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Water Management in Poland and Modeling of Catastrophic Flows

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Water management,

A branch of economy and a scientific discipline dealing with methods and means of shaping inland surface and groundwater resources for: water supply, protection against flooding and protection of water resources against exhaustion and pollution

https://encyklopedia.pwn.pl
Rules of Water Management

1. Water management is carried out in accordance with the principle of rational and comprehensive treatment of surface and underground water resources, taking into account their quantity and quality.

2. The principle of common interests is taken into account in water management and cooperation of public administration, water users and representatives of local communities and is required in order to obtain maximum social benefits.

3. Water management is based on the principle of reimbursement of the costs of water services, taking into account environmental and resource costs as well as economic analysis.

4. Water management is carried out in accordance with the public interest, preventing avoidable deterioration of the ecological function of waters and deterioration of the status of terrestrial ecosystems dependent on waters.

source: Dz.U.2018.0.2268 t.j. - Ustawa z dnia 20 lipca 2017 r. - Prawo wodne Polish Water Law, act from 2017 07 20
Hydrological conditions existing in Poland
rainfall

after: Punzet [1971]
unit outflow
Water supply

in yellow – surface water

in red – groundwater

published for year 2011

source: www.pgi.gov.pl
Water resources per 1 citizen

water resources
[m3 per capita]

source: Gutry-Korycka (2018)
Fresh water availability in Europe

https://ungc.org.pl/info/zasoby-wodne-polsce/
Changes

prognoses for Europe
Number of combined tropical nights (> 20 °C) and hot days (> 35 °C)

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SSR – seasonal severity rating index (severity, riskiness, indecency)

other http://klimada.mos.gov.pl/blog/2013/04/15/gospodarka-wodna/
Prevention

Theoretical analysis

- methods of decreasing risk of droughts

- methods of decreasing flood risk
water circulation change

source: Norbert Bäuml, Bauoberrat, Bayerische Verwaltung für Ländliche Entwicklung, 2010
impermeable surfaces also named “land cover”

elimination or reducing of impermeable areas

reparation activities
“forest retention”

http://dzienniklesny.pl/przyroda/lasy-w-liczbach/
Land cover changes

- embankments,

- spatial planning

- sustainable development
reservoirs

equalisation of outflow

environmental flow
small retention

Friedrich-Wilhelm Brumberg, Richard Kempe, 2010

Bartnik et al. 2006
Retention Development Program

Plan of the Polish Government for years 2021 – 2027 (2030)

In Poland about 4 billion cubic meters of water flow has been accumulated. This is about 6.5 percent volume of the average annual river outflow.

This is definitely not enough to include counteract the effects of drought. In eight years we want to increase this ratio by more than half and retain about 15 percent.

- Malczyce weir (Odra River),
- Racirórz Dolny polder (Odra River),
- fish ladder (Biała Tarnowska),
- Siarzewo wier (Vistula River),
- Kąty Myscowa reservoir (Wisłoka River),
- Wielowieś Klasztorna reservoir (Prosna River).
CHAPTER I - GENERAL PROVISIONS

1. The purpose of this Directive is to establish a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the Community.

For the purpose of this Directive, in addition to the definitions of ‘river’, ‘river basin’, ‘sub-basin’ and ‘river basin district’ as set out in Article 2 of Directive 2000/60/EC, the following definitions shall apply:

1. ‘flood’ means the temporary covering by water of land not normally covered by water. This shall include floods from rivers, mountain torrents, Mediterranean ephemeral water courses, and floods from the sea in coastal areas, and may exclude floods from sewerage systems;

2. ‘flood risk’ means the combination of the probability of a flood event and of the potential adverse consequences for human health, the environment, cultural heritage and economic activity associated with a flood event.
Floods Directive

2007/60/EU

CHAPTER II - PRELIMINARY FLOOD RISK ASSESSMENT

2. Based on available or readily derivable information, such as records and studies on long term developments, in particular impacts of climate change on the occurrence of floods, a preliminary flood risk assessment shall be undertaken to provide an assessment of potential risks. The assessment shall include at least the following:

   (a) maps of the river basin district at the appropriate including the borders of the river basins, sub-basins where existing, coastal areas, showing topography and land use; scale and,

   (b) a description of the floods which have occurred in the past and which had significant adverse impacts on human health, the environment, cultural heritage and economic activity and for which the likelihood of similar future events is still relevant, including their flood extent and conveyance routes and an assessment of the adverse impacts they have entailed;

   (c) a description of the significant floods which have occurred in the past, where significant adverse consequences of similar future events might be envisaged;

...

4. Member States shall complete the preliminary flood risk assessment by 22 December 2011.
Floods Directive

2007/60/EU

CHAPTER II - PRELIMINARY FLOOD RISK ASSESSMENT
CHAPTER III - FLOOD HAZARD MAPS AND FLOOD RISK MAPS

3. Flood hazard maps shall cover the geographical areas which could be flooded according to the following scenarios:
   (a) floods with a low probability, or extreme event scenarios;
   (b) floods with a medium probability (likely return period ≥ 100 years);
   (c) floods with a high probability, where appropriate.

4. For each scenario referred to in paragraph 3 the following elements shall be shown:
   (a) the flood extent;
   (b) water depths or water level, as appropriate;
   (c) where appropriate, the flow velocity or the relevant water flow.

8. Member States shall ensure that the flood hazard maps and flood risk maps are completed by 22 December 2013.
CHAPTER IV - FLOOD RISK MANAGEMENT PLANS

5. Member States shall ensure that flood risk management plans are completed and published by 22 December 2015.
Minimising flood risk

- causes (to keep flood away from people)
- consequences (to keep people away from flood)
- vulnerability (to prepare people for flood)
Minimising causes

minimisation flood losses – in flood defense

- technical tools
  - active protection
  - nonactive (passive) protection

- nontechnical tools
Active protection tools are regulated by staff (they cannot run automatically):

- retention reservoirs,
- polders with adjustable openings
- dry reservoirs with regulated outflow
- icebreaking by ships and other methods

and activities:
- retention increasing by afforestation of basin
- retention increasing of small ponds, reservoirs or rivers
- proper agrotechnics and agromeliorations
Technical Tools
Passive Protection

Passive protection tools automatically activates during floods
(work as designed to protect against flood events)

- embankments,
- polders without adjustable openings (only wires and designed capacity channels/culverts)
- dry reservoirs without closings
- bypass channels
- flood protecting gates
- regulated rivers and streams

Their efficiency depend on their distribution an maintenance.

There is a very important to flood protection services work properly.
nontechnical tools

- administration responsibility and powers (in different levels)
  government (hierarchy)
  flood protection committees

- organizational responsibility

- warehouse equipment,

- orders and prohibitions relating to the development of areas where the risk of inundations is proofed,
  Especially areas of:
  a) 100 year flood zones,
  b) areas of dam and embankment break risk
  c) areas of violent rainfall-runoff regime

others like:
  - warning signals
  - emergency services
Solutions?

1. How to describe flood risk?
2. How to decrease risk?

1. **How to describe flood risk?**
   Answer can be found after the modelling of the flood pass

Flood risk can be described by:
- historical events
- gathering of the information about landuse

- modelling of flow (flood propagation) - flood zones
Procedures for increase of knowledge

- inundation areas
- alternative simulations
historical events
Which method to choose?

**1D modelling**

**2D modelling**
Which method to choose?

1D modelling
2D modelling
Which method to choose?

1D modelling
2D modelling
Which method to choose?

1D modelling
2D modelling
Which method to choose?

1D modelling – villages
2D modelling – cities (urbanized areas)

Fig. 1. Map of the floodplain.
Which method to choose?

1D ?

2D?
Which method to choose?

1D modelling – villages
2D modelling – cities (urbanized areas)
Steps for preparing model

1. hydrological data
   (basin area, precipitation, landuse, passed floods)

2. hydraulical data
   (profiles, cross-sections, bed and valley roughness, hydraulic structures)

3. DTM
- precipitation
- soils
- landuse
- basin parameters
  area, slope ...

- historical floods
  for verifications
hydraulical data

cross-sections
flow roughness
DTM
DTM
building model
the result of 1D modeling
numerical model of water surface
inundation areas
inundation areas
After the flood zones are drawn we can determine possible actions in flooded area.

22 December 2013 – flood zones are ready
Alternative scenarios:

- new/rebuild

- embankments,

- reservoirs,

  - redesigned openings, gates
  - changed capacity
  - operation scenarios

- channel capacity analysis
Solutions?

1. How to describe flood risk?
2. How to decrease risk?

**Which scenario should be chosen?**

S.M.A.R.T. method to search for good solution

* Specific, e.g. contain answers to the questions: what do you want to achieve and where, what is the reason for implementing the action, who will do it and what can it be limitations and problems
* Measurable, which means that effects should be assigned to them, what their implementation will bring and measures of controlling the achievement of these effects
* Achievable, which means that there are adequate resources and forces that allow to achieve them, and the social environment allows for their implementation
* Relevant, which means that the action is adequate and important for achieving the goal we want to achieve
* with Time-bound, which means that it work must have a certain implementation schedule and, consequently, achievement of the goal, for which it was developed.
Minimising flood risk
- causes (to keep flood away from people)
- consequences (to keep people away from flood)
- vulnerability (to prepare people for flood)
consequences (to keep people away from flood)
sustainable development
river flow regime
~~~~~~~~~~~~~~~~~~
human needs
vulnerability (to prepare people for flood)

monitoring system

evacuation plans

education

self defence
vulnerability (to prepare people for flood)
monitoring system
evacuation plans
education
self defence

http://przeciwpowodzi.pl
vulnerability (to prepare people for flood)

self defence
Thank You