

Preface

The symposium *Soil as World Heritage* was held in the spring of 2012 to celebrate the half century of systematic field experiments at Balti, in the north of Moldova. The experiments monitor and evaluate the impact of crop rotations, monoculture, fallow, fertilization, tillage and irrigation on crop yields and soil fertility. The proceedings highlight the importance of such experiments for understanding the consequences of current farming practices, especially on the famous black earth or chernozem. But there is more.

Between 1965 and 1980, the *green revolution* increased crop yields two- to threefold, transcending differences in soils and climate. For a generation, food production was carried ahead of population growth, and political attention was turned away from land, food and agriculture. Policymakers today face new challenges and bigger challenges:

1. Burgeoning demand means that, by 2050, food production will need to be 70 % greater than now – double in developing countries. All this production must come from the same land and water resources or, if present trends continue, much less; there are no great reserves to draw on, the area under cereals peaked in the 1980s and diversion of arable to biofuel production intensifies the pressure.
2. We have passed peak soil. On top of historical land degradation, today's agricultural practices are driving land degradation, water shortage and contamination, loss of biodiversity and climate change. The last quarter century has witnessed degradation of one-quarter of the land surface; every continent and every biome is affected. The issue goes beyond mismanagement: tracts of the best land are being lost every year to cities and connecting infrastructure, and it appears inescapable that rising sea level will flood great cities and productive farmland.
3. The food system is unsustainable. The green revolution depended on cheap fuel, fertilizer and irrigation applied to new, responsive crop varieties. Fuel and fertilizer are no longer cheap, water resources are overcommitted and crop yields have levelled off – in some places they are falling.

4. Climate change is driven both by burning fossil fuels and by the insidious destruction of soil organic matter – yet the soil is the only buffer against climate change that we know how to manage. The symposium highlights the effects of drought on crop yields across southern and eastern Europe; yet more dramatically, by 2050, half of what is now India's high-potential wheat-growing land is likely to be heat-stressed, short-growing-season cropland.

One response is the international land grab where the power lies with the big players and which does nothing to help the global situation. Contributions to this symposium indicate a sustainable alternative that combines proven practices of conservation agriculture or ecological agriculture that retain and rebuild the soil with precision farming that tailors crops and operations to the natural variability of the landscape. This is high farming that demands high knowledge at the policy level and in the field – knowledge that depends on better information on land resources and relearning much that has been forgotten. We have to grow both the soil and the knowledge.

Chernozem is, simply, the best arable soil in the world. Historically, it has been the breadbasket of the Old World and the New. The chernozem of the Balti steppe was also at the heart of the foundation of soil science. Dokuchaev visited this very place, collecting material for *Russian chernozem*, and his first account is a concise statement of the principles of a new science. He wrote: 'The chernozem seemed to me, in 1877, so typical in its thickness, structure and humification that I called it first class. The analysis showed the content of humus was 5.718 %'. That soil now, under the plough, has nowhere more than 3.8 % humus and chernozem everywhere have lost 20–70 % of the humus that binds the soil together and created what appeared to be inexhaustible fertility. On present trends, by 2026, the humus content of chernozem across the country will be down to 2.5–3 %, and approaching a catastrophic shift to a different and unstable ecosystem; the black earth will turn to dust as it did in the prairies of America and Canada in the 1930s.

Agricultural practices are driving global warming, leaching of nutrients, pollution of water resources and diversion of rainfall away from replenishment of soil and groundwater to destructive runoff. These are pressing issues for our generation and will press harder on future generations. Long-term field experiments, and the scientific skills and experience that they nurture, will be increasingly valuable as a foundation and a focus for interdisciplinary teams of specialists studying the effects of farming practices on the soil and on both above- and below-ground components of flora, fauna and microorganisms. Experimental data built up over the last 50 years demonstrate the damage caused by human activity to the productivity and integrity of chernozem and, also, ways to restore its fertility.

For all these reasons, the chernozem of the Balti steppe under the long-term field experiments has been proposed as the first World Heritage Site for soil and soil science as *an outstanding example of human interaction with the environment that has become vulnerable under the impact of irreversible change, of significant ongoing ecological and biological processes in the evolution and development of terrestrial ecosystems and communities of plants and animals, and containing the*

most important natural habitats for in situ conservation of biological diversity, including threatened species of outstanding universal value. By safeguarding this unique ecosystem and testimony to civilization, we may work towards sustainable development of society – and agriculture in particular. The ongoing scientific work is also a foundation for public appreciation of soils and soil science which is critical for wise policy and management.

These proceedings include contributions from 14 countries under headings: *The Soil and Environment, Soil Fertility: Lessons from Long-Term Field Experiments, Different Ways of Doing Things, and Soil Policy and Communications to Decision Makers.* On the last topic, there has been much wringing of hands by the scientific community about the lack of effective action to arrest land degradation, loss of biodiversity and climate change. Inaction is not due to lack of information: inaction stems from a lack of acceptable courses of action. If acceptable, and effective, courses of action are to be developed, the scientific community must involve itself in practical and political developments – even though this means venturing to the exposed frontiers of its own knowledge and experience. Therefore, at the request of the President and Government of Moldova, our communications to decision makers include recommendations of all the participants. These recommendations include definition of a new research thrust to support more sustainable land use through crop rotations that can be commercially viable, self-sufficient in energy, and which restore the stocks of soil organic matter; and a soil resolution that may serve as a basis for legislation. Important and achievable recommendations include:

1. Initiatives have to be within the framework of national policy for food and water security. Our first recommendation is to review this policy in the light of present knowledge of the land and develop *a national program for food and water security and safety worked out at local, regional and state level, including support for or creation of markets for the required production and services such as water management and carbon sequestration.*
2. Knowing what you want to achieve, it may be useful to set out ground rules in the form of a soil law. This is our second main recommendation: *adoption of a soil law to secure the services provided by the soil to society and the environment. This law should be the basis for allocation of payments or other incentives necessary to achieve the required protection of soil services.*

Examples of incentives include *green water credits* paid to farmers for water management services (in the shape of approved soil water management and soil conservation practices). This does not require the government to find new money; credits are paid for by the direct beneficiaries of this service, the water users. Also, we may draw on EU experience of integrating soil protection within the Common Agricultural Policy; to receive support from the EU budget, farmers should respect standards set nationally to protect the soil against erosion, maintain soil organic matter and soil structure and avoid degradation of habitats and landscape features.

3. *Application of such policy and compliance with its conditions requires revitalized state services, working in partnership with land users, to elaborate*

whole-farm and community plans for rational land use, to provide on-farm support for the adoption of best practice and to monitor the state of soil and water resources. This recommendation does require new money!

4. The system of landholding goes against the requirement of sustainable land management, but this is not the time for another upheaval. We recommend evolution of the system towards something better fitted to the task. Possibilities include extension of the period of leasehold to, at least, the length of a sustainable crop rotation (say 7 or 8 years) or, better allow 99-year leases so that the leaseholder has incentive to take good care of the land. The final, easy-to-implement recommendation is: *support for cooperation between individual farmers for purchasing inputs, marketing produce and services, soil and water conservation at the landscape scale, and mutual exchange of know-how and support for services to cooperatives by contractors, especially for the purchase of new equipment needed for conservation farming.*

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