

Institute for Agricultural and Forest Environment Polish Academy of Sciences

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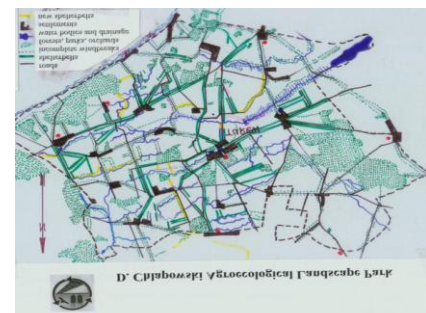
The Institute was established to take up and develop studies on the protection and sustainable development of countryside.

Interdisciplinary investigations carried on by Institute are focused on integrated analysis of fundamental ecological processes driving functions of agricultural landscape and on the possibilities to modify them towards counteraction environmental threats and climate change.



Staff: 75 persons including 37 scientists (12 Professors and Assoc. Professors, 17 Doctors, 7 assistants. Specialization: ecology, biology, entomology, meteorology, hydrology, climatology, chemistry, agriculture, sociology, forestry and hydrobiology.

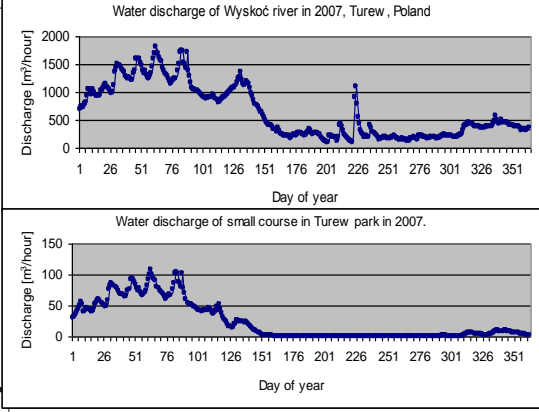
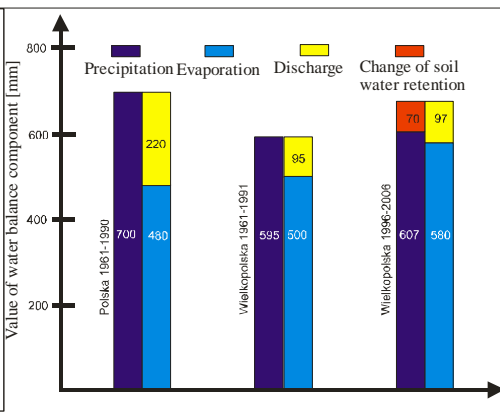
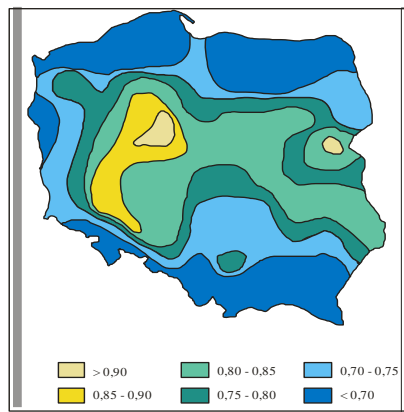
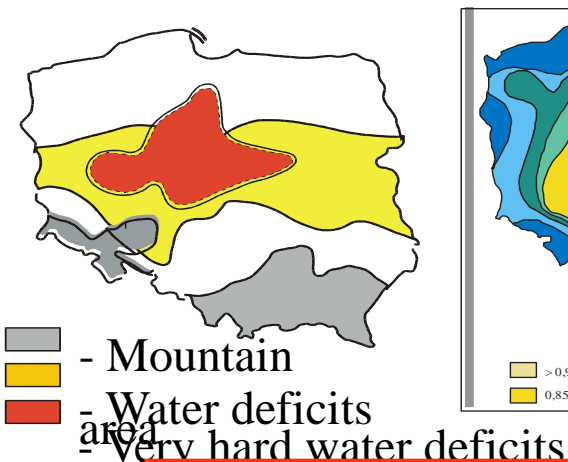
The activities of the Institute are focused on the following fundamental processes and problems: energy flow (fluxes and heat balance, primary production) matter cycling (mainly water and organic matter), climate changes (extreme events like floods and drought), quantity and quality of water (water deficits and pollution of ground and surface water), role of plant cover (mainly shelterbelts and meadows) in protection and enrichments of biodiversity and in controlling of chemical compounds originated from agricultural activity and transported by ground water.



Typical landscapes in Turew vicinity

Problem of water shortage in Polish agriculture

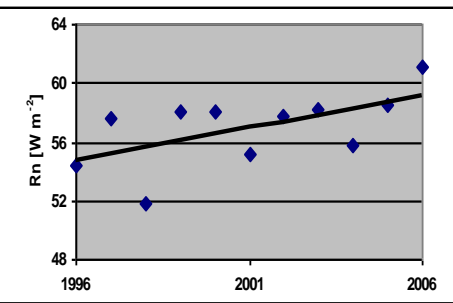
The surface water shortage in Poland resulting from low runoff and tight water balance affects the area of about 120 000 km², which is 38% of the total area of the country. In Central Plains the annual runoff is less than 2 l s⁻¹ km⁻² thus threatening occurrence of the water shortage. The Wielkopolska region, located in western part of the Central Plains, was recognized as the area the most affected by the water shortage. Poland, in terms of water resources is one of the poorest countries in Europe.



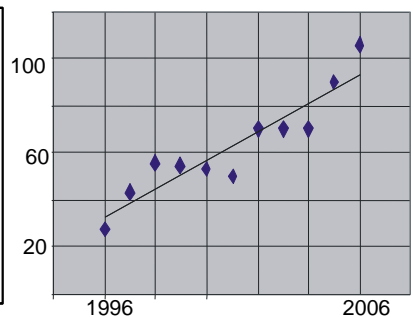
Impact of climate change on water condition in an agricultural landscape

As a result of increase of air temperature, wind speed and relative sunshine we observed increase of:

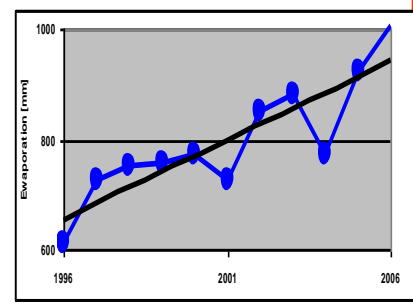
Net radiation



Atmos. water demand



Water evaporation



As a result of these climatic changes during last two decades we observe lowering of water surface level in lakes by 0.5 to 1.0 m depending of land use in the catchment, and lowering of ground water level even by 3 – 4 meters.

Problem of water pollution in Polish agriculture

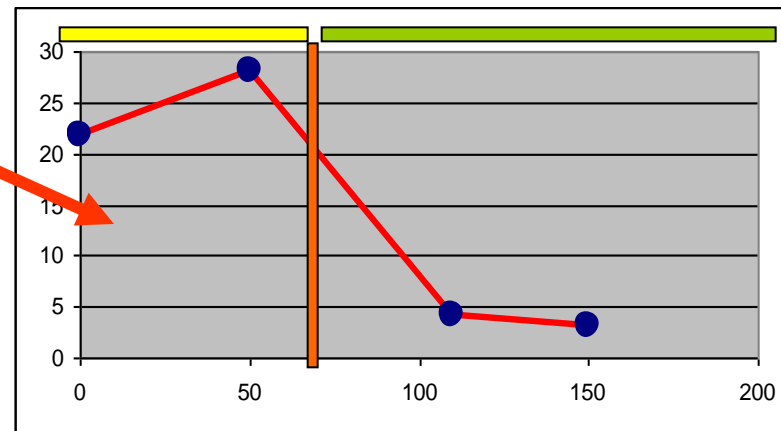
Most inland waters in Poland does not meet criteria of clean water. State of purity of water in Poland during many years deteriorated (Now, the situation is much better). Rural economy as a whole and especially , domestic sewage, septic tanks, the inorganic fertilizers and livestock as well as collection of waste are the main sources of water pollution.

AGRICULTURAL WATER POLLUTION: manure and domestic sewage; - **fertilizers (nitrogenous and phosphorous)**; **pesticides**

Fertilizers are applied incorrectly. Usually it is applied in one dose instead of a few because of economic reasons; farmer wants save money

In Polish agricultural landscape concentration of nitrates in ground water under arable and was much higher than under forest.

Ground water was much more polluted than surface water



Improvement of water conditions in an agricultural landscape

1. Increasing the small water retention.

1. Use of existing mid-field ponds
2. Restoration of post glacial ponds,
3. Retention of drainage water in local denivelation,
4. The introduction of more weirs in drainage ditches

2. Increasing of soil water retention.

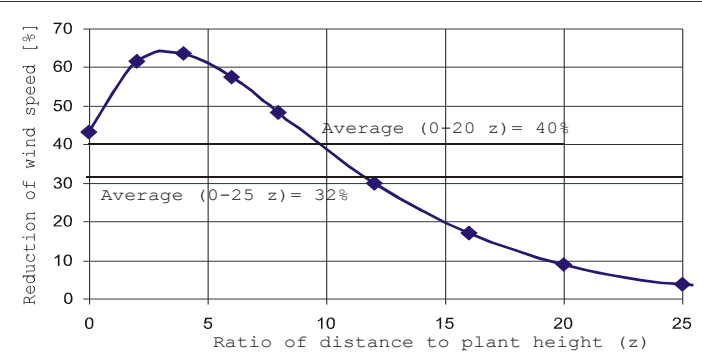
1. Increasing of organic matter in the soil,
2. Improvement of soil structure – no tillage system

3. Appropriate shaping of the structure of vegetation

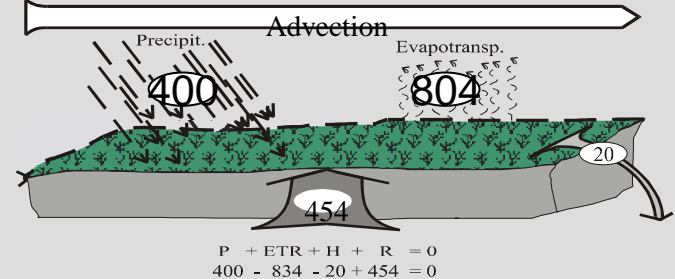
1. Control of wind speed
2. Shaping of water balance
3. Control of water cycling
4. Control of advection

4. Increase the complexity of the landscape by:

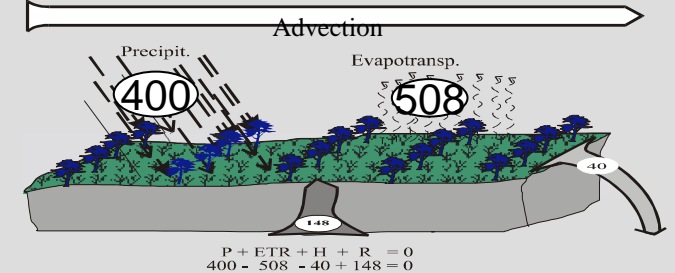
1. Introduction of shelterbelts,
2. Introduction of strips of meadow and brushes
3. Restoration of postglacial ponds and building of small artificial water reservoir



Water balance of alfalfa field without shelterbelts



Water balance of alfalfa field with shelterbelts



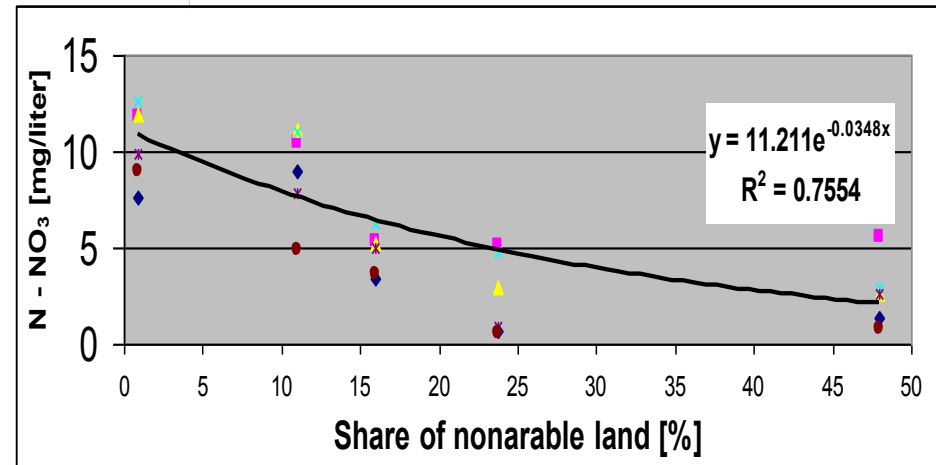
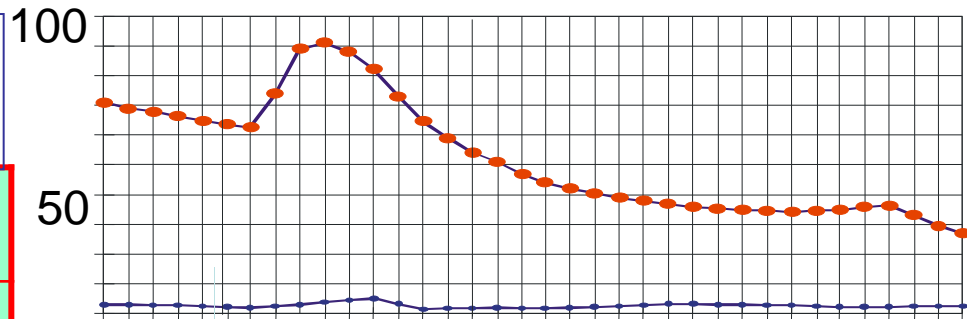
A new paradigm is emerging from these guidelines:

Retain as much and as long as possible water in the landscape remembering about necessity of its proper allocation

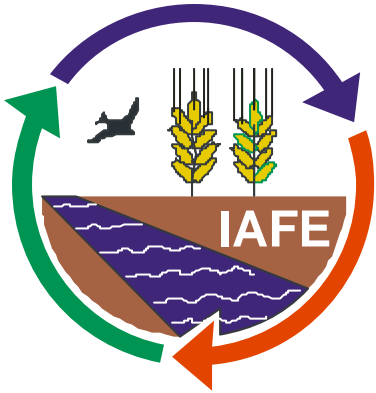
Possibility to counteract water pollution of an agricultural landscape

Introduction of shelterbelt net and increasing landscape complexity is one of the best tool for control of non point pollution

Period of sampling	Cultivated field (a)	Shelterbelt (b)	Meadow (b)	Rduction (a-b):a (%)
1982-1986	22.2	1.0	-	95
1982-1986	37.6	1.1	-	97
1972-1973	12.6	0.3	-	98
1984-1986	52.4	2.7	-	94
1994	13.1	4.9	-	63
1995	48.3	-	6.5	87
1986-1989	15.9	-	0.7	95
1987-1989	13.1	-	2.8	79
1987-1989	18.7	-	1.4	92
1987-1991	22.1	-	2.0	91
1993	19.1	-	1.2	94
1993	13.4	-	2.4	82
1994	18.3	-	0.6	97



On a yearly basis, the amount of nitrogen (nitrates and ammonia together) leaching from one hectare of uniform landscape reached as much as about 200 kg, while from the mosaic one it amounted to only 20 kg. In the latter, higher doses of fertilizers can be applied without negative effects on water quality than in homogenous ones.



Long term investigation carried out by Institute for Agricultural and Forest Environment showed that increasing complexity of agricultural landscape mainly by introduction non productive elements like shelterbelts, strips of meadows, bushes and small midfield ponds is one of the best tools for controlling water cycling as well as chemical pollution of surface and ground water in agricultural landscape. This activity must be, of course supported by technical means.