SUMMARY AND REMARK: SESSION 1: AGRICULTURAL USED AREA (AUA) DECREASE, WORLD POPULATION INCREASE, CLIMATE CHANGE: ROLE OF MECHANIZATION

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1. Introduction

Opening the session, Prof. Danilo Monarca highlighted the crucial role of mechanization in addressing future global challenges. He emphasized the dual responsibility of mechanization: firstly, to meet the food demands of a burgeoning world population, projected to reach 9.5 billion by 2050, and secondly, to mitigate its environmental impact.

The central challenge, as Danilo outlined, is in the distribution and development of new productive and economic models. He underscored the importance of mechanization in navigating the complex terrain of diminishing agricultural land and a declining number of farmers, particularly in an increasingly urban-centric world population.

The session's themes, as introduced by Danilo, revolve around exploring how mechanization can bridge these critical gaps. He expressed gratitude towards the session's speakers for their contributions and support in fostering a meaningful discussion on these pressing issues.

Danilo's address set the stage for the session, highlighting the interconnectedness of agricultural mechanization, global demographic shifts, and the imperative for sustainable solutions in the face of climate change. His emphasis on the need for innovative approaches in distribution and production models highlighted the session's focus on forward-thinking strategies to address these global challenges.

2. AUA and world population increase: present and future situation

In this era of significant human transition, we face the dual challenge of a rapidly increasing global population and a decreasing Agricultural Used Area (AUA). The need for higher food production with reduced labor, evolving cultural lifestyles, and food consumption patterns presents a complex scenario. The dramatic population growth, from around 150 million during the time of Jesus Christ to an estimated 9 billion by 2050, has led to a marked shift from rural farming communities to urban living. This urbanization trend raises critical questions about sustainable food production and distribution.

A pressing concern is the availability of land for agriculture. Currently, 73% of the Earth's surface, excluding ice-covered regions, is utilized by humans, with tropical deforestation contributing significantly to the loss of natural forests. This loss of agricultural land intensifies the challenge of feeding the growing population amidst shrinking resources.

The impact of climate change, particularly the rising levels of CO_2 and global warming, cannot be overlooked. The geopolitical implications of shifting agricultural production to northern regions, such as Russia and Canada, due to climate change are profound. This shift may redefine global agricultural dynamics and food security.

Agriculture today is riddled with paradoxes. The coexistence of undernourishment and obesity, the extensive use of land for livestock and biofuels, and the issue of food waste are some of the contradictions that need addressing. Water scarcity is another critical issue, with varying levels of water consumption for agriculture across different regions.

In response to these challenges, carbon farming emerges as a promising solution. The concept involves incentivizing carbon sequestration in agriculture, a strategy supported by the European Commission. This approach, along with technological advancements such as the digital twinning of trees and crops and various carbon monitoring technologies, offers a pathway to balance the demands of a growing population with the decreasing availability of agricultural land and the impacts of climate change.

As we navigate this human transition, technological advancements will play a crucial role, particularly in agricultural mechanization. Innovative solutions are required to address the complex interplay of population growth, land scarcity, and climate change. The future of agriculture hinges on our ability to adapt and evolve, ensuring food security and sustainability for generations to come.

3. Climate change and agriculture: from challenges to solutions

This presentation explored the complex and multifaceted relationship between climate change and agriculture, emphasizing the challenges and potential solutions. The discussion was grounded in extensive research, mainly drawing from the IPCC AR6 reports, to provide a scientific basis for understanding the impacts of climate change on agriculture and the necessary responses. The presentation highlighted climate hazards' intricate and cascading effects on food security and nutrition. This included an examination of the physical impacts of climate change and their subsequent influence on market prices and food accessibility, illustrating the far-reaching consequences of climate-related events.

Much of the presentation was dedicated to synthesizing observed impacts on crop yields and productivity. This analysis underscored the substantial effect climate change has had on agricultural output, explicitly focusing on the global effects of various biotic and abiotic stresses on wheat production, a global staple food.

Transitioning from discussing hazards to assessing risks, the presentation showcased how different factors contribute to the overall risk landscape in agriculture under the influence of climate change. This included an analysis of the susceptibility of crops and countries to multi-scale droughts between 1981 and 2016, providing insights into the vulnerability of different regions and crop types.

Looking toward the future, the presentation projected the effects of climate change on main crops in Europe by the end of the century, using modified data from IPCC AR6. This forecast highlighted the need for robust adaptation strategies, which formed a crucial part of the discussion. Various approaches to mitigating climate change's impacts on agriculture were outlined, emphasizing the importance of proactive and informed responses.

A specific focus was placed on Europe, comparing the forecasted situation in 2055 to 1995 under a global warming level scenario of 1.7°C. This regional analysis provided a more detailed understanding of the potential impacts and necessary adaptations in a European context.

The presentation discussed the synergy between adaptation and mitigation strategies, integrating various response options to enhance ecosystem services and meet sustainable development goals. This part of the discussion underscored the importance of integrated response strategies to ensure sustainable agricultural practices in a changing climate. The presentation also offered a comprehensive view of the challenges posed by climate change to agriculture and the multifaceted strategies required to address these challenges. It highlighted the need for a deep understanding of the interrelation of climate hazards, agricultural productivity, food security and the necessity for integrated, informed response strategies.

4. Food-waste, food-loss, and new bio-economy models to solve the problem

The third presentation of session one explored the critical intersection of waste management and economy, particularly in the context of land system change and its implications for our planet. A startling revelation from recent studies is that six out of ten indicators of planetary hazard risk are already being trespassed, with land system change being a significant concern. This situation underscores the urgency to conserve land, especially given the growing global population.

A substantial portion of primary agricultural production is, unfortunately, wasted. Estimates suggest that 15% to 30% of food is lost, depending on measurement methods. This loss translates into unnecessary pressure on land resources. The solution seems straightforward: reduce food waste to alleviate land pressure. However, implementing this solution is complex.

To tackle this issue effectively, it's crucial to understand the nuances of waste, loss, and residue. Loss refers to biomass that doesn't reach the final consumer for various reasons. Residue is what remains after a transformation or transaction, such as processing or selling. On the other hand, waste is biomass that loses value because it is not utilized. It is essential to emphasize the importance of value in this context. These three elements – loss, residue, and waste – are interconnected and transform into each other based on their value.

Analyzing where food waste occurs within the supply chain is vital. Waste can happen at various stages, including production, processing, aggregation, distribution, markets, and consumption. For instance, at the farm level, practices like threshing maize on the ground can lead to product loss due to exposure to parasites and heat. Similarly, during transportation, as seen in Bangladesh, milk transported in open tanks is prone to spoilage due to unfavorable conditions.

Commercial factors also contribute to waste. For example, consumers often reject naturally misshapen carrots, excluding them from supermarkets. Additionally, regulatory aspects like 'best before' dates can result in supermarkets discarding still-consumable products.

Technological, regulatory, economic, and social drivers are crucial to understanding and addressing waste generation. Technologically, innovations like solar-powered micro chillers can help preserve food at the farm level, reducing spoilage. Monitoring tools in restaurants can track and reduce waste, while infrared technology can assess food ripeness, aiding in better storage and reducing spoilage.

Economically, logistics costs, processing challenges, and transaction complexities play a role. Socially, consumer preferences significantly influence what is considered waste. For example, changing consumer attitudes towards naturally imperfect produce can reduce waste.

Finally, the concept of a circular economy is pivotal. Instead of the traditional linear approach where waste is an endpoint, a circular economy designs processes to avoid creating residues and losing value in food. This approach involves transforming biomass into high-value products, following a hierarchy of value extraction before considering energy production. Addressing food waste requires a holistic approach, integrating technological, economic, social, and regulatory aspects. It's about envisioning new systems and paradigms in agriculture and food processing, where waste reduction and value creation are central. This approach is essential for staying within our planet's boundaries and ensuring sustainable food systems for the future.

5. Agricultural mechanization, one of the solutions making it possible to reconcile the scarcity of agricultural land, a decline in the number of farmers and an increase in the world population in a context of climate change

The last presentation explored the critical role of agricultural mechanization in addressing the challenges posed by the decreasing number of farmers, the increasing world population, and the constraints of climate change. The expansion of agricultural land is becoming increasingly difficult due to land scarcity and competition for land use, making it imperative to find alternative solutions. One such solution is enhancing yields and work productivity, especially considering the competition between human and animal feeding and the dual use of agricultural produce for food and non-food purposes.

The speaker emphasized the significant advancements in agricultural sciences, including varietal selection, genetics, and using fertilizers and pesticides. The evolution from animal to mechanical traction, followed by the integration of digitalization, precision agriculture, and the incorporation of robotics and AI, marks a substantial advancement in agricultural technology.

Agroecology emerged as a key topic in my presentation, highlighting its importance as a framework for transitioning to sustainable practices and adapting to climate change. This approach combines agronomy and ecology, aiming to enhance the self-regulatory capacities of ecosystems while reducing reliance on synthetic inputs. The complexity of managing agroecological systems necessitates using digital tools, such as digital twins, to manage farms effectively.

The role of mechanization in agroecology was also a focal point, with the French Recovery Plan encouraging the adoption of precision equipment conducive to agroecological practices. This includes a variety of machinery and tools designed to facilitate these methods.

Robotics was identified as essential for agroecology due to its precision, adaptability, and ability to perform complex tasks, thus reducing the need for manual labor. This is particularly crucial in the context of developing countries, as exemplified by the MecaWAT project in Ivory Coast, Benin, and Ghana, which aims to establish an ecosystem favorable to mechanization in agroecological transitions.

Agriculture's main challenge today is feeding a growing population in an uncertain and changing environment. Mechanization, digitalization, AI, and robotics are integral to meeting this challenge, with education and accessible technology pricing being crucial for widespread adoption. The presentation highlighted the integration of cutting-edge technologies with agroecological practices to address the pressing challenges in modern agriculture.

6. Panel Discussion

The panel discussion following the presentations at the conference offered a rich exchange of ideas and perspectives, addressing several key issues in agriculture, environmental sustainability, and the socio-economic impacts of these fields.

One of the first topics discussed was the temporary nature of carbon sequestration in trees and plants. A concern was raised about whether this is a long-term solution, considering that trees could re-release the sequestered carbon once decomposed. The response highlighted the importance of maintaining cover for extended periods and managing the biomass at the end of its life cycle. The discussion underscored the need for sustainable practices, such as converting biomass into bioenergy or incorporating it into the soil, to maintain a balance in the carbon cycle.

The conversation then shifted to the socio-economic implications of environmental policies, particularly in rural communities. A concern was raised about government policies favoring environmental processes, like carbon credits, at the expense of traditional farming, leading to the loss of rural communities and landscapes. The response emphasized the potential of creating carbon-neutral districts for food production, where agriculture, forestry, and other land uses coexist and compensate for each other's emissions. This approach could preserve rural communities and landscapes while contributing to environmental goals.

Another significant topic was the financial and societal costs of combating climate change. The panelists discussed the need for a holistic approach, integrating various sectors like water management, agriculture, and renewable energy. They stressed the importance of convincing society about the multifaceted benefits of such integrated actions. The discussion also touched on the misconception that reducing consumption necessarily means reducing quality of life, arguing instead for reevaluating what constitutes quality of life.

The panelists also explored the potential of agricultural soils for carbon storage and the importance of innovative farming practices and equipment in enhancing soil health and resilience to climate change. They highlighted the need for a systemic approach to agriculture, focusing on preventing waste and loss through more resilient agro-systems.

Education was another focal point, with discussions on sensitizing younger generations to climate change and related issues. Suggestions included supporting programs dedicated to climate change, improving skills in data analysis and innovative tools like AI, and promoting interdisciplinary education to address complex problems holistically.

The debate on using genetically modified organisms (GMOs) to adapt crops to changing climate conditions was also a crucial part of the discussion. While not opposed to new breeding techniques, the panelists emphasized the need to use such technologies wisely and within a broader context of addressing agricultural challenges.

Finally, the discussion touched on food waste and distribution, highlighting innovative solutions like apps for redistributing surplus food and the need for systemic changes in food production and consumption patterns.

The panel discussion debated the multifaceted challenges and opportunities at the intersection of agriculture, environmental sustainability, and socio-economic dynamics. The exchange of ideas accentuated the complexity of these issues and the need for integrated, innovative solutions.