



Key messages

- Introduction of technological innovations in crop production enables farmers to harvest high yields of premium quality.
- Mobile network technologies and the 5G technology have created a variety of new opportunities.
- The technical pre-conditions for introduction of technologies based on IT and artificial intelligence are available in Mongolia.
- Introduction of technological innovations requires financial support and building of the human resource capacity.
- The national R&D system needs to be strengthened.
- A national structure for transfer of technological innovations into crop production needs to be established.

Importance of introducing technological innovations in crop production

Introduction of innovations, especially technological innovations, in crop production increases the possibilities of crop farmers to harvest high yields of premium quality. Automation of production processes that normally require substantial human involvement, and reduction of power consumption and costs, in particular, can unleash a tremendous potential for reducing production costs and enhancing the quality and standard of the products. Through continuous focus of the government and other relevant stakeholders on this issue, the crop sector of Mongolia can reach the next level of its development. This policy brief, prepared by the German-Mongolian cooperation project "Sustainable Agriculture", aims to inform the policy makers and other stakeholders in the crop sector on the current situation of technological innovation, its diffusion in the crop sector and key issues to be addressed for introducing selected innovations.

Global overview of technological innovations in the crop sector

Mobile network technologies and the recently introduced 5G technology have created a variety of new opportunities. In particular, they allow fast-speed transfer of a large amount of data that is required by driverless tractors and harvesters and self-propelled machines. Connected with satellites, this technology is increasingly used in combination with the Global Positioning System (GPS). Meanwhile, various GPS sensors and data transmitters have been developed, and integrated into smart phones and a range of other devices. The autonomous technology and artificial intelligence, among others, enable quick reaction to unforeseen threats and a high precision of the technical procedures in crop production.

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The use of drones in monitoring of soil moisture and temperature, weeds and insect infestations, and nutrients contents of soil is also spreading around the globe, and increasingly seen as a cost- and time-saving approach. Often, however, remote sensing is combined with conventional research methods for verification of data collected and the results of data evaluation.



Soil monitoring with a drone (Source: Bayartulga, L. 2019)

Robots tend to become useful assistants in vegetable production, and in greenhouse farming in particular. A pioneering example is the Grand Farm project in the USA, funded with a USD 1.5 million grant by Microsoft, which is known as one of the leading visionaries in the world. The Grand Farm is a farming complex with fully automated production systems without any human involvement, and with its drones and robots operated by artificial intelligence.



Soil tillage by the autonomous system AgroBot (Source: aurora-robotics.com)

Water is an essential input in crop production. As the vast amount of water used in cropping is increasingly becoming a critical issue, however, the emphasis is now placed on water-saving methods. Israel is among the leaders in the development of water-saving smart irrigation systems. The Israeli manufacturer Netafim launched, for the first time in the world, a self-learning artificial intelligence system that autonomously operates irrigation facilities of any size, and has meanwhile introduced it in crop production. The R&D of the company on water-saving irrigation has also resulted in a range of drip irrigation systems that use up to 75 percent less water compared to conventional irrigation systems.



Does Mongolia have the pre-conditions required for introducing these technologies?

Introduction of any new technology or innovation requires that certain pre-conditions are met. For the introduction of the modern technological innovations mentioned above, in particular, sufficient and stable supply of electric power, and capacity and coverage of the application of information technologies are of essential importance.

In 2018, Mongolia produced 1.122 megawatts of electric power, with thermal power plants contributing 90%, renewable energy power plants 6%, hydroelectric power plants 6%, and diesel power plants contributing 2%, respectively. The total length of the fibre-optic network was 45 thousand km, and the numbers of internet and cell phone users were 306 thousand and 3.3 million, respectively. 3G networks counted 2.5 million mobile data users while 1.47 million users were registered in 4G/LTE networks. Mongolia holds the official permit to use the satellites INTELSAT 960 and APSTAR 5. However, depending on the technologies used, the networks of a range of other satellites are regularly accessed too.

In summary, Mongolia does meet the technical requirements and has a considerable potential for introducing modern technological innovations based on information technologies and artificial intelligence.

Introduction of technological innovations requires financial support.

Out of a number of technological innovations already introduced in crop production, only a few have been tested in Mongolia. One of the main reasons for the insufficient adoption is the lack of financial support by the government. Technological innovations are usually expensive because they result from research and development programs implemented for many years. Their prices, however, tend to go down when the number of buyers i.e. adopters increases. Since most crop farmers in Mongolia are under the pressure of credit repayments and have limited capacity to take the risk of investing in new technological innovations the first steps towards introduction of technological innovations should be taken as a collective endeavour of the government, scientific institutions and the private sector. There are plenty of successful examples of such collaborative initiatives in many countries around the world.

Policy recommendations:

- Approval of government budget for introduction of several technological innovations in crop production on an annual basis,
- Obligation of new international projects and programs for introduction of technological innovations in crop production;
- Creation of incentives for development and adoption of domestic technological innovation, and mechanisms for ensuring the continuity of technological innovation processes.

The human resource capacity for introduction of technological innovations has to be built.

Recent technological innovations are often based on advanced information technologies, thus requiring a certain level of IT expertise, which is largely not available in the crop sector of Mongolia. Another problem is that the software interface is displayed in a foreign language. Also, user manuals are not translated into Mongolian. Thus, Mongolian users without sufficient foreign language competences are not able to operate the systems, or likely to make errors when trying to operate. In fact, there are cases of Mongolian farmers who are already in possession of those technologies but not able to operate them correctly, due to their lack of either IT expertise or language competence, or a combination of both. The main problem is the lack of training opportunities for crop sector personnel on the use of technological innovations.

Policy recommendations:



- As a first step, government-funded short- and long-term training programs to provide crop sector personnel with the IT expertise required for the use of technological innovations should be implemented.
- Mandatory subjects on the use of technological innovations e.g. smart farming, operation of ITs and artificial intelligence etc. should be added to the curricula of degree programs at all levels for qualification of crop sector personnel, such as agronomy, irrigation and agricultural engineering.
- Domestic and international study tours on technological innovations should be organised for crop farmers, and funded through a combination of funds provided by international projects and participation fees.
- Government co-funding of selected high-tech institutions that conduct R&D on introduction of technological innovations in grain and vegetable production sectors, which are of strategic importance.

The national system of research and development needs to be strengthened.

Crop research in Mongolia is largely focused on the study of biological and non-biological environmental factors affecting crop growth and yields. Research on technological innovations is almost non-existent. This results from the lack of legal and policy frameworks and funding schemes for intersectoral R&D on the one hand, and the lack of emphasis on technological innovations in the crop sector on the other. Integration of technological innovations into the R&D activities of universities and scientific institutions will therefore require enabling policy and institutional frameworks and a set of incentives. For strengthening the linkage between the IT sector and the crop sector, a practical initiative would be to connect the regularly organised competitions Robocon and “IT Olympiad” with the crop sector as to encourage the participants to develop robots and software for use in crop production.

A national structure for transfer of technological innovations to crop production needs to be established.

The responsibility for transfer of technological innovations into the crop production shall not be simply left to the crop farmers. Policy support is required in the form of funding arrangements and incentives as well as for establishing a technology transfer structure with the involvement of all relevant institutions in the crop sector. Once established, such a structure does not have to be fully funded or coordinated by the government; a better option is to maintain it as a collaborative structure of public and private sector stakeholders and international organisations working the crop sector of Mongolia.

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