



Promoting IPM on a large scale in DPR Korea

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Summary

Agriculture is crucial for the Democratic People's Republic of Korea (DPRK), involving approximately 50% of the economically active population and contributing an estimated 25% to the gross national product. However, agricultural production has remained low due to soil degradation and pest damage in cabbage and maize (particularly due to lepidopteron pests), amongst other reasons. To help improve productivity and address food security issues, CABI has been working in DPRK since 2002 to introduce integrated pest management (IPM). This is a sustainable approach combining cultural, biological and chemical control methods to provide stable yields and long-term reduction in pesticide use. By integrating IPM into agricultural production, as well as into extension and education in DPRK, higher yields for staple crops, such as maize and cabbage, have been achieved and communities protected from the short- and long-term effects of harmful chemical pesticides.

Sustained support and facilitation from CABI to national research institutions has also helped to strengthen capacity, so that further IPM can be developed across the country. Whilst the initiative initially focused on technical interventions, including the introduction of biocontrol - using *Bacillus thuringiensis* (Bt) biopesticides and *Trichogramma* wasps - CABI's approach changed over time. In order to scale up successful interventions in the field, CABI recognised that it needed to develop a broader approach. This involved training with:

- technicians - to produce the biocontrol agent;
- extension workers - to introduce participatory approaches for the training of farmers in IPM practices;
- farmers - to apply the biocontrol method and other IPM tools.



Raising awareness among Ministry of Agriculture (MoA) officials was also an important component, to ensure their support of the IPM approach and to have them coordinate the farmer training by extension officers. Latterly, CABI's involvement shifted to a focus on institutional change, networking between stakeholder organisations, and policy level support for implementation of sustainable agriculture, including IPM.

The achievements in DPRK have therefore not been the result of one CABI project or set of activities. The technical component has been key, with the introduction of local biocontrol facilities and scaling up of effective IPM solutions to larger areas. However, the achievements overall are due to the move over time from a 'one problem – one solution' pest specific approach towards integrated solutions focused on institutional change. This has involved building on

lessons learned and delivering the solutions through an innovation systems (multi-stakeholder) approach.

Key highlights

- IPM is implemented in maize and cabbage production in DPRK, on approximately 120 cooperative farms (more than 50,000 ha)
- 29 *Trichogramma* rearing facilities are now operational, located in one-in-ten counties in DPRK, providing enough beneficial wasps to protect approximately 5% of maize (more than 25,000 ha) from pest damage.
- Using IPM, maize yields increased by over 10%, resulting in a surplus of 0.55 tonnes of maize grain per ha each year.
- Pyongyang Agricultural University (PAU) lecturers were supported to develop an IPM course, which is now part of the PAU syllabus.
- Agreement of the DPRK Ministry of Education to the PAU IPM syllabus led to the adaptation and introduction of IPM training at provincial universities and county agricultural colleges nationwide.
- Policy workshops with the MoA to develop national IPM guidelines led to maize IPM being set as a high priority area by the government.
- Key stakeholders in DPRK agreed to form an Integrated Crop Management Technical Advisory Group, with over nine organisations now operating as an advisory body to the government and as a platform for IPM related activities in DPRK.
- Plant protection is now recognised in DPRK as a major factor influencing crop production and the implementation of IPM is seen as important. As a result, a new Department of Plant Protection was established in 2012 under the MoA to address crop protection issues.

Context

Agriculture is of high importance in DPRK, with 90% of production generated through a cooperative farming approach involving an estimated 6 million people on around 3,000 cooperative farms (550-750 ha each). The MoA defines agricultural policy and guides the rural economy by establishing agricultural priorities, overseeing national annual farm production plans and coordinating all government support for agriculture. However, severe winters and a relatively short growing season, in addition to only 15-20% of land being available for farming, mean that potential agricultural production is not high. Furthermore, during the 1980s and 90s, farm work teams responsible for crop production found it increasingly difficult to meet targets due to declining soil fertility and increasing pest damage, together with limited access and poor quality of fertilisers and pesticides.



Maize, for example, is a key staple crop in DPRK and, in 2007, was planted on almost 20% of arable land (over 495,000 ha). The Asian corn borer (*Ostrinia furnacalis*) causes the most extensive damage, resulting in typical yield losses of 10-30% but occasionally reaching as high as 80%. In addition, pest damage reduces the quantity of crop residues (leaves and stalks) available for animal feed. Cabbage is another key crop, of high importance in the traditional diet and local economy. It is a particularly important food source during winter as it is processed into a national dish, kimchi, a long lasting pickle.

As a result of increasing pest damage in maize and cabbage, plant protection products (e.g. hazardous synthetic chemicals, sometimes mixed with botanical extracts) had increasingly been used to try to maintain crop production. However, since 1995, regular food shortages have occurred for various reasons, including natural disasters.

Introducing IPM

Although agricultural development is challenging within DPRK due to the relatively inflexible and highly regulated state control, the political ideology of *juche*, national self-reliance, presents both a challenge and an opportunity. To help support improved food security in DPRK, CABI Switzerland supported the Plant Protection Institute (PPI) of the Academy of Agricultural Sciences (AAS) and the Central Plant Protection Station (CPPS) of the MoA in Pyongyang, including county level stakeholders, to implement IPM in cabbage and maize.

IPM in cabbage

Collaboration led to the development of an appropriate IPM approach and tools. The tools included seedbed management, monitoring of pest populations, and the application of locally produced, environmentally-friendly *Bacillus thuringiensis* (Bt) biopesticides, which targeted only the pest (particularly diamondback moth, *Plutella xylostella* and the small white butterfly, *Pieris rapae*). IPM for cabbage was tested on five cooperative farms in 2003/04, resulting in a yield increase of 40%.

As a result of this initial success with IPM in cabbage, there was significant motivation to scale-up the approach and an opportunity opened up to provide practical training activities at the cooperative farm level. In order to reach as many farmers as possible, a 'Training of Trainers' approach was adopted to familiarise extension specialists from county and cooperative farm level with the IPM technology, as well as with participatory approaches for training.

To support the IPM training, manuals were jointly developed with the AAS Plant Protection Institute providing:

- a farmer friendly overview of crop specific IPM;

- factsheets about key insect pests, diseases and beneficial insects;
- practical exercises for IPM implementation; and
- information on safe and judicious use of pesticides.

In addition, insect identification sheets were developed for use at the cooperative farm to support the application of IPM principles to other crops (such as potato, cereals and rice) and crop rotation leaflets, explaining the principles, effects and requirements for cooperative farm managers and work team leaders.

Cooperative farm level training activities improved the linkages with those in the MoA responsible for extension, which subsequently catalysed further motivation and involvement of national stakeholders.

IPM in maize

With maize, the key technical element of the IPM approach was the mass release of a parasitic wasp, *Trichogramma*, which successfully controls Asian corn borer. Highly successful *Trichogramma* mass production technology was imported in 2005 from China and adapted, in collaboration with Korean specialists, to ensure its sustainability under local conditions. Adaptations included reducing electricity consumption and using locally available materials whenever possible in the facilities and rearing processes. Prototype and pilot facilities were also used to enable adaptations to be refined.



Additional measures to ensure the sustainability of the facilities was undertaken, through training of local staff for production and maintenance of the equipment to multiply *Trichogramma*. To provide a step by step rearing guide, a production manual and video was produced. Strict quality control (in line with international recommendations) was also implemented to ensure production of high quality *Trichogramma* egg cards. With the proven success achieved with the cabbage-related activities, IPM training in maize was planned and implemented with the MoA and farm level extension specialists, including training on the correct

application of the parasitic wasps.

By 2014, 29 *Trichogramma* facilities had been established to produce and distribute 8,750 million *Trichogramma* wasps every year (sufficient to protect over 20,000 ha of maize), contributing to an estimated 10-20% increase in maize yield and surplus of 15,000 tonnes per year. As a result, the DPRK government now anticipates further nationwide implementation of the approach, which could result in an additional 375,000 tonnes of maize per year.

Strengthening institutional capacity

Whilst experimentation with biocontrol products using trial plots quickly proved the benefits of IPM to the experimenting farmers and their neighbours, scaling up these results required institutional change, particularly within the MoA and the university system.

With the MoA responsible for large-scale dissemination of new practices to approximately 3.2 million staff at the 3,200 cooperative farms, achieving inclusion and understanding of IPM approaches among ministry staff was key. However, training such a significant number of farm workers was not possible within the scope of the project. A more effective way to achieve IPM implementation at a large scale was through institutional capacity building to support MoA officials to understand the IPM principles, and achieve inclusion and coordination of the IPM approach through participatory extension approaches.

As most MoA officials and cooperative farm work-team leaders are trained through the university or in agricultural colleges, it was also important to introduce IPM, and the use of participatory training

approaches, into the curricula. Capacity building activities were conducted with PAU agricultural personnel, with CABI providing a series of IPM lectures to lecturers and post-doctorate students, which were then used for the joint development of their own locally adapted lectures. An IPM course, made up of theoretical and practical aspects, is now an integral part of the PAU syllabus. IPM has also been embedded in national, provincial and county education systems throughout DPRK, as a consequence of the Ministry of Education approval of the PAU curriculum in 2011.

Policy-related issues were another focus of capacity strengthening within the MoA. Maize IPM, and particularly the use of *Trichogramma* wasps, had been set as a high priority by the government. As the initial project activities provided a model for how nationwide maize IPM implementation could be achieved, capacity building activities focused on strengthening ownership, planning and logistical skills of relevant MoA departments. In a joint effort with local specialists, internationally compatible 'Best Practice Documents' for Cabbage and Maize IPM in DPRK were developed as an accompanying measure to amplify nationwide IPM implementation.

In 2010, specific institutional capacity building projects were launched with the MoA and AAS. Connections were stimulated by linking scientists within the AAS institutes as well as with the international scientific community. Through skills training, ICT infrastructure, IPM conferences, an IPM working group and study tours abroad, the skills and knowledge of AAS staff quickly developed and they were found to be highly responsive to new ideas for the enhancement of food production in DPRK. This was a significant improvement for the country's science community, particularly as the exchange of ideas with scientific communities from outside the DPRK had been much restricted since the 1950s.

The resulting developed capacities have subsequently been used to jointly organize and prepare for national events, like the National IPM Workshop (2010) and an international symposium ('Monitoring and Forecasting, 2012').

Building trust for a multi-stakeholder approach

As the activities in DPRK evolved, CABI became a trusted facilitator, opening up dialogue between stakeholders working on sustainable production in different regions of the country, and also linking DPRK scientists to the international IPM community. By recognizing that socio-cultural issues are as important as technical issues, CABI was able to work within government and social norms and present new ideas through the multi-stakeholder forum (see below on ICM-TAG). Understanding and working with the motivations of key actors, within the country as well as abroad during the study tours, were essential ingredients to long-term change.

With increased national linkages, an Integrated Crop Management Technical Advisory Group (ICMTAG) was established during 2007-2009¹ to further facilitate dialogue between stakeholders. Linking representatives from various institutions, including the MoA, the AAS, the PAU, counties and cooperative farms to jointly work on IPM issues, in a context where inter-institutional exchange is normally very limited, was a success in its own right and much appreciated by stakeholders. Furthermore, as members of the forum included those at senior level in the MoA, ICM-TAG was in a position to inform the government, such as through distribution of jointly developed 'best IPM practice' documents for cabbage and maize. The outstanding impacts of promoting these practices included use of biocontrol (if available) and, if required, rational use of appropriate pesticides.

Key to success in establishing the *Trichogramma* rearing facilities was the involvement of the county farm management boards (CFMBs). The CFMBs represent the MoA at county level and oversee the management of the cooperative farms, providing them with required inputs for production and ensuring that targets set out in the annual yield plans are met. CFMBs were found to have a strong interest in *Trichogramma* production and provided support to establish the facility and, in due course, to make

¹ Stakeholders represented in the ICM-TAG include: three Ministry of Agriculture departments (Science and Technology Transfer, the Central Plant Protection Station, and Plant Protection); two institutes within the Academy of Agricultural Sciences (Plant Protection Institute and Crop Cultivation Institute); Pyongyang Agricultural University; the County Farm Management Boards; and the cooperative farms (one Farm Manager and one Chief Engineer).

inputs available for sustained production. The commitment and motivation at county level, in combination with the technical knowledge from AAS and background support from MoA representatives involved in central planning, proved to be very successful.

Another key element in the development of CABI's activities was DPRK becoming a member country of CABI in 2010, which was initiated during an invitation for the DPRK Ambassador to Switzerland to visit the CABI centre. As a direct result of this visit, support for CABI in DPRK significantly increased. Indirectly, the Embassy visit created further networking opportunities with local authorities which, after a few more years, led to CABI membership. With DPRK becoming a CABI member, networking within DPRK, as well as at Embassy level in Switzerland and in the UK at CABI headquarters, led to increased support for project activities and for improved collaboration. To aid these efforts, CABI was able to open a project office in Pyongyang in 2011.

Impact implications

As a result of CABI's activities over the past decade, plant protection is now recognized in DPRK as a major factor influencing crop production, which resulted in the upgrading of the Plant Protection Section of the MoA department for production into the MoA Department of Plant Protection (2012) dedicated to crop health. The establishment of the new Department of Plant Protection has had a positive effect on the implementation of IPM. This is mostly due to an increase in staff from one to five, who are now able to follow up on topics of sustainable agriculture/IPM with the MoA and have more direct contact with the cooperative farms and CFMBs.

As a result of collaboration and collective action, DPRK is steadily moving towards better use of IPM and reduced crop losses. Concepts, knowledge and skills regarding the development and implementation of sustainable approaches for improved food production are well anchored in the relevant national institutions. In maize for example, national stakeholders are implementing and scaling up use of key IPM approaches, including the establishment of new *Trichogramma* facilities as well as changes in practice at field level. This remains a high priority for the government, although its support is currently limited to training activities and technical support to the production units. In addition, the cabbage and maize IPM best practice documents have been incorporated into the DPRK production guidelines and they are influencing the way in which these key crops are produced nationwide.

Ultimately, awareness of and motivation for IPM implementation in DPRK remains high and further joint activities addressing soil pests and problems in apple production are being implemented or are planned. Participatory approaches to training are now more common for extension specialists and scientists, which had previously been unknown in DPRK culture. With the ongoing institutional changes and multi-stakeholder approach, there will undoubtedly be further impact achieved from continued collaboration between CABI and its partners in the country.

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Several presentations by CABI and DPRK partner organization representatives

Cabbage and Maize IPM Farmer Manuals

Crop Rotation Leaflet

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