CLUB OF BOLOGNA, 2005

CONCLUSIONS AND RECOMMENDATIONS

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1. INTRODUCTION

63 experts from **25 countries in addition to different international organisations** took part in the 16th Club of Bologna meeting, held on 12 and 13 November 2005 within the XXXVI EIMA Show, under the aegis of **CIGR** and with the sponsorship of UNACOMA.

There were two topics under discussion, of which the first was **"Alternative Fuels for Agricultural Machinery Utilisation"** with keynote contributions by three speakers: Dr. Gustavo Best, FAO Senior Energy Coordinator, with a paper on "Alternative energy crops for agricultural machinery biofuels (focus on biodiesels)"; Prof. Dr. Ing. Giovanni Riva, Università Politecnica delle Marche, who spoke on "Utilisation of biofuels (especially vegetable oils) on the farm"; Dr. Hartmut Heinrich, Director of Research on Fuels and Oils, Volkswagen AG, with a contribution on "Utilisation of biofuels (especially biodiesels) in internal combustion engines".

The second topic was **"New Raw Materials for Agricultural Machinery Manufacturing"**, with two keynote papers by Dr. Robert Adams, representing the CNH tractor and equipment manufacturer, "Reasons for steel price increases and the impact on the agricultural machinery industry" and by Dr.-Ing. Klaus Martensen, Maschinenfabriken Bernhard Krone KG, "Progress in typical materials for agricultural machinery".

2. CONCLUSIONS

2.1 Topic 1. The first paper (**Alternative energy crops for agricultural machinery biofuels – focus on biodiesel**.) was presented by Dr. Gustavo Best, FAO Senior Energy Coordinator. There is a large variety of bioenergy sources, each one with social and scientific implications on rural poverty, high-tech industry, agronomy, new crop development and selection, land tenure issues, biodiversity impacts, rural employment, etc.

Biodiesel is a clean burning alternative fuel, produced from vegetable oils. Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend. It is biodegradable, non-toxic and essentially free of sulphur and aromatics.

Biodiesel is produced mainly from the following crops: soybean, rapeseed, sunflower, palmoil, linseed, canola, etc. The US National Biodiesel Board concluded that the energy balance for biodiesel may be from 1.44 (not including a credit for byproducts) up to 3.2. Advantages of biodiesel are: it is environmentally superior to other fuels (50% less CO; 80% less CO2; etc.); actually cleans engines; can be grown in arid, marginal, degraded lands; less toxic than table salt; byproducts may be used in agro- and livestock industry.

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In 2004 the main biodiesel producers were Germany, USA, France and Italy. Production is increasing by 20-25% per year and has reached around 2.5 million t. The future vision is positive and the international bioenergy programme is pointing to promote and monitor the sustainable use of modern systems for a sustainable development, energy security and climate change mitigation.

The second paper (**Utilisation of biofuels (especially vegetable oils) in the farm**) was presented by Prof. Ing. Giovanni Riva from the Università Politecnica delle Marche (Italy). The utilisation of biofuels in the farm is different following the increase in the cost of fossil fuels in comparison with the perspectives for agriculture. There are three different groups of countries:

- countries with industrial agriculture (e.g. in Argentina and Brazil in South America);
- western industrial countries (e.g. the European Union EU);
- less developed countries (many countries around the world).
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In the first group of countries the cost of agricultural products is lower and competitive and big plants for the transformation of the raw material could be feasible. Very often the possibility to convert the raw material in food and/or in biofuels may be a way to optimise the income of agriculture.

On the contrary in the western industrial countries the value of commodities is decreasing, with a consequent low profitability. Incentives are given for the RES (Renewable Energy Systems) development, especially for the “green electricity” and very often the idea to produce crops for energy production is studied with a great interest. In the EU the renewable energy consumption on the total gross energy is at present about 4% and it is planned its increase to 5.8% in 2020 and to 6.5 ten years later.

At last in the less developed countries the following points must be taken into account: economy is stagnating and subsidies are given in fossil fuels; energy needs are often solved by diesel generators; rural development is problematic; cost of energy efficiency (EE) for rural communities is usually very high and this justifies labour and investigation for EE production.

The following advantages must be taken into consideration: oleaginous crops are possible with all climatic conditions; the oil is extractable from the seeds with very simple machines; the byproduct from the pressing operation is a cake and it is often interesting to use it as a fertilizer or as a feedstock; diesel generators sets may be directly used with vegetable oils.

As a conclusion the use of raw vegetable oils seems an interesting option, when the quality of these oils is controlled. It is a must to prepare standard lines for the use of pure vegetable oils for diesel engines.

The third paper **(Utilisation of biofuels (especially biodiesels) in internal combustion engines)** was presented by Dr. Hartmut Heinrich, Director of Research on Fuels and Oils, Volkswagen AG. The world energy demand is rapidly increasing and non-conventional fuels (coal, CH4/H2, gas, new renewables) will fill the future energy gap. The demand on future fuels must fulfil a safe supply, an easy handling and storage, a high energy density, an economic competitiveness in addition to the consideration of environment and climate protection.

Future fuels should be such to be blended into existing fuels and be diversified on the primary energy side. The scenario of the fuel evolution is from diesel to synthetic fuels (based on natural gas and coal), to sun-fuels (based on renewables) and to hydrogen (also based on renewables). The EU

scenario is foreseeing by 2020 8% of biofuels, 10% of natural gas and 5% of hydrogen, with a total of about 23%.

Due to its properties (material incompatibilities, non fulfilment of stringent exhaust gas legislation, non compatibility with diesel particulate filters and with preheaters) a pure biodiesel cannot be used and it is rejected by the automotive industry; but it can be added to crude oil in the refinery.

As a result in the EU 25 (the European Union with the 10 new members, admitted in 2004) it is possible to blend at the moment up to 5% biodiesel, but the automotive industry is open for a 10% blending in a few years. In the EU 25 the diesel fuel demand in 2005 is 169 Mt, supposed to increase to 197 Mt in 2010, of which at present biodiesel is 13 Mt and will reach 23Mt in 2010.

2.2 Topic 2. The first paper (**Reasons forsteel price increases and the impact on the agricultural machinery industry)** was presented by Dr. Robert Adams, representing the CNH tractor and equipment manufacturer. Steel has been of paramount importance and is heavily used in the manufacturing of machinery and equipment. Its supply and price were not a problem up to a couple of years ago. Due to a strong steel consumption in China, India and other Asian areas, prices recently grew up and available stocks went down. As an example Chinese economy's share of global market doubled to 4% in the last decade, but she is consuming 27% of world steel products, with a demand increasing by more than 20% per year.

For tractors and combines, CNH relies on steel products as the principle source of components. For a tractor, ferrous metal products represent 30% of costs; for combines this dependence goes up to a 44%. To overcome this point, it has been decided to implement a global commodity strategy focused on quality, technology, delivery and total costs, through a strategic approach to: standardisation, technical saving, global sourcing, alternative technologies.

A disciplined process has been carried out to identify cost reductions from material specifications through to manufacturing processes, with actions that could result from a change of a component or component system, including: delete component functionalities; change material; standardise/communisation; reduce number of manufacturing processes; increase tolerances; reduce weight; simplify/change packaging; benchmark against competitor solution.

The second paper (**Progress in typical materials for agricultural machinery**) was presented by Dr.-Ing. Klaus Martensen, Maschinenfabriken Bernhard Krone KG. The recent most important milestones in the agricultural machinery manufacturing can be listed as follows: combination of several process steps in one machine; oil hydraulic drives and controls; electronic controls; extreme increase in the performance of individual machines.

Not long ago, a typical agricultural machine consisted almost exclusively of "iron and steel". This has changed and the main reasons are: higher load on the component due to increased performances; imperative light-weight design on account of legal regulations and avoidance of soil compaction; increase of the resistance to wear due to higher loads on components; increased demands on lifetime of modern machinery; increased demands on design and ergonomics.

Let us consider the material groups: structural steels; alloyed steels; cast materials; light alloys; wearing materials; synthetic materials. Machinery size is increasing, but legal requirements limit the total weight and/or the weight per axle. As a consequence fine-grained structural steels, high-

quality alloyed steels and cast iron and steel are generally used. For machinery parts subject to wear, blades and other similar components are coated with hard metal parts.

Light aluminium alloys are used to reduce weight, especially when a front or rear attachment requires to minimise the weight transfer from one axle to the other. Also gear housing of the various drives contribute to this end.

Synthetic materials are employed in versatile forms. Today, aesthetically shaped panelling dominates the market: glass-fibre reinforced plastic; thermo-plastic materials; rotational moulding or rotational sintering process polyethylene parts.

In the future other new materials will be used: metal matrix composite steel and ceramic materials, for wearing materials; piezoelectric materials, with the size increasing when an electric current passes through; twinned martensite, where a high load deformed part may return to the original shape by a simple heating.

3. RECOMMENDATIONS

3.1 Topic 1

- **Having recognised** that China, India and other developing countries economic uprising had a major influence on the fuel market in the past few years and that oil prices are forcing to develop new energy sources;
- **Having noted** that biofuels (biodiesel and bioethanol) are a necessary component of future energy supplies and that they attract a growing interest by politicians, the public, the farmers and that the best option is the conversion of biomass into liquid fuels;
- **Having recognised** that in the future energy scenario the contributions from agriculture are a must and that following the Kyoto protocol for a clean development, it is necessary to develop a conservation agriculture with alternative crops for bioenergy, considering the emission control;
- **Having noted** that the relationship between the oil and the energy crops prices and the tax situation in both products in each country is very important and that legislation is influencing sometimes in a positive and sometimes in a negative way the research and studies on various biofuels and their local production and diffusion and that subsidies are not normally accepted by WTO, although exceptions already exist;
- **Having noted** that manufacturers are normally conservative and not in favour of alternative fuels and that engine manufacturer design will be driven by the large scale producers, i.e. the automotive industry;
- **Having recognised** that bioethanol and biodiesel are products actually applied in some remarkable quantity and that a high level of efficient transformation from sugar cane to ethanol has already been achieved in Brasil and that the German “100 tractor programme”, supported by the government, demonstrated that pure rape seed oil is not able to be used economically for mobile machinery right now, as about 35% of the machines had severe break downs;
- **Having recognised** that EU is supporting the use of alternative fuels even if pure biodiesel seems to be not well suited for modern diesel engines for passenger cars with particle filters, while for trucks and agricultural machines the situation is different and that a general agreement on diesel engines fuels can be used in a mixture of 5% biodiesel and 95% conventional diesel, with increasing percentage of biodiesel for the future;

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- **Recommend** that to find the most effective system of transforming biomasses into energy and biofuels seems to be the most feasible and sustainable alternative to provide a clean, renewable and environmentally friendly energy source, not only for agricultural machinery but also for automotive and transport means;
- **Underline** that the processing of alternative fuels (from plant to tank) must be improved and that BTL (biomass to liquid) fuels shall be further developed in the (near) future;
- **Acknowledge** that the approach for developing bioenergy utilisation should be based on local social-economic conditions and that even if in EU the biodiesel is now to be blended in a 5% percentage, in developing countries there will be more expansion of bio-based fuels, as it is possible to implement easier transformation process and input preservation;
- **Underline** that the production of biofuels need a careful planning of the agricultural activity at regional, national and international (in the EU) level and of the areas where biomasses are produced in order to optimise (reduce) the transportation costs, with the precondition of a low energy input for cultivation;
- **Confirm** that the cultivation and transformation of biomass are essential to the development of agriculture in a future; in addition in a lot of countries marginal lands shall be used to prevent an impact to food security and conserve the limited farmland for grain production;
- **Reassert** that on the contrary a broad cultivation of the alternative energy crops according to the climatic and soil conditions are a suitable solution for the cultivation of crops for non food production purposes in the countries with food over-production as well as an important help in the energy supply and protection of environment;
- **Underline** that the relationship between the prices of natural oil and biocrops and tax situation determinate the possibility of developing these technologies in each country and that it is further necessary to promote bio-energy with research, development, dissemination of knowledge and subsidised and non-taxed applications;
- **Confirm** that future research and development related to renewable fuel and energy is very important and **acknowledge** that bioenergy is coupled with a number of problems of "waste products". These do not get enough consideration in the energy balance. Agricultural engineers must take into consideration both the problem of waste management and environment impact;
- **Remind** the conclusion of the "100 tractor programme" in Germany, that has to be studied and be taken into account to avoid the possibility for farmers to damage their tractors by using inappropriate fuels;
- **Underline** that with the worldwide increase in biofuels, it is important that FAO takes a leading role in their promotion, to coordinate research and convene international meetings on the regulations and trade aspects of biofuels in the global markets;
- **Underline** that agricultural engineers must collaborate with the big engine manufacturers, but with the important need to understand and develop processing of biofuels crops in order to ensure as much added value as possible;
- **Reassert** that in spite of the difficulties of using pure biodiesel, a scenario may be successfully developed to increase the percentage of biodiesel in the marketed diesel fuels, in such a manner that a considerable market share of biodiesel versus the overall diesel fuel consumption is achieved;
- **Recommend** that quality of biofuels should be standardised internationally according to the needs of efficiency of the combustion and with respect to the reliability and durability of the internal combustion engines;
- **Acknowledge** that the chances of using pure plant oils – especially in developing countries with a deficit energy supply - are rather seen for stationary power plants and that stationary

plants can better handle not only pure plant oils but also pure biodiesel than mobile machines.

3.2 Topic 2

- **Having noted** the increasing cost of raw materials and especially of steel;
- **Having recognised** that it is not easy to forecast the future trend of steel prices;
- **Having noted** that China development had a major influence on the steel market in the past few years, including the availability and price of steel;
- **Having noted** that the cost of high tech materials such as fine-graded steels increases more than proportionally with their performance and that for the manufacturing of agricultural machinery cost, weight and environment view points have to be considered;
- **Having recognised** that for agricultural machinery there are few alternatives to steel as a material that provides strength and that the economic development and the requirements for weight reduction and operational life of equipment make that a lot of attention goes to rational selection of materials for equipment;
- **Having noted** that high tech materials are today a standard in highly developed countries for agricultural machinery manufacturing and that the utilisation of new materials will increase in the future, but the most important factor in addition to technical consideration is their price, which will determine the effective use of these new materials;
- **Having recognised** that the quality and reliability of materials are important and that manufacturers are prepared to transfer the cost of good quality materials on the customers;

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- **Reassert** the necessity to increase the search for new materials, including new technologies to mould and/or to cast and/or to shape them, and **recommend** optimisation procedures for design that include the new materials, to make it possible for manufacturers to introduce these materials in a cost-effective way;
- **Acknowledge** that the general trend of material cost is favouring interesting chances for a general use of high tech materials;
- **Underline** that light weight materials, manufactured with light metal alloys, should be applied to agricultural machinery when appropriate, especially to reduce the weight of equipment to avoid soil compaction;
- **Underline** that the Chinese boom will probably return to a balance with slightly reduced steel prices, so that price contracts on steels could become again possible and the importance of spot markets will decrease;
- **Recommend** that small and medium sized manufacturers should be educated on materials trends and alternative materials;
- **Confirm** that to improve and develop new and better alternative materials, a condition is to encourage, to invest and to carry out research and development both at university and in industry, to also reduce dependency on steel and **suggest** to use a more intensively optimisation methodology in design of farm machinery supported by shape and parametric analysis;
- **Reassert** that consideration should be pointed to reliability, serviceability, time required for repair and maintenance, etc., to achieve an optimum design;
- **Underline** that the question of material recycling and eco-technologies should be faced and studied, as biodegradable materials are not at present a practical alternative;
- **Recommend** a bigger use of bio-materials and renewable materials in agricultural machinery and other products manufacturing, to improve efficiency, reduce costs and give the possibility to recycle them;

- **Recommend** that the research institutions and the industry should be encouraged to work together in order to develop biological materials, to replace the metal and plastic materials used in the manufacturing of agricultural machinery and equipment.