AGRO – ECOLOGICAL PRINCIPLES FOR SUSTAINABLE AGRICULTURE

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Agriculture in all over the world is facing many challenges:

- high level of dependence on non-renewable sources of energy and their derivatives (mineral fertilizers, especially nitrogen, and pesticides etc), which are reducing the economic competitiveness of farms;
- pollution of the environment and degradation of natural resources, including soils and the danger of pollution on the whole food chain;
- reduction of biodiversity in the above – and below ground strata of the soil profile with negative consequences on ecosystem and social services provided by soils;
- lack of food security at local, regional and global levels as well as food sovereignty for people with an inadequate income;
- increased negative consequences of global warming etc.;
- rural community disintegration.

- Industrial model of agricultural intensification based on the concept of “green revolution” didn’t address many of the above mentioned challenges and consequently didn’t provide a sustainable development
- Conventional agriculture is build around two related goals: the maximization of production and the maximization of profit with the externalization of the negative consequences on the environment and health of people

Six basic practices oriented towards increasing the level of yields are used without taking in consideration their long-term consequences on the environment and health of people:

- intensive tillage, mainly moldboard plow with low diversity of crops in crop rotation and monoculture;
- Irrigation;
- application of inorganic fertilizers, especially nitrogen synthesized by industry;
- chemical pest, disease and weed control;
- high yielding varieties and hybrids with narrow genetic basis, including genetic manipulation of crop plants.

Fig. 1. Yields of winter wheat in the long-term field experiment of the RIFC "Selectia" (crop rotation and permanent crop) and in average for the Republic of Moldova, 1962-2011, t/ha

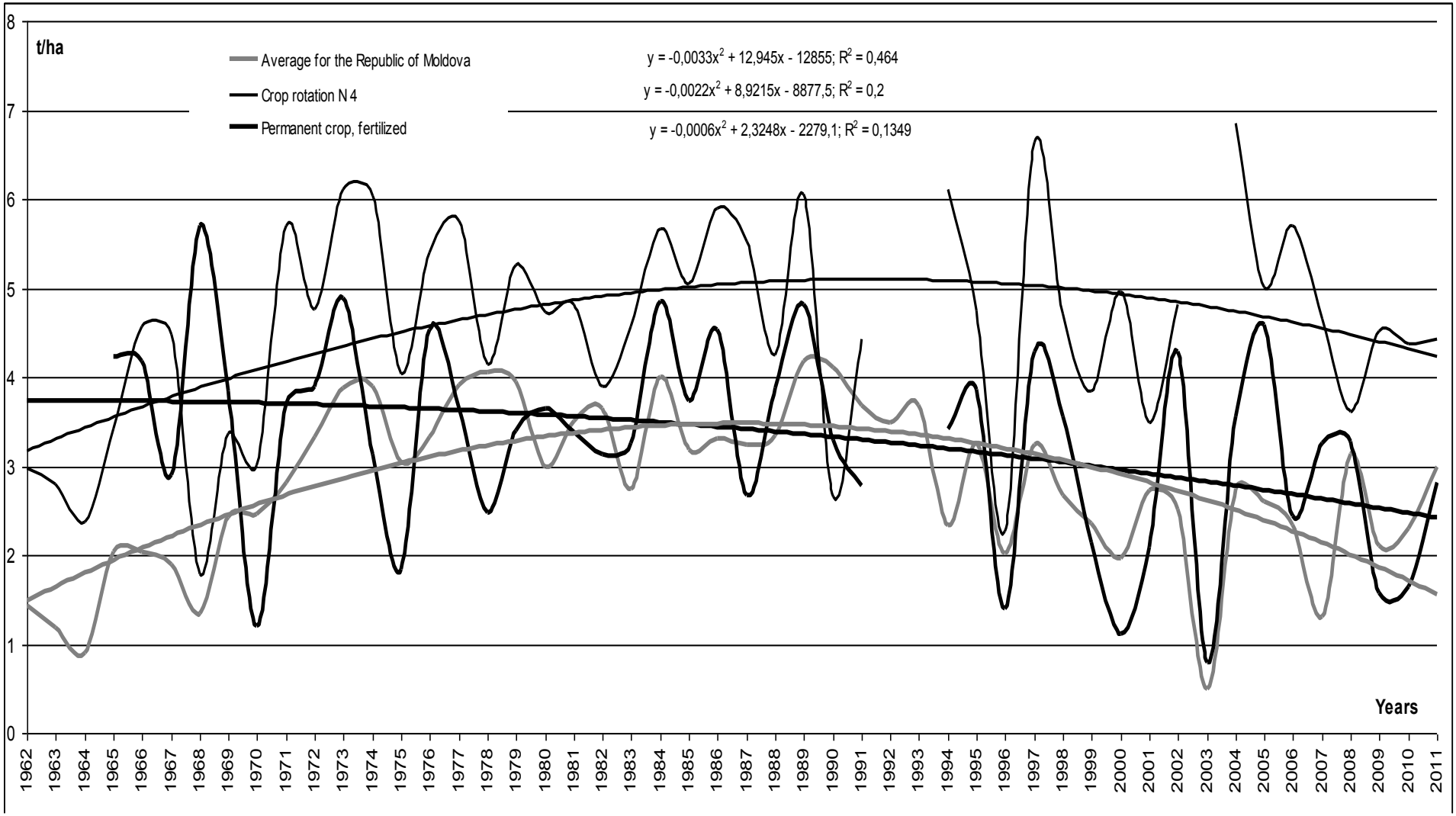

Fig. 2. Distribution of profit between the three sectors of agro industrial complex (according prof. S. Smith, 1991)

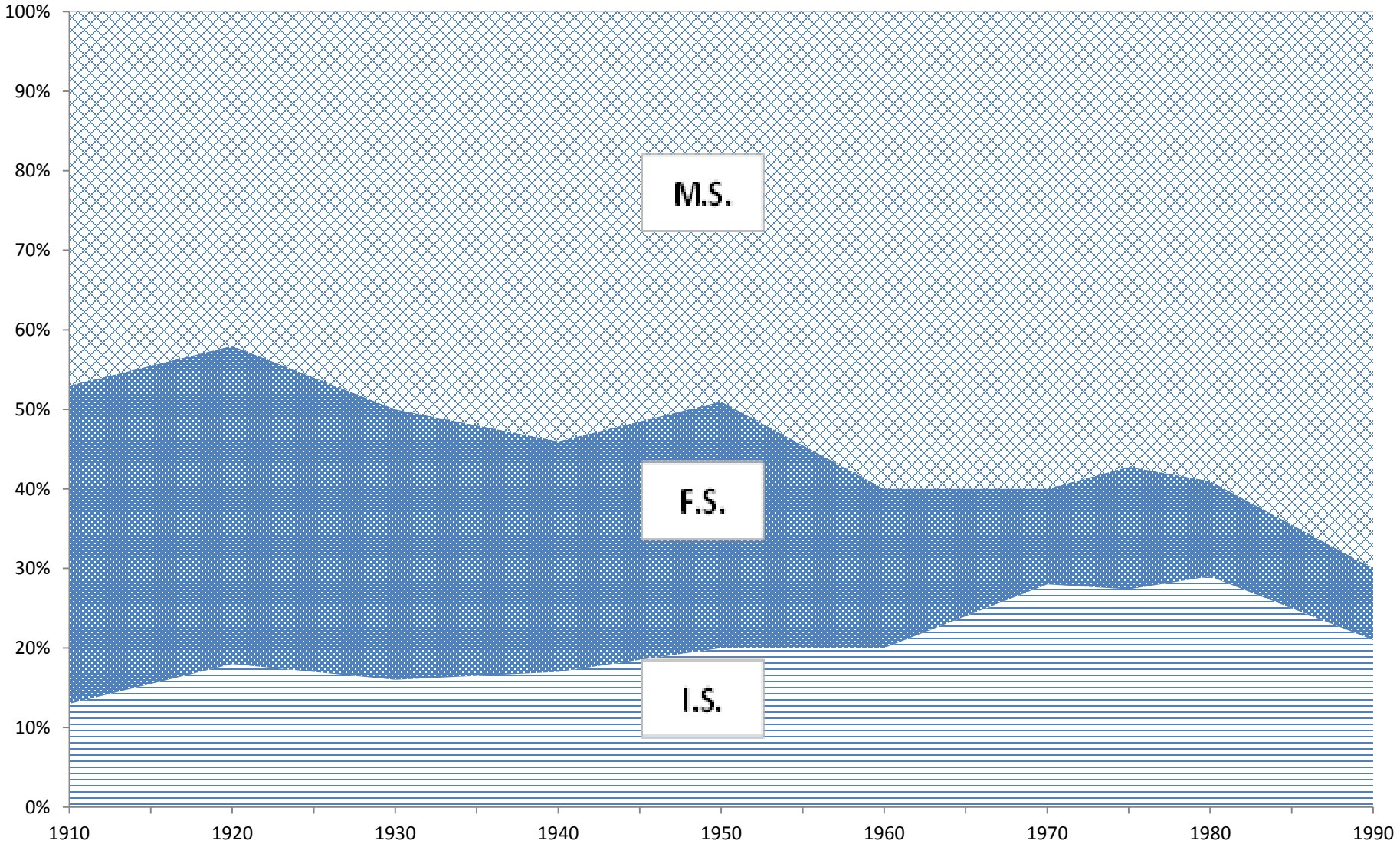

Fig. 3. The yield of winter wheat after different predecessors in crop rotation and in permanent mono-cropping, average for 1994-2011, in the long-term field experiment of the RIFC „Selectia” average for 1994-2011, t/ha and %

Predecessors	**Fertilization**		**± from fertilization**	**Yield production relatively to early harvested predecessors**	
	unfertilized	fertilized		unfertilized	fertilized
Spring vetch and oats for green mass	4,20	4,54	+0,34 / 8,1%	-	-
Corn for sillage	3,30	4,01	+0,71 / 21,5%	-0,90 / 21,4%	-0,53 / 11,7%
Corn for grain	2,57	3,59	+1,02 / 39,7%	-1,63 / 38,8%	-0,95 / 20,9%
Winter wheat (continuous crop)	1,82	2,78	+0,96 / 52,7%	-2,38 / 56,7%	-1,76 / 38,8%

Fig. 4. The share of soil fertility in yield formation (%) in crop rotation and permanent crop for winter wheat, average for 1994-2011

Systems of fertilization	CROPS						Productivity of crop rotation
	Winter wheat	Sugar beet	Corn for grain	Spring barley (postaction)	Sunflower	Spring vetch and oats for green mass (postaction)	
Unfertilized	**100**	**100**	**100**	**100**	**100**	**100**	**100**
NPK 130 kg a.i./ha	**77,8**	**63,5**	**85,1**	**64,7**	**92,7**	**80,1**	**76,8**
NPK 130 kg a.i./ha + 10 t /ha of farmyard manure	**75,2**	**56,1**	**89,1**	**54,0**	**89,3**	**70,2**	**70,4**
NPK 130 kg a.i./ha + 15 t /ha of farmyard manure	**77,0**	**50,8**	**87,0**	**46,9**	**90,7**	**62,9**	**69,6**
15 t /ha of farmyard manure	**77,0**	**57,8**	**87,8**	**54,8**	**89,8**	**71,1**	**73,3**

- Soil organic matter (humus) is an integral index of soil fertility (soil quality, soil health)
- Soil quality (soil health) is crucial in the transition to a more sustainable agriculture

- Changes in the soil structure due to compaction by heavy farm equipment suppress root development, thus reducing the quantity of soil nutrients and water that can be accessed by crops
- A decline in soil organic matter following intensive tillage can reduce the water-holding capacity of a soil, making the crop more susceptible to water deficits and drought during the growing season
- A soil with good physical, chemical and biological properties is able to produce higher yields, can generate more income than a poor-quality soil

A good quality soil can provide a better ecosystem and social services:

- Filtering and purifying water before it is released to waterways;
- Inorganic and organic pollutants can be absorbed and some can be degraded;
- Buffer for climate changes by promoting the growth of plants that sequester CO2 from the atmosphere and contributing to the humification and physical protection of carbon from plants and other organic residues;
- Healthy soil provides health for the whole chain: crops – animals – peoples;
- Changing the habits to eat will stimulate transition to a more sustainable agriculture.

Simplistic (reductionistic) approach to farm management should be replaced by holistic (systemic) approach in order to achieve a more sustanable development of agriculture. Agriculture requires as never before both techological and, especially, system modernization.

Among the agro-ecological principles to be respected for a higher resiliency to climate changes and economic uncertainty are:

- Landscape approach to land organization with differentiated land use, including the implementation of the achievements of precision agriculture
- Crop rotations with a higher species and genetic diversity of crops in time and space for longer period of time during the vegetation period, including perennial leguminous crops, better adapted to local conditions and able to restore soil fertility and soil functionality
- Integration of crop and animal husbandries for a more complete recycling of nutrients and energy in the frame of each farm etc.

Interdisciplinary researches are required with the participation of specialists from different branches of knowledges in order to work out the best alternative farming systems able to respond to challenges faced by modern agriculture.


Thank you very much
for your attention!
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