Land owners /farmers: Activities 1, 2,3,4,5

- ✓ Farmers will be the main actors of implemented activities and also beneficiaries of the Project.

Laboratory testing Institution: Activities 6,10.

- ✓ Perform soil testing analysis

RIFC "Selectia", ACSA, SAUM: Activities 5, 10, 11

- ✓ Provide training for farmers on use of varieties of seeds for crop rotations.
- ✓ Establishment of demonstrational plots at RIFC" Selectia" for on-going adjustment and technological support provided to farmers/land owners involved in the Project.
- ✓ Provide consultancy on site specific application of technology

The State Hydro Meteo Service will provide weather forecast.

1.3. Project Idea "Vetch field as green fertilizer into five- year crop rotation" .

Introduction

The classical tillage system cannot be replaced by soil conservation works on circa 30% of arable lands[11] because of specifics of crops (fodder beets, vegetables etc.) growing, as well as for other reasons. This system mandatorily implies moldboard ploughing at 20-35 cm depth, which turns over the topsoil layer (furrow), and ensures preparation of a fine seedbed. The classical tillage system, although resulted in a gradual increase of agricultural output, caused the phenomena of soil characteristics degradation. Excessive cultivation of lands favoured dehumification, damaged the soils structure, increased the danger of erosion. Heavy and frequent traffic increased compaction and, consequently, triggered other negative phenomena.

Predominantly, Moldova has fine textured loamy-clay or clay-loam soils (up to 80% of the total area). The arable layer of these soils, as a rule, is deconstructed and lacks resistance to compaction. Because until 1990 soils were mainly ploughed to a depth of 35cm, while now the soil is tilled not deeper than 10-20 cm, a very compact post-arable layer has formed under the recently arable layer.

The main cause of soils characteristics degradation in the classic tillage is dehumification.[12] 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 problem[13], but particularly acute in Moldova where 80 percent of soils are characterized by fine texture[14]. 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.

Under circumstances when manure is underused as fertilizer (10-20 kg / ha / year according to statistics) and scarcity of fertilizers (20-30 kg / ha / year active ingredient), in order to reduce the process of dehumification, damaging the structure, strong compaction of the arable layer and increase resistance to compaction and soil erosion, it is recommended to include in a 5 fields crop rotation based on classical tillage, a field occupied by an annual leguminous crop - autumn and spring vetch (2 vetch yields incorporated into the soil as green fertilizer once in 5 years on each

[11] *Nicolaev Nionila, Boincean B. Agrotehnica. Bălți: Presa universitară bălțeană, 2006. 298 p.*
[12] *Boincean B.* Lucrarea solului - tendințe şi perspective. În: Academos, nr. 3(22), 2011, p. 61-66.

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

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

field). The crop rotation structure may be as follows: vetch field → winter wheat→ corn → winter wheat or barley → sunflower. It is necessary to note that vetch, as green fertilizer, can be used in all basic soil cultivation options.

The advantages of this technology are the following:

- ✓ the population is used to tillage practices;
- ✓ total incorporation of crop residues, weeds and their seeds;
- ✓ safety in operation due to simple construction of the plough;
- ✓ the effect of soil loosening and intense fertility mobilization;
- ✓ the crops are fully provided with nitrogen during 4 years due to return in soil of about 500-600kg/ha nitrogen with crop residues and vetch roots;
- ✓ Considerably restores physical quality and improves biological condition of the soil.

Sidereal annual legume crops, as a mandatory component part of a crop rotation scheme where one field is occupied by vetch (two yields per year incorporated into the soil as green fertilizer), enrich the top layer of the soil with high quality crop residues which are very rich in nitrogen (the yield of dry air mass reaches 7-8 tons / ha, containing about 4-5% nitrogen), cause intensification of biological processes of humification (and the main crop residues with low content of nitrogen), and formation of new active organic matter, which leads to the accumulation of nutrients, formation of valuable agronomic structure, reducing topsoil layer compaction[15]. Organic carbon reserves, biological activity, above ground and underground biodiversity and soil structure are increased and improved. The need for fertilizers and soil restoration interventions decreases. More intense biological activity results in formation of well-connected macro biopores, mainly vertical, which increase water infiltration and resistance to intense mechanical compression.

Two crops of vetch in an agricultural year accumulate about 20 -24t/ha of organic matter dry in soil (residues of the air mass and roots) containing about 3.0% nitrogen. This amount of nitrogen-rich organic matter in soil ensures synthesis of about 6 t/ha of humus or 3, 5 t/ha of carbon. It provides for a good balance of humus, carbon, nitrogen and CO2 emissions in soil. In terms of adaptation benefits, the arable layer becomes looser, with higher resistance to compaction and erosion. The arable layer of loose soil, enriched with new organic matter is characterized by high water capacity and is more resistant to pedological drought than a soil with a compact arable layer.

The Project idea was developed within TNA Project Republic of Moldova Technology Needs Assessment and Analysis of Barriers and Enabling Framework for Climate Change Adaptation based on the technology with similar title and content, passing assessment, prioritisation, barrier analysis applying Logical Problem Analysis (LPA), Problem tree, Objective tree, economic-financial analysis, market analysis using market mapping approach, development of measures as TAP to technology diffusion. The methodological guidance of climate change Technology Needs Assessment was received from UNEP Riso Center and Asian Institute of Technology (AIT), Bangkok, also following a number of methodological sources elaborated by *UNEP RIso Centre, UNDP,* Asian Institute of Technology, Climate TechWiki website.

The Project idea was elaborated by national experts of TNA Project in consultation with stakeholders, representatives of the Ministry of Environment (ME) and Ministry of Agriculture and Food Industry (MAFI), business, and academia representatives. Proposed Project idea is directly related to adaptation targets set for Agriculture sector of Moldova and is consistent with the existing policy framework.

Objectives of the Project

The main objectives of the Project is to assist poor resourced framers of Moldova to stop soil degradation, restore soil physical quality, increase soil productivity, make the humus and soil carbon balance positive or well-balanced, improve the soil biota status, increase resistance of soil to drought.

- ✓ Promote soil erosion control through applying vetch field as green fertiliser into five-year crop rotation, which will ensure more competitive agricultural products both by quantity and quality, lower costs and higher profit, due to the improved soil characteristics and functions, and environmental protection factors.

[15] *Cerbari V., Ciolacu, Tatiana. Metode fitotehnice de remediere a însuşirilor degradate ale cernoziomurilor. În: Academicianul I.A.Krupenikov – 100 ani. În: Culegere de articole ştiinţifice. Red.resp.: Tamara Leah. Ch.: S.n. (Tipogr. „Elan Poligraf" SRL), 2012, p. 62-68. ISBN 978-9975-66-231-4.*

- ✓ To apply sustainable farming practice adapted to specific type of soil and requirements to main cops planted in Moldova on the area of 200, 000 ha in conditions of conventional tillage system (by ploughing).
- ✓ Restoration of degraded characteristics of the arable and underlying layer of soil at 0-35cm depth on lands to be used for phased implementation of the 5 field crop rotation scheme with one field sown twice a year with winter vetch and spring vetch as "green fertilizer", annually on the area of 40 000 ha;
- ✓ Developing a system for monitoring the soils evolution process (data banks) under the influence of the organic mass of stems and roots of 2 vetch yields incorporated into the soil as green fertilizer.

Outputs.

Project outputs are:

1. Stopped soil degradation, restored soil physical quality, increased soil productivity, positive or well-balanced content of humus and soil carbon balance, and improved the soil biota status, increased resistance of soil to drought.
2. Established soil erosion control through applying vetch field as green fertiliser into five-year crop rotation, improve soil characteristics and functions and environmental protection factors.
3. Applied sustainable farming practice adapted to the type of soil and requirements to main cops planted in Moldova on the area of 200, 000 ha in conditions of conventional tillage system (by ploughing).
4. Restoration of degraded characteristics of the arable and underlying layer of soil at 0-35cm depth on lands using for phased implementation of the 5 field crop rotation scheme with one field sown twice a year with winter vetch and spring vetch as "green fertilizer", annually on the area of 40 000 ha;
5. Developed monitoring system of the soils evolution process (data banks) under the influence of organic mass of 2 vetch yields incorporated into the soil as green fertilizer.
6. Developed recommendations to improve the conventional soil tillage systems taking into account local conditions of soil, climate, and endowment with machinery, equipment and materials, to widely disseminate the proposed technology.

The aforementioned outputs are measurable based on soil indicators, data collected, sustainable practices applied:

1. Assessment of the degree of degradation of soils exploited until now under the conventional tillage system involving ploughing ("base-line", beginning of the project state).
2. Evaluation of soil fertility status using soil fertility indicators to establish the level of recovery of soil organic matter as integral index of soil fertility;
3. Evaluation of soil physical, chemical and biological properties and identification of soil quality changes under sustainable practice of green fertilizer application in different zones of Moldova.
4. Sustainable practices of vetch filed into five-year crop rotation incorporated into soil management of various types and relief location on the area of 40, 000 ha annually in 2 cycles of application of the proposed technology. Establish the relationship between soil characteristics and intensity of cropping.
5. Restored characteristics of soils on the total area of 200, 000 ha using soil testing indicators and their comparing with the "base-line" state of soil quality.
6. Developed databank on soils evolution process under the influence of organic mass of 2 vetch yields incorporated into the soil as green fertilizer.
7. Developed and disseminated recommendations to improve the conventional soil tillage systems taking into account local conditions of soil, climate, and endowment with machinery, equipment and materials.

Relationship to the country's sustainable development priorities

The Project meets the objectives of the National Sustainable Development Strategy for the agricultural sector of the Republic of Moldova (2008-2015)[16], approved by Government Decision no. 282 of 11.03.2008 and contributes to addressing the problems listed in the Soil Fertility Conservation and Enhancement Program for 2011-2020, approved by the Government Decision no. 626 of 20.08.2011[17].

Project Deliverables

1. Implemented technology of crop rotation with vetch plants as green fertilizer, planted on one field once per 5 year. The system will ensure agricultural production competitive by quantity and quality, generating higher profits due to improved soil characteristics and functions on the area of 40 000 ha annually, for a total area of 200 000 ha of arable land during project lifetime.
2. Replacement of chemical fertilizers with nitrogen green fertilizers rich in biological nitrogen (60% of symbiotic origin), which will increase the agricultural output of high quality. Positive balance of humus, carbon and nitrogen in soil;
3. Comparative analysis of soil fertility indicators.
4. Increased profitability of agricultural production process by 30% due to improved soil characteristics an applying of on-site specific crop rotation with vetch as green fertilizer, planted on one field once per 5 year (2 yields in an agricultural year), 2 cycles of technology during 10 years.
5. Accumulation in soil, on the account of organic waste and roots of the 2 yields of vetch, of about 6 t / ha of humus (3.5 t / ha of carbon) and 600 kg / ha of nitrogen;
6. Restored soil characteristics of degraded arable layer of 0-35cm; improved indicators t of organic matter, structure, porosity; water permeability will increase and soil erosion hazard will decrease; decompaction and loosening of arable layer, increased field capacity for water and reduced danger of pedological drought. These changes will result into stabilised economic, ecologic and social rural life of Moldova's villages.
7. Developed databank on soils evolution process under the influence of organic mass of 2 vetch yields incorporated into the soil as green fertilizer.
8. Developed and disseminated recommendations to improve the conventional soil tillage systems taking into account local conditions of soil, climate, and endowment with machinery, equipment and materials

Project Scope and Possible Implementation

The project can be implemented by any farm which uses ploughing in basic cultivation of soil, has crop cultivation machines, able to allocate land for a field sown with vetch (2 yields incorporated into the soil as green fertilizer) in a five-year crop rotation. Minimum size of farms is 200 ha however, a 5000 ha arable land better suits the implementation of technology.

Due to the circumstances, that in Moldova soils were overexploited, their current conditions is advanced degradation. For soil recovery the application of one field of vetch as green fertilizer once per five year is not sufficient to restore soil's good properties therefore, the proposed technology will be applied in 2 cycles: 5 year time per each cycle for a total area of 200, 000 ha,(40, 000 ha annually) then repeatedly applied during next 5 years. In terms of climatic conditions, relief and soil type, this system can be implemented in all climate zones of the country with site specific management. Considering that soil erosion and degradation is a common issues of all arable land in country , the successful implementation of Project idea will lead to adoption of this technology on other arable degraded land.

The Project idea is feasible, as it is based on common, previously applied in Moldova's agriculture production techniques. The management of implemented activities require continuous consultancy, which will be provided by Project consultants during Project lifetime.

[16] *National Sustainable Development Strategy for the agricultural sector of the Republic of Moldova (2008-2015), Government Decision no. 282 of 11.03.2008. www.maia.gov.md*

[17] *Soil Fertility Conservation and Enhancement Program for 2011-2020, approved by the Government Decision no. 626 of 20.08.2011. www.maia.gov.md*

The Project idea feasibility increases if investments funding will be provided as grant funding, the farmers benefiting on training, consultancy and technical assistance free of charge and equipment purchased under the project to remain in their own use.

Project activities

During the Project lifetime the following main activities will be implemented:

1. Develop Project activities time schedule and implement them accordingly.
2. Provide the basic training for farmers adopting proposed sustainable practice and review the need for training annually.
3. Acquisition of dedicated equipment and machinery.
4. Acquisition of vetch seeds for sowing the fields incorporated into site-specific crop rotations.
5. Implement technology of five-filed crop rotation with vetch plants as green fertilizer, planted on one field once per 5 year on the area of 40,000 ha annually. Sawing of basic crops of site-specific crop rotation, sawing of vetch plants, management of activities.
6. Continuous support and consultancy for agricultural producers' farmers to allow incorporation of a vetch field into site specific crop rotation. Sowing of winter and spring vetch plants, incorporation into the soil of vetch green mass.
7. Collect soil samples and perform soil testing analysis periodically to determine the effect of applied technological practices on soil quality. Perform comparative analysis of soil indicators during Project lifetime.
8. Comparative analysis of crop yields during implementation of the Project.
9. Organize national and regional networking groups for farmers interested in promoting climate technologies.
10. Assure an efficient coordination between the main actors of green fertilizers chain.
11. Develop a databank on soils evolution process under the influence of organic mass of 2 vetch yields incorporated into the soil as green fertilizer.
12. Public awareness on soil erosion issues and dissemination of information about implementing of environmentally friendly practices.
13. Dissemination of project achievements.
14. Monitoring and evaluation of project activities.

Timelines (What are the timelines e.g. one quarter, one year, multiple years?)

The project has a timeline of 10 years, 5 year time per first cycle for a total area of 200, 000 ha; 40, 000 ha recovered annually. The cycle will be repeatedly applied during next 5 years for full recovering of eroded soils.

Budget/Resource requirements

Considering the total timeline of the Project being 10 years, the costs distributed per year are provide in the table 1.3.1

Table 1.3.1. General analysis of costs for an area of 40 thousand ha

Category of indicators	Year I	Year II	Year III	Year IV	Year V	Year VI	Year VII	Year VIII	Year IX	Year X
Capital investments***, thousand €	4000	0	0	0	0	0	0	0	0	0
Material costs*, thousand €	4576	4576	4576	4576	4576	4576	4576	4576	4576	4576

Labour retribution fund **, thousand €	60	60	60	60	60	60	60	60	60	60
Total, thousand €	8636	4636	4636	4636	4636	4636	4636	4636	4636	4636

*This category was determined only cost diesel fuel consumption and wear and tear of machinery, including repair and maintenance. Usually, it is considered worth 10% of the total investment amount.

the respective calculations.

**Compulsory medical insurance and pay for mandatory health insurance were considered.

*** Refers to capital investment cost of choppers to incorporate vetch mass into the soil. Operating period of aggregates- up to 10 years.

Thus, the total cost of 10-year implementation of the technology is 50, 362,000 €. However, the cost-benefit analysis of the Project (table 1.3.2) shows net benefits starting with year 2 of the Project. Annual farm net benefit exceeds considerably the implementation costs of the technology and expenses could be covered by operation benefits. The technology is developed based on grain yield growth over 5 years in the rotation sowing vetch rotation in the first year. Income from operating activities is a fleet size due to changes in grain commodity price influence depending on natural conditions, the market, the production obtained. Thus, for the Project implementation it is necessary to consider first year expenses, including capital investments, material costs(seeds costs, fuel costs, fixed assets wear), labor retribution costs, with a total of 8, 636,000 €.

Table 1.3.2. Operational costs and benefits of *Vetch field as green fertilizer into 5 year crop rotation* technology for first cycle (5 years)

Category	Year 1	Year 2	Year 3	Year 4	Year 5
Benefits from operation th, €	0	16200	12960	8640	5400
Operational costs th €	4636	4636	4636	4636	4636
Net benefits, th €	-4636	11564	8324	4004	764

Additionally to technological costs, Project activities costs are to be added (farmers training, consultancy, recommendations publishing, public awareness campaign, laboratory work, establishing of farmers' network, other costs) at estimated amount of 500,000 €. Thus, the total estimated costs of the Project are 9, 136,000 €. Detailed budget with costs per activity will be elaborated during Project proposal development.

Measurement/Evaluation

- ✓ During the implementation of the Project the regular evaluation to assess progress made will be performed using project management indicators.
- ✓ The evaluation of farmers' abilities to individually implement the whole farming system.
- ✓ Evaluation of soil quality indicators during Project lifetime.
- ✓ Cost/benefits analysis of applied technologies in crop rotations. Comparative analysis with similar indicators of conventional agriculture without applying vetch filed.
- ✓ Comparative analysis of crop yields during implementation of the Project.
- ✓ Final Project evaluation and accountability to assess its efficiency and effectiveness.

Possible Complications/Challenges

Possible complications :

- ✓ Insufficient legal and regulatory framework;
- ✓ Lack of involvement of stakeholders in decision making;

- ✓ Lack of investment for procuring the equipment and organization of local production of vetch seeds;
- ✓ Low interest of land owners in maintaining long-term quality status and production capacity of soils;
- ✓ Lack of economic incentives to encourage farmers to use green fertilizers in order to maintain long-term quality status of soil;
- ✓ The mentality of rural population that crop cannot be incorporated into the soil as organic fertilizer;
- ✓ Lack of awareness by farmers of organic fertilizers' role in maintaining the quality status and production capacity of soils;
- ✓ Government insufficient efforts on consolidation of fragmented land;
- ✓ Low discipline in terms of accurate and timely fulfilment of all technological operations necessary for the proposed tillage system.

Responsibilities and Coordination

Ministry of Environment (ME) (Implementation Unit of the Project, IUP) will be the responsible institution for Project coordination, management and implementation. Implemented activities will involve also other stakeholders, sectorial institutions, land owners, researchers : Activities 1-12.

Ministry of Agriculture and Food Industry (MAFI),local public administration: Activities - 8, 11,12

- ✓ Organize and coordinates the large scale implementation of the technology, contributes to the restoration of the indigenous seed pool of autumn and spring vetch.
- ✓ Develop informational marketing, organizes training of agricultural professionals.
- ✓ Organise consolidation activities of agricultural lands into agricultural exploitations larger than 400 ha managed by one operator.
- ✓ Organize national and regional networking groups for farmers interested in promoting climate technologies

Land owners/ farmers: Activities 2,5,6,9.

Farmers will be the main actors of implemented activities and also beneficiaries of the Project.

Laboratory testing Institution: Activities 6,10.

Provide soil testing analysis.

Companies /owners of specific machinery: Activities 3

Support in providing equipment.

RIFC,"Selectia", ACSA, SAUM: Activities 5,11

- ✓ Provide business consultancy for agricultural producers.
- ✓ Create awareness and provide training for agricultural professionals at the local and national level.

The **State Hydro Meteo Service** will provide weather forecast.

Chapter 2. Project Ideas for Human Health Sector

2.1. Brief summary of the Project Ideas for Human Health Sector

The impact of weather on human health, particularly summer heat waves, has become an issue of increased significance for Republic of Moldova's population. Despite emphasis being placed on the health problem caused by heat waves in Moldova, little effective measures have been adopted and not being fully utilized. Therefore, the implementation of ***Provisional posts of medical emergency care and prompt rehabilitation during critical periods of waves*** health care measure is seen as innovative, adaptation action to avoid heat stress and dehydration during periods of hot weather, particularly in urban areas. In the *Introduction* part of Proposed Project idea are summarized key issues and challenges related to heat impact on population health, which are convincing arguments for implementing protective measures against adverse impact of climate change.

The Project idea has been developed within Republic of Moldova TNA and Analysis of Barriers and Enabling Framework for Climate Change Adaptation Project based on health are measure with similar title. The original health care measure of TNA had a wider coverage including district level towns, while proposed Project idea covers two big municipalities: Chisinau and Beltsy. The Working group of Human Health sector has considered starting implementation in two locations as a pilot version of Project, as these two cities urgently need the implementation of this health care measure due to exacerbating temperatures during summer time. Also despite its simplicity, the proposed Project Idea requires much cross-sectorial management, that is time and efforts consuming action therefore, it was considered better to concentrate on the urgent need of two cities, get experience on implementing this health care measure, then to expand over the all country. The idea was elaborated by national experts of TNA Project in consultation with stakeholders, representatives of the Ministry of Environment (ME) and Ministry of Health (MH), business, academia representatives. Proposed Project idea is directly related to adaptation targets set for Human Health sector of Moldova and is consistent with the existing policy framework and will directly contribute toward implementation of Technology Action Plan.

During the TNA Project were identified constraints and barriers to public health adaptation, arising from uncertainties of future climate and socioeconomic conditions, as well as financial, technological, institutional, social and individual cognitive limits. Among the barriers facing the diffusion of health care measure, a leading cant occupies the financial resources of the health care sector. Another significant barrier is the lack of regulations at the state and local level of complex emergency assistance (primary health care and social assistance) in cases of emergencies, including heat period. These and other barriers have been considered during development of Project idea.

The enabling environment of proposed health care measure relies on the Government contribution trough development of appropriate policies and regulations. Also it was analyzed from many viewpoints within TNA Project: country specific circumstances, characteristics of temperature and drought effects, health care measure capacity, physical space, personnel availability and skills, regulatory requirements for implementation of measure, policies to support adaptation to rising temperatures, sectors available infrastructure, other factors.

It was assumed, that proposed health care measure will be provided by a budgetary funded health care agency/organization, international funding organization, or based on donations, charity organizations, voluntary approach of NGOs. Therefore, the services provided would be free of charge. For this reason, it is seen as free of charge activity and the economic- financial analysis performed during TNA project was done for non-profit version.

Provisional points of medical emergency care will be served by the institutions subordinated territorial Health Centers. Costs for health care are assured by the National Company for Health Insurance (NCHI), operating on the basis of the law on compulsory health care insurance, Nr. 1585 from 27. 02. 1998.

Implementation of Project idea will contribute to saving lives and adapting of population to extreme temperatures generated by climate change. Being a short term and inexpensive, this measures will be very efficient during critical periods of heat waves. This measure is essential in the process of adapting to climate change.