2.2. Implementation of conservative technologies, with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer

2.2.1. Introduction/Background

Project implementation is the R. of Moldova, Agricultural soils. The following main challenges the project seeks to address:

a) To stop degradation and erosion of agricultural soils. Arable agriculture in Moldova mostly uses conventional land and crop management technology, such as ploughing the soil, several subsequent cultivations and crop establishment with seed drills. While such techniques have worked, they are no longer sustainable due to the negative impact they have had on the soil quality, damaging effects being soil erosion, loss of organic matter, soil compaction and other. During 1990-2010 years, when the transition from the planned to market based economy was promoted, the negative soil balance was recorded with up to 0.6-0.7 t of carbon/he losses;

b) To maintain and increase agricultural crop while climate is changing. During the last period high frequency of extreme natural phenomena and exceptional situations in Moldova agricultural sector (heavy rains, hail, freezing, floods, droughts) have been recorded and that has made very instable plant production during the years;

c) To fulfill country commitment on GHG emission reduction, established in Annex II of Copenhagen Accord. Nowadays, according to the calculations made, from the 0-30cm of soil layer 0.65 tone of humus/he or 0.38 tone of carbon/he is lost each year, equivalent to 1.4 tone of CO2/he emissions in atmosphere.

To reach these goals friendly practices to the soils should be applied, they leading to organic substance stocking in the soil, finally contributing to enough humus creation in the land. Three technology have been selected by working group for further promotion, as ones distinguished by reaching progressive soil conservative effects, namely:

- No till soil cultivation system with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer (NTV).
- Mini-Till soil cultivation system with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer (MTV).
- Classic tillage, including a vetch field (two yields per year – autumn and spring), as a „green fertilizer field" into a 5-fields crop rotation (CTV).

The main reasons why NTV, MTV and CTV technologies were identified as ones priority measures for Moldova Agriculture sector are derived from the fact that they ensure long term maintenance of soils fertility – the main production means of the country, and protect the farmlands from desertification. These technologies share the same barriers as they represent three possible land cultivation techniques that can reduce GHG emissions and minimize the degradation of soil quality. All the technologies apply vetch as a „green fertilizer field" into a 5 fields crop rotation; they differ mainly by the depth of tillage applied and

degree of agriculture waste conservation into the soil. The farmers' choice of one of the technology depends on their local tradition, machinery availability and level of precipitation. For example, in the country south part droughts predominate, NTV being the most recommended technology.

2.2.2. Objectives

- The target is to achieve the diffusion of NTV, MTV and CTV technologies over a total area of 600,000 hectares, which constitutes 36% of total country arable land. It is forecasted 200,000 hectares be involved per each of three technologies, 20,000 hectares each year, during 10 years, starting with 2014 year. As a consequence a positive balance of humus and carbon, and nitrogen fixation in soil will be created as a result of systemic use of green fertilizer (autumn vetch of *Violeta* variety and spring vetch of *Moldavscaia 82* variety), leading to reducing practically total CO2 and N2O emissions from soils.

2.2.3. What are the outputs and are they measurable?

- Carbon conservation and humus increasing in the soil. The share of carbon in the soil can be measured by applying all known methods of laboratory analysis (ERASC 2002).
- Agricultural crop per hectare. Their quantity will be determined by scales and then compared to the crop obtained at the same lands in the past.
- GHG emission abatement. CO2 emission reduction will be calculated based on the appropriate UNFCCC CDM Methodologies.

2.2.4. Relationship to the country's sustainable development priorities

- NTV, MTV and CTV promotion are supported by many country's policy instruments, including:
  - Program for Soil Fertility Conservation and Enhancement 2011-2020 (Fertility 2011);
  - Low Emission Reduction Development Strategy of The Republic of Moldova to 2020 (LEDS, 2012);
  - National Strategy for Republic of Moldova Agro-industrial complex sustainable development (2008-2015) (NSSDA 2008);
  - Soil protection measures in the frame of Agriculture practices (SPM 2008).

- According to (Fertility 2011) the following overall objectives to soils improvement are established:
  - By end of 2020 to stop the active degradation of 887,000 hectares of arable land;
  - By 2020 to implement works of soil conservation and fertility improvement on an area of 1.7 mln. hectares.
- The key Agriculture sector objectives are in compliance with established country sustainable environment goals. According to SNC HAS, up to 323.3 Gg CO2eq emissions should be reduced in Agriculture sector by 2020. That is why, NTV, MTV and CTV are included in the list of LEDS NAMAs and are viewed as priority solution to reach the LEDS target.

2.2.5. Project Deliverables

- Main deliverables are (Rusu 2005, Cerbari 2012):
- crop increasing by up to 35%, it being of high quality;
- decreasing by up to 80-90% nitrogen fertilizer needed annually;
- up to 30% decreasing of fuel used by tillage machinery;
- restoration of the humus content, favorable structure and fertility of the soil arable layer;
- decreasing of non-productive losses of water from soil due to mulching which contributes to combating pedological drought;
- partial or total stop of the soil erosion (the stubble field and mulching favoure reduction of leaks and accumulation of water from precipitations in the soil);
- establishment of a positive balance of humus and carbon in soil, with no GHG emissions from agricultural soils.
- Main beneficiaries: rural population – their welfare will increase, labour migrants will return to their native villages and exodus will decrease; the country in the whole – the GDP will increase.
- Main benefits: crop yield increase of 1.0 t/ha (wheat); fodder production/quality increase; farm income increase; reduced labour and energy inputs; national institution strengthening; soil cover improvement (residues, early seeding); increase in soil moisture; increase in soil fertility; soil loss reduction; increase in soil organic matter; biodiversity enhancement; flexible labour inputs: seeding is independent of rain onset; fewer tractor passes in field; reduced downstream flooding, etc (WOCAT 2007). More specifically:
  - By 2020 the implementation of abovementioned conservative technologies will assure 540.4 GgCO2/year emission reduction, much higher than it was planned by SNC for agriculture sector (323.3 Gg CO2eq). That is explained by both the progressive technologies' evolution and increased farmers' awareness to implement such technologies. The new target of GHG emission reduction will be reflected in the country Third National Communication that is in the process of elaboration now;
  - Relatively stable agriculture production, it being less vulnerable to climate change, leading finally to country economic growth. Lately the contribution of the agricultural sector in the R. of Moldova GDP ranged between 14.5 – 22.4 percent, plant production contributing by 67,7% (NS 2011);
  - Stabilization of economic, ecological and social situation in rural areas. Because of high land fragmentation, low land productivity and income received the exodus of population out of the countryside has begun around fifteen years ago and is continuing up to now;
  - Reduced labour input.
- The project promotion will lead to:
  - Land consolidation. In order to achieve economies of scale and higher returns, conservative technologies in agriculture must be implemented on large plots of land. Land ownership in Moldova is highly polarized, with few large corporate farms and many small and fragmented family farms;
  - Stronger stakeholder cooperation. The level of collaboration between non-governmental organizations and public authorities in the sector is generally inadequate, which leads to a

poor understanding of local needs and opportunities for implementing conservative technologies.

- Vetch production in Moldova could be launched, vetch seeds cultivated serving not only for country own use, but for export as well.

2.2.6. Project Scope and Possible Implementation

- The Project Scope refers to soil conservation, aiming to restore the humus content, favorable structure and fertility of the soil arable layer, exclude soil erosion. And thus, the project is one sustainable.
- As it was mentioned above, overall for Moldova, the target is to diffuse each of three technologies over 200,000 hectares of land over a period of 10 years (20,000 ha annually each) using 5-field crop rotation. The estimated benefit as a result of improved crop yield is 47Euro /he/year (NTV, MTV) and -60 Euro/he/year (CTV) in the first year, reaching 255 Euro/he/year (NTV, MTV) and 192 Euro/he/year (CTV) in the 10th year, while CO2 reduction is estimated at the level of 2.54t/ha/year and 2.03t/ha/year respectively. NPV for the first 5 years is US$38,3million and US$21.82 million for (NTV, MTV) and (CTV) respectively, without carbon trading. So that the project is quite feasible.
- As soon as the project is implemented and experience is gained, NTV, MTV and CTV could be spread over other arable land of the R. of Moldova, the total area of which is around 1.83 million hectares at present.
- Totally on around 2,4% of country arable land NTV and MTV is used, but Hairy Vetch for Cover Cropping in Organic Farming is not used at all in the R. of Moldova.

2.2.7. Project activities

- The project should start with Land consolidation. In Moldova there are few large corporate farms and many small and fragmented family farms.
- The necessary agricultural equipment for direct sowing farming should be bought, including:
  - seed drills for direct seeding;
  - special tractors;
  - herbicide sprayers;
  - seed and fertilizer drill systems;
  - combine harvesters and other machinery required by the technology.
- On site the following activities are foreseen (WOCAT 2007):
  - Stubble maintenance (no grazing, only partial straw removal after harvest);
  - Direct seeding/fertilizer (N/P) banding using no-till drill (early November);
  - Chemical weed control (December/January);
  - Nitrogen fertilization (March);
  - Harvest (May: after 6 months crop period;
  - Leave fields to fallow for 18 months; apply herbicides if needed.

- As it was specified above, a total of 200 000 hectares of agricultural soils will be allocated to be used per each of NTV, MTV and CTV technologies, annually 3x20 000 new agriculture surface being attracted in this process. In the first year, per each technology, 1/5 of the area, i.e. 4000 he, is sown with vetch seed and this area ensure a higher harvest only in the second year. In the second year another new 1/5 area is sown with vetch seed, etc. After five years a new rotation will follow. On the lands where the vetch is not sown the vegetable residues remained on the ground.

2.2.8. Timelines

- The project is planned for 10 years implementation. Each year 20,000 hectares per each of NTV, MTV and CTV will be attracted into the project realization.
- Land consolidation, equipment acquisition and staff training will require additional 2 years before on site tillage will start.

2.2.9. Budget/Resource requirements

- US$8.2 million investments are required to attract into the project 3x20,000 hectare of lands each year during 10 years, including:
  - US$2.4 million per each of NTV and MTV technology
  - US$3.4 million for CTV
- US$17.6 million O&M costs, including for seeds acquisition, are needed, in the first year. In the 10th year O&M costs will rise up to US$175.5 million as 600,000 hectare will be attracted into the project. Respectively, O&M cost for separate technologies will be:
  - US$5.5 million in the first year and US$54.8 million in the 10th year for each of NTV and MTV technology
  - US$6.6 million in the first year and US$65.9 million in the 10th year for CTV technology
- Only in the first year for all technologies and partially in the second year for CVT technology the income obtained from project activity will not be enough to cover both investments and O&M costs above specified. After 1-2 years the benefit becomes positive. Such results are obtained if the following grains are in the 5 years crop rotation agrotechnique and the harvest is sold on the market at 2012 prices: Vetch (is used for own needs only), Maize, Winter wheat, Peas, Sunflower.
- The farmers launching the project are eligible to get subsidies from state budget, according to Government Decree (Subsidies 2007). In 2012 400 million Lei (around US$33million) were allocated from the state budget as subsidies to agriculture farmers.
- Ministry of Agriculture and Food Infrastructure has been considering the elaboration of a subvention scheme for the purchase of equipment for conservative technologies to cover up to 20-30% of total cost. But up to now no concrete decision has been published.
- As vetch fertilizer is not used in Moldova, an appropriate consulting agency should be hired before the project starts.

- NTV and MTV technologies are used on around of 44000 hectares in Moldova. Respective cooperation agreements should be established with the appropriate farmers in order to make project implementation with fewer mistakes.
- An active partnership should be established with local authorities in order to have support on the stage of Land consolidation and further project development

2.2.10. Measurement/Evaluation

- The factors to evaluate and monitor are:
  - Content of humus (organic carbon) in the soil. That is the key parameter that should be evaluated and monitored. It will be measured annually after the September harvesting, hiring in this respect a R&D institution;
  - Time schedule implementation;
  - Type and quantity of herbicides used;
  - Weather data;
  - Quality and quantity of grains sown and harvested;
  - The number of effective hectares of land attracted in the project per each of technology, i.e. NTV, MTV and CTV;
  - Effective quantity of crop harvested at the lands with and without vetch fertilizer;
  - The quantity of GHG emission reduction, calculated based on humus structure (organic carbon) and methodologies approved in the frame of UNFCCC;
  - Economic data: investments, O&M costs, Income.

  All this factors should be subject of comparison with the ones predicted or planned by the project, in order to identify why they are different and what should be done to reach the performance of best practices.
- According to LEDS, NTV, MTV and CTV refer to NAMAs supported internationally. Such mitigation action requires international measuring, reporting and verification (MRV), the guidelines for which are yet to be developed. MRV framework of the measure and its effectiveness would likely require a greenhouse gas emission output indicator and can be expected to follow the approaches currently used in the CDM scheme (LEDS 2020).

2.2.11. Possible Complications/Challenges

- Because the use of vetch as organic fertilizer is a new approach to maintain and increase the agricultural crop, the local farmers may manifest a reluctance to promote NTV, MTV and CTV with vetch application. There is a resistance to change due to strong reliance on traditional cultivation techniques and skeptical appreciation of practices that defy the familiar. Information and awareness raising campaigns, trainings are needed to overcome this challenge. Programs to improve soil management through good agricultural practices exist, but their funding and coverage remains limited.

- Land consolidation could meet difficulties. Some of land owners may impose not reasonable conditions at the stage of signing leasing contract, leading to resource spending and delay in the project starting.
- Most individual farmers have little business management experience and have had limited exposure to modern technologies that can be employed to increase the efficiency of land works and improve production processes in agriculture. Managers of corporate farms also have insufficient knowledge in areas such as corporate administration, demand forecast, financial management, procurement and marketing.
- The lack of labour opportunities in rural areas has led to a massive labour migration out of the countryside. Most of the migrating population has been young people, and specialists with medium and high level of education.
- Access to soil and other testing facilities is limited in Moldova. Although there are some soil testing laboratories across the country, these are not strategically placed, which limits the farmers' ability to determine the proper mix of fertilizers required for their soil.
- Weaknesses and how to overcome (WOCAT 2007):
  - High level of management is required. Training of land users is needed;
  - Sensitive to nitrogen level management. Soil tests/application of azote according to needs of crops under NTV, MTV and CTV technologies (NTT) is a mandatory;
  - High disease and pest prevalence if crop residues are not well managed. Resistant varieties and early seeding of diverse crops is required;
  - Reduced availability of straw (fodder). Crop optimization/livestock integration is needed: straw production under NTT is higher but farmers have to be convinced to remove only part it; use fodder crops in rotation is required;
  - Unforeseen environmental risks: e.g. soil or ground water contamination with herbicides/phosphate;
  - Weed control in NTT is critical: weed infestation if not well managed; high cost of herbicides. Measures to overcome: environment-friendly herbicides application, crop diversification; hand weeding;

2.2.12. Responsibilities and Coordination

The actions needed to undertake, the responsible stakeholder, the stakeholders attracted, when and how the measures should be promoted is reflected in the Table 2.2.12-1.

Table 2.2.12-1. Responsibilities and Coordination

Action	Responsible stakeholder	Stakeholders attracted	When?	How?
Information and awareness raising campaigns, trainings	MAFI	ACSA, AAPI, Farmers	2013-2020	A program for disseminating information and raising awareness about conservative agriculture should be elaborated, approved and promoted. To apply Subsidies for the acquisition of services of training to farmers and enterprise managers.
To promote land consolidation	MAFI	ALRC, Farmers	2013-2018	Incentivize single-party land ownership over areas of more than 200-400 hectares; encourage long-term leasing and strive to

Action	Responsible stakeholder	Stakeholders attracted	When?	How?
				reduce transaction costs for selling and buying land.
To reduce transaction costs associated with land sale-purchase and lease contracts	LRCA	MAFI	2013-2016	Replacing the minimum notary fee with a pro rata fee, simplifying the ownership-transfer procedures, allowing consolidation of multiple small contracts in fewer bulk transactions to reduce total fees
To boost the implementation of policies and action plans promoting conservative agriculture	MAFI	AAPI	2013-2014	To elaborate the Program for promoting conservation agriculture. Put in practice a subvention scheme
To promote stronger stakeholder cooperation and foster a culture of participation	MAFI	ACSA, AAPI, Farmers, Local Authorities	2013-2018	Financial support to strengthen institutional capacities of local authorities so that they can take on greater responsibilities for environmental protection. Public-private dialogue, to establish a road-map that will build trust among the various players along the value chain of agricultural production.
To strengthen advisory services to help promote sustainable practices	ACSA	MAFI	2013-2015	To enlarge financial support from country budget; To apply to donor support.
To improve laboratory infrastructure	MAFI		2013-2020	To increase the number of laboratories in the strategic rural points
To improve the national system of pedologic research	MAFI	Agriculture research institutions	2013-2020	To apply a single land tax instead of at least six existing taxes. To elaborate the digital country-wide pedological map
To establish and maintain a centralized database on soil quality	MAFI	Agriculture research institutions	Starting with 2014 and maintain permanently	To designate an institution for creation a centralized database on soil quality. The appropriate fund should be allocated
To apply to donors support for NTT promotion	MAFI	Farmers, AAPI, MEn	2014-2020	To prepare concrete formal requests and apply to donors.
To get financing, including from donors	MAFI	Farmers, AAPI	2014-2020	Investment contract signing
NTT machinery acquisition	Farmers	AAPI	2014-2020	Negotiation with NTT machinery producers
NTT on site implementation	Farmers	Local authorities	2014-2024	NTT agro technique application