

AGRICULTURE AT THE CROSSROAD

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Agriculture in all over the world, including in the Republic of Moldova, is facing many challenges at the moment and, especially, for the future:

- Limited natural resources, including nonrenewable sources of energy (oil, natural gasses, coal) with regularly increased prices on them;
- Worsening of economic conditions for farmers activities because of unfair increased prices for industrial inputs and agricultural products;
- Providing food security at the local, regional and global levels in the conditions of higher density of population and climate change.

This issue is becoming crucial during the pandemic situations and regional or global military conflicts. That`s why food is one of the most important for achieving peace in all over the world.

- Biodiversity losses both on the surface of the soil and, especially, in the soil;
 - Soil degradation and danger of ground waters and food pollution on the whole food chain in the conditions of the globalization of economy;
 - Increased negative consequences of the global warming with more frequent manifestation of droughts (heats) and other natural calamities;
 - Rural community disintegration;
 - Increased expenses for public health (nontransmissible diseases);
- Market economy can`t and couldn`t address all these challenges.

They have appeared as the consequence of industrial model of agricultural intensification based on the concept of „Green Revolution”.

Agriculture couldn`t achieve a sustainable and resilient development because it is oriented mainly towards higher yields and profit, by neglecting the negative environment and social consequences. In other words, conventional agriculture is externalizing the negative consequences on the environment and health of people.

- Prices for agricultural products are not real prices, because they don`t take in consideration the expenses required for recovering the negative consequences on the environment and health of people. Who is paying for them?
- In the concepts of agricultural development worked out by UN and FAO there were a statement: „Agriculture as usual doesn`t work”;
- Agriculture in all over the world requires changes of the paradigm of the agricultural intensification-transition from industrial inputs to a better recycling of energy and nutrients in each farm, predominantly by using renewable sources of energy of local origin;
- Soil is treated as a substrate where water and nutrients are applied for obtaining yields. Food production is treated like an industrial process, where plants

assume the role of miniature factories: their output is maximized by industrial inputs and soil is simply the medium in which their roots are anchored;

- In reality soil is a living organism and it plays a poly-functional role by providing ecosystem and social services, which are not evaluated and the society doesn't pay for them;

- Only healthy soils can provide ecosystem and social services as follows:

- filtration and purification of drinking water;

- habitat for a higher biodiversity on the whole food chain, which provide health for the whole complex of interaction:

soil-crops-animals-people-Planet;

- Mitigation of global warming through absorption of CO₂ from the atmosphere by crops and carbon sequestration as soil organic matter;

- Natural ecosystems should serve as models for sustainable and resilient agroecosystems by respecting the following principles:

- living roots should be as long as possible in the soil in order to provide food for soil biota through root exudates;

- permanent coverage of soil with crop residues;

- avoiding mechanical and chemical disturbance of the soil in order to provide a more efficient recycling of water and nutrients;

- a higher diversity of crops (main crops and cover crops) in the crop rotation at the level of each field and at the landscape level;

- Sustainable soil management requires a higher diversity of crops with permanent supply of fresh organic residues (wastes) for continuous transformation of soil organic matter (synthesis-humification and decomposition-mineralization);

- The key issue for the agroecosystems comparatively to natural ecosystems is insufficient amount of organic matter returned back to the soil and the domination of mineralization under humification of soil organic matter as a result of:

- oversaturation of the structure of sowing areas with row crops, and especially technical crops, with excessive moldboard plowing;

- replacement of perennial crops by annual crops;

- lack of organic fertilizers and excessive use of mineral fertilizers, especially of nitrogen, which is increasing the mineralization of soil organic matter;

- Carbon sequestration is the first and the most important step in providing food security and mitigation of global warming. Carbon nutrition of the soil is more important than nutrition with NPK;

- Experimental data from the long-term field experiments at Selectia Research Institute of Field Crops are proving the crucial importance of crop rotation and soil fertility for sustainable development of agriculture (tab.1 and tab.2).

The effect of crop rotation, both on fertilized and especially on unfertilized plots, is significantly higher than the effect of fertilization, in case of sowing winter wheat after early harvested predecessors.

By sowing winter wheat after late harvested predecessors, the effect of crop rotation is decreasing, but the effect of fertilization is increasing.

Tab.1 Crop rotation effect and fertilization effect (%) for winter wheat after different predecessors, average for 1994-2020, Selectia RIFC, Balti, Republic of Moldova

	Predecessors	Fertilization		Extra yield from fertilization, t/ha	Effect of fertilization, %
		unfertilized	fertilized		
Crop rotation	Mixture of spring vetch and oats for green mass	4,46	5,05	+0,59	13,2
	Corn for grain	2,56	3,60	+1,04	40,6
Permanent monocropping	Winter wheat	1,93	2,96	+1,03	53,4
Extra yields from crop rotation	Mixture of spring vetch and oats for green mass	t/ha	+2,53	+2,09	
		%	131,1	7,06	
	Corn for grain	t/ha	+0,63	+0,64	
		%	32,6	21,6	

Tab.2 Nitrogen use efficiency by winter wheat sown in crop rotation after different predecessors and in permanent cropping, average for 1984-2020, Selectia RIFC, Balti, Republic of Moldova

Predecessors	Extra yield, t/ha	Nitrogen taken up by extra yield, kg/ha	Total amount of nitrogen taken up by yield, kg/ha	Nitrogen applied with mineral fertilizers, kg/ha	Nitrogen use efficiency from mineral fertilizers, %	The share of soil fertility in yields formation, %
Crop rotation						
Vetch and oats for green mass	0,59	19,5	167,0	90	21,7	88,3
Corn for grain	1,04	34,3	118,8	90	38,1	71,3
Permanent cropping						
Winter wheat	1,03	34,0	97,7	90	37,8	65,2

We can't afford anymore to compensate lack of crop rotation by extra amount of mineral fertilizers and pesticides.

This isn't reasonable not only from economic, but also from environment and social points of view.

Nitrogen use efficiency from mineral fertilizers is very low – 21,7 % for winter wheat sown after early harvested predecessor and 38,1 % after late harvested predecessors. It should be taken in consideration that price for nitrogen mineral fertilizers have increased at least five times during the last 10 months.

It is not reasonable from economic point of view to use only 1/3 from the applied amount of nitrogen with mineral fertilizers. Simultaneously, the other 2/3 of nitrogen is lost in the form of oxides of nitrogen which are significantly more dangerous for global warming than carbon dioxide.

It is evident that soil fertility is playing the predominant role in yield formation even by using optimal rates of mineral fertilizers.

Building soil fertility is one of the best solutions for transition to a more sustainable farming systems.

Conclusions

1. Agriculture requires a new paradigm for intensification based on agroecological principles, in order to reduce dependence from nonrenewable sources of energy and their derivatives (mineral fertilizers, pesticides, etc.);
2. Building healthy soil in the frame of crop rotation, with a higher diversity of crops, allows to reduce utilization of industrial inputs (mineral fertilizers, especially nitrogen; pesticides for weed, pest and disease control; to replace inersive by non-inersive soil tillage or No-till, etc.);
3. Agriculture can provide autonomy in suppling with biological nitrogen and energy by using methanization of the green mass of alfalfa and other crop residues and wastes for biogas production.

Literature:

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