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Toward Sustainable Pest Control: Back to the Future in Case of Kazakhstan

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1. Introduction

Problems related to pest control and pesticide use in agriculture can be found in similar forms across the world. Worldwide, crop production losses from agricultural pests average 35-40% before harvest and 10-15% after harvest (e.g. Oerke et al., 1994; Struik & Kropff, 2003). After the introduction of synthetic pesticides after World War II, agriculture in many countries became reliant on chemical pest control. In the 1960s, the environmental and health problems became apparent, as did the problems of pests becoming resistant to pesticides and the destruction of natural enemies leading to pest resurgence and secondary pest outbreaks. Farmers often use pesticides injudiciously, and find themselves caught on a pesticide treadmill, which increases the social, environmental and economic costs of chemical control (Bale et al., 2008; Carson, 1962; Kishi, 2005; Palladino, 1996; Perkins, 1982; Pretty & Waibel, 2005). These problems with pesticides gave way to the Integrated Pest Management (IPM) approach, which utilises ecological principles to manage agro-ecosystems in an economically and environmentally sustainable fashion (Kogan, 1998, 1999; Morse & Buhler, 1997; Struik & Kropff, 2003). IPM has become an alternative approach to exclusive reliance on pesticides as the sole means of pest control (Van Huis & Meerman, 1997). This change in approach has been quite widely accepted, although not universally.

This chapter explores the case of Kazakhstan where integrated pest management, once widely practised, has given way to an exclusive reliance on pesticides. IPM/ecology-based pest-control approaches were extensively developed and practised in the 1970s and 1980s in the USSR, which Kazakhstan was then part of. The USSR was an early adopter of IPM. This changed dramatically in Kazakhstan after 1991 with the fall of the Soviet system, when sustainable approaches to pest control were substituted by an exclusive focus on chemical pest control. This has given rise to indiscriminate pesticide use. The focus of plant protection research also shifted from IPM/ecology-based studies to pesticide testing.

The startling point of this study is to examine this paradox that, at the moment, when Kazakhstan became more strongly incorporated in a world that sees sustainable production methods and ecologically-friendly pest control as an important priority the country abandoned an IPM approach to pest control. To date, no literature has addressed this shift and looked for reasons behind abandoning the ecological approaches for pest control developed and practised in the past. This paradox leads us to the central research question of this chapter: Why did the shift occur from an IPM/ecology-centred to pesticide-centred pest-control perspective in Kazakhstan after 1991?

The focus on one particular field of agricultural research and practice, namely plant protection, is instructive for exploring wider political, socio-economic and technological issues. The study of plant protection perspectives in Kazakhstan in two different socio-economic and political formations reveals the crucial role of state organization and public and market institutions in shaping pest-control perspectives. It puts upfront the issue as to which elements of scientific knowledge and knowledge/skill configurations have to be preserved when dramatic political-economic changes tend to undermine the dynamic development and application of science.

2. Conceptual framework

The conceptual focus of this chapter is mainly on transition, public goods, collective action, integrated pest management and knowledge.

2.1 Transition

In the 1990s, the world witnessed an unprecedented scale of price liberalization, privatization and deregulation in the countries of Central and Eastern Europe and the former Soviet Union. After the collapse of the USSR in 1991, Kazakhstan became influenced by neoliberal ideology and was drawn into a transitional process towards a free market economy (World Bank, 1993). The concept of transition was theoretically viewed as an economic, social and political transformation towards a free market economy and democracy (Sasse, 2005; Spoor, 2003; Svejnar, 2002; Tanzi, 1999). Markets appeared, though not in the form envisioned in theoretical prescriptions, and new political regimes emerged, though not necessarily democratic. The failure of neoliberal prescriptions (liberalize, privatize and deregulate) has become evident in many countries, where the invisible hand of the free market has not been able to regulate the economy for the benefit of its people and national interests have not been served (Harvey, 2003, 2005; Henry, 2008). Now, especially after the global financial crisis, from the autumn of 2008 onwards, it is increasingly accepted that only a visible state with well-defined functions is able to regulate the market so that it serves common interests. Currently, many societies are seeking a new balance between state and market institutions.

The process of transition from a state-centred to a neoliberal economic formation points to the importance of studying the extent to which the new socio-economic configuration that emerged after 1991 in Kazakhstan influenced changes in technological thinking and practices, such as plant protection.

2.2 Public good

This chapter conceptualizes the development and promotion of sustainable ecology-based plant protection approaches as a public good, even though many on-farm pest-control activities have to be dealt with privately. A public good is any good that, if supplied to anybody is necessarily supplied to everybody, and from whose benefits it is impossible or impracticable to exclude anybody (McLean & McMillan, 2003). In other words, public goods are non-exclusive and non-rivalled (Kaul & Mendoza, 2003; Scott & Marshall, 2005). In most cases, the state provides a public good, e.g., national defence or a fire service.

There are three reasons to support the notion that the development and promotion of ecologically sound methods and technologies for pest control is a public good. First, when national food and/or health security is at stake research on, and control of, highly harmful pest organisms, including quarantine and migratory ones, becomes the task of public institutions (e.g. Perrings, et al. 2002; Toleubayev et al., 2007; Toleubayev et al., 2010b). Second, investment in, and the development and promotion of environmentally friendly pest-control measures, resolves several problems associated with chemical control – the pollution of the environment, health hazards during application and pesticide residues in food that affect the health of people (Kishi, 2005). Third, considerable resources are necessary to develop and promote long-term ecologically sound methods and technologies of pest control and, to a large extent, only the state can afford this (Pretty & Waibel, 2005). Hence, the concept of public good is essential for analysing the shift from an IPM/ecology-based perspective to one based on the use of pesticides in Kazakhstan after 1991.

Problems caused by agricultural pests are significant – from outbreaks of highly destructive migratory insect-pests (e.g. locusts) to crop diseases causing epiphytotics (epidemics) across vast cropping areas (e.g. stem rust). These pest organisms recognise no frontiers, can devastate thousands of hectares of crops and pose a threat to national food security. Individual farmers cannot monitor such pest organisms or develop ecologically sustainable and environmentally friendly preventive and/or protective measures against them. Thus, these activities very often require formalized knowledge systems and collective (concerted) action from government offices, researchers, extensionists and farmers.

2.3 Collective action

Collective action in the spheres of agriculture, environment and development can take various forms (e.g. Agrawal, 2003) and there is disagreement about how to distinguish between different forms of collective action (Meinzen-Dick et al., 2004; Poteete & Ostrom, 2004). Contemporary issues in this area largely focus on the management of common-pool resources, which are discussed in relation to processes of the decentralization of central state control over natural resources (Agrawal & Ostrom, 2001; Acheson, 2006), and the large-scale political activism of social movements (Edelman, 2001; Hargrave & Van de Ven, 2006). Collective action can emerge in situations where uncoordinated individual actions may not result in the best outcome (McLean & McMillan, 2003).

One illustrative example is uncoordinated pest control in a farming community. If one farmer controls pests on his/her plot but the neighbour does not, then pest organisms accumulate on uncontrolled fields and subsequently re-infest adjacent plots where control measures were carried out. Thus the efforts of the farmer who carried out control measures fail. Equally if the timing of control measures is different on neighbouring fields this also may result in unsuccessful pest control, because one farmer carries out control measures too early and the other neighbour is too late in controlling pests. Therefore, an optimal control time needs to be set and neighbouring farmers should agree on appropriate control methods and synchronize their plant protection activities. In many cases, this requires the involvement of plant protection professionals. Furthermore, problems associated with agricultural pests and pesticides frequently require collective action at a higher level than that of individual farmers' fields.

Collective action involves a group of people with a shared interest who are prepared to take some kind of common action in pursuit of that shared interest (Meinzen-Dick et al., 2004). This chapter does not address many of the models or concepts, e.g. such as a game theory, prisoner's dilemma, free-riding or rational behaviour often associated with the term 'collective action' (Harding, 1982; Olson, 1971; Sandler, 1992). Instead, it simply conceptualizes collective action as joint and concerted action from policymakers, plant protection researchers and practitioners, service and input providers and agricultural producers in order to deal with pest and pesticide problems. Equally, the phrase 'loss of collective action' is used in this chapter to imply the shift from an IPM/ecology-based to pesticide-based pest control, as happened in Kazakhstan after 1991.

2.4 The knowledge-intensiveness of Integrated Pest Management

One could argue that the concept of collective action underlies recent developments in participatory approaches to Integrated Pest Management (IPM), often through Farmer Field Schools (FFS), where farmers obtain knowledge about the ecology and functioning of their own agro-ecosystems (e.g. Norton et al., 1999; Van den Berg, 2004; Van den Berg & Jiggins, 2007).

IPM-based pest control needs to be incorporated into everyday farming routines through explicitly knowledge-based plans for action. Integrated pest management, as any knowledge domain, requires certain skills, often of a highly specialized nature, on the part of the practitioner and user of the knowledge (Holzner & Marx, 1979). For this reason, the role of plant protection professionals and facilitators is very important in promoting IPM knowledge in farming communities (Flint & Gouveia, 2001; Morse & Buhler, 1997; Van den Berg, 2004), particularly through FFSs. While it has the direct effect of reducing pesticide use and/or elevating yields, it also enhances farmers' technical, educational, social and political capabilities (e.g. Bartlett, 2004).

IPM is a multifaceted technological approach that incorporates a wide range of sustainable pest-control methods (e.g. biological, agronomic and physical) to manage agricultural pests in complex agro-ecosystems and to reduce pesticide use (Bale et al., 2008; Kogan, 1998; Morse & Buhler 1997; Van Huis & Meerman, 1997; Van Lenteren, 1997). IPM is very knowledge-intensive (Flint & Gouveia, 2001; Morse & Buhler, 1997) and requires an extensive knowledge of agro-ecosystems. The knowledge-intensity of IPM is one key factor in explaining the decline in IPM/ecology-centred approach and the rise in to pesticide-centred approach to plant protection in post-1991 Kazakhstan.

3. Integrated plant protection in Soviet time

The term IPM is broadly used in English publications and the Russian equivalent - *Integrirovannaya Zashita Rastenii-* literally Integrated Plant Protection (IPP) has a similar meaning. The IPM approach emerged in the 1960s as a response to the severe problems caused by the overuse of pesticides in northern America (Morse & Buhler, 1997; Palladino, 1996; Perkins, 1982) and has since been continuously developed and promoted in many countries (e.g. Bruin & Meerman, 2001; Morse & Buhler, 1997; Sorby et al., 2003). Similarly, the Soviet Union prioritised, developed and practised the IPP-based pest-control approach throughout the 1970 and the 1980s to avoid environmental and health hazards (Fadeev & Novozhilov, 1981; Shumakov et al., 1974).

A major contribution of the IPM approach to agriculture has been to demonstrate the need to base all phases of crop production on sound ecological principles, with the ultimate goal of creating agro-ecosystems that are economically and ecologically sustainable. IPM emerged as a reaction to an overwhelming reliance on pesticides, which came to be recognized as a short-term solution that had far reaching negative consequences. Over the last four decades IPM evolved from a technical approach into a paradigm of long-term sustainability in agricultural production that incorporates environmental, economic and social aspects (Flint&Gouveia, 2001; Kogan, 1998, 1999; Morse & Buhler, 1997; Norton et al., 1999; Struik & Kropff, 2003; Van den Berg, 2004; Van den Berg & Jiggins, 2007; Van Huis & Meerman, 1997).

The Soviet Integrated Plant Protection (IPP) system can be best characterised by the following definition chosen from a list of IPM definitions collected by Bajwa&Kogan (2002:14):

Integrated Pest Management (IPM) for agriculture is the application of an interconnected set of principles and methods to problems caused by insects, diseases, weeds and other agricultural pests. IPM includes pest prevention techniques, pest monitoring methods, biological control, pest-resistant plants varieties, pest attractants and repellents, biopesticides, and synthetic organic pesticides. It also involves the use of weather data to predict the onset of pest attack, and cultural practices such as rotation, mulching, raised planting beds, narrow plant rows, and interseeding.

This rather technical definition of IPM captures the broad range of an interconnected set of principles and methods that were utilized in the Soviet crop protection system. The Soviet literature (e.g. Fadeev & Novozhilov, 1981), recognised IPP as a complex approach incorporating biological, agronomic, physical and other methods to reduce pesticide applications while still effectively controlling agricultural pests. Continuous monitoring and forecasting of the population dynamics of pest organisms and the application of pesticides based on economic thresholds were at the core of pest-control activities in the IPP schemes. The ultimate aim of the IPP approach in the Soviet crop production system was to integrate all the possible environmentally friendly and safe pest-control measures.

The Integrated Plant Protection approach was widely used in the crop production system of the Soviet Union, including Kazakhstan (e.g. Beglyarov, 1983; Chenkin et al., 1990; Fadeev & Novozhilov, 1981; Shumakov et al., 1974). Some books by Soviet authors, e.g. *Integrated Plant Protection* (Fadeev & Novozhilov, 1981) and *Biological Agents for Plant Protection* (Shumakov et al., 1974), promoting the IPP approach, have been translated from Russian into English by western publishers. This suggests that the western world had an interest in the IPM work of Soviet scientists. However, western authors barely acknowledge that Soviet researchers and practitioners widely promoted IPM in the countries of the Soviet bloc. For example, Oppenheim (2001) reviews the use of alternatives to chemical control, especially biological control, in Cuban agriculture but makes no reference to the significant role of Soviet researchers and practitioners who promoted IPM in Cuba – even though Cuban plant protectionists acknowledge Soviet assistance in pest management issues (e.g. Perez & Spodarik, 1982).

In the Soviet past, the Plant Protection Service (PPS) was responsible for all crop protection issues nationwide (Toleubayev, 2008). The unified PPS was set up in 1961 (after the decree of the Council of Ministers of the USSR №152, February 20, 1961). It emerged as a network of plant protection stations, including monitoring and forecasting units, spread across the Soviet Union and coordinated from Moscow. In the Kazakh SSR the Ministry of Agriculture hosted the Republican Plant Protection Station which then operated plant protection stations at the regional and district level. By 1978, there were 15 regional PPSs in Kazakhstan coordinating 206 district PPSs. Overall there were 29 biological laboratories, 16 toxicological ones, 72 monitoring units and numerous specialised spraying teams (Kospanov, 1978). The network of district and regional plant protection stations was closely linked to crop producing farms, the agricultural research institutes and the experimental stations within each region. Plant protection specialists fulfilled the role of extension agents in the Western sense. On November 2, 1970 the Ministry of Agriculture of the USSR issued a decree entitled '*State control of the crop protection activities in the USSR*'. This empowered the specialists of PPS with inspection authority to control all activities concerning plant protection, including pesticide use. They assisted researchers to introduce research recommendations on farms, discussed pest-control issues with farm agro-technicians and managed pesticide use. Plant protectionists, including researchers, promoted the principles of Integrated Plant Protection.

The IPM approach widely used within the USSR in the 1970s and the 1980s required detailed knowledge of complex agro-ecosystems. It also required specific institutional support in the form of a strong research base, plant protection extension network and concerted action from involved actors. IPM was backed up by significant investments into plant protection research and extension, training of specialists, building bio-laboratories and technological lines for producing bio-agents. Pesticide use was kept at low levels by monitoring pest organisms, forecasting their population dynamics and using appropriate biological and agronomic control methods based on economic thresholds and predator/prey ratios. IPM was promoted and implemented under the institutionalised guidance of plant protection professionals, including researchers. Morse and Buhler (1997) note that IPM is a model of what crop protection should look like and represents an ideal that many more would follow if they could. The Soviet system made substantial efforts in creating conditions conducive for IPM to work. In post-1991 Kazakhstan, hardly any of these conditions have been available.

4. Post-Soviet situation in plant protection domain

The fall of the Soviet system in 1991 and the subsequent process of neoliberalization in Kazakhstan had severe consequences for the public institutions involved in plant protection

(Toleubayev et al., 2007; Toleubayev, 2008; Toleubayev, 2009; Toleubayev et al., 2010b; Toleubayev et al., 2011) and, as will be shown below, for the use of Integrated Pest Management (IPM). This section examines the impact of the shift to market-driven institutions on IPM practices in Kazakhstan.

Since the collapse of the Soviet system pesticide spraying has become the main approach to pest control in post-1991 Kazakhstan (Sagitov, 2002; Toleubayev, 2009). At the same time, inspection of pesticide residues in produce disappeared or stopped being enforced and the use of environmentally benign pest-control methods ceased. Why did the pesticide perspective become dominant both in pest-control practices and in setting the research agenda and why is IPM not in use anymore in post-1991 Kazakhstan? The study of Toleubayev (2009) takes an IPM-based pest control in the Alma-Ata region of the Kazakh SSR in the 1970 and the 1980s as a case study and examines the role of institutional support from the state in creating the conditions for implementing IPM. In doing so it argues that the IPM approach is knowledge-intensive and needs an institutional backup and concerted action for its implementation, conditions which are in short supply in contemporary Kazakhstan.

With the end of collective farming (Toleubayev et al., 2010a) and the budget cuts, plant protection research and extension was severely weakened (Toleubayev, 2008; Toleubayev et al., 2010b). Numerous individual farmers emerged, most of them newcomers, who did not have adequate knowledge and lacked the institutional backup to organize pest-control activities. This vacuum created an opportunity for the pesticide industry to make farmers think about crop protection solely in terms of pesticide spraying. The pesticide industry has succeeded in setting up an infrastructure to deliver information and pesticides to farmers, while knowledge and information on IPM has diminished or vanished altogether. The interviewed plant protectionists referred to the non-agronomic background of the majority of current farmers as a main reason for poorly managed fields and inadequate pest-control activities. However, even those with a professional agronomic background may not always be able to grasp the complexity of pest control.

Advanced farmers (mainly former collective farm agro-technicians) do their best to control pests on their own fields by using pesticides or combining it with other agronomic practices. However, very often their attempts to control pests do not succeed because of poorly managed neighbouring fields, which serve as a source of pests. The problem of controlling pests on separate and individual farm fields is a consequence of the break up of the collective crop production system. In the past, the centralized public plant protection service monitored and controlled pest organisms across the country, irrespective of administrative borders between farms, districts or regions. Nowadays individual farmers have to deal with pest problems themselves at the level of their own fields and to rely on own resources. The majority of them do not possess sufficient intellectual, technical and financial resources to use the IPM approach. For this reason, Van Huis and Meerman (1997) suggest that renewing the practical value of IPM for resource-poor farmers implies focusing more on IPM as a methodology and less as a technology and on developing appropriate pest management strategies through self-discovery learning processes and participatory programmes. However the new farmers in post-1991 Kazakhstan are not engaged in participatory programmes and are struggling individually. The conditions for running such programmes and triggering learning process and concerted action for pest control among individual farmers have not been created. The more advanced farmers in Kazakhstan recognize the importance and necessity of collective action for inter-farm pest control, but they lack institutional support to promote such initiatives. The type of institutional backup that existed in the past to serve the collective farms has collapsed, and a new institutional framework to support individual farmers (except for pesticide market) has not yet been established. Moreover, it is very difficult to establish such an institutional base for concerted pest control since public initiatives and collective action have been marginalised in post-1991 Kazakhstan.

This paper also implies that there is an increased risk that the IPM knowledge developed locally before 1991 will be lost. IPM schemes need to be developed locally, taking the dynamics of particular agro-ecosystems into account. At the same time, however, the principles of IPM are universal and an institutional backup is needed to reintroduce IPM principles into practices of the new individualised farmers. This chapter shows that this reintroduction depends not only on developing and communicating appropriate knowledge but also on the socio-economic situation that is conducive to IPM approach. Kazakhstan's society would benefit if the government would create favourable conditions for fostering the required institutional changes that can challenge the dominance of the networks promoting pesticides.

There has been a dramatic shift in plant protection research agenda in the post-Soviet period in Kazakhstan too. Throughout the Soviet era, even in the middle of the difficult period of the 1930s, plant protection research served national interests. This research domain aimed to secure crop production against harmful agricultural pests, e.g. locusts (Toleubayev et al., 2007) and to develop the integrated pest management schemes minimizing pesticide use (Toleubayev et al., 2011). These characteristics of plant protection research faded away after 1991. The commodification process and the 'import of technology' principle all too readily dovetailed with a pest-control strategy based on using imported pesticides. These changes are incompatible, in their current form, with pest control based on IPM schemes or biological control agents, which require continuous examination of and adaptation to the specificities and complexities of local agro-ecosystems. Many elements of plant protection research before 1991 corresponded to the public good character of sustainable pest control. In post-1991 Kazakhstan, research in developing ecologically sound pest-control approaches is not recognized as a public good by policymakers. The risk is that further neglect will jeopardise the development and promotion of long-term, environmentally safe and ecologically balanced pest-control measures, thus threatening national food and health security.

5. Lessons to be learned from locust control in Kazakhstan

This section identifies several factors that support the argument that locust control is a public good requiring collective action. Locusts breed and multiply in natural habitats after which they migrate to agricultural areas where they destroy crops during outbreaks and plagues. Agricultural producers are not able to control locusts outside their private plots. This is why many countries treat the control of migratory and highly destructive pests as a public service, comparable with emergency services such as the fire-brigade and the police.

When faced with disasters or a common enemy, nations and international organizations, e.g., UN and NATO, often respond with collective action (Sandler, 1992). International undertakings to control the Desert Locust exemplify the need for collective action: FAO Regional Commissions have been established in locust affected countries in Africa, the Middle East and southwest Asia. In addition, locusts induce international collective action when they cross interstate boundaries, leading states to develop institutions and rules to control this transboundary movement.

What can we learn from the history of locust control in the Soviet Union? The impact of Soviet technoscience is multifaceted. The literature documents periods of scientific stagnation, bureaucracy and the subsumption of the organization and content of science to political and ideological motives, exemplified by Lysenko's command of the Soviet Academy of Agricultural Sciences (Medvedev, 1969). Furthermore, the impact of the virgin land campaign and the expansion of irrigated areas, i.e., typical high-modernist projects, had unforeseen consequences on the amount of land suitable on which locusts could breed.

However, the seventy years of Soviet history also show a collective response to the locust problem. An intensive knowledge system was coupled with an extensive monitoring and control system, which seems to have kept locust populations at manageable levels. Locust damage was largely prevented through substantial scientific research on population dynamics, considerable expenditure on control operations and the establishment of an extended network in which monitoring agencies, local practitioners and scientists collaborated to generate operational knowledge that led to an effective control strategy. Above, efforts were made to develop an ecological perspective on locusts and their control. Knowledge building, concerted action, habitat management, understanding ecological relationships and long-term analysis and planning were key features of these efforts. This does not mean that the system was in equilibrium. It changed continuously and there was a high level of model uncertainty (Peterson et al., 1997), i.e., many of the connections between forms of land use, climate, locust population developments, locust control measures and so on were uncertain. But for quite some time there was a substantial capacity for learning and adapting control strategies to ecosystem dynamics, which made the locust control system quite resilient (Walker et al., 2002).

However, this locust control system could not cope with a fundamental uncertainty (Peterson et al., 1997), i.e., its dependence upon an unstable political system. The transformation of the political system led to a new social-technical configuration, which gave very low priority to locust control and changes in the agro-ecosystem. This created more favourable conditions for the development of a locust plague in a less desired state of ecosystem services (Folke et al. 2004). This new political configuration, which swept away concern for delivering many public goods, including pest control, led to a new dilemma over collective action. The official hostility to public action and the glorification of individualist, profit-driven and market-oriented change during the Transition Period, contributed to the breaking up of the organizations and knowledge structures in the field of plant protection. The knowledge and capability to control locusts quickly disintegrated in Kazakhstan after the collapse of the Soviet Union and plant protection was left to individual farmers. However, it was not in their individual interest, and beyond their capacity, to invest in monitoring and controlling locusts. This resulted in a many more farmers being affected by the subsequent locust plague. In shifting to a market economy, the government did not recognize the dramatic impact that institutional collapse would have on the monitoring and control of locust populations.

The locust plague of 1998–2001 led to a reinvention of collective action in Kazakhstan. Once the locusts invaded the capital top-level decision makers started to realize that the dismantling and privatization of the plant protection service had unforeseen consequences. They became aware that locust control requires state intervention and some remnants of the Soviet knowledge structure were reinstated. Former chiefs of the regional Plant Protection Stations and influential scientists in the plant protection domain used this opportunity to revive the Plant Protection Service. Their work on locust control regained legitimacy, as did public expenditure to support it. The crisis also had other political repercussions (Hargrave & Van de Ven, 2006). The reinstatement of some elements of the former locust control system raises the question of the extent to which this recent form of collective action builds on past forms and the extent to which it differs.

The rebuilt Plant Protection System has to operate with far fewer people than before and has to work with market actors, i.e., suppliers of pesticides and spraying services. However, from an ecosystems perspective there are other more fundamental differences. The latest policies tend to assume that the currently available stock of technology, basically pesticide applications, is sufficient to control locust plagues. Decision-makers even express the belief that it is possible to eradicate the locust, i.e., that total control of nature is possible. Past efforts to construct a more ecological view and to build knowledge and knowledge networks for understanding relationships between climatic variability, land use changes and locust population dynamics have not yet been taken up again. Furthermore, recent policy measures seem to be mainly incident driven and largely take a short-term perspective. If we consider ecosystem and locust population dynamics as a slow variables (Holling, 2004) the collapse of the Soviet Union has made sustaining these variables more difficult. This is a major transformation in the sense of Holling (2004) since the interaction between structure and processes have become qualitatively different. The long time frame for responding to locusts, which was previously institutionalized in the long-term funding of plant protection services and knowledge building, career perspectives for scientists and the organization of a multi-agency monitoring network, has been not been re-established. The most recent transformations have, in fact, institutionalized the short time frame perspective that emerged in the Transition Period.

It also follows from discussion of knowledge about locusts (Toleubayev et.al, 2007) that locust control requires collective action at a higher level than the local level of, for example, farmer fields or single watersheds. National and even transboundary forms of management have to be established. There is little indication that independent civil society groups with an interest in locust control will emerge in Kazakhstan in the near future. Service companies have been formed that carry out the pesticide spraying at the regional level but, given their objective of trading in pesticides and spraying services, it is unlikely that these will soon convert into advocates for a sustainable, long-term and ecosystems perspective on locust control. Although local level participation may be crucial, as in the past when herders were part of the locust monitoring network. These participatory approaches to local level ecosystem management (Walker et al., 2002) and the current market-driven, short-term thinking about locust control in Kazakhstan are inadequate for developing a framework for rebuilding adaptive management of ecological services at a higher level and with a long-term perspective.

6. Back to the future in pest control for Kazakhstan

6.1 Change in the technological approach and pest-control perspectives

It is often assumed that progressive technological changes precedes and underpins positive socio-economic changes. The Kazakhstan case has illustrated a regressive technological change. The post-1991 socio-economic changes in the agrarian sector transformed the large-scale, highly mechanized and knowledge-intensive farming (using IPM) into a mainly small-scale and simplified farming technological system. The number of tractors used in the farming sector in Kazakhstan dropped by 80%, from more than 240,000 in 1990 to less than 45,000 in 2005. A common practice of using technological maps in the centralized crop production system that incorporated crop rotation, fertilization, irrigation and pest-control schemes was abandoned. Farmers after the break-up of the collective farming were disorganized and challenged to deal individually with a wide range of farming technicalities such as soil cultivation, seed selection, crop husbandry practices, soil fertility, irrigation and pest control. The farmers with professional farming knowledge and skills and with advantageous socio-economic, political and knowledge networks from the Soviet past had the best chances for the economic survival in the harsh market environment.

The collapse of collective farming and the unified plant protection system that went with it had a problematic impact on pest-control practices after 1991 and brought about a crisis in the IPM perspective. Before 1991 IPM was an essential part of the crop production system in Kazakhstan. This approach incorporated biological control technologies, monitoring and forecasting, and agronomic and other means to control pests and reduce pesticide use. Before 1991 up to 400,000 ha of cropping area in Kazakhstan, and more than 33,000,000 ha in the USSR as a whole, were protected against pests through biological means. This is an extraordinary fact that ought to be better known among 'western' conservationists and advocates of 'sustainable agriculture'. This effort required a high level of organization and coordination of pest-control activities both at collective farm level and higher.

Morse and Buhler (1997) argue that IPM is an ideal approach to crop protection but that it is not easily achieved in reality. This scepticism is based on awareness by these authors that IPM is a knowledge-intensive approach requiring a strong research base, extension network, highly qualified specialists and significant investments for its development, promotion and use. This chapter has demonstrated that this knowledge-intensiveness of IPM approach was characteristic of a more generally knowledge-intensive character of Soviet collectivized farming system. In those areas where it was widely implemented, IPM was backed up by an extensive research and plant protection service. The state-facilitated, science-based organization of plant protection activities made IPM work, and provided a concerted response to pest problems. Collective responses to pest problems were embedded in the centralized structure of the Soviet system. This was pragmatic, in the sense that the IPM approach was given priority over chemical control perspective, thus reducing negative health and environmental effects.

After the disintegration of the USSR the pesticide industry colonised the vacant agricultural input markets of the newly established independent states. The annual imports of pesticides into Kazakhstan increased from about 2,000 tonnes in 1999 to 17,000 tonnes in 2006. This only takes into account those chemicals imported and sold through official channels; the volume of pesticides smuggled into the country is not known while illegal outlets can be found in many towns. But point of particular concern is that the industry was able quickly to fill in the institutional gap in knowledge and infrastructure for pest control. The numerous fragmented farmers did not have a chance to pursue an IPM approach because the organizations that could have delivered the inputs (biocontrol agents) and the necessary knowledge (research and extension) were severely handicapped or had disappeared. The pesticide industry had the necessary know-how, funds and infrastructure to deliver its products to farmers. Its prime interest was to sell its products and not to provide the knowledge that would minimize the use of pesticides. Pesticide company representatives distribute colourful leaflets and posters and present easily understandable and rapidly implementable solutions to pest problems. Farmers literally follow the prescriptions provided. Moreover, farmers blindly use readily available pesticides, being afraid of losing cultivated crops and risking to become a bankrupt. Consequently, the pesticide use perspective has become dominant in the pest-control practices of individualized farmers in Kazakhstan after 1991.

6.2 Change in knowledge generation and ecological consequences

A sound scientific research base is necessary prerequisite for knowledge and technologies to proliferate. In the transition period, the research base in Kazakhstan has been severely eroded. Low salaries, deteriorating research facilities and lack of perspective in the public research institutes have made the recruitment of young researchers difficult. Many researchers have emigrated or left the scientific domain in search of better paid jobs in the private sector. The number of researchers in all research domains in Kazakhstan dropped more than 70%, from 31,250 in 1990 to 9,000 in 2000. Public science became an under-financed sector because of deliberate policy reforms and/or severe budget cuts. Expenditures for R&D (research and development) from GDP declined from 0.80% in 1991 to 0.18% in 1999. As a result, agrarian knowledge generation and technological development became 'endangered species' in contemporary Kazakhstan.

The government has recognised that loss of scientific and technological capacity is an important problem associated with post-1991 transition. Various S&T (science and technology) policies and R&D models have been tried out to 'fill the gap'. Under one 'model' ministerial authorities in charge of managing the public research institutes have more or less forced researchers to commercialize their research outputs and market them to end-users in order to become financially self-supporting. In the pest-control field this had the effect of pushing public plant protection researchers to accept incentives provided by the pesticide industry in order to cope with periods of economic instability. The pesticide industry was able to make use of this situation and took over the human capital needed for a more rational IPM approach. As a result, plant protection research has become commercially-oriented through pesticide testing and promotion. In this way, plant protection research carried out according to ecologically sound principles on highly destructive pest organisms threatening national food security has diminished, and the development of sustainable pest-control approaches is now severely neglected. The public good characteristics of the plant protection research have been replaced by market orientation and commoditization. The demand for immediate outputs in research has led to a policy culture dominated by short-term thinking, and the negative effect of this short-termism can be immediately seen in areas such as control of highly destructive migratory pests such as locusts.

6.3 Governing pests – the future

This chapter argues that pest control, as a strategically important sector of knowledge, requires a direct involvement of state institutions. This is not an easy or popular argument to make in a former Soviet country, where neoliberal enthusiasts assume that everything associated with the old state system must, by definition, have been bad. A new state order established in Kazakhstan after 1991 broke up the organizations and knowledge structures that had previously developed and promoted ecologically sustainable pest-control approaches. The farming sector also underwent significant socio-economic changes, resulting in the break up of the old collective farms and resulting in a highly fragmented agrarian sector. The damage that then resulted has been documented in this study. A question that remains is 'what now is to be done'? Can elements of a positive legacy of ecological thinking associated with science under the Soviet system (Weiner, 1988) be recovered and put back to work?

Under the current situation in farming sector, with fragmented and resource-poor farmers, implementation of IPM/ecology-based protection of crops will only be possible if it receives relevant institutional support (information, knowledge, training and facilitation). The experience with IPM, globally, is that it requires farmers to learn about their agro-ecosystems (e.g. via the farmer field school systems fostered by FAO), because ecological pest control is often counter intuitive at two levels. The first is that plants can tolerate quite some defoliation by herbivores before yields are affected. The second is that pesticides create pests because natural enemies are destroyed. Very often natural enemies are not recognized and showing their existence and actions serves as an eye-opener to farmers. This may help farmers to understand agro-ecosystems better, and thus lead them towards use of this knowledge in pest management strategies that are less reliant on pesticides. This focus-shifting from an exclusive pesticide perspective is a major challenge in Kazakhstan, considering the current ways in which policymakers think about pest-control issues at the farm, research, extension levels. Perhaps some exposure of policymakers to IPM initiatives in other countries using (for example) the farmer field school approach would be a useful starting point for changing attitudes.

At policymaking level the state has fulfilled the mission it defined, for itself, i.e. to facilitate the transition to a free market economy. Consequently, the state distanced itself from providing public goods in strategically important domains of research and practice, in particular the pest-control sector. After 1991 the state no longer supported development, promotion and use of ecologically sound and environmentally benign pest-control approaches and testing of pesticide residues in farm produce. A vacuum was created, with ample opportunity for the pesticide industry to influence the plant protection research agenda and to gear pest-control practices to an exclusive focus on pesticides, despite the manifest unsuitability of such approaches to major problems, such as locust control, facing Kazakhstan. There is probably now need to curtail this pesticide approach through emphasis on regulatory environments, e.g. legislation restricting pesticide imports and tight control of pesticide retailing and use. Also strict and enforced sanitary requirements on pesticide residues in farm produce (especially when driven by customer and consumer concerns) may help invoke more judicious use of pesticides, and make farmers look for alternative pest-control methods. Currently the public plant protection domain lacks the necessary resources to address the demands and opportunities of fragmented farmers and to develop and promote ecology/IPM-based pest-control approaches for a large mass of independent small holders. Bottom up approaches (as attempted in many developing countries) are still weak because farmers, largely, are not well enough organized to express their need for support.

7. Conclusion

This paper urges to rethink and rebuild the role of the governments in pest-control issues. Without stronger pest control policy, highly destructive pest organisms will keep threatening national food security, and indiscriminate and injudicious pesticide use will continue to pose considerable hazards for human health and environment. It has been shown that plant protection is more than just getting rid of pest organisms at the farm level. Pest-control issues are deeply embedded in political-economic-social contexts via which the development and use of ecologically sustainable approaches and collective action for pest control can be either promoted or hindered. The governments across the globe have a key function in supporting this long-term endeavor and creating conducive conditions for this to happen, as this will ultimately contribute to a more sustainable system of agricultural production and thus benefit society as a whole.

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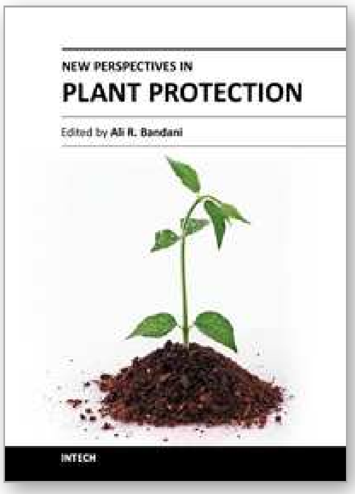

New Perspectives in Plant Protection
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Crop losses by pests (insects, diseases and weeds) are as old as plant themselves but as agriculture are intensified and cropping patterns including the cultivation of high yielding varieties and hybrids are changing over time the impact of the pests becoming increasingly important. Approximately less than 1000 insect species (roughly 600-800 species), 1500 -2000 plant species, numerous fungal, bacterial and nematode species as well as viruses are considered serious pests in agriculture. If these pests were not properly controlled, crop yields and their quality would drop, considerably. In addition production costs as well as food and fiber prices are increased. The current book is going to put Plant Protection approaches in perspective.