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Integrated Drought Management

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Activity 5.6.

Development of proposals for the precipitation harvesting and practices for moisture conservation in agricultural lands (Output 3b)

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Name of the milestone:	**Milestone 4:** Moldova: Development of proposals for the precipitation harvesting and practices for moisture conservation in agricultural lands (Output 3b)
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Participating partners:	GWP-Ukraine GWP-Moldova

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1. Introduction

Actual report has been prepared on the base of analysis of existed practices in Moldova on soil moisture conservation in the frame of the IDMP SEE programme supported in Moldova by GWP CEE. Summary of relevant practices was presented to relevant stakeholders during 2nd National Consultation Dialogue on drought management organized in Chisinau in the Soil Research Institute of Moldova, on 16 December 2014.

Moisture conservation practices were subject for discussions in the frame of consultation meetings (in June-July 2014; you can check the report online) with sectoral authorities and farmers during 2014 in the southern, central and northern regions of Moldova. During these events a number of field trips were organized for participants of the event to present best practices on erosion reduction as a tool for moisture conservation, small irrigation, use of straw, etc. As a results participants of the consultation events pledged for dissemination of the results and preparing of relevant guide for farmers and sectoral authorities on practices on moisture conservation and precipitation harvesting as a measure to reduce negative impacts of droughts on agricultural crops in different parts of the country.

2. Practices

Applications of agro technical practices for moisture conservation in Moldova are divided in two categories:
1) general, which refer on soil processing, cultivation, ploughing between rides in multiannual plantations, etc., and
2) Specific activities, which facilitate slowing of the erosional processes, reduction of the volume of surface runoff, moisture retention through creation of special spaces on the soil surface for moisture accumulation, through additional ploughing creating depressed forms with the depth 10-20 cm on the surface of arable lands, etc.

The regime of the soil moisture is different in the seasons of the year:

1. Winter regime – is determined by the amount of the moisture originated from the snow melting and atmospheric precipitations. This moisture moves in the soil profile with a gravitation in a liquid or vapor state.

2. Spring regime depends on water content accumulated from precipitations during autumn-winter period, and depends on the processes of melting and absorption of moisture by soil patterns.

3. Summer regime – is characterized by the loses of moisture through transpiration of vegetation

4. Autumn regime – significant reduction of moisture use for transpiration with vegetation and evaporation processes due to reduction of temperatures of soil and air.

The volume of soil moisture is presented in mm of the width of water strata and thus becomes comparable with volumes of precipitations and evaporation.

According to different data erosional processes significantly influence on the resources of soil moisture. According to the data from the southern part of Moldova (table 1.) erosional processes are responsible for significant losses of moisture.

Table 1. Resources of common and productive moisture in soil (0-100 cm) in the period 2011-2014 (period spring-autumn)

Grade of erosion	General moisture, mm	Resources of productive moisture, mm	General moisture, mm	Resources of productive moisture, mm	Resources of general moisture, mm	Resources of productive moisture, mm
Atmospheric precipitations						
	20.04.2011		21.07.2011		3.11.2011	
Weak erosion	293,7	152.8	213,2	72.3	-	-
Average and strong erosion	280,4	133,0	225,1	77,7	-	-
	27.03.2012		05.06.2012		11.10.2012	
Weak erosion	264,5	127.7	228.8	87.9	153.9	13.5
Average and strong erosion	239,5	92,1	242,2	95,4	155,9	9,5
	06.03.2013		16.04.2013		17.09.2013	
Weak erosion	280,9	140.0	306.5	165,6	316.4	175,5
Average and strong erosion	289,3	141,9	297.9	150.5	319,5	172.1

According to the data presented in table 1(Rusnak V.; Agrotechnicalmethods as a way of accumulation of moisture in soil; Scientific conference of the northern part of the Black sea basin, Bender, 2014) activities aimed at erosion reduction could lead to the saving of around 10-15% of moisture in soil during summer period under different agricultural crops and agrotechnical soil processing. For moisture conservation next issues could be proposed:

- plugging without turning of the soil strata;
- minimal soil processing aimed at mineralization of the use of agrotechnical machines with the use of fertilizers immediately after previous crop harvesting with soil cultivation on the depth of 6-8 cm. During vegetation period processing with pesticides on necessity and seeding according to prescriptions of agricultural authorities;
- zero soil processing; Limited soil processing to be used in case of soil agrregationon the depth 5-7 cm with application on the surface fertilizers, predominantly organic one in autumn after crop harvesting.

Water content is soil is accessible to agricultural crops under different conditions. Main types of water accessibility are presented in table 2.

Table 2. Main types of water accessibility for agricultural crops

Soil moisture accessibility	**State of water (moisture) in soil**
Moisture, which can be used by crops	
Moisture very accessible for plants	Interval of moisture content from total saturation to field capacity (moisture moving in soil gravimetricaly and does not retain in soil for long time – 2-3 days)
Moisture easy accessible	Interval in moisture content from field capacity to interruption of water in soil capillaries (moisture movement in capillaries and its retention in soil for a long time – 5-7 days)
Moisture difficult accessible for crops	Interval of moisture content in soil from capillaries water to stable water content (pelicular moisture, moving in soil under sorption forces and retained in soil for long time)
Inaccessible water	
Moisture inaccessible or extremely poor accessible to the crops	Moisture content from difficult accessible to hygroscopic moisture content (pelicular moisture)
Moisture not accessible to crops	Moisture content less than hygroscopic and is contained in soil minerals

Main factors identifying soil moisture accessibility to crops:

- Soil texture; Average content of clay particles in Moldavian soil is around 50% and depends on mother rock, explosion, inclination of slope etc. Moisture content is in clay soils more accessible than in sandy ones due to retention capacity of clay minerals, but at the same time its aggregation is higher than on sandy soils and water is retained by gravimetric forces.

- Soil structure; Determines compactability of soils. In agricultural soils ploughing could lead to aggregation and thus reducing of moisture content accessible for crops. Irrigation norms for such soils should be calculated in function of aggregation and used water has to have as low mineralization as possible. In the Dniester basin mineralization of the water has increase for last 50 years for 20-30% and actually reaches around 700 mg/l in the lower Dniester.

- Organic content; Humus content in soil is an essential factor influencing moisture availability for crops. Based on that agrotechnical processing should be aimed at application of organic fertilizers, creation and maintenance of the green belts (species with the length 3-4 meters) and erosion reduction.

Main dependences of soil density (aggregation) and moisture content in soils are presented in table 3.

Table 3. Average data on dependence of soil moisture content and soil aggregation

Density of soil (dv), g/cm³	Moisture on the level of field capacity (CC), % g/g		Moisture content on continuation interuption of water in soil capilars (URC), % g/g		Easy accessible moisture (CC – URC), % g/g	
	Soil Clay -argil	Soli argil	Soil Clay-argil	Soil argil	Soil clay-argil	Soli argil
1,10	29,1	30,2	19,8	24.1	9,3	6,1
1,25	27,0	29,0	19,6	23,9	7,4	5,1
1,30	25,9	28,0	19,5	23,8	6,4	4,2
1,35	24,8	26,8	19,2	23,0	5,6	3,8
1,40	23,4	25,8	18,7	22,2	5,0	3,6
1,45	22,7	24,5	18,3	21,2	4,4	3,3
1,50	21,6	23,4	17,9	20,9	3,7	2,9
1,55	20,4	22,3	17,5	19,6	2,9	2,7
1,60	19,6	21,0	17,1	18,7	2,5	2,4
1,65	18,8	19,0	16,8	17,8	1,5	1,2
1,70	17,4	17,8	16,4	17,0	1,0	0,8

Recommendations for moisture soil conservation:

1. Introduction in crop rotation 5 agricultural crops – 5 year cycle with 1 year of seeding of the lucerne with raigras. This will lead to biological accumulation of nitrogen and at the same time accumulation of the green straw as a resource for humus. Organic patterns remained after this crop will also serve as an antierodation measure and will conserve soil moisture associated with organic material.

2. Introduction of organic fertilizers. Actually application of the organic substances in Moldova is rather poor, but for humus creation it is necessary to apply around 10 tons of organic per ha. Actual capacities of animal breeding could cover 5-10% of necessity and large introduction of composting practices of organic patterns are necessary for humus conservation in soils.

3. Maintenance of the green belts (protected zones) on agricltural lands. Creation of new structure of such belts should be aimed at selection of relevant species, which will not have a large root system and will mostly serve as anti-erosional measures.

4. Plantage ploughing to the depth of 35-50 cm once 4-5 years in order to avoid creation of the strata of high aggregation (compact zone) under arable horizon. This will allow introduction in the circuit of additional moisture resources accumulated in under arable strata for better moisture availability for crops.

Fig 1. Agrotechnical machines for soil processing Mini-Till in combination with subsoil ploughing (depth till 35cm without turning of the soil strata).

The use of such equipment allows soil processing in the most moisture conservation manner and has a minimum impact of the soil structure (fig.2)

Fig 2. Distribution of the root of lucerne crop with the Mini-Til system

Thus the use of different practices for the moisture conservation in soils could lead to increasing of moisture content on arable lands for 10-15% event in the hottest time of the year. Proposed measures aimed at moisture

conservation will be detailed presented in the guide for farmers, which is going to be presented up the end of the IDMP CEE by GWP Moldova.

3. Conclusions

Moisture conservation practices are developed based on implementation of the erosion reduction measures and also the use of crops rotation systems with including of the bean crops, which contribute to the soil fertility.

Capacities and experience of local agricultural and local authorities to deal with drought management are limited due financial constrains for attraction of best agricultural practices (machines, fertilizers, sorts, etc). At the same time commitment of farmers and authorities to introduce best moisture conservation practices is very high as well intention of Ministry of Agriculture and experts from the research institutions to develop drought management practices based on EU experience in relevant domain in cooperation with GWP CEE (Moldova).

National dialogues on drought management should be continued and targeted oriented in order to prepare project files for moisture conservation and in general for drought management. Development of the drought indicators and methodology should be next step in the research activities as a part of the implementation of the climate change adaptation strategy and rural development.

4. References

1. Annual statistic report of the Republic of Moldova, Chisinau, 2012-2013
2. Rusnak V. Agrotechnical methods as a way of accumulation of moisture in soil. Scientific conference of the northern part of the Black sea basin, Bender,2014
3. Nutrient balances for the Danube countries and options for surface and groudwater pollution (Moldavian report), Vienna, 1999
4. Danube Pollution Reduction programm (Moldavian report), Vienna, 2001