces and other concerned institutions and actors.

Integration of NWMP and RBMP (2)

- In an iterative harmonisation process, the national level and basins/provinces elaborate in parallel basin master plans and NWMP. ***The basin master plans are integral part of NWMP***.
- Once the NWMP (together with the basin master plans) is approved by the competent political authorities, ***"roads maps"*** defining tasks and responsibilities are prepared for all institutions involved in the implementation of the National Water Master Plan.

NWMP versus RBMP (1)

- NWMP and RBMP follow **one and the same methodology** (analysis of present situation followed by development strategy: policies, reform programs, investment and action plan).
- NWMP elaborates the (highly aggregated) national framework whereas RBMP elaborates in much more detail the development framework for the river basin and sub-basins.

NWMP versus RBMP (2)

- Key differences in focus:
  - The analysis of water balances in RBMP is much more detailed than in NWMP.
  - NWMP defines a macro investment framework; **RBMP** advances the ***project identification and planning process***.
  - NWMP addresses issues of national dimensions that cannot be addressed on the basin level, for example deficiencies in data management, professional deficits caused by deficits in the educational system, etc.

Data and information management

Data sources of NWMP

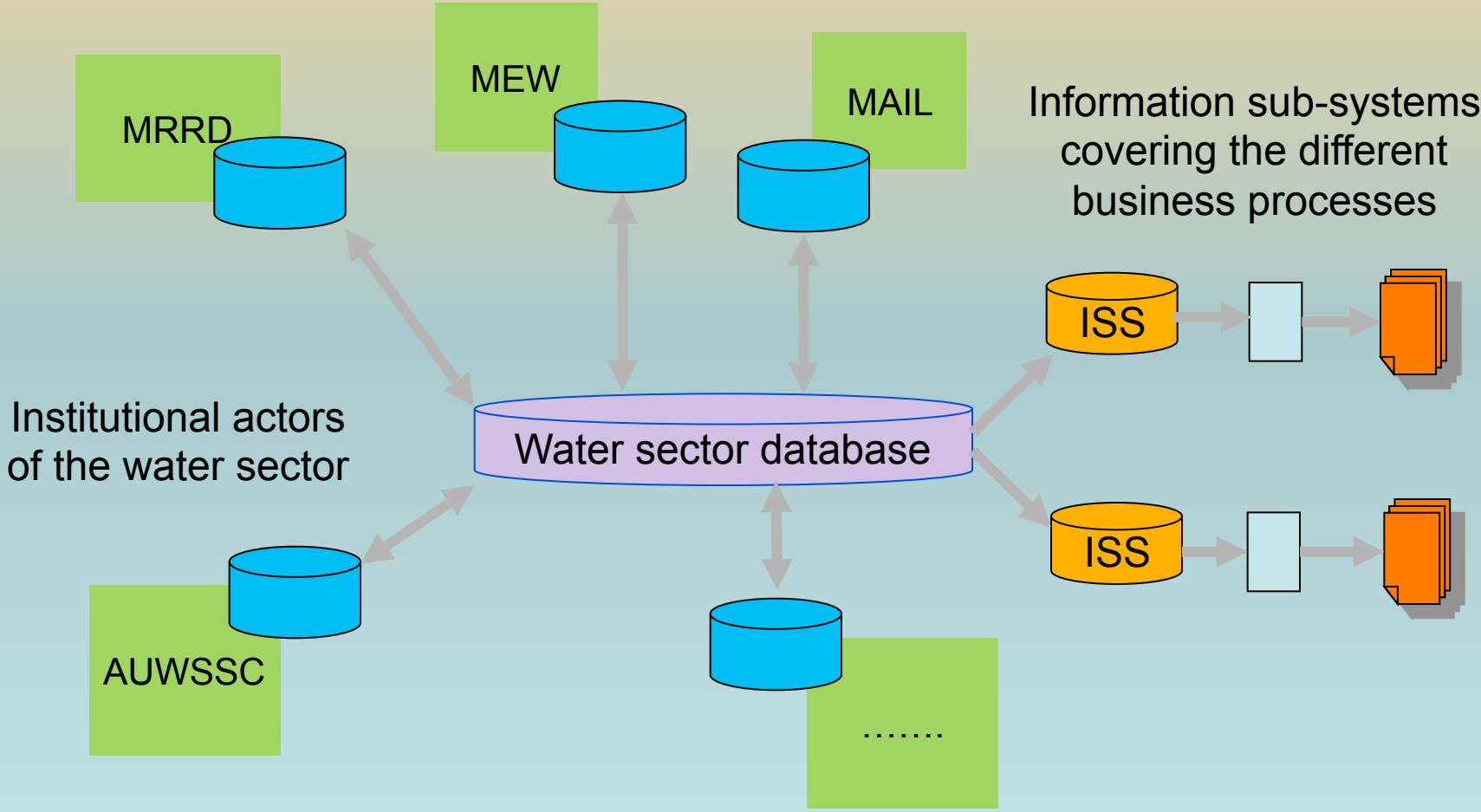
- The NWMP process is dependent and built on a number of data sources, especially:
  - Climate and hydrological data;
  - Operational and consumption data of the different water uses;
  - Socio-economic data (population statistics, economic trends, development scenarios);
  - Cost and financing data of water sector operations.

Organisation of water sector data management

- Data and information management in the water sector has to be organised in a sectoral framework. The following approach is proposed:
  - Each water sector institution will organise its data in an institutional databank;
  - All **institutional databanks** will be linked and „build up a sectoral databank“
  - The **sectoral databank** will be managed by a special sectoral unit assuring continuous updating and organising access procedures.

Water sector data management – a system view

Network of institutional databases

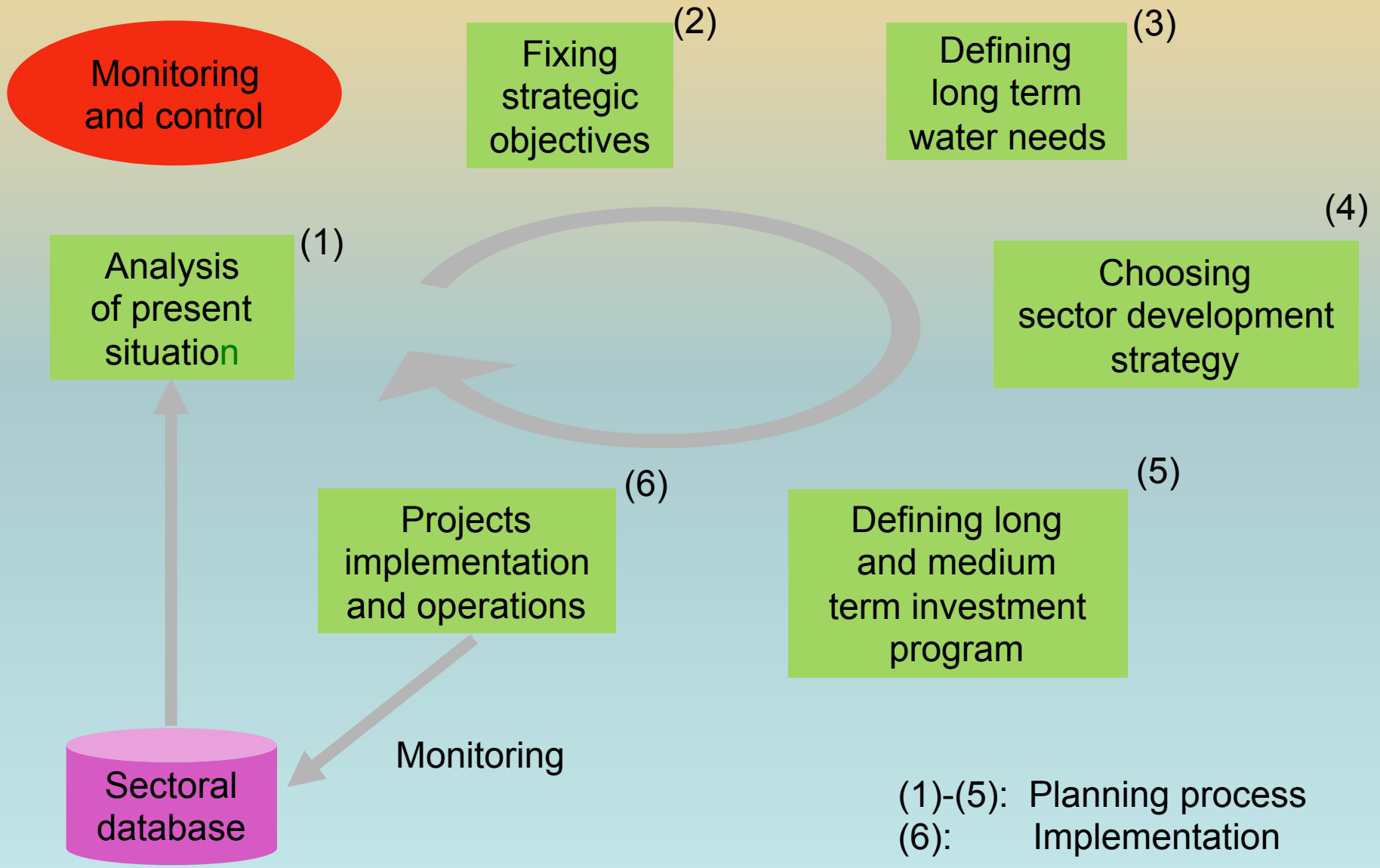


ISS: Information sub-system

Dedicated information sub-systems

- The sectoral databank will allow to establish dedicated information sub-systems (ISS) covering the different areas of water sector management (examples: drinking water supply, wastewater management, water quality, irrigation systems, investment plans, etc.).
- Each ISS is „planted“ on the sectoral databank and is managed by the lead institution in charge of the concerned water sector management area.

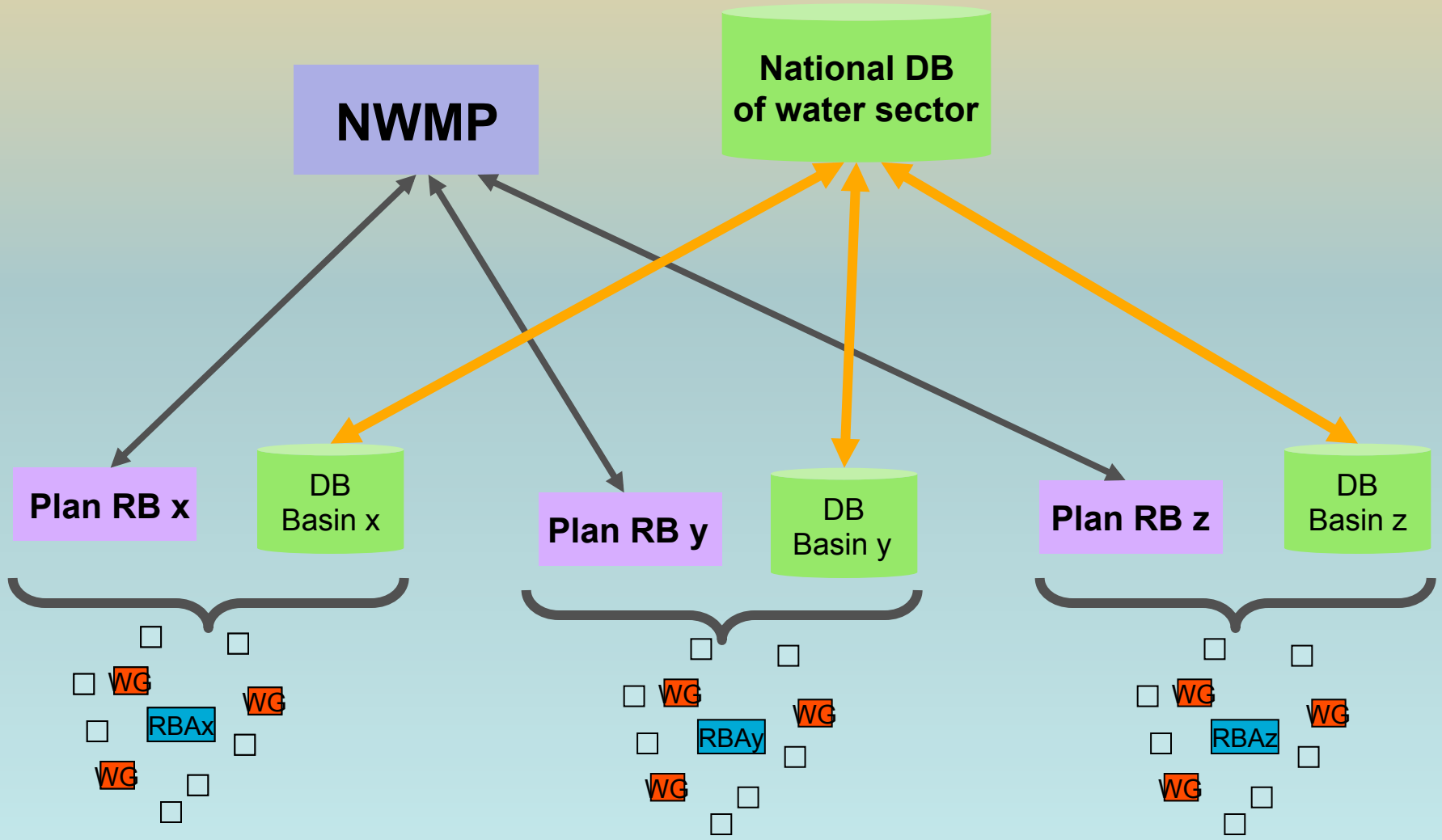
Planning cycle and data management



National databank and river basin databanks

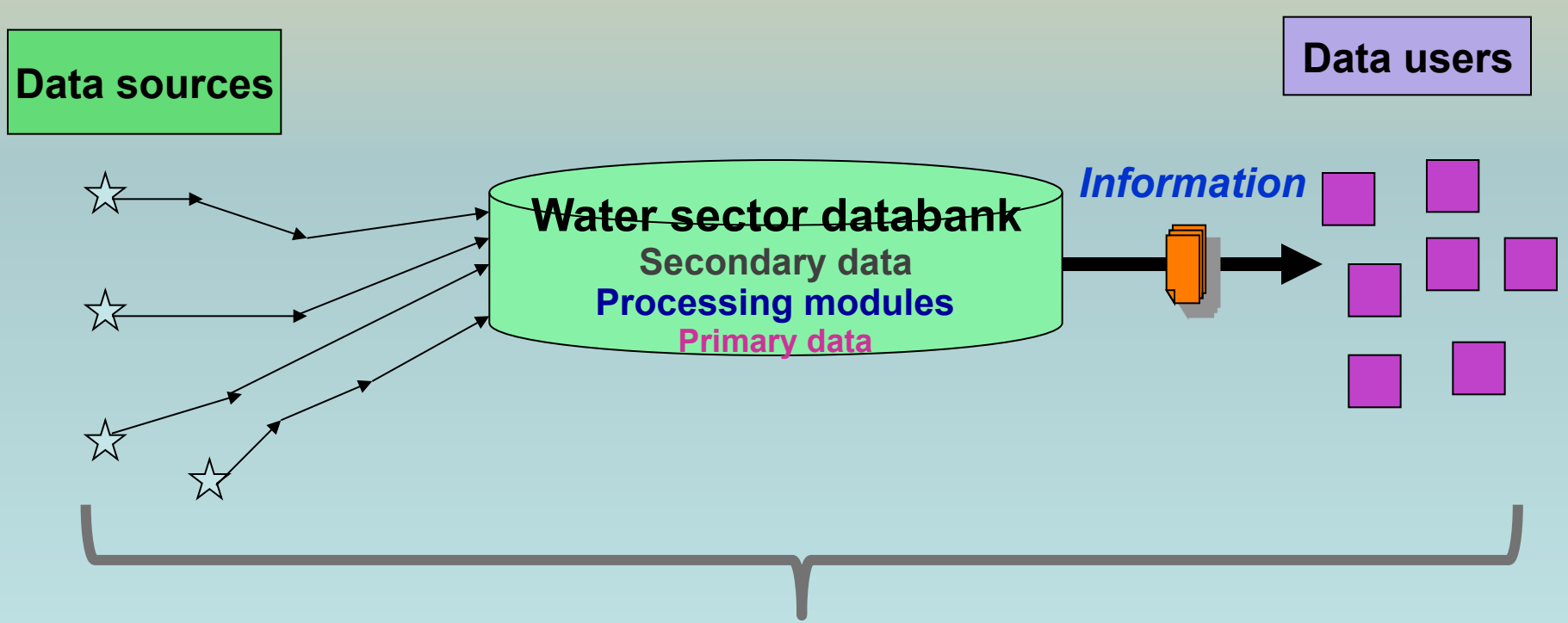
- The national planning process in the water sector is broken down into planning processes for the 5 river basins. Thus, the planning framework integrates the National Water Master Plan with the 5 River Basin Master Plans.
- Accordingly, data management on river basin level is organised in a river basin databank. The 5 river basin databanks are components of the national databank.

NWMP databank and RBP databanks



Integrated information management – view 2

Data management processes:
from the data source to the data user



Thank you for your attention