

1.3. Action Plan for Vetch field as green fertilizer into 5 year crop rotation technology.

The technology passed through technology prioritization phase of TNA Project performed by national experts and completed through a stakeholder consultation process. The Adaptation working group of the Agriculture sector has considered the many advantages of this technology referring to simplicity in its application, as it is based on common tillage habits using relatively simple construction of plough with many benefits to environment and communities. It is also an efficient management practice oriented toward assigning to land owners the responsibility for long-term maintenance of soil quality. Diffusion of this technology will bring to Moldova's agricultural businesses and general public experience of sustainable management of natural resources, contributing to climate change resilience.

1.3.1. General description of Vetch field as green fertilizer into 5 year crop rotation technology.

Climate aridization along with classic cultivation leads to dehumification of agricultural soils, soil structure damage and strong secondary compaction of the arable layer. Currently the arable layer of agricultural soils lost its natural ability to compaction resistance. Dehumification, dissolution and secondary arable soil compaction is a global problem¹⁵, but particularly acute in Moldova where 80 percent of soils are characterized by fine texture¹⁶. These soils have a high production capacity only if their structure is agronomical favorable and contributes positively to regulate air-fluid and nutrient regimes, ensuring optimal conditions for plant growth and development. In a compacted layer of soil moisture reserves are almost by two times less accessible than in the same loose layer with agronomical favorable structure. Therefore, soils with a high content of humus, agronomical favorable structure and loose arable layer are more adapted to climate change. To adapt to increasing desertification due to dehumification, dissolution and secondary compaction of the arable layer of soil generated by climate change, 6 technologies described below are recommended.

The advantages of this technology are: common tillage habits; total incorporation vegetal waste, weeds and their seeds; reliability due to the simple construction of the plug; soil loosening effect (intensive mobilization of soil fertility, complete assurance of crops with nitrogen for 4 years due to return into the soil of about 400kg/ha of nitrogen with vetch vegetal waste; significant rehabilitation of physical quality of the soil, biological improvement of the soil. Two crops of vetch per one agricultural year accumulate about 20 t / ha of dry organic matter in the soil which ensures synthesis of 5 t / ha of humus or 2.9 t / ha of carbon. It develops a balance of humus, carbon, nitrogen and CO₂ emissions from soil. The technology can be successfully implemented by all agricultural businesses on cca 200-400 thousand ha during 5-10 years, on each field in crop rotation every year, the total area is 40 000 ha / year. This amount of humus is sufficient to create a positive carbon and nitrogen balance in soil during 5 years. The arable layer will become structured, loose, will contribute to a favorable air-fluid and nutrient regime and will increase the plants resistance to drought. Technology entails environmental friendliness of agriculture, more effective use of water and nutrients from the soil.

This technology can be successfully implemented on all agricultural lands of farmers. It can be implemented under any land cultivation system. In order to implement this technology, it is necessary to create the autumn and spring vetch seed production operation. The autumn vetch shall be planted, as appropriate, in late August or early September and spring vetch – in early May of the next year after incorporation of autumn vetch mass into the soil.

Environmental benefits. It stops soil degradation, makes the humus and soil carbon balance positive or well-balanced, cardinaly improves the soil biota status, increases resistance of soil to pollution and of plants to drought.

Social-economic benefits. The social - economic effect of this technology implementation will be the following: it will increase the turnover and quality of agricultural production on arable soils, well-being of rural population, decrease migration, create the economic prerequisites for projects to improve the ecological status of villages.

1.3.2. Targets for transfer of Vetch field as a green fertilizer into 5 year crop rotation technology

- Creating prerequisites for implementing sustainable agriculture practices on an area of 200,000 ha by introducing a "field of vetch as green manure (2 yields per year)" in a 5 field crop rotation.

¹⁵ Guj P., Rusu T., Bogdan I. *Asolamentele, rotația culturilor și organizarea teritoriului. Cluj-Napoca: Risoprint, 2004. 219 p. ISBN 973-656-566-1*

¹⁶ Cerbari V., Scorpan V., Țăranu M., Bacean I. *Remedierea stării de calitate și capacității de producție a cernoziomurilor obișnuite din sudul Moldovei sub influența unor măsuri fitotehnice. În: Mediul Ambient. Nr. 1 (61), Februarie, 2012. p. 38- 43. ISSN 1810-9551*

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- Improving the soil quality in an area of 200,000 ha, 40 thousand ha annually, by creating a positive balance of humus and carbon, and nitrogen fixation in soil as a result of systemic use of green fertilizer (autumn vetch of *Violeta* variety and spring vetch of *Moldavscaia 82* variety) on an area of 200,000 ha of arable lands. Stabilizing effect of technology will occur over 3 to 4 turns of crop rotations, by 2030 y. During 2013-2015y.y. – the technology will be tested with establishment of fall and spring vetch database.
- Restore the ecological balance in the existing agricultural systems on an area of 200,000 ha by reducing practically total CO₂ and N₂O emissions from soils as a result of biological fixation of carbon and nitrogen by the leguminous crop used as green fertilizer.
- Increase production capacity of the soils in an area of 200,000 ha as a result of improving physical, chemical and biological characteristics of anthropically degraded soils, as a result of systemic use of green fertilizer.

1.3.3. Enabling business environment of Vetch field as green fertilizer into 5 year crop rotation technology.

- Amendments to the Land Code are regarding responsibility of agricultural lessors for the soil quality. Making the long term land lease rules and the monitoring of the quality of leased soils more specific.
- Consolidation of agricultural lands into agricultural exploitations larger than 400ha managed by one operator. Sustainable profitable agriculture is only possible in big farms.
- Developing an indigenous seed pool for autumn and spring vetch. Restoring the seed pool of this crop, which was destroyed during the land reform.
- Setting up a financial incentive fund for farmers implementing technologies which ensure soil protection. Stimulate implementation of environmentally friendly agricultural technologies.
- Improving the land lease system by taking into account of the interests of owners, leasers, soil protection needs. Development of the legal prerequisites for rational farming of lands leased by agricultural businesses.
- Organization and management by the Ministry of Agriculture and Food Industry, relevant bodies of the local public administration of the process of technology implementation. Administration and organizational support in the process of technology implementation.
- Improving the soils quality control and monitoring system. It is necessary to improve the national soil research system and to create control service.
- Support from the state in ensuring the equipment necessary to implement the technology. Low interest loans and longer grace period.
- Introducing diversified crop rotation where the share of weeding crops does not exceed 50 %. To protect the soil from erosion and improve the degraded lands.

A number of services are available for technology transfer, the most important are:

- Ministry of Agriculture and Food Industry (MAFI), the local public administration organize and coordinate the large scale implementation of the technology, contribute to the restoration of the indigenous seed pool of autumn and spring vetch varieties.
- Ministry of Finance (MF) and MAFI protect the local agricultural producer on the market; create favorable conditions to sell the agricultural products.
- MAFI, Associations of Agricultural Producers ensures quality of the products by monitoring the quality in specialized laboratories.
- Companies /owners of specific machinery offer support in providing equipment.

1.3.4. Barriers to the technology's diffusion

Economic and financial

- Scarcity of investment capital
- Lack of finance at low interest rates
- Lack of financial possibility to create a fund for stimulation of agricultural businesses which use green fertilizer.

Market imperfection

- Poor market infrastructure
- Poor quality products, lack of operation and maintenance.
- Lack of interest from businesses for improving the quality of the soil.
- The absence of market prices for the environmental benefits of soil improvement works

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- Lack of co-ordination among different interest groups.

Policy, legal and regulatory

- Insufficient legal and regulatory framework.
- Policy intermittency and uncertainty.
- Lack in the Land Code of provisions about the lessor's responsibility for the quality of the leased soil, in the chapter on lease of agricultural lands.

Network failure

- Lack of involvement of stakeholders in decision making.
- Weak connections between actors.

Institutional capacity

- Small Size farms
- Indifference of local public administration about the quality of communal soils.
- Lack of standards and indicators to assess the quality of soils.

Information and awareness

- Lack of awareness about issues related to climate change and technological solutions.
- Unawareness of the relevant bodies of local administration, local business and local population about the need to have an organic matter flow in soils to maintain quality and productivity capacity of the soils.

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Table 1.3.1 Proposed Technology Action Plan for *Vetch field as green fertilizer into 5 year crop rotation technology*

S. No.	Measure	Why the measure/action is needed	Who (government agency, private sector, etc.)	Mode of implementing (How should they do it?)	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost how it can be funded	Indicators of success, risks
1	Develop a system of economic incentives for agricultural enterprises that use manure and green fertilizers.	Incentives for farmers to improve and maintain in the long run the soil quality by increasing the flow of organic matter in the soil.	This system has to be developed by the Ministry of Agriculture and Food Industry jointly with the Ministry of Environment and Ministry of Economy.	By setting up a special financial facility or fiscal policy aimed at reducing taxation for those who implement the technology.	Starting with 2015 y.	Payment of 500 mdl / ha / year to the farmer for technology implementation.	<ul style="list-style-type: none"> ✓ Available financial support for implementation of technology that increases soil resistance to climate change. ✓ Keeping the long-term fertility and the production capacity of the soils for agriculture production. .
2	To reduce/ exempt for profit taxes farmers investing in good agricultural practices, including procurement of equipment.	Tax policy benefiting the farmers who implement the technology will help to spread the technology faster and successfully.	MAFI and ME jointly with local administrations.	Drafting a special law or regulation approved by the Government.	By 2015 y.	Exempting from income tax the farmers who implement this technology: 22,000 for the second year of operation, 15,700 mdl for III year; 7,540 mdl for the IV year; 1,400 mdl for the V year.	<ul style="list-style-type: none"> ✓ Faster and wider implementation of technology on arable land. ✓ Projected are for technology implementation within the terms set.
3	To provide subsidies for farmers implementing climate technologies.	To get farmers interested in implementing environmental friendly practices.	MAFI and ME jointly with local administrations.	Development of a regulation approved by the Government of RM.	By 2015y.	1500 mdl/ha – cost of seeds.	Faster and wider implementation of the technology on arable lands.
4	Increase accountability of	To reduce the risk of anthropogenic	MAFI , Agency for Land Relations and	Building farmers' awareness regarding	Continuously	100,000 mdl / year for the awareness	Informing the farmers

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	farmers for long-term maintenance of soil quality.	degradation of arable soils in farming practices and increases their resistance to drought and other climatic changes.	Cadastre (ALRC) through subordinated institutions.	personal responsibility for maintaining long-term soil quality.		campaign for farmers on responsibility for maintaining soil quality. Support from local mayoralty, extension service ACSA, grants.	that land, though privately owned, is also a wealth of all the people, and they bear responsibility for maintaining this wealth.
5	Provisions on soil management responsibilities in the Land Code and in the Law of the Republic of Moldova on Environmental Protection.	To specify by law the responsibility of farmers for the soils quality.	MAFI , Agency for Land Relations and Cadastre (ALRC)	Supplementing the Land Code with a paragraph providing for penalties for degradation and deterioration of agricultural soils	By 2015y.	Financial means from the ALRC budget for development of land legislation 5,000-8,000 mdl for each legislative initiative	It will become binding for agricultural businesses, land lessors to use soil protecting agricultural technologies
6.	Accountability assessment by introducing some specific points in the Land Code Act and the Moldovan Law on Environmental Protection.	Farmers to assign responsibility for long-term maintenance of soil quality.	Land and Soil Protection Directorate commonly with State Environmental Inspectorate.	By developing these points and their adoption by the Parliament.	By 2015y.	5,000-8,000 mdl for each legislative initiative.	Will increase the responsibility of the governing bodies and farmers to protect soil quality.
7.	Make the agricultural businesses and general public aware about the	For private farmers awareness and heads of agricultural enterprises on agricultural	MAFI, ACSA, rural entrepreneurs.	Organizing workshops, seminars and round table with rural entrepreneurs.	Annually, during the cold weather of the year.	10,000 mdl for a seminar.	Farmers will be informed of environmentally friendly agricultural practices.

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	environmentally friendly practices.	environmentally safe techniques.					
8.	Develop the logistics for the procurement by agricultural producers of equipment for climate technologies.	In order to correctly organize the purchase of equipment for farmers implementing green technologies.	MAFI, rural entrepreneurs, farmers.	By organizing tenders for equipment vendors.	2015-2030y.y.	According to existing prices.	Providing the necessary equipment to farmers to promote environmentally friendly agricultural practices.
8.	Cadastre Agency intensifying land consolidation process.	To build a system of profitable, environmentally safe modern agriculture (conservation) on consolidated lands	MAFI, Agency for Land Relations and Cadastre (ALRC) jointly with local public administration.	By cooperating with private land owners.	10-20 years	Continuity of "Land consolidation" project implemented by ACSA and funded by the World Bank and FAO.	Farms with an area greater than 200 ha suitable to implement modern agriculture and soil protection systems.
9.	Improve R&D in soil science.	To implement soil protecting conservation agriculture system.	MAFI through subordinated institutions.	By financial and scientific support of agricultural producers.	10-20 years	1,000, 000 mdl/year from the state budget or from grants. Funding by ALRC.	Protecting soils from degradation processes.
10.	Assure efficient coordination between main actors of organic and green fertilizers chain.	To gradually implement sustainable, ecologically safe agriculture in the	MAFI	Coordinating the process of technology implementation	10-20 years	Within the salary limits of MAFI staff	Control and effective coordination of the said technologies implementation process

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11.	Organize national and regional networking groups for farmers interested in promoting climate technologies.	To create a system of conservative agriculture profitable, environmentally safe, based on households' own resources.	MAIF, National Farmers Federation of Moldova.	By working with private land owners.	10-20 years	100,000 mdl annually to promote and implement the technology.	Collective farmers jointly promote and implement technology to help restore soil quality and increase their resistance to pedological drought.
12.	Promote training Programmes on education in soil management.	To train specialists in the proper management of soils, primary input in agriculture, the main natural wealth of the country.	MAFI through subordinated institutions SAUM, profiles Ecology, Plant Protection, free tuition.	Setting up of extension centres within agricultural research and education institutions to improve farmers' knowledge on proper management of soils in the farming process.	5 years	Within the financial resources allocated for education and research.	Farmers with rich knowledge on the proper management of soil resources in the farming process.