14 December, 2014

1. Basic information

Name of the activity	Drought management by agricultural practices and measures increasing soil water holding capacity
Name of the milestone report	**Milestone 3: Evaluation of second year of experiment**
Activity leader	Pavol Bielek (Slovak Republic)
Participating partners	Jiři Hladík (Czech Republic), Andrzej Kedziora (Poland), Pavol Bielek (Slovak Republic), Rok Mihelič (Slovenia), and their teams
Duration (milestone 3)	November 2013 – November 2014
Chairman of the CWP	GWP Slovakia: Elena Fatulova

**Milestone report is information about the progress made within this activity from previous milestone report for GWP CEE Regional Secretariat, Programme Manager, Peer Review Group and partners involved into IDMP CEE. It is not intended for further distribution.*

2. Activity Report

2.1 Short summary of the milestone report (max 2500 characters*); What have been done after the previous milestone report(s)?*

The Czech Republic assessed within the field experiments the difference between water infiltrations on diversely cultivated agricultural land (using technologies and procedures supporting soil hydrologic functions) and conventionally managed fields.
In this year the following work has been accomplished: (i) repeated sampling and analysis on the current study area Trebsin and new one Oubenice, which was cultivated in a form of ecological farming. (ii) It was simultaneously, measurements of saturated hydraulic conductivity were repeated again in the field to verify and to see how precise results from the first year are.
The main tasks of Milestone 3 which have been done:

- finished measurements of saturated hydraulic conductivity both in the field and a laboratory;
- determination and analysis of porosity and other soil characteristics of soil sampling for the pilot study plot Trebsin and the other study plot Oubenice.

In Slovak Republic the new additional field experiments have been set up. It means that besides of singly subsoiled fields observed in year 2013 also new singly and crossly subsoiled fields have been set up. These fields are close to the previous year observed fields - Koliňany. This was necessary for possibilities to receive information not only on residual effect of subsoiling from previous year but also about influence of new subsoiling technology (cross subsoiling) and about sensitivity of other different plants on soil subsoiling measures as well. Also differences in results between times of subsoiling (spring, autumn) have been available with the help of newly set up field experiments.
Penetrometric parameters, saturated hydraulic conductivity data and yields of plants have been determined during year 2014 for all observed experimental fields. Moreover, a new theoretical product focused on theory of water content and movement in soil have been collected, evaluated and presented in a national report which is needed as a background for final report of the activity 5.1. and for the Compendium of good practices (act. 7.1).

In Poland the following investigations have been carried out (6 field experiments):

- measurement of soil surface infiltration using double rings methods;
- measurement of hydraulic conductivity in deeper layer of soils using auger hole method;

- measurement of water retention of topsoil using flooded method to get information about field capacity (FC) and tensiometer to get information about pF values between FC and critical water content CWC (pF=3.0);
- estimation of density of macrofauna in upper layer of soil as well as epigamic macrofauna.

All measurements were performed on two different fields, one was under traditionally tillage, while the second was under no-tillage system.

In Slovenia in the 2014, at the experiments 'Mamino' and 'Kumrovo', was measured important parameters to evaluate the effect of different tillage on soil water characteristics, and on oilseed rape yield. The composting tillage (E) was tested against conventional tillage by moldboard plough + pre-seeding tillage combination (O). The subsequent effect of sub-soiling (45 - 50 cm deep soil loosening), which was performed in the summer 2011 on the ploughed (OP) and on the composting tillage observations (EP), was also observed by the rapeseed yield measurements.

2.2 Describe the progress to the objectives of your activity?

In Czech Republic during the two years field experiments the difference between infiltrations on diversely cultivated agricultural land (using technologies and procedures supporting soil hydrologic functions) and conventional management was compared. Compacted or in other aspects degraded soils have restricted ability to infiltrate water and they contribute to accelerated surface water runoff. Case study of the Czech Republic contains at this stage:

- (i)Assessment of field capacity, saturated hydraulic conductivity, porosity, bulk density, water holding capacity and 30 min. moisture;
- (ii)It was done for different soil management: ecological farming, conventional tillage, sub-soiling, conventional tillage with manuring and conventional tillage with green maturing;
- (iii)Mutually compared impacts on soil-water holding capacity of the soil management variants.

In Slovakia following preliminary conclusions can be summarized from experimental results:

- effect of subsoiling operation increases the water infiltration into the soil profile in following order: no subsoiled, singly subsoiled, crossly subsoiled;
- lower positive effect of subsoiling on water infiltration into the soil have been observed in the second year after subsoiling (less than 5 %) what is argument for recommendation of additional subsoiling application after 3-4 years;
- subsoiling applied in spring increased more water infiltration into the soil in comparison to autumn subsoiling;
- potential total volume of water infiltration into the soil profile is increasing in following order: no subsoiled (approx. 90 m3 of water per ha), singly subsoiled (approx.53-108 m3 of water per ha), cross subsoiling (about 600 m3 of water per ha);
- after singly subsoiled soil the yields of maize corn was higher for about 10 %, but total green matter of maize can be higher for about 40 %.It is excellent result in case of silos maize harvesting. When cross subsoiling is applied increase of yield can be even higher;
- electronical version of geographical information system about soils of Slovakia is usable as background for generalized results and for recommendations of subsoiling operations. General principles are presented in a national report and will be in more detailed version presented in the final national report (next year).

Results from **Poland** show that water infiltration of the two fields was rather low, 1.9 and 9.5 mm/hour respectively. It was a result of relatively high density of soil (from 1.7 to 1.8 g / cm^3). However, the basic infiltration of no-tillage field was several times higher than in the tillage field.

Hydraulic conductivity was very low in both fields, and was a result of heavy mechanical composition of the soil (loam), which increases with depth. The tillage system has no impact on the structure of these deep layers of soil.

Retention capacity of the topsoil is better in case of no-tillage system. Total available water (TAW) constitutes 52.3% of pore volume, while on the tillage field only 38.3%. It means that in 0.5 meter of topsoil can be retained 85 mm from which 48 mm is the readily available water (RAW).
System of tillage has a clear and strong impact on macrofauna of soil. During five field expeditions always richness of organisms was much higher in soil under no-tillage system (1132 individuals/m^2) than in field under traditional system (133 ind./m^2). This fact explains better water retention capacity of this soil: simply, in no-tillage soil there are much more mesopores, than in fields being under traditional system.

At the both experimental sites in **Slovenia** the yield of oilseed rape was the lowest in the ploughed tillage (O) (the difference was not statistically significant). Subsoilling caused evident subsequent positive effect on yield at the both sites especially in the heavier soil type in 'Kumrovo', but the effect was evident only in the plough treatment (O), and not in the composting tillage (E). The soil tillage treatments conducted for three years did not significantly change the soil water holding capacity nor in the bulk density either in the light or heavy soil sites. At the both location, the composting tillage slightly improved the infiltrability of the water into the soil; in a case of silty-clay soil of 'Kumrovo', the effect was significant. The treatment (E) caused more compaction than plough treatment (O) at the both sites. Subsoiling, which was done in summer 2011, had no significant effect in the soil compaction readings 3 years later in the summer 2014. More compacted soil under the composting tillage (E) was not negatively influenced the rapeseed yield, nor the infiltration capacity. It can be beneficial in terms of better traffic-ability of the fields. Soil under the Composting Tillage (E) is more compact, but still intensively rooted. The primary/tap roots of oilseed rape under the shallow tillage layer (ca. 10 cm) are following the soil cracks and earthworm furrows. In spite of the compaction, the soil at (E) was crisscrossed by bio-pores of elder roots and earthworms, and that is why the roots grow was dense even at the depth of 60 cm.

2.3. The expected final output (s). At what stage you are now in the process of producing the final output(s)?

All results, studies and recommendations related to this activity will be summarized **in a final joint report (March 2015).** Following outputs (products) are expected:

- study on the soil water regime; theory related to agricultural practices as backgrounds for country water regime evaluations and regulations;
- theoretical and practical study on water holding capacity increased by farming innovation systems, mainly by subsoiling, no tillage farming, mulching, composting tillage, organic fertilizers use and other measures;
- new agricultural policy proposals as a support for farmers to use recommended farming systems; which will bring increase of the soil water holding capacity and improvements in water regime;
- practical manual how to implement measures and farming systems; including recommendations for appropriate support systems for farmers, establishment of control mechanisms, systems of evaluations and other principles as parts of national agricultural policies.

In Czech Republic expected final output is the report "Analysis and proposals of preventive measures as tools for drought management in agricultural practices and technologies". Report will be the input for "Compendium of good agricultural practices" focused on water holding capacity increase of farming land and agricultural territories.
Now it is the phase of data verification by infiltration and retention maps, which come out from the soil database and the Complex soil survey of the Czech Republic. Afterwards will be finished National final reports and practical documents.

From Slovak Republic results can be expected as final outputs: (1) developed procedure proposals (methodology) for subsoiling application in agricultural practice; (2)system usable for identification of fields where subsoiling is needed and recommended; (3)theory, data and procedures offered for results inserting into the Compendium of water management practice; (4) study published for Slovakian needs as far as of soil water holding capacity increase by Slovakian agriculture practice; (5) proposals for implementation of results into the

CAP of Slovakia.

From **Poland** all outputs will be focused on no tillage farming systems principles and outputs as recomendations for water regime regulation in the country of Poland and others.

Slovenian final report will summarize the work done (experimental and the literature review) into a practical manual for the policy maker and for the farmers on how to increase soil resilience to soil water shortage by sustainable agricultural practices and measures. We will describe and propose the best available agricultural practices for the various particular pedo-climatic regions across Middle-East European Countries. Future research needs and technological development will also be proposed

2.4. Have you introduced any change in the original plan as outlined in the Activity List?

No

2.5. Identify links with other IDMP CEE activities

Described practical examples will be transferred into a Compendium of Good Practices (Activity 7.1). There is also a link with Act. 2.1: Guidelines for Drought Management Plans. Tested measures (to prevent or mitigate drought in normal, pre-alert, alert and extreme conditions) collected are important input for the Guidelines (Act. 2.1).

2.6. Other issues (problems during the implementation, how they were solved, etc.)

No substantial

2.7. List if National Reports have been used, and if so, provide details on the National Reports (title, authors, publication data and location)

Only National Milestone Reports to 5.1. Activity from Czech Republic, Poland, Slovakia and Slovenia have been used (are presented separately).

3. Attachments

Annex 1_Slovak Milestone 3 report
Annex 2_Czech Republic Milestone 3 report
Annex 3_Poland Milestone 3 report
Annex 4_Slovenian Milestone 3 report