



How to Realize Multifunctional Land Use as a Contribution to Sustainable Development

Johan Bouma *

Soil Science, Wageningen University, Wageningen, Netherlands

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MULTIFUNCTIONALITY IN RELATION TO THE UN SUSTAINABLE DEVELOPMENT GOALS

Schröder et al. (2020) have identified five well documented reasons why farmers are reluctant to adopt multifunctional land use (MLU), pointing out correctly that just advocating MLU without considering farmers attitudes (Veerman et al., 2020) is meaningless. Their rather pessimistic analysis, which questions whether farmers can be convinced to embrace MLU, is very well documented and increases our knowledge and understanding as required by any scientific analysis. Still, the analysis can also be more positively focused on exploring ways to enhance application of MLU by farmers, taking into account their demands and concerns in a multidisciplinary context (e.g. Ingram et al., 2010; Kahan, 2015; O'Sullivan et al., 2018; Krzywoszynska, 2019; Schulte et al., 2019; Salazar et al., 2020). Why do so? Because MLU is crucial when considering the UN Sustainable Development Goals (SDGs) that point a way to a future where emphasis should not only be on crop production (SDG2) but simultaneously on a number of associated environmental conditions in terms of good quality of ground- and surface water (SDG6), low emission of greenhouse gasses and carbon capture (SDG13) and biodiversity and nature preservation (SDG15). The EU-Green Deal, presented in 2019, follows the SDG principles. Both the SDGs and the Green Deal, not mentioned by Schröder et al. (2020), are important because they put sustainable development in a clear, transparent and legally binding framework while creating specific goals to aim at, defining ecosystem services related to land use (Robinson et al., 2012; Keesstra et al., 2016).

This opinion paper will argue that setting specific environmental goals, initiating payment procedures for ecosystem services and introducing goal oriented policies, can potentially overcome the reluctance of farmers that now: “*feel in the dark what to do*” (Schröder et al., 2020). But if the scientific community does not indicate sources of light who will? Moreover, computer analysis of the soil-water-atmosphere-plant system can quantify effects of soil degradation but, more importantly, the major future effects of climate change that should already affect the current discourses by: “*quantifying long term implications*” that are now largely absent according to Schröder et al. (2020).

CHALLENGES FACED BY MODERN FARMERS

Farmers are hesitant about multifunctionality because of at least five problems: 1) insufficient visible proof of soil degradation and benefits of preventive vs. curative measures; 2) limited awareness of long term synergies; 3) insufficient remuneration of ecosystem services; 4) lacking trustworthy knowledge; 5) absence of incentives and regulations on soil management and their enforcement (Schröder et al., 2020). Reference will be made to these five problems in the remaining part of this paper.

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Industries du Vivant et de
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***Correspondence:**

Johan Bouma
johan.bouma@planet.nl

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Farmers are besieged by advocates of particular farming systems: biological, biological-dynamic, circular, nature-inclusive, regenerative, precision, and others. Farmers don't see: "a point at the horizon" to aim for, nor do complex agricultural policies show the way. The UN-SDGs and the EU-Green Deal can, however, provide this future perspective but this needs a substantial research effort focused on the measurement of ecosystem services, contributing to the various SDGs. What does this imply?

CAN MEASUREMENT OF ECOSYSTEM SERVICES PROVIDE AN ENLIGHTENING AND PROFITABLE FUTURE ROADMAP?

1) Food production responds to market forces and determines food quality, that can be affected by soil pollutants. Food quality is now closely monitored by governmental services (SDGs 2,3). Farmers are part of the food chain and increased emphasis on sustainability by market forces has a positive effect on consumption patterns, in turn stimulating farmers to become more aware of the need for multifunctionality. 2) Water quality (SDG6) is regulated by the EU Water Framework, requiring farmers to adjust their fertilization practices to prescribed application rates. But water qualities are not measured on-farm but elsewhere or not at all and this fuzziness creates lack of engagement (e.g. Bouma, 2011). Why not instead measure water quality at farm level? 3) In future, regulations are likely to be introduced on carbon capture as part of climate mitigation policies (SDG13). Why not take a pro-active approach and explore which soils have potential for carbon capture and which management procedures can restrict release of greenhouse gasses? (Amelung et al., 2020). Still, there is scepticism about the feasibility of carbon sequestration in soil and more field research is needed to show its real potential (Amundson and Biardeau (2018), and 4) A similar discourse applies to life on land (SDG15) covering first the quality of the soil biome, essential for soil functioning where % organic matter can initially act as a suitable proxy value, and, second, the effects of soil management on surrounding nature as partly expressed by the SDGs 6 and 13.

The time has passed that monitoring necessarily implied long, tedious and costly procedures involving field sampling and laboratory analysis. Now, automatic field equipment is available to measure water quality; satellites and drones can measure greenhouse gasses and crop conditions, proximal sensors can rapidly measure soil organic matter content (e.g. Viscarra Rossel et al., 2010). All these measurements have to be made at prescribed moments in time and threshold values have to be defined separating favorable from unfavorable conditions for each of the ecosystem services at any location. For example, groundwater quality is already defined considering a threshold value of 50 mg nitrates/litre. Also, dynamic simulation models are available for the soil-water-atmosphere-plant system both at national and European scale that allow to estimate losses of nitrogen, phosphorous and greenhouse gases to air and water (e.g. De Vries et al., 2015) and that show the hotspots where the

needed improvements in nutrient use efficiency are most urgent to protect air and water quality (e.g. De Vries and Schulte-Uebbing, 2020). They are already widely applied to characterize regional environmental conditions of water, air and vegetation. They could also be applied at farm level when detailed data are available.

HOW TO IMPROVE COMMUNICATION BETWEEN FARMERS AND THE SCIENCE COMMUNITY?

How to communicate effectively with farmers as these new technological opportunities arise? A key problem is the fact that many innovative management procedures are available but not applied. Every farmer is different and tailor-made personal advice by commercially independent experts may work better than an impersonal computer-guided Decision Support System. Bampa et al. (2019) indeed report that: "farmers recommended small participatory research projects building momentum with colleagues to try new approaches". Joint work of scientists and farmers on farms acting as: "Living Labs" with emphasis on joint learning rather than on topdown advice (Veerman et al., 2020) would be important to facilitate knowledge transfer and to generate new knowledge, addressing problem 4. And, finally, technological developments can support the upbeat opinion that: "what is good for business can be good for the environment". An example is precision farming, applying agrochemicals at the right time, the right place and in the right way cutting environmental pollution and the cost of fertilizer and biocide use by 25% in a case study (e.g. Stoorvogel et al., 2015). Higher net returns for farmers can also be achieved by lowering costs! Why not promote this and try to generate other examples where striving for environmental quality is not necessarily bad for business?

Having provided good monitoring data and when measured values are below the various thresholds, tailor-made payment for provided ecosystem services could follow and environmental laws and regulations could focus on goals rather than on means to reach goals, addressing problem 5 (Vrebos et al., 2017). The proposed European Common Agricultural Policy 2021–2027 has a budget of 350 billion €. Recent discussions suggest that part of the funds will still be assigned to pillar 1 (direct payment on a per/ha basis) but an increasing quantity to pillar 2, providing ecosystem services. Research, focused on the assessment of ecosystem services, as discussed above, could provide a sound basis for such payments, addressing problem 3. Still, the issue of payment for ecosystem services still needs research on methodology, thresholds and amounts to be paid where, again, the example of the ecosystem service: "water quality" can act as an example, except for the amount to be paid, an issue that has not yet been addressed. The literature so far is partly skeptical about the feasibility of payment for ecosystem services (e.g. Chalhoub et al., 2020; Baveye et al., 2013; Baveye et al., 2016) while also positive results have been reported (Jónsson and Davíðsdóttir, 2016).

Translating the nebulous concept of sustainable development into specified ecosystem services (with associated payments) would engage farmers, the more so because they can then focus on the type of management corresponding with their particular farming style, addressing problem 4. Every farmer is different and faces different opportunities and conditions. The possibility that: “anything goes”, as long as the environmental thresholds are not exceeded, would present a big relief to the farming community!

CLIMATE CHANGE AS A CHALLENGE

However, the: “*point at the horizon*” right now is quite different from the one in 2050 and beyond when many areas in the world will become too dry and hot for agriculture, when areas with fertile soils near rivers and the sea may flood due to sea-level rise and when elsewhere dry periods will expand while showers become more intense (IPCC, 2019). But areas with still suitable climates for agriculture and healthy soils in future have great potential and this would be a welcome and engaging message for worried farmers in such areas. An Italian case study showed that healthy soils made significant contributions to SDG2, also when exploring the effects of climate change up to the year 2,100 based on IPCC scenarios (Bonfante

et al., 2020). This study, based on modeling the soil-water-atmosphere-plant system, also indicated production losses resulting from soil degradation processes such as erosion and compaction as well as potential gains by raising the organic matter content, both under current and future climate conditions. This way, “*long-term implications*” can be quantified (addressing problems 1 and 2).

How to feed 9.7 billion world inhabitants in 2050 is a key question and that farmers put climate regulation at the bottom of their listing of important multifunctional factors in Schröder et al. (2020), painfully demonstrates that the scientific community faces a challenge to improve their communication practices.

AUTHOR CONTRIBUTIONS

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