

SAFETY IN FOOD AND AGRICULTURE

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Summary

Occupational and food safety are major issues in relation to sustainable agriculture and sustainable development. Special care has to be taken in the development and handling of pesticides. In most countries strong regulations for those sectors and application are in place, which limit the acceptable daily intake and also restrict the maximum exposure for farm workers and consumers.

Another important issue is the influence of pathogens from different animal manure (slurry, farm yard manure etc.) on human health and well-being as a direct or indirect cause of human enteric illness, especially in areas with large livestock operations and/or a direct contact between farm animals and humans, be it the general public or farm workers a transmission of diseases is likely. Less important is the transmission of diseases via products, however, care has to be taken to avoid transmission of endoparasites via consumption of products.

Survival of the organisms in soil, manure, and water indicate significant variability in resistance to environmental challenge that are characteristic of the organisms themselves. Generally, pathogens survive longer in cool and dry environments but differences have been reported in liquid and solid manure. Special care has to be taken in the use of human wastes as organic fertilizers, because a transmission of diseases is much more likely compared with the situation of animal excrete.

1. Introduction

In the context of sustainability and sustainable development the term safety embraces various different fields. It includes aspects of safe handling of organisms as well as

issues related to the use and treatment of wastes in agriculture. Another major issue is the effect of invasive species on human health and the environment. All aspects will be dealt with in the following sections.

2. Safe Handling of Organisms and Biologically Derived Material

Biological hazards can be important sources of human health hazards and also affected natural balances. It is thus by definition all material or organism which may cause any harm to human health or the environment. Given this definition many different types of organisms must be considered, including biologically derived material, such as spores of fungi, mycotoxins, bacteria or endoparasites. In particular cases it might also involve the effect of invasive species, cell cultures or genetically modified organisms.

Under the headline of 'safe handling of organisms' falls the introduction of agricultural pests often called invasive or feral species. In some cases this is done deliberately, in other cases by chance. There are a great number of examples of invasive plant species in various regions of the world and the unintentional introduction has increased in recent years due to international and intercontinental travel.

One prominent example is *Bromus tectorum* (Drooping Brome, downy brome, or cheatgrass), which spreads rapidly after burning, and crowds out plants used by grazing animals in large areas of Western North America. Because it has fairly low nutritive value to grazing animals, it does not substitute either economically or ecologically for the displaced native plants. In Australia the most dramatic example is the introduction of the prickly pear (*Opuntia*). It was first recorded as an animal fodder in the Parramatta district, near today's Sydney in the early 1800's. There is also a record of a pot plant being taken to Scone, NSW in 1839 where it was grown in a station garden. The property manager later planted it in various paddocks with the idea that it would be a good stand-by for stock in a drought year. Early settlers took plants to other parts of New South Wales and Queensland because of its potential use as an alternative food source for stock, especially during dry times. Prickly pear was also planted at various homesteads as a hedge. The hedges flourished and bore fruit. Excess pieces were dumped in the bush. Prickly pear quickly established over a large area and became a major pest, which was later controlled by the introduction of cactoblastis caterpillars (*Cactoblastis cactorum*). The first liberations of cactoblastis were made in 1926, after extensive testing to ensure they would not move into other plant species.

A recent example for an introduction of an agricultural pest in Europe is the Western Corn Rootworm (*Diabrotica virgifera*), which has been introduced from the US in the Balkans in 1999. Since then it has spread to Hungary, Switzerland and Italy and already affects hundreds of thousands of hectares in Europe. It currently spreads with an annual speed of 40 to 80 kilometers and will thus reach Germany in a few years. Each single worm can severely damage a maize plant and therefore the threshold for spraying insecticides against the Western Corn Rootworm is low.

Invasive animal species have also caused great environmental damage in various regions of the world. Most dramatic examples include the introduction of domestic and wild animals in Australia. Given the fragile ecosystem of Australia, the introduction of

foxes, cats, rabbits, trout, horses, donkeys etc. had a dramatic and long lasting effect on the natural fauna and flora. Rabbits alone have been responsible for some of the worst damage on soil over vast areas. During the long drought in the 1870s, sheep and cattle turned millions of hectares into dust. Almost no tress grew for 70 years and rabbits virtually had controlled everything of what could grow. The main plants in the pastures of Australia became species that rabbits would not eat. Until the 1940s southern Australia became a bleak place. Severe effects were also inflicted by the introduced cats and foxes, which developed into great threats for the small, mostly nocturnal marsupials. In areas without protection, a lot of those marsupials have gone extinct.

Another dramatic example of an introduced species with effects on native animals is the case of the introduction of the Cane Toad (*Bufo marinus*) in Australia. It started in the 1930 in attempts to control the native Cane Beetle and great numbers were released in sugar cane growing areas of northern Queensland near the cities of Cairns and Innisfail. Since their initial release, toads have rapidly multiplied in population and now estimates go up to 200 million individuals. Cane toads have large poison glands, and adults are highly toxic to most animals if ingested. When threatened, the Cane Toad secretes a milky-white fluid known as bufotoxin from these glands. Bufotoxin contains components that are toxic to many animals. There are many reported deaths of animals and even humans are affected. The Cane Toad itself is now considered a major pest in many of its introduced regions, as its toxic skin kills many native predators when ingested.

Another example of an introduced species, which not only affects fauna and flora but my also pose risks for humans is the Giant Hogweed (*Heracleum mantegazzianum*). Originally located in parts of Asia, the Giant Hogweed was first introduced in Europe as an ornamental plant; however, some economic uses were also discussed. Beekeepers thought of the plant as an interesting source of pollen and Giant hogweed was also used in forestry plantation to allow wildlife to find some shelter in young plantations. Giant Hogweed is a so called phototoxic plant. Its sap can cause skin inflammations (photodermatitis) after when the skin is exposed to sunlight or to UV-rays. In Germany, where Giant Hogweed has become a real nuisance in some areas, there are about 16,000 victims per year.

Apart from the direct effect on fauna and flora, the hybridization of native animals and introduced, feral species might be a problem. Again an example of the Australian environment illustrates this threat. The dingo (*Canis lupus dingo*) is a primitive dog that evolved from a wolf more than 6,000 years ago in Southern Asia. The dingo migrated to Australia somewhere between 3,500 and 4,000 years ago possibly with the assistance of early Aborigines. With the European settlers came dogs to Australia, which became feral and interbred with the Australian dog, the Dingo. The Australian dingo is currently endangered and threatened with extinction. The threat is predominately due to this hybridization, inbreeding and hunting. Dingoes are now considered to be native Australian mammals that are protected in many regions because they probably play a vital role in ecosystems. Whilst it may be possible to maintain island populations of pure dingoes – one example is the population on Fraser Island - a new approach is necessary for defining dingoes in the face of hybridization with domestic dogs.

Currently is under debate, whether transgenic varieties of crops must be treated as invasive species. This is definitely a matter of propagation of the particular crops. Given the situation in Europe, a widespread propagation of transgenic maize is highly unlikely, whereas transgenic canola (rapeseed) might easily propagate either via wind dissemination or due to the fact that canola seed shows the phenomenon of dormancy and therefore may stay viable in soils for over a decade. Additionally hybridization with a great number of other crops, mainly vegetables, and weed species is possible.

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Biographical Sketch

Wolfgang Heyer studied agriculture from 1969 to 1972 at the Martin-Luther-University in Halle (Germany), with the specialization in plant protection, particularly in integrated pest management (IPM). In 1976, he received his PhD from same University. He wrote his thesis on ecological investigations of the cereal leaf beetle in the central parts of Germany (life cycle, population dynamics, damage capacity).

The results were used to create a monitoring system for the whole country, including computer based simulation models for cereal leaf beetle dynamics in winter wheat fields (PESTSIM OUL). This was followed by five years research work on pests in tropical bean stands in the Caribbean (computer aided pest prediction, damage thresholds, monitoring instructions). Recent work at Halle University is mainly concerned with studies on beneficial arthropods in agricultural land, with the aim of their possible protection and support for increasing their population. Additionally, these ecological results form a basis for evaluation of farming systems with special focus agro-ecological questions and biodiversity.

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