SESSION 1

AGRICULTURAL MACHINES - SUSTAINABILITY ASSESSMENT AND CIRCULAR ECONOMY

by the Session Coordinator and Chairman: Peter Pickel (John Deere, Germany)

CONCLUSIONS

Chairman Session Conclusions

General Statements

Three oral presentations were held in this Session that was followed by a discussion.

1. Importance of sustainability assessment and circular economy in agricultural machinery production, by Giuseppe Gavioli, Gavioli Consulting LLC;
2. CO_2 savings of agricultural machinery until 2030, by Fabienne Seibold, Axel Kunz and Peter Pickel, John Deere;
3. Agricultural machinery and smart agriculture. Which contribute to achieving "Sustainable Development Goals (SDGs)", by Muneji Okamoto, Kubota Corporation.

24% of global GHG emissions result from agriculture which is one of the major GHG emitting economic sectors and is hurt by climate change primarily. Therefore, all measures possible must be undertaken to create a more sustainable and more circular agroeconomy. Agriculture and agricultural engineering must develop measures for climate protection as well as measures to mitigating the climate change. Agricultural sustainability explicitly covers all relevant aspects: ecological, social, and economic sustainability.

Development targets must be set realistic for reasons of motivating relevant activities. Overall reduction of GHG by 40% until 2030 (as desired in EU) is challenging but fully reasonable and still realistic. Thus, this objective should be met by changing agriculture and agricultural technologies. On the very long run (e.g. by 2050), a fully circular agriculture economy should be the final goal of developing new technologies and modifying the agricultural economy and beyond just the primary food production the whole production chain of food needs to be revised. This also invokes the need for new education models for all involved stakeholders and operators.

Globally, there are already countries and societies operating much more in the sense of circular economies compared to the highly developed or industrialized countries. These circular economies can at least partially be seen as models for others mainly highly industrialized countries.

The German project EkoTech has shown that GHG emission reduction from fuel use in agriculture by almost 40% by 2030 is possible when fuel use is related to yield. This does not only result from improvement of machine technologies (such as more precise operation or more efficient engines) but results also from the overall progress in agriculture covering improvements such as for example from breeding. Furthermore, relative GHG emission savings (GHG reduction per yield) as declared in EkoTech will not be sufficient to meet true sustainability goals and thus might not be accepted by policy makers and society alone.

Subsidy policies can stimulate establishment environmentally beneficial technologies and practices to a certain extend. But principally, activities towards higher sustainability should rather be stimulated by market than by regulation (politics). While regulations can be necessary in some cases, sometimes, regulation can also impact (negatively) equipment life or use time as new legislation can outdate existing products and design. The time of use of machinery as well as uptimes should be maximized for best sustainability.

"True" metrics are basis for evaluation of efforts for sustainability. In agriculture, a full life cycle assessment (LCA) is needed to determine the true environmental footprint of machines and technology progress. LCAs include viewing the whole life time from production over use period to end of life (EOL). LCAs are still not established as a standard in product engineering of manufacturers. Progress is urgently requested as future engineering should take impacts of product design over full life into account – from production (including material related aspects) over use phase towards re-use, recycling, or re-manufacturing (EOL: end of life). With this task engineers take over a crucial role for future sustainability of agriculture. Material related aspects need specific investigations for upcoming growth of application of electric components. The material background is of specific importance.

This task of implementing LCA in product design needs modification or adaptation of education of engineers. Forecasting of environmental impact during product design phase can be done based on digital twins or AI technologies. Both methods for forecasting are based on historic data (experience). Consequently, digitalization means "digitalization of the history".

Principally, today's waste culture is also relevant for GHG emissions and needs to be changed. A metric for this is the so-call Earth Overshoot Day which currently is dated end of July. Especially waste of food plays a significant role and must be reduced - but also other waste (e.g. plastics).

Process related aspects

GHG emission result from a high variety of sources. Some source are related more to product (machine) design other more to the application of machines and technology in the agricultural process. A set of best practices has to be developed including mechanization models to support farmers in optimizing process management.

In operation users should get direct or immediate feedback about the environmental impact of their work (remote and onboard monitoring to improve efficiency of operation). Feedback systems shall be used to control and optimizes the overall agricultural process in the sense of a holistic process evaluation. In this context, smart products (smart agricultural machines) can enable GHG emission reductions if interconnected to a holistic farm management system. Thus, the ongoing development of digital farming ("Agriculture 4.0") unleashes a great potential of improvements in sustainability. Recently announced data and cloud connectivity is a big step towards Ag 4.0. Today's and future agricultural robots might play a big role in Ag 4.0. Engineers will be responsible that these machines fulfil appropriate highest safety requirements.

Especially heavy soil tillage has severe influence on GHG. Tillage effects fuel use but also C-fixation in soil. The latter of course is a matter of fertilization. In addition, soil compaction will stay a top issue in farming. Smaller machines (robots) might be enabler for better operations due to smaller machine weights. Engines (fuel use) is just one source of emissions. GHG emissions from livestock and fertilizer production is much higher. Nevertheless, fuel use must not be ignored. Biofuels to reduce GHG emissions need to be considered again.

New business models such as machine or product as a service (MaaS, PaaS), other service models, or performance-based contracting could improve life cycle impact since service providers (which could be a new role of the OEMs, too) will optimize products (e.g. spare parts) and product use.