Optimization and Minimization towards Sustainable Soybean Production

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Abstract: Soybean (*Glycine max* [L.] Merr.) is an important oil-bearing crop, which was originally domesticated in northeastern China. Soybeans have been part of the Asian diet for millennials and are consumed in many forms, while in the Americas and Europe the crop is mainly used to produce edible oil and animal feed. The production of soybean reached 371 million tons in 2021, making it the most important legume crop in the world. Soybean is a multi-functional crop, which provides food, feed, fertilizer and fuel (biofuel), as well as supports livelihoods in particular for smallholder farmers. Therefore, soybean contributes directly to achieve multiple Sustainable Development Goals (SDGs), such as Zero hunger (SDG 2), Good health and well-being (SDG 3) and Responsible consumption and production (SDG 12).

The soybean production is, currently, facing with five major challenges: 1) the diminished arable land resource, because expansion of soybean production has caused server losses of forests and savannahs; 2) low use efficiency of resource, such as 60 percent of applied N remains unused or lost from soil; 3) poor resilience to stresses as some soybean cropping systems are more vulnerable to external shocks from pests and diseases, as well as droughts and floods; 4) weak agricultural extension services, which result in low adoption rate of good agricultural practices; and 5) ineffective enabling environment, including the inadequate investment and lack of coherent policies and regulatory frameworks to support farmers who desire to adopt new technologies.

The key strategy for promoting sustainable soybean production is: to optimize all the positive aspects of soybean cropping systems while minimize all the negative positive aspects of the systems. These should include: 1) increasing in recourse use efficiency in particular the water and fertilizers; 2) building more resilient and diversified soybean cropping systems; 3) promoting application of innovative technologies such as alternative for mineral fertilizers; 4) fostering context specific agricultural extension services, such as Farmer Field Schools (FFS); and 5) creating enabling environment covering national framework and strategies, relevant international code of conduct, standards for good agricultural practices, incentive mechanism, and financial support.

Key Technologies for sustainable soybean production cover: 1) adaption of improved varieties and production and supply of good quality seeds; 2) development and adoption of optimized soybean cropping systems resilient to biotic and abiotic stresses; 3) promotion of integrated pest and disease management; 4) enhancement of soil health management; and 5) large-scale extension of precision fertigation.

The key elements to promote future sustainable soybean production are composed of: 1) strategic Planning based on priciples of optimatzation and minimization; 2) technical synergy at global regional and national levels; 3) multi-stakeholder engagement including research and academia, extension and education, NGO, private sector and development organizations; 4) knowledge sharing among different stakeholders; and 5) international cooperation, such as international guidance, international platform (network), international standards, and international working groups and coordination mechanism.