CLUB OF BOLOGNA

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on occasion of

EIMA INTERNATIONAL 2014

Conclusions and Recommendations

"Agricultural Mechanization: the Engine of Energy for Life"

Road to EXPO 2015

CONCLUSIONS AND RECOMMENDATIONS

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Luigi Bodria, President of the Club of Bologna, **65 experts** from **22 Countries and 3 Representative of an International Organization** (FAO, UNIDO e CEMA) took part at the 25th Meeting of the Club of Bologna, held on 15 and 16 November 2014 in Bologna (Italy), on occasion of EIMA International 2014 and with the sponsorship of FEDERUNACOMA.

The title of the meeting was ***"Agricultural Mechanization: the Engine of Energy for Life - Road to EXPO 2015"*** and it was aimed to emphasizing the close link of agricultural engineering to the central theme of Expo *Feeding the Planet, Energy for Life*.

Eleven Key-Note Reports subdivided into 5 Sessions were presented underling the key role played by agricultural mechanization in the general framework of sustainable agricultural production and food security.

The Session 1 – **Agricultural Mechanization Development and Human Growth International Organizations** concerns a general overview on the role of the mechanization in agriculture and, more in detail, for the human beings progress. Two reports have been presented:

- **Agricultural mechanization: its role in the development of civilization***,* by Luigi Bodria (University of Milan, Italy) and Karl Renius (Technischen Univ. München, Germany);
- **Sustainability. The industry approach for improving competitiveness and future viability** by Norbert Alt, (VDMA, Germany).

The Session 2 – **Intensive Farming Systems: Innovation for Efficiency and Sustainability** concerns the main challenge of farm machinery of the future to produce more in an environmentally friendly way.

Three reports have been presented:

- **Ongoing improvement on automatic milking, forage harvesting and sustainable energy production**, by Evert J. Niemeijer (Lely Industries, The Netherlands);
- **Intensive farming systems: efficiency and innovation for sustainability**, by John K. Schueller (University of Florida, USA);
- **Overview of two recent EU-projects in robotic agriculture**, by Roberto Oberti (University of Milan, Italy).

The Session 3 – **Extensive Farming Systems: Innovation for Food Security** concerns the contribution of appropriate mechanization in order to improve production in traditional farming in less developed counties.

Four reports have been presented:

- **Agricultural mechanization strategies for sustainable production intensification: concepts and cases from Africa**, by Josef Kienzle (FAO, Rome);
- **Agricultural development and mechanization in 2013. A comparative survey at a global level**, by Namal Samarkoon (UNIDO, Wien);
- **Advancing agricultural mechanization in Africa. What kind of public-private strategies are needed?**, by Ulrich Adam (CEMA, Paris);
- **Low input production systems: innovation in mechanization for food security**, by Gajendra Singh (Doon University, India).

The Session 4 – **Product Traceability and Food Quality** concerns the need to ensure the end user a complete information on the origins and processing of food products with the presentation of the report:

- **Good agricultural practices, product traceability and food quality**, by Josse De Baerdemaeker (KU Leuven, Belgium).

The Session 5 – **Farm of the Future** concerns the evolution of the farm as a result of dramatic innovation resulting from the rapid technological development of the last years with the presentation of the report:

- **Farm of the future**, by Giuseppe Gavioli (CNH, Modena).

CONCLUSIONS

SESSION 1 – AGRICULTURAL MECHANIZATION DEVELOPMENT AND HUMAN GROWTH

The first Keynote Report "**Agricultural mechanization: its role in the development of civilization**", by Luigi Bodria from University of Milan (Italy) and Karl Renius from Technischen Univ. München (Germany) underline that for 10,000 years and up to three centuries ago the development of human society was based on technical development of tools and facilities dedicated to primary economic sector and therefore the "agricultural engineering" - in its earliest and simplest forms – can be considered the origin of all innovation.

In 1700 tools evolve into machines and begins the dramatic development of mechanization that today led to increase by more than a thousand times the productivity of human labour reducing employees in agriculture to 1-2% of active population in more industrialized countries.

Nowadays agricultural mechanization is facing two major challenges: from one side to produce food supplies for a growing population that is expected to rise to 9 billion in a few decades and on the other hand protect and preserve the environment.

An additional global strategic role of mechanization is to increase agricultural production and economic conditions in the less developed countries in order to reduce food shortage and improve the economic conditions of those countries.

Driving forces of modern farm machinery are automation and electronics with enormous progress in diffusion of IT technologies that have led to tremendous improvement in both efficiency and productivity of machinery and environmental protection during operations as has often been discussed in the Club of Bologna meetings.

The second Keynote Report "**Sustainability. The industry approach for improving competitiveness and future viability**" by Norbert Alt from VDMA (Germany), considers the progressive significance of the sustainability criteria within the agricultural machines production processes.

Today sustainability is not only a social requirement with respect to finite resources and climate change but primarily due to its holistic approach it also offers the opportunity to increase the competitiveness and future viability of a company. The VDMA Task Force 'Sustainability' was installed to provide specific recommendations concerning the development and application of sustainability criteria in order to assist VDMA member companies when implementing the principle of sustainability. The Task Force concentrates on the following items:

- to develop a concept for the implementation,
- to develop a tool for assessing the status of the company's sustainability,
- to provide recommendations for presenting sustainability reports,
- to support the development of the international standard for sustainability.

The report will present the actual status of the discussion, provide detailed information about the available results and show the need for future actions.

SESSION 2 – INTENSIVE FARMING SYSTEMS: INNOVATION FOR EFFICIENCY AND SUSTAINABILITY

The first Keynote Report "**Ongoing improvement on automatic milking, forage harvesting and sustainable energy production**", by Evert J. Niemeijer, from Lely Industries (The Netherlands), focuses on the change induced in the industry of agricultural machinery by the present evolution of the farm processes and the social needs linked to them. The politics

and the public opinion demand more attention in the favour of human welfare, animal welfare and environment protection and these changes are forces by agreements and laws created by the local governments, EU and UN.

Therefor the industry has to come up with solutions to solve this issues but of course to stay in business as well and to survive. The changes and the solutions can only be made by a company when the mentality of the employees of such companies changes as well. Only when they recognize the problems they are able to work on the solutions.

The second Keynote Report "**Intensive farming systems: efficiency and innovation for sustainability**", by John K. Schueller from University of Florida (USA), highlight as growing of world's population and increasing standards of living have augmented the demands for food, feed, fiber, and fuel. Consequently intensive farming systems have risen to challenge of producing these items in a manner which is economically, environmentally, and socially sustainable. In the North American very high level of productivity and efficiency, while maintaining sustainability, allows a single farmer to produce enough food for over 140 people.

In order to face the high costs of labour and inputs integrated system of powerful and reliable equipment were developed able to perform very high rate of work, thereby reducing economic risk.

Environmental sustainability is also promoted by contemporary intensive farming systems. Precision agriculture technologies insure that the needed inputs are supplied to maximize production while minimizing environmental impacts. Other aspects of agricultural mechanization systems are also designed, manufactured, and managed to efficiently perform their needed tasks.

With proper support, further advances in such areas as precision agriculture, robotics, and information technologies will help produce enough food, feed, fiber, and fuel to meet the needs of nine billion people in 2050.

The third Keynote Report "**Overview of two recent EU-projects in robotic agriculture**", by Roberto Oberti from University of Milan (Italy), reports the main results of two major projects on the application of robotics in field operations: (i) RHEA – Robot Fleets for High Effective Agriculture and Forestry Management and (ii) CROPS – Clever Robots for crops intelligent sensing and manipulation foe sustainable production and harvesting of high value crops.

The projects involved a total budget of over 14 million Euro in four years and saw the participation of 15 partners from 8 countries the first, and 14 partners and 10 countries the second.

The main goal of REHA was to configure and operate a fleet of complementary robots in order to cooperate in weeding and pest management operations minimizing the environmental impact and maximizing efficiency and safety.

In case of CROPS the overall objective was to develop and operate a modular, highly reconfigurable, multifunctional robot suitable for: maturity/quality crops monitoring, intelligent spraying, and selective harvesting.

The projects have led to a long list of lessons learned, showing on the field some relevant success in autonomous crop management.

SESSION 3 – EXTENSIVE FARMING SYSTEMS: INNOVATION FOR FOOD SECURITY

The first Keynote Report "**Agricultural development and mechanization in 2013. A comparative survey at a global level**", by Namal Samarkoon UNIDO (Vienna), shows how the emerging countries such as India, China and South-Africa are seeing significant economic growth and progress in agricultural production. They are becoming important players on the world markets for agricultural machinery and also represent promising markets with high demands for further mechanization.

Strong advances towards high levels of mechanization can be expected if the current trend of technology transfer is pursued and issues like e.g. property rights, different taxation practices across countries and unequal subsidies, market access, etc. are further dealt with.

The most challenging region for agricultural mechanization development remains Africa. While only limited progress has been achieved in terms of increased number of machines and market expansion, the predictions over the next ten years are positive. However increased investments are needed both from the national governments and the private sector.

The second Keynote Report "**Agricultural mechanization strategies for sustainable production intensification: concepts and cases from Africa**", by Josef Kienzle from FAO (Rome), emphasizes the role of agricultural mechanization in developing countries and especially in Africa were food production is generally very labour intensive and with very poor yields. Therefore the use of appropriate farm machinery is a crucial input in order to increase crop production and to improve processing and transport.

However agricultural mechanization is also much more complex in its application, requiring not only correct use, but also a service infrastructure for maintenance and repair and for this reason it is essential to consider the agricultural mechanization be part and parcel of an integrated approach to rural development sector.

Due attention must also be paid to possible detrimental effects of mechanized farming on the environmental sustainability and correct technologies must be applied in order to avoid soil compaction/erosion and chemical pollution.

One of the major mandates of FAO is to assist member states to make their input supply and food production chains more effective and efficient and at the same time provide farmers with improved livelihoods. The effective and sustainable use of increased levels of mechanization is one of the most important means of achieving this.

After providing some lessons learnt from the experiences of past decades the paper highlights how crucial it is to clearly define and divide the roles for the public sector, as well as for the commercial private sector, from financing and operational arrangements for the use of agricultural mechanization, to training in the use of machines, their maintenance and the related private sector supply infrastructure for sales, and after sales services.

On these conditions, mechanization can powerfully contribute to face the challenges ahead for food production and sustained livelihoods in a scenario of increasing population, rural-urban drift and natural resource degradation.

The third Keynote Report "**Advancing agricultural mechanization in Africa. What kind of public-private strategies are needed?** ", by Ulrich Adam from CEMA (Brussels), discuss which kind of cooperation mechanisms and strategies between public and private actors could be envisaged to ensure that agricultural mechanization efforts in Africa will succeed. Agricultural mechanization levels differ dramatically across the globe and Africa remains the most challenging region for mechanization. In Sub-Saharan Africa (SSA), land productivity is among the lowest in the world, and Agricultural Mechanization has either stagnated or retrogressed in recent years.

In order to develop mechanization in Africa in a sustainable and inclusive manner the public and the private sector will need to work together to nurture an adequate enabling environment that will allow the largely self-sustaining private sector to develop and operate effectively.

The fourth Keynote Report "**Low input production systems: innovation in mechanization for food security**", produced by Gajendra Singh from Doon University (India), point out that with growing population food security remains a major challenge in many countries in Asia where more than half the malnourished and under nourished people live. Mechanization is a powerful tool for achieving sustainable agricultural production as the labor productivity rapidly increases with increased level of mechanization.

Main challenges for mechanization include, 1) small land holdings (average size is only about 1 ha) and low investment capacity for majority of the farmers; and 2) the use of sub-standard manufacturing technology producing poor quality products performing poor quality work.

There is then the need for greater regional cooperation in information sharing, collaborative R&D and harmonization of standards, as well as improving of manufacturing processes in order to produce quality machines with improved safety standards.

SESSION 4 – PRODUCT TRACEABILITY AND FOOD QUALITY

The Keynote Report "**Good agricultural practices, product traceability and food quality**", by Josse De Baerdemaeker from Catholic University of Leuven (Belgium) shows the major developments occurred in the world related to food safety and traceability both from governments to protect the health of the citizens and from private initiatives by growers and retailers in order to meet the expectations of their customers with respect to food safety.

It appears that the origin and destination of animal feed, materials and food in all stages of production and distribution must be known and as information available to the qualified authorities or to food safety departments at manufacturers or retailers. To this purpose precision agriculture and automation represent a very powerful tool able to provide a lot of measurements at different spatial scales (from single plants to entire fields) and at different moments during crop production as well as location and time information of all treatments.

Traditional traceability systems are mainly identification systems. The generated information is of a static nature and does not contain dynamic information especially in the post-harvest chain. Process conditions are relatively easy to measure but continuously measuring product quality is often not feasible. However, quality change models can be used to predict product quality based on the initial quality and the measured conditions. Quality change models can be integrated with traceability systems to lift these administrative tools to the level of decision support systems accounting for quality of the product going through the chain.

SESSION 5 – FARM OF THE FUTURE

The Keynote Report "**Farm of the future**", by Giuseppe Gavioli from CNH Industrial Modena (Italy), introduce the impressive evolution of the farms in the next 30 years. There are several external drivers that will have a very strong influence on the farm of the future such as: the increase of food demand for growing world population and for growing individual food consumption, the need to increase productivity and efficiency of production on current crop land and to cultivate new land, the availability of new technologies for farm tools, the pervasive presence of information and data. The farming activities will also have to be increasingly sustainable for the environment.

Farmers will interact more and more with global crop and food markets, which will increasingly drive farm medium to long term strategy, while they will be strengthening links and connections with local farm communities and groups, leveraging on local and regional networks for energy production and sharing, logistic optimization, information and services.

RECOMMENDATIONS

SESSION 1 – AGRICULTURAL MECHANIZATION DEVELOPMENT AND HUMAN GROWTH

- ✓ **recognizing** the fundamental role of mechanization to release people to perform other tasks in developing society and civilization;
- ✓ **stressing** that the primary scope of agriculture is the production of food and alternative production of energy crops and fiber should be limited to countries self-sufficient in food production;
- ✓ **recalling** the three global role of agricultural mechanization: produce food (classic role), in sustainable way (environmental role), and with high labour productivity (strategic role);
- ✓ **underlining** that transition from machinery of power to machinery of intelligence as well as increase of productivity and efficiency, including environmental aspects, are the challenge for future machine development;
- ✓ **considering** that the large amount of information related to new sensors and precision farming far exceed the knowledge of farmers;

the Participants unanimously:

- ✓ **recognize** the full evidence that agricultural mechanization plays major role in the development of civilization and improvement of human life, and that future welfare and food security will be highly dependent on its development;
- ✓ **acknowledge** that future progress of mechanization should be mainly focused towards environmental sustainability;
- ✓ **hope** that in the current information revolution that offers the farmers a huge amount of "green data", useful data from which extract information of value to improve mechanization will be identified and selected;
- ✓ **invite** to take into account all the possible actions for the development of appropriate mechanization in order to help the less developed countries to advance towards food self-sufficiency;

- ✓ **recommend** to carefully consider ethics aspects of human well-being with a fair distribution of food resources;
- ✓ **recall** that full exploitation of technological innovation cannot be separated by an appropriate updating of farmer's knowledge.

SESSION 2 – INTENSIVE FARMING SYSTEMS: INNOVATION FOR EFFICIENCY AND SUSTAINABILITY

- ✓ **considering** that automation of the agricultural operations is essential in highly developed countries due to lake of human labour willing to perform heavy manual work;
- ✓ **recalling** that the intensive agriculture is applied very successfully in Europe and in the United States but raises important issues of environmental friendliness due to high doses of chemicals used;
- ✓ **noticing** that worldwide agriculture slightly move toward intensive farming as the main means to cope with the growing food requirement of the planet;
- ✓ **underlining** that the huge advances in electronics and automation have led to the development of site-specific farming techniques able to tailor the application of chemicals by reducing the dose to the minimum required so as to join high productivity and sustainability;
- ✓ **believing** that the use of robots for some specific application appears very promising even if there are still some constraints to be overcome such as the low speed of work and therefore robots can contribute to optimize the timing of operations and get over the shortage of labour in agriculture;

the Participants unanimously:

- ✓ **invite** policy makers to consider the scientific research in agricultural engineering as a high priority to ensure the growth of food production needed to feed the world in the coming years;
- ✓ **note** that the use of robots albeit still critical from economic point of view has a great potential for environmental protection mostly in the case of spraying;
- ✓ **stress** that lack in education will hamper the diffusion of technical innovation therefore appropriate actions to provide farmers with the necessary qualities of knowledge, skill and ability for optimal use of modern technologies must be implemented;
- ✓ **remember** that sustainable farming systems relies also on suitable irrigation mechanization;

SESSION 3 – EXTENSIVE FARMING SYSTEMS: INNOVATION FOR FOOD SECURITY

- ✓ **recalling** that low level of agricultural mechanization correspond generally to high level of poverty besides to a restricted availability of food resources;
- ✓ **noticing** that emerging countries such as India, China and South Africa are seeing significant economic growth and progress in agricultural production while Africa remains the most challenging region for agricultural mechanization development;
- ✓ **considering** that in Sub-Saharan Africa land productivity is among the lowest in the world and agricultural mechanization has either stagnated or retrogressed in recent years;
- ✓ **underlining** that though there are positive lessons to be learned from development of agricultural mechanization in Asia there is still a great challenge of research about agricultural mechanization in Africa;

the Participants unanimously:

- ✓ **stress** that agricultural mechanization strategies for developing countries need to be tailored, inclusive and integrated with a joint action by industry and FAO/UNIDO in order to promote with local authorities and farmers associations the definition of organized and integrated programs for appropriated mechanization development;
- ✓ **recommend** that given the positive results of the development of agricultural mechanization achieved in Asian countries, the possibility of creating a South-South dialogue for technology transfer should be seriously considered;

- ✓ **point out** that development of agricultural mechanization must be based on parallel development of education and training of farmers and technical staff for correct use and maintenance of machines;
- ✓ **remember** that food production in developing countries is adversely affected not only by the low values of production but also by the high values of the losses during product storage and therefore conservation efficiency need to be improved by creating appropriate structures;
- ✓ **emphasize** that a more widespread use of agricultural tools is not possible without an adequate economic policy able to guarantee a sufficient level of income to small farmers;

SESSION 4 – PRODUCT TRACEABILITY AND FOOD QUALITY

- ✓ **stressing** that precision farming provides a lot of measurements from single plants to entire field at different moments during crop production and therefore it is a key element for the implementation of traceability systems, able certify origin and destination of animal feed, materials and food;
- ✓ **recalling** that GPS on agricultural machinery give location and time information of all treatments and that nowadays tools are available for on the go measurement of the type and dose of treatments and for identification of possible infection;
- ✓ **considering** that measuring and reporting all steps and variable in the production process allow for reporting but also improving the process itself, traceability is strictly linked to sustainability that first of all is awareness and information;

the Participants unanimously:

- ✓ **underline** the fundamental role of new innovation of agricultural machinery in terms of development of sensors, automation al information technologies for the achievement of widespread traceability systems of primary production up to the gate of the farm;
- ✓ **encourage** the development in partnership between governments and public/private associations of worldwide accepted Good Agricultural Practices (GAP) standards for primary agricultural production in order to ensure integrity, transparency and safety of the whole production chain;
- ✓ **recommend** the evolution of current traceability identification systems in dynamic quality change models able to predict the final quality of the product known the initial quality and the measured process conditions;
- ✓ **remember** that traceability is also a promising tool to add value to information from precision agriculture making data useful for farmers in improving their financial gain selling certified high quality products;

SESSION 5 – FARM OF THE FUTURE

- ✓ **considering** that the future agricultural system, under the dramatic pressure of three key global drivers: the expected grow of world population, the need to rapidly reduce the number of the chronically undernourished people and to use farming practices that minimize the impact on the environment, will have to evolve substantially in order to increase its overall output becoming increasingly sustainable;
- ✓ **remembering** that land, water, energy and technology are the key factors and in the farm of the future they need to be considered in a holistic integrated view to reach the goal of increasing production minimizing the impact on the environment;
- ✓ **noticing** that advanced technology has already well demonstrated to be a key positive factor for the development of agriculture and with closed-loop systems allows actions directly related to specific plants conditions and needs;
- ✓ **underling** that there is no competition between robotics and employment in agriculture but this is a way to meet the challenge to increase production and improve working conditions.

the Participants unanimously:

- ✓ **stress** once again the central role of mechanization in new farming and the need for a harmonious development of smart technologies in order to provide farmers with the appropriate technical means required to face future challenges;
- ✓ **recommend** in future farming the intensification of interaction between biotechnology, agronomy and engineering in a multidisciplinary integrated approach as key to a more efficient food production;
- ✓ **emphasize** the need for appropriate professional growth of farmers through training, education and technical support to enable them to face with skill and technical competence the deep chances of agriculture in the years to come;
- ✓ **push** policy makers to promote public and private research in the field of agricultural engineering as well as the information technologies related to it in order to support further organic development of a sustainable mechanization.

Milan, December 2014