Keynote Speech

Towards a Knowledge-based Bio-economy: New Challenges, Opportunities and Solutions Livestock Production and Aquaculture

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Introduction

Various definitions have been used in scientific literature to define the term 'Bio-economy'. For the purpose of this presentation the definition given by the European Commission (Schmid *et al.*, 2012) is used. According to this definition a bio-economy means "an economy using biological resources from the land and sea as well as waste, including food wastes, as inputs to industry and energy production". The definition emphasizes biological resources and biomass as inputs to other industries. In a bio-economy, biotechnology contributes to a significant share of its output. It encompasses the use of advanced knowledge of biotechnology and the use of renewable biomass and efficient bioprocesses that support sustainable production.

The economic development of the past 200 years or so would not have been conceivable without the use of non-renewable resources such as coal and oil. They were the basis for continuous technological progress over the years and have contributed to the development of strong economies around the world. However, along with a growing world population and the rising demand for food, energy, infrastructure and healthcare services, the question is being asked: Can this economy continue to grow sustainably?. Bio-economy can make a significant contribution towards solving this situation since it stands for the knowledge-based creation and use of renewable resources to provide products, processes and services in all economic sectors within the framework of a future-oriented economic system.

Biotechnology, a major contributor to bio-economy, has been an evolving success story in the area of agriculture. Biotechnologies such as genetic modification (GM)–eg. Gene shuffling, molecular markers, marker aided selection, etc. have revolutionized the global production of food and feed from many plants species. Research has been abundant into developing improved crop varieties that are resistant to drought, pests and diseases, through the manipulation of agronomic traits.

Knowledge based bio-economy in Livestock production and Aquaculture

On a global level, livestock management is a multifunctional activity. In addition to generating food such as meat, milk and eggs, livestock plays a valuable role as a source of income, renewable low cost power for agricultural operations and transport and a store of wealth providing an efficient safety net during times of economic hardship.

With the continuous increase in world population (estimated to be around nine billion by 2050) there will be an increase in demand for land-intensive foods such as meat, milk and eggs and, for fish. While conventional technologies will continue to support production of animal-based food, new knowledge based technologies especially those using biological systems, living organisms or derivatives there of– biotechnologies would be required to ensure global food and nutrition security in the future.

Among the animal biotechnologies, the most widely used ones, especially in the Asian region, are the application of assisted reproductive biotechnologies such as artificial insemination (AI), progesterone monitoring, oestrus synchronization, embryo transfer, in vitro fertilization, Cryopreservation and recombinant DNA technology. Molecular markers for genetic diversity studies are also used widely, but marker-assisted selection for genetic improvement is only used in a few of the more developed countries. In animal health, molecular based serological techniques using monoclonal antibodies and recombinant antigens as well as PCR-based methods are used for diagnosis of diseases and epidemiological studies (FAO, 2010a). Biotechnologies are also used to improve animal nutrition through the use of feed additives (eg. amino acids, enzymes, ionophores, probiotics and prebiotics etc). This is especially so in the preparation of feed for monogastric animals.

However, more advanced technologies such as cloning and transgenesis are hardly used in developing countries, because of limitations in

success rates and cost effectiveness as well as ethical, religious and animal welfare concerns.

Biotechnologies are now emerging as useful tools for increasing the productivity and sustainability of the fisheries sector. Although aquaculture has not made the full use of conventional technologies in selection and breeding improvement programmes it is considered a likely sector to benefit greatly from the application of genetic and reproduction biotechnologies such as the use of hormones for the control of reproduction and inducing maturation, disease control, feeds and nutrition and environmental improvement (FAO 2010b).

Biotechnologies for the future

A number of biotechnologies in agriculture, health and industry have been identified as having a high potential and a high probability of reaching the market by 2030. Those applicable for livestock production and aquaculture are:

- Marker assisted selection in plant, livestock, fish and shellfish breeding
- GM animals for producing pharmaceuticals and other valuable compounds
- Improved varieties of feed crops with higher yields, pest and disease resistance and stress tolerance
- Diagnostics for traits and diseases of livestock and fish species, including shellfish
- Cloning of high value animals as breeding stock

Challenges

The development of a bio-economy requires successful innovation. Biotechnology R&D must be performed and paid for, to realize commercially viable products and processes. Regulations that ensure safety and efficacy of the products, issues related to intellectual property rights and patenting, social attitude to biotechnology and biotechnology products, human resource base and business models that cater to biotechnology opportunities will influence the development of biotechnology. Overcoming social and institutional factors, especially public opposition/opinion to biotechnology and biotechnology products could be major barriers to the use of biotechnology in the future.

The full benefits of a bio-economy could only be achieved through a goal-oriented policy. This will require leadership and commitment by both governments and public sector organizations to set in place goals for the application of biotechnology in agriculture, health and industry

that will ensure successful adaptation to new opportunities.

References

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