



Towards an integral approach to sustainable agriculture and healthy nutrition

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Towards an integral approach to sustainable agriculture and healthy nutrition

*Vision of the Scientific Council for
Integral Sustainable Agriculture and Nutrition*

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Foreword

This document is the first publication by the Scientific Council for Integral Sustainable Agriculture and Nutrition (RIDL&V). In this document, we present a new, integral vision on sustainable agriculture and healthy nutrition. We start by analysing the current, isolated approach to both issues. The vision concludes with a new research agenda.

Our vision is the result of concerns shared by the members of our Council. We are not only concerned about the limited scale of sustainable agriculture and often unhealthy nutrition, but also about the fact that these issues are generally approached in isolation. As a result, important relationships between the two remain poorly illuminated, and opportunities for synergy are lost. One current example is the excessive use of antibiotics in livestock farming. The result is a generation of antibiotic-resistant bacteria that has penetrated into our food and our hospitals.

The central element in the analysis by the Council is that unsustainable agriculture and unhealthy nutrition are, to a considerable extent, the consequence of disrupted ecological and social ties and relationships. It is crucial to repair and strengthen these relationships.

This document is primarily aimed at policy makers in the field of agriculture, nutrition and health, as well as politicians and scientists. Over the coming year, the Council intends to further expand on this vision in the form of a number of case studies.

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March 2012,

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Contents

Summary	7
Unsustainable agriculture, unhealthy nutrition	9
Inhibiting factors	10
Integral vision	18
Objectives and resources of the Council	27
A research agenda for integral sustainable agriculture and nutrition	28
Appendices	31

Summary

Sustainable agriculture and healthy nutrition are high on the social agenda. Work is now being done to face both challenges, often with measurable success. However, huge changes are still needed and some problems have even been exacerbated. Although agriculture and nutrition are closely linked, both issues are often dealt with in isolation. One example is how the recent proliferation of antibiotic-resistant bacteria in livestock farming has claimed victims in hospitals.

*The problems facing agriculture and nutrition have a range of different causes. According to the Council for Integral Sustainable Agriculture and Nutrition there is one important but underexposed cause: to a large extent, food production has been removed from its ecological and social context. As a consequence, vital relationships and interactions have been lost. The **ecological** context of agriculture has been reduced to systems with disrupted cycles and low biodiversity, in which little self-regulation takes place. Such agricultural systems are highly dependent on external inputs of fertilisers, pesticides and veterinary medicines. In the **social** context of agriculture, the relationships between consumer and producer have for the most part been lost. The geographical distance between the two has increased, as has the number of links in the food production chain. Much of our food is processed, with the consequence of it becoming anonymous to the consumer. As a result, consumers feel little responsibility for the production methods and the agro-ecosystem. The same also applies to the intermediate links: each is specialised in its own part of the chain, without having a view of the chain as a whole. A system of 'organised irresponsibility' has been created. Although each link is attempting to make its own contribution more sustainable, the result will not necessarily be a sustainable chain.*

*According to the Council, there is an urgent need for an integral approach in three respects: a) social and ecological sustainability, b) all links of the chain and c) agriculture and nutrition. The central element is that food must once again be reconnected with visible ties to its ecological and social context, so that relationships and contexts can be re-established. A related consequence is that food production must be removed from its situation of anonymity, and once again acquire a face and an identity. Such a development is often simpler if food originates from your own region. The linear food **chain** must give way to a circular food **cycle**, whereby consumer and producer re-establish some form of communication with one another, and feel responsible for one another. This could result in increased ecological resilience and social support, risk reduction and spread, the recovery of nutrient cycles and an improved food quality as well as food culture..*

Both at local level and in a number of chains, steps are already being taken in this direction. The Council wishes to encourage these developments. Because any such change will require new insight and knowledge, as its first step, the Council has drawn up a research agenda in respect of the recovery of agro-ecological, social and societal relationships.

Unsustainable agriculture, unhealthy nutrition

Sustainable agriculture and healthy nutrition are high on the social agenda. Nonetheless, a wide gap still exists between food and society. More people are eating unhealthily – too many "fast" carbohydrates, saturated fats – and partly as a consequence thereof are suffering from obesity and the related diabetes, cardiovascular disorders and other chronic diseases.¹ In the US, 6 out of the 10 major causes of death are related to dietary factors.² At the same time, the remarkable phenomenon has emerged that *overfed* people are increasingly *underfed* in terms of micronutrients.³

The same applies to the agro-ecosystem: on the one hand it is being overfed with nitrogen, phosphate and pesticides, while at the same time, the soil is often "underfed" in terms of organic matter and certain micronutrients, such as selenium. In several European countries, the organic matter content of the soil has declined over the past decades.⁴ Deficiencies of micronutrients also lead to a reduction in product quality.

On a global scale, agriculture is contributing to climate change. Livestock farming in particular produces large volumes of greenhouse gases – in particular methane, nitrous oxide and carbon dioxide. At the same time, agriculture is imposing ever greater demands on rapidly-disappearing natural resources. Fresh water is becoming scarce in an increasing number of regions. Use of fossil-based fuel energy – direct use on the farm as well as indirect use via artificial fertilisers and animal feeds – is high. As organic matter, also biodiversity in agro-ecosystems is in decline, both in the soil and above ground. The variation of crop and livestock species and varieties – and hence the variation in food – is also shrinking. It is expected that global stocks of phosphate and zinc will start to become scarce in this century. All these problems of scarcity are being further increased by the increase of crops grown for energy production. In the tropics, the area of farmland is still expanding at the expense of nature habitats, above all the savannah and rainforests of South America. This is partly being undertaken for soybean production for Dutch livestock. Much work has been done on all of these problems and still continues. Major progress has been achieved in a number of areas, such as pesticides, fertilisers, ammonia and animal

¹ Even in the slums of India, chronic diseases (in particular cardiovascular disease and cancer) are by far the most important causes of death among adults (infectious diseases are most important among young children). See: Suman Kanungo 2010. *Use of verbal autopsy to determine mortality patterns in an urban slum in Kolkata, India*. Bull. World Health Organ. 88: 667–674 | doi:10.2471/BLT.09.073742. It should be noted, however, that these diseases are not all food-related, but also show links to exercise and age.

² See also <http://www.health.ny.gov/prevention/nutrition/> en: G. Danaei et al. 2009. *The Preventable Causes of Death in the United States: Comparative Risk Assessment of Dietary, Lifestyle, and Metabolic Risk Factors*. PLoS Med 6(4): e1000058. doi:10.1371/journal.pmed.1000058

³ One hypothesis that could help explain this, is that if the body identifies a shortage of a particular micronutrient, it can issue stimuli to continue eating. There are also indications that some shortages can cause cancer. The phenomenon that many foodstuffs, including soft drinks are low in nutrients can be viewed as the food equivalent of inflation. See: M. Pollan 2009. *In defense of food*. We take in more macronutrients than enough. In 1960, for example, the Dutch population consumed 23 kg of protein, while we only require 18 kg. In 2007, consumption had in fact risen to more than 30 kg per year, 60% of which animal protein. See: Wageningen World 2011, no 2, p. 36.

⁴ In the Netherlands, the decline in soil organic matter was observed in the 1980s and 90s on numerous plots of sandy soils. See: M. Hanegraaf et al. 2009. *Trends in soil organic matter contents in Dutch grasslands and maize fields on sandy soils*. European J. Soil Science 60: 213-222. The continuous cultivation of maize has proven to be particularly harmful.

welfare. Progress is no longer restricted to niche markets such as organic, local produce and Fair Trade.

For example, coffee with the Utz Certified label has become mainstream in Dutch supermarkets. Companies such as Unilever and Albert Heijn are taking steps towards sustainability across their full product range and the entire chain. For its entire range, Unilever has formulated ambitious targets in terms of social and ecological sustainability for 2020.

In the meantime, however, the problems remain considerable and in certain cases have even increased. For example, the use of antibiotics in Dutch livestock farming has exploded over the past decade. This has led to a spread of resistant bacteria that represent a major risk to livestock, livestock farmers and public health, right through to hospitals – because these bacteria can no longer be countered. The Dutch livestock and meat sector have also recently recognised that this situation has become untenable.⁵

Inhibiting factors

What are the causes of these problems? **One primary cause is that our food production has been removed from its ecological and social context.**

More specifically, crops and livestock have been removed from the context of the ecosystem, nutrients from the context of food, food from the context of eating patterns and eating patterns from the context of lifestyle.⁶ **As a consequence, relationships and connections have been lost, and consumer and producer feel hardly responsible for one another.**

This multifaceted reduction, isolation and alienation process can be explained by 11 factors:

1. *Simplification of the agro-ecosystem*

Agriculture is by definition a simplification of the agro-ecosystem in that farmers promote one or a small number of species, while at the same time reducing or eliminating the majority of other species. In many practices, however, this simplification has gone far beyond what is necessary and effective. The range of varieties has been severely narrowed. Crops and livestock are often bred for high production exclusively, at the expense of their natural resistance. The system also features ever-decreasing numbers of species of wild plants, animals and microorganisms, and as a consequence

⁵ In the Netherlands, stakeholders in the food chain, including supermarkets, have signed the Den Bosch Covenant, in which they agreed to massively reduce the use of antibiotics starting in 2012. *Alle vlees duurzaam in 2020 [All meat sustainable by 2020]*. Report of the Van Doorn Committee, September 2011. Meat conglomerate Vion has now decided to no longer purchase livestock treated with 3rd and 4th-generation antibiotics, which are the types that should be used most sparingly.

⁶ The last three contexts were identified by the American Professor Marion Nestle in *Food Politics* (2002). In respect of genetic modification, we can add a fifth context to the list: genes have been isolated from their genomic context, and inserted at random in another biological context, “foreign” to them, while science still has little or no knowledge of the numerous and complex interactions between genes.

an ever-decreasing number of relationships between species. As a result, numerous natural mechanisms for self-regulation have been lost. These have been replaced by synthetic inputs such as artificial fertilisers, pesticides and veterinary medicines, including antibiotics. These agents subsequently often lead to the further elimination of natural mechanisms.

Overall the agro-ecosystem has become heavily dependent on industry. The reduction in biodiversity has also been at the expense of the variety and hence the health of our food. In the United States, just four crops – maize, wheat, rice and soybean – are directly or indirectly responsible for two-thirds of the number of calories consumed by the population. In addition, the relationship between the farmer and his livestock has been narrowed as a result of economies of scale. Farm animals have increasingly become objects.

2. *Increased separation and alienation between the links in the food chain*

This alienation is the consequence of far-reaching specialisation, globalisation, and lack of transparency. *Far-reaching specialisation* has meant that the production process has largely been dissected into individual links. For example, large sections of the chain have been industrialised. The stakeholders involved feel responsible for their own link, but not for the entire chain. The majority of players attempt to achieve optimisation *within* their own link or section, not *between* links and sections. As a consequence, specialisation has reached a level where it has become counterproductive.

Globalisation has further increased the separation between producer and consumer. That too has negatively influenced the mutual sense of responsibility.

Lack of transparency has even further undermined the sense of responsibility. Why should I feel responsible for something of which I have no knowledge or for somebody whom I do not know? Most food has become anonymous. This is the result of industrialisation, economies of scale – also in the retail sector⁷ – and an increasing number of processing stages.⁸ We have little or no idea of the origin and production methods and as a result no longer feel any shared responsibility for the sustainability, let alone a willingness to pay more or to consume less. We have little idea of how farmers treat their animals. The fact that beans from Egypt, roses from Kenya and asparagus from Peru are produced at the expense of the local water supply and food production

⁷The policy of large supermarkets to sell ever more products under their own private label has further undermined the recognisability of food. Private-label products must after all be interchangeable; their origin and identity should not be visible. A remarkable success in the Netherlands is that suppliers of eggs from the recently developed, animal-friendly Rondeel farm type in the Netherlands have maintained their identity. This is even reflected in the round shape of the egg box.

⁸ Processing is very often not in the best interests of the nutritional value of the product. The most valuable grain components of white bread (and even much brown bread) have been removed, and this bread above all now contains rapidly-digestible and therefore fattening carbohydrates. The same applies to white rice. The addition of vitamins need also not represent an improvement, because outside their natural context, vitamins are often not healthy. For example, for the sake of shelf life, the food industry often removes components that contain omega-3 fatty acids. This is one reason why the relationship between omega-3 and omega-6 fatty acids in our food has become out of sync. The low point in the history of processing was the conversion of liquid vegetable fatty acids into solid fatty acids – so-called trans fatty acids – in margarine. Trans fats cause heart failure and have since been silently removed from margarine.

remain beyond our horizon. The producers and retailers in turn pass responsibility to the consumer who "simply wants the cheapest possible product". In the same way, European livestock farmers barely recognise that forests and savannah in the South are being destroyed to supply the animal feed they purchase. For the livestock farmer, these developments are "out of sight, out of mind". As a consequence, problems are transferred elsewhere, beyond the horizon of the manufacturer and the consumer.⁹ We could almost use the term "organised ignorance and irresponsibility".¹⁰

3. *Increased separation between farmer and policy*

Agricultural policy and environmental policy are to a large extent drawn up in Brussels, far from the average European farmer. Even the Dutch government is less well informed on farming practice than it used to be, partly due to privatisation of its extension service. Supervision is often replaced by excessively-detailed regulations. Several years ago, for example, Dutch farmers wishing to plough deeper than 40 cm were required to apply for a permit.¹¹ In addition, rules for the capture and cleaning of waste water have also been applied to condensation water draining from the evaporation unit of the cooling installation, during the cooling process. This water consists of water particles extracted from the air, and as such is as pure as can be. Finally, there are a number of different grant-awarding schemes, but even those sometimes have a discouraging effect.¹² The result is an aversion among farmers to government and environmental policy.

4. *A market economy in which external costs are barely, if at all, included in the price.*

If external costs are not included in the price, competition almost inevitably leads to ecological and social damage. Although the EU is operating an ever-better system of

⁹ Another side effect of globalisation is that an increasing number of plants, animals and microorganisms from other continents are being deliberately or accidentally introduced. With increasing regularity, this is leading to harmful bio-invasions. See: W. van der Weijden, R. Leewis and P. Bol 2007. *Biological globalisation - Bio-invasions and their impacts on nature, the economy and public health*. A classic example is the *Phytophthora* disease, imported into Europe in 1846 or earlier, probably on seed potatoes from Mexico. The consequence was an epidemic of potato blight that caused tremendous damage in northwestern Europe, above all in Ireland. Even today, *Phytophthora* is still the number-one target for pesticide use in the Netherlands. A recent example of a bio-invasion is the antibiotic-resistant EHEC bacteria in Germany and France in 2011, which originated from a batch of contaminated fenugreek seeds from Egypt. A number of other of these unintentional imports include the potato cyst nematode, Colorado beetle, white fly and bluetongue disease.

¹⁰ This term was employed in 2010 in the Dutch manifesto *Pleidooi voor een duurzame veehouderij – einde aan de georganiseerde onverantwoordelijkheid* [Call for sustainable livestock farming – an end to organised irresponsibility] issued by a large number of professors. <http://www.duurzameveeteelt.nl/>

¹¹ The maximum depth was subsequently increased to 50 cm, under pressure from the Dutch parliament.

¹² Example 1: the Dutch MIA/VaMil scheme intended to encourage environmental investments by tax savings. As part of the scheme, such detailed conditions are imposed that very few environmental investments are in fact eligible. In addition, thanks to the investment, farmers make little or no profit, meaning that little or no further tax deduction is possible. Example 2: the subsidy scheme for sustainable sheds. There is far more interest in this subsidy scheme in practice than budget available. Solution: the drawing of lots! A highly discouraging choice. It would be better to slightly reduce the subsidy or reserve its payment for the best option. Example 3: the granting of innovation subsidies, but only for the knowledge component, not for the hardware. Any innovating farmer has often spent a great deal of time elaborating a good idea, but the construction of a prototype machine is extremely expensive because it is a tailor-made product and not mass-produced. The farmer is allowed to hire engineers to write the costly report, but is not able to call on the local mechanisation company to build a prototype. In addition, engineers often subsequently submit claims for the patent rights.

environmental standards and social standards, these do not cover all external costs (for example not the costs for the emission of greenhouse gases) nor do they apply to products imported from elsewhere, such as soybean.¹³ As a result, liberalisation of the agricultural and trading policy has time and again threatened to result in a *race to the bottom*. In addition, liberalisation has resulted in ever-larger markets, dominated by ever-larger players who are capable of dictating low prices to their suppliers – prices at which sustainable production is not possible any longer. To put it in a broader context, ecological sustainability only has a chance of success if combined with social sustainability.

5. *Reduced level of environmental ambition within the Dutch government*

Whereas in 1990 the Netherlands was a European leader in environmental and nature policy, the ultimate wisdom in the Dutch government today is the *level playing field*. Any "head" poking above the parapet of European environmental and nature policy is quickly mown down. As a consequence, the Netherlands has slumped on the international rankings of environmental performance.¹⁴ Heads above parapets are now only acceptable in the field of animal welfare.

6. *The runaway ideology of "individual responsibility"*

The currently dominant ideology imposes severe burdens on the shoulders of the individual entrepreneur and the individual consumer. Through the privatisation of agriculture information provision, for information farmers have become dependent on suppliers of animal feed, artificial fertiliser, pesticides and capital (banks). Even veterinarians have to a considerable extent become suppliers of inputs (in this case veterinary medicines). The advice given by these suppliers and advisors does not always tie in with the interests of the farmer, and is sometimes diametrically opposed to sustainability.

When it comes to collective interests, the Dutch government is increasingly relying on self-regulation. Although self-regulation has resulted in a number of success stories – above all in animal welfare – monsters have also been born, such as multi-antibiotic-resistant bacteria. Following the ban on the administration of antibiotics to livestock as a growth promoter, the government trusted the individual responsibility of the veterinary practitioners. They, however, switched to prescribing more and more antibiotics on "veterinary grounds". The government failed to recognise the social dilemma: while it is essential if we are to uphold the common good (in this case effective antibiotics), that every livestock farmer and veterinarian moderates the use of these agents, for the individual, non-moderation can sometimes offer the best outcome.

¹³The WTO is quick to ban government-imposed sustainability requirements on the grounds of "distortion of the market". Broadly speaking, only those requirements are accepted that are based on global treaties, such as the Montreal Protocol for the protection of the ozone layer. The EU, for example, is not permitted to demand that no rainforest or savannah is destroyed for imported soybean (private businesses are able to impose such demands). In addition, land provided free to farmers in parts of the Amazon area of Brazil is not viewed as a form of concealed market-distorting subsidy that would be eligible for compulsory reduction.

¹⁴Stichting Natuur en Milieu (Nature and Environment Foundation). 2011. *Ranking the stars*. Utrecht.

Also in terms of eating patterns, the Dutch government constantly refers to individual responsibility. The government still sees a task for itself in relation to tobacco and alcohol, but any attempt to influence eating patterns is quickly viewed as meddling and mollycoddling.¹⁵

The government has continued to facilitate information provision by the Netherlands Nutrition Centre, despite cuts to that organisation's budget. On the other hand, as compared to the massive advertising budgets of food manufacturers and supermarkets, the Nutrition Centre's budget was already a drop in the ocean. Although the private sector has been self-regulating for a number of years – for example via the Healthy Weight Covenant – every day consumers are swamped with a flood of advertising focusing more on low prices – and other non-food related gifts such as football cards – than on quality, health and sustainability. What is really needed is more advertising for fresh products and less for processed foods, but that would be contrary to the interests of the food industry. At the end of the day, consumers themselves are obliged to make more effort to find reliable information about healthy eating patterns and lifestyles.

7. *Insufficient management in the food chain*

Due to insufficient chain management, until recently not a single link in the chain felt any responsibility for the chain as a whole. However, a change for the better has now taken place. Integrated chain management has for example become common practice for food safety. Rudely awoken by a number of major food safety affairs, in particular the BSE crisis, the EU has now introduced chain liability based on *tracking and tracing* systems. As a result, chain management has become an economic necessity for businesses. Even so, this management is still insufficient, as witnessed by the proliferation of antibiotic-resistant bacteria in meat and occasionally even in vegetables.

Over the past few years, supply chain management in the Netherlands has been established in relation to the health aspects of food, partly as a consequence of the Healthy Weight Covenant. Result 1: lower contents of saturated fats and added sugars and salt in a large number of foodstuffs. Result 2: two health labels - *Gezonde keuze* [Healthy choice] and *Ik kies bewust* [I choose consciously] – that are applied to a large number of foodstuffs. The products in question are above all pre-packed and pre-processed – and include a number of products that could hardly be described as healthy, such as crisps. These labels are far less widely used for fresh products, although these are in fact often far more healthy.¹⁶

¹⁵ In the tobacco arena, the Dutch government has recently taken a number of retrograde steps: smoking in small bars is once again tolerated, support for those wishing to stop smoking has been removed from the basic health insurance package, public information campaigns have been halted and Stivoro – the watchdog for the anti-tobacco movement since the 1970s – has been closed down. J. Mackenbach and O. van Schayk, *Nederland steunt tabaksindustrie* [The Netherlands supports the tobacco industry]. NRC Handelsblad 21 September 2011.

¹⁶ Aside from that, the European Food Safety Council (EFSA) has started with a systematic scientific assessment of specific health claims in respect to food. The products in question are above all *functional foods*, food items to which nutrients have been added. To date the vast majority of claims have been rejected. The added value of functional foods as compared to “real” food would appear therefore to be limited.

Chain management is also advancing steadily in respect of the environment. This started in the nineteen seventies with chains relating to organic farming. In the 1990s, *mainstream* food industries and supermarket chains followed suit. Until very recently, environmental protection issues related only to the plant-based chains – for example potatoes, vegetables and fruit – and the use of pesticides. A number of supermarkets and food industries, however, have now started more integrated environmental protection measures, some of which include reduction of greenhouse gases. In the livestock-based chain, for the most part, supermarkets have left environmental protection to the industry. To date, this has remained limited to a small number of issues, such as soybean in livestock feed from South America.¹⁷ In respect of animal welfare, however, interesting progress have been made. The laying-battery egg has disappeared from shop shelves, and Albert Heijn – market leader among Dutch supermarket chains - now only sells pork that has been awarded at least a one-star quality rating by the Society for Animal Protection. There are also some examples of international chain management aimed at integral social and ecological sustainability: in niche markets, such as Fair Trade and in mainstream markets, such as Utz Certified (coffee) and Unilever (various foodstuffs).¹⁸

In all of these forms of chain management, the system of tracking and tracing – introduced to improve food safety – represents a sound basis. The trend among leading supermarkets to establish more long-term relationships with preferred suppliers is further broadening the support base for these systems, but we still have a long way to go.

8. *Concentration of power in the food industry¹⁹ and the supermarkets*

As a result of power concentration, the food industry and supermarkets occupy an increasingly strong position with respect to farmers on the one hand and consumers on the other. They are able to demand such low prices from farmers and market gardeners

¹⁷The forerunner in environmental protection in fruit and vegetables were Albert Heijn and Unilever. Heineken and Mars are now also both highly active in this respect.

¹⁸ In its *Sustainable Living Plan* (2010), Unilever launched an integrated chain-wide programme in which the following themes are addressed: improved health, reduced environmental impact (climate, water, waste) and improved living conditions (sustainable purchasing, small farmers). The plan is promising but restricted by the fact that the health of food is above all interpreted as tinkering with food (less saturated fat, no trans fat, less salt, sugar and calories) not as promoting “real” food. In that sense, the programme is less integral than called for by the Council.

¹⁹ In the US, three developments in the 1970s had a huge influence on food, eating patterns and food sciences. When demonstrations were held in 1971 to protest against massive food price rises, the Nixon government decided to freeze prices and to introduce a policy aimed at increasing agricultural production so as to structurally reduce prices. The policy proved effective, but the larger volumes and low prices also contributed to the rise of the fast food industry. In 1973, under pressure from the food industry, the US Congress ended the obligation to label every food product that was an imitation as “imitation”. This removed an obstacle to the addition and removal of nutrients and strengthened the reductionist thinking in terms of nutrients rather than whole food. In 1977, a Senate committee that had been appointed with the intention of eradicating poor food issued a recommendation to eat less red meat and dairy products. However under pressure from the meat and dairy lobby, the committee withdrew its recommendation within just a few weeks, and replaced it with the – scientifically poorly-underpinned – advice to eat less saturated fat. This turnaround also helped promote thinking in terms of nutrients. The consequence was that hundreds of traditional products known to everyone slowly started to disappear from the shelves. See M. Pollan 2008: *In Defense of Food*.

that working conditions, animal welfare and biodiversity are under continuous pressure.²⁰ On the other hand – certainly in the Netherlands – supermarkets have little leeway to charge higher prices to the consumer, because they are forced to compete with one another. But through their huge advertising budgets, they are able to influence the buying and eating habits of consumers. The overall result can be non-sustainable products at low prices. One example in Dutch supermarkets is the so-called *kiloknaller* [kilo stunner], extremely cheap pig or poultry meat.²¹

9. *The competition policy of the EU and the Dutch government*

In theory, farmers can join their market forces in order to demand a greater share of the margin. However, competition policy makes this more difficult. As a result, farmers receive only a small proportion of the added value and are forced to permanently operate at the very cutting edge. Although the food industry and retailers are imposing ever-stricter demands in respect of the environment and animal welfare, they rarely pay higher prices in return. If they are willing to reach agreements on these financial questions, they too run up against competition policy. To give a recent example: of the populations of chickens from which the Plukon slaughterhouse obtains its meat, at least 40% are kept antibiotic-free, in return for a slightly higher selling price. Now that poultry farmers wish to reach sector-wide agreements on this issue, the Netherlands Competition Authority (NMA) is threatening to intervene based on the argument that such a move would distort competition.²²

10. *Patent rights*

It is increasingly common for a patent right to be applied to the plant traits or a technique in plant breeding, as a result of which plant varieties are indirectly covered by patent protection. This undermines the farmers' rights and the opportunity for breeders to use existing varieties as a basis for further crop development.²³ Patent law is therefore restricting both the essential diversity of species and the freedom of farmers. As a consequence, the food supply is at risk of increasingly becoming controlled by an ever-smaller dominant group of seed companies.

11. *Reductionism, specialisation and tunnel vision in science and the financing of research*

Reduction is common practice in science: reduction of the agro-ecosystem to a small number of components, of the food chain to separate links with little overall coherence, and food to nutrients that can be freely removed or added and nutrition to a biological

²⁰Another contributing factor is the overproduction in the Dutch pork and poultry industry, leading to a buyers' market with low prices.

²¹It does in fact appear that the kilo stunner is on the way out from Dutch supermarkets, above all thanks to the publicity campaigns of the NGO Stichting Wakker Dier [Alert Animal Foundation].

²²Of the populations of chickens from which PLUKON obtains meat, at least 40% are already kept free of antibiotics (however, this does not imply that the animals receive no antibiotic at a young age) in return for a slightly higher selling price.

²³ See Report *Veredelde Zaken [Breeding Issues]*, published by the Centrum voor Genetische Bronnen Nederland [CGN - Centre for Genetic Resources Netherlands] and submitted and discussed in the Dutch Parliament in April 2011.

activity, isolated from its socio-cultural context.²⁴ There is still little attention for the complete system with all its complex biological and social relationships and ties. This reductionism for example made it possible for offal from slaughterhouses to be processed as a "normal" source of protein in feed for herbivorous animals, in particular cows. The result was that first the cows became sick, and subsequently consumers became ill.

The latest knowledge of plant physiology suggests a possible 7000 to 10 000 components in a single vegetable product. Our current knowledge of foodstuffs is therefore very much the tip of the iceberg. The total composition of substances in food – and the still barely understood interactions between them – may play an important role, alongside that of the "traditional" nutrients. It has for example been demonstrated that fish, grain, vegetables and milk have an extra health-promoting effect as compared to their components (such as omega-3 fatty acids, vitamins, antioxidants).²⁵ Trouble arises because much food-related research is financed by an industry that has more interest in patentable products²⁶ than in "system questions" such as the relationship between biodiversity and sustainability of production, the effects of that relationship on the quality of food, and the effects thereof on the health and wellbeing of the consumer.

To summarise, there is a clear need for a more **integral vision on agriculture and nutrition** focused on the total system with all its links and connections. The Scientific Council for Integral Sustainable Agriculture and Nutrition hereby presents its vision.

²⁴One of the first reductionists in the field of agriculture and food was Justus von Liebig, who expressed the belief that plants can survive on only nitrogen, phosphorous and potassium. He further suggested that people could get by on proteins, carbohydrates, fats and a number of metals. Later, vitamins, minerals, essential fatty acids and oxidants were added to this list, but even that is not the full story. Using modern techniques, more and more secondary nutrients are being discovered. Few people know that Von Liebig later drastically changed his vision, emphasising the key role of organic matter in the soil.

²⁵D.R. Jacobs et al. 2007. *Food, Not Nutrients, Is the Fundamental Unit in Nutrition*. Nutrition Reviews 65: 439-450. And in de Volkskrant newspaper of 17 October 2011, the Wageningen Professors Frans Kok and Ellen Kampman – in response to the question "Can vitamins in a pill replace fruit and vegetables?" – responded that vegetables and fruit owe their health-promoting effects to the interaction between a huge range of components. Kok: "It is not possible to imitate the cocktail in fruit and vegetables using multivitamins and mineral supplements." Kampman: "The dosages of vitamins are different from those contained in fruit and vegetables, and synthetic vitamins sometimes work differently from those contained in food".

²⁶ Industry has little interest in a non-patentable component such as vitamin D, although there are indications that this vitamin is far more important than believed until recently.

Integral vision

As indicated above, the Council relates the current problems facing sustainable agriculture and healthy nutrition to the loss of coherence and weakening or disrupted relationships: between consumer and farmer, between consumer and food, between farmer and ecosystem and between man and livestock. **The central task therefore is to re-establish relationships and coherence.** The Council uses the word *integral* instead of *integrated* to express its view on sustainable agriculture and healthy food as one whole rather than to suggest only linking various elements. It thereby integrates various key systems: agro-ecological systems, physiological systems of plants, livestock and consumers, and socio-economic and cultural systems.

The Council has expressed its integral vision in the following 15 statements:

- 1. Humans and the food chain are and remain part of – and are intrinsically linked to – nature.** Food and agriculture are as it were the umbilical cord by which we are linked to nature. For mankind food is the most intimate relationship with nature because with food we absorb "a part of the outside world" into our bodies. For that reason, the health of crops, livestock and consumers are jointly dependent on the health of nature: *One Nature, One Health.*²⁷

Conversely, via food, we exercise major effects on the agro-ecosystem and nature. American opinion leaders summarised this relationship with the essential message: *Eating is an agricultural act.* And: *Eating is a moral act.*²⁸ We could add a third message: *Eating is an ecological act.*²⁹ In choosing our food, we must therefore demonstrate respect and responsibility for the quality of the living outside world and a balance between giving and taking. This two-way relationship is of vital importance for the future of the triangle made up of humans, agriculture and nature.

In this way, it is also essential that food once again is recognised as more than a package of nutrients and instead as an integral product from a coherent biological and social system. Food cannot be isolated from that system.³⁰

²⁷The World Health Organisation uses this motto for infectious diseases, but it applies equally well to food quality.

²⁸ The first quote is by the American farmer/writer/opinion leader Wendell Berry, the second by the American agricultural and environmental activist David Andrews.

²⁹Traditionally, food is part of the social context of a shared meal. We can therefore add the phrase: *Eating is a social act.* This context has partially been lost with the advent of single-person meals, fast food and ready-meals. On the other hand, eating out together in restaurants has increased considerably in the Netherlands. Given the increasingly industrialised processing of much food, in a contemporary context we could also apply the phrase: *Eating is an industrial act.*

³⁰ In substrate-based cultivation in greenhouses, food has partially been removed from its ecological context. This development is going even further with the "food flats" and "multi-storey car park cropping" currently being developed at a fast pace in the framework of local food production. See www.verticrop.com and www.plantlab.nl. These solutions involve hydroponics, in which plants are fed with nutrient solutions in a sterile environment to avoid the need for pesticides, and often using LED lighting, so that no sunlight is required. The idea is that through these methods, at a single location,

Another aspect of the connection with nature is the fact that we are being increasingly confronted with the finite nature of natural resources such as fertile soil, water and in the future also energy, phosphates and biodiversity.

- It is not unusual for nature being considered as a formidable competitor of man – take for example agricultural pests and competition for land and water with nature areas. **Nonetheless, nature is primarily a (potential) partner.** To begin with, living, healthy soil is the basis for all agriculture and hence for most of our food. We must preserve the soil and keep it healthy. The diversity of species and regulation mechanisms offered by nature must also be cherished, and wherever possible, exploited. In most agricultural systems, a disturbed balance is increasingly restored by delivering external inputs. There is a great deal to be said for more natural, self-regulating systems that maintain their own balance, with a minimum of external inputs.³¹ The farmer is then not focused primarily on increased production but on maintaining, strengthening and utilising that self-regulating capacity (Figure 1).³²

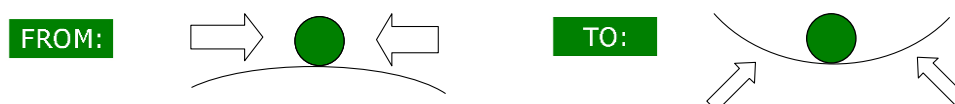


Figure 1. From a production system controlled by high levels of external input to an ecologically sound and resilient production system with minimal external inputs. The second system broadly compensates for disruptions (such as disease pressure) in the system itself; the external inputs are minimised to the absolute essential.

Based on: Ten Napel et al., 2006. Transforum, *Inventions for a sustainable development of agriculture. Working Papers 1.*

Stability can only partially be achieved at the level of individual field or farm, because agriculture everywhere is part of a greater ecosystem. Stability must above all be aimed at on the scale of the entire landscape. Eventually, the aim must widen to a global scale through society-wide reduction of emissions of greenhouse gases to mitigate climate change.

throughout the year, chemically untreated products can be grown, without contamination through transport. A system of this kind could contribute to sustainability in technical terms, but hardly in biological terms. The question for example is how resilient a system of this kind is and what – also given the new understanding of plant physiology – the nutritional value of the products is compared to products grown in the soil.

³¹In traditional systems, hygiene is also becoming increasingly important. In that sense, hygiene is to some extent an input, focused on excluding infection. Excessively strict hygiene, however, can damage the self-regulating capacity of crops and livestock, thus making the system more susceptible to infections. It is far from clear where the optimum balance lies.

³²Optimum use of ecological mechanisms is at least as important as optimum use of technology. The latter is referred to as *high tech*, and for the lack of a sound term, we could coin the phrase *high eco*. Optimum sustainable agriculture makes use of both.

3. **More respect is needed in our relationship with animals.** In food production, the animal – unlike other companion animals – has become increasingly an "object". Societal resistance to this development has grown considerably. Thanks to pressure from society, animal welfare has been placed high on the Dutch political agenda across the political spectrum. This relationship will have to be increasingly based on respect.³³ In the future, livestock should be given more space for natural behaviour.³⁴
4. **Diversity is of key importance; not only diversity in nature but also in the agricultural system, in our food and in our culture.** Diversity in the agricultural system relates to crop varieties and livestock breeds, wild species (also in the soil) and farming systems. Such diversity can contribute to stability and resilience³⁵, for example with respect to pests, extreme weather and climate change. Diversity in crops including breeds can also contribute to healthy nutrition by meeting an important food-related recommendation: eat a varied diet. The more types of crop and varieties we eat, the more essential nutrients we take on board³⁶. Diversity in our food culture is a valuable good, in itself. Inversely, through a varied consumption pattern, we contribute to the diversity of agriculture and landscape.

Of primary importance is the fact that we cherish, maintain and strengthen the existing biodiversity of varieties. This for example calls for plant breeders' rights to continue to prevail above patent rights. In addition, an active policy is needed in order to maintain wild species and old landraces. Farmers must also be given effective incentives to promote biodiversity of "wild" species – both above and below the ground on their farms.

³³ Respect for food and livestock is also central in: Louise Fresco 2005. *Nieuwe Spijswetten – Over voedsel en verantwoordelijkheid [New Food Laws – On food and responsibility]*. She also refers back to religious roots in this respect.

³⁴ In Dutch dairy farming, cows still have fairly considerable space for natural behaviour, but this is being restricted now that more and more cows are kept in-doors all year round. An interesting example of a modern operating system where the animals do have plenty of space for natural behaviour is the Round-house system for poultry in Barneveld (province of Gelderland) and Wintelre (province of Brabant).

³⁵ For an overview, see B.B. Lin 2011. *Resilience in agriculture through crop diversification: adaptive management for environmental change*. *BioScience* 61: 183-193. "Resilience" is a term employed in ecology, biology, the social sciences and also in health sciences. It was recently proposed to include resilience in a new definition of health: "Just as environmental scientists describe the health of the earth as the capacity of a complex system to maintain a stable environment within a relatively narrow range, we propose the formulation of health as the ability to adapt and to self manage." See: M. Huber et al. 2011. *How should we define health?* *BMJ* 21011;343:d4163

³⁶ This also applies to secondary metabolites. Certain plants produce secondary substances, for example to protect themselves against natural enemies, stress and the harmful influence of oxygen – the latter in particular in leaves, where photosynthesis takes place. Thyme alone contains 34 antioxidants. Wild plants often contain more secondary substances than cultivated crops. High levels of fertiliser reduce the quantity of these plant health-promoting substances; this is one of the reasons why organic products – grown under lower fertiliser levels – contain higher levels of such antioxidants. See e.g. K. Brandt et al. 2011. *Agroecosystem Management and Nutritional Quality of Plant Foods: The Case of Organic Fruits and Vegetables*. *Critical Reviews in Plant Sciences* 30: 177-97.

5. **The food chain should no longer strive mono-dimensionally for higher production, profit and material gain in the short term, but for social added value in both the short and long term.** In other words, it should focus on *values for money*.³⁷ More specifically, we mean: benefits for health and welfare of the consumer, for the producing and self-regulating capacity of agro-ecosystems, and for the added value of agriculture in the form of ecosystem services.³⁸
6. **Sustainable agriculture and healthy nutrition are issues that should not be approached in isolation but in conjunction with one another.** A well-known example is that responsible use of pesticides and antibiotics increases food safety. However, more is necessary. Partial solutions should give way to system changes, in both the agro-ecological system and in the social system surrounding the food chain. For example, reducing the use of antibiotics cannot be achieved through improved hygiene only, but also calls for alterations to the livestock (less rapid growth, more natural resistance and resilience, different races, more genetic diversity), the accommodation (inducing less chronic stress), the management (nutrition, animal care) and the structure of the sector (less large livestock numbers, greater distance between stables). Farm advisors and suppliers such as veterinarians and the feed industry will also have to shift the goalposts.
- Sustainable agriculture and a healthy diet are also related via our consumption patterns. For example, eating according to the Dutch Good Food Guidelines (eat less, in particular less meat and dairy) broadly speaking also supports sustainability.³⁹
7. **Integral sustainable agriculture and healthy nutrition are only truly possible if vital relationships are recovered and/or improved. Characteristics of those relationships are:**
- multidimensional (biological, social, cultural and economic);
 - no anonymity - instead, transparency and communication;
 - respect;
 - balance between giving and taking;⁴⁰
 - realisation of joint responsibility for the partners in the food chain.

³⁷ Formulation by Tim Lang, Professor of Food Policy at City University London.

³⁸ An ecosystem service is a service provided by an ecosystem to society. It concerns the provision of a product by the ecosystem (for example food or drinking water) of regulatory services (e.g. the pollination of crops), cultural services (e.g. providing opportunities for recreation) or services that support the other services (e.g. the nutrient cycle). nl.wikipedia.org/wiki/Ecosysteemdienst

³⁹See also *Richtlijnen goede voeding ecologisch belicht [Good food guidelines considered from an ecological viewpoint]*. Publication no. 2011/08 of the Dutch Health Council, to be downloaded via www.gr.nl. This Council examined three sustainability themes: land use, emission of greenhouse gases, and biodiversity. It concludes that the recommendation to eat less dairy and meat contributes to sustainability but the recommendation to eat fish twice a week does not. Interestingly, recent research has revealed that a low-calorie diet considerably lengthens the lifespan of a wide range of organisms – from yeasts and worms through to mice and people. In humans, this even applies with fewer calories than generally recommended. L. Fontana et al. 2010. *Extending Healthy Life Span From Yeast to Humans*. *Science* 328: 321-26. DOI: 10.1126/science.1172539.

⁴⁰ In respect of ecosystems, "giving" refers to returning minerals and organic matter (e.g. in the form of high-quality animal manure), care for natural pollinators (bees) and antagonists (e.g. ichneumon wasps) but also (space for) wild plants in field margins.

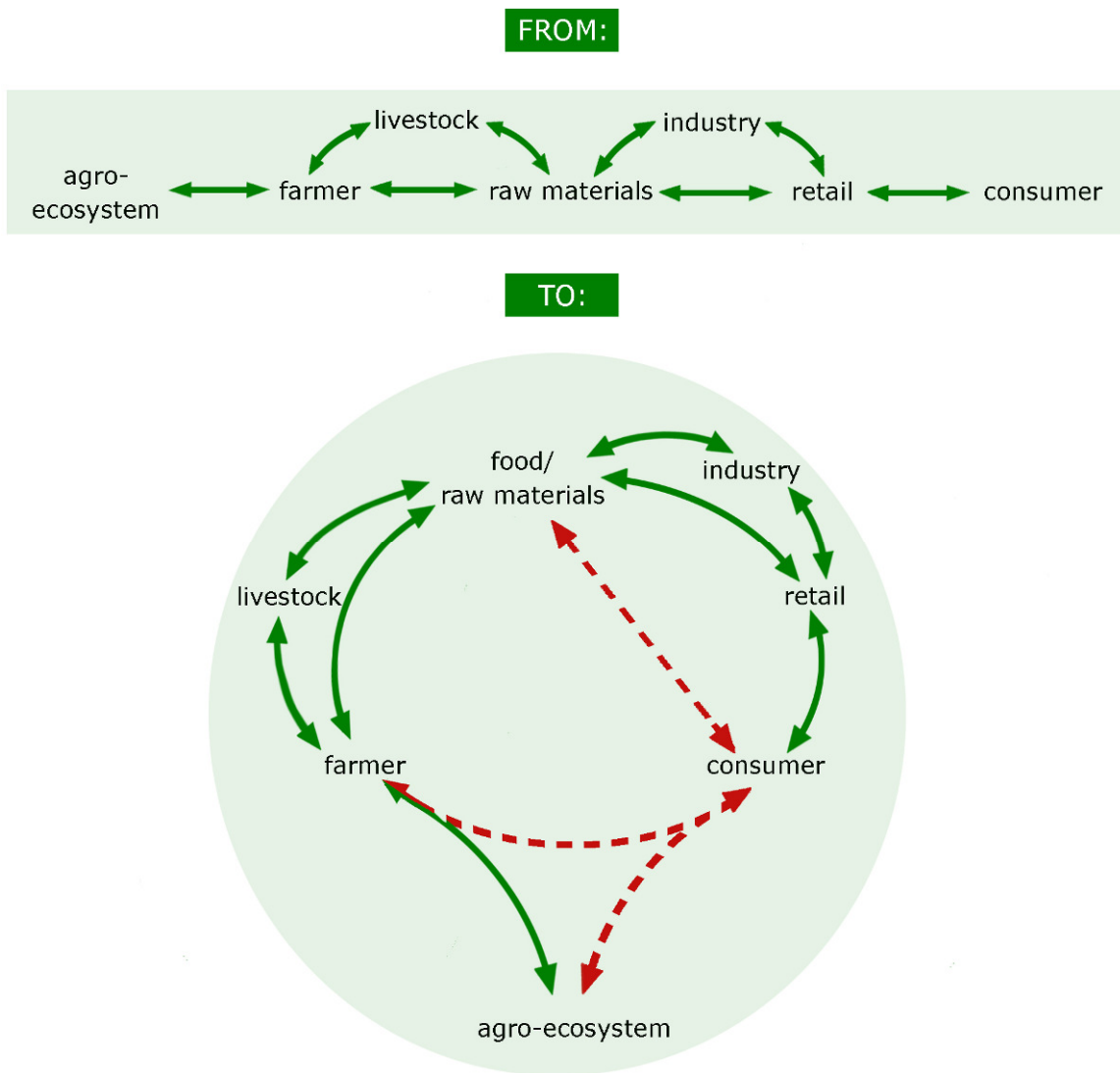


Figure 2. From a straight line (linear chain, current situation) to a circular chain in which farmer and consumer once again have a relationship. The red lines of communication are as yet underdeveloped.

8. **In good relationships, alienation gives way to bonding. In that situation, the system of organised *irresponsibility* can change to a system of organised *shared responsibility*.** To express this in a highly simplified way, we need to move away from a linear food chain to a circular chain (see Figure 2) whereby consumer and producer once again communicate with one another in some manner. Food once again needs to be given an identity, a face and a story.⁴¹ There are already numerous initiatives in this respect: farm or cow on the milk pack, selling directly from the farm, subscriptions to vegetable box schemes, farmers markets, Open Farm Days, farm campsites, Bed & Breakfast on the farm, "community-supported agriculture (CSA)", allotments, urban agriculture, local city/countryside projects,⁴² visitor barns, webcams in the barn, and farmers with city-based followers on LinkedIn.⁴³ In the future, social media will play a major role in this respect, also over larger distances.⁴⁴

This need not mean that the major players in the food industry and the retail sector lose importance. But they will increasingly have to take account of signals issued by new, direct communication networks. They will also have to give a broader share in the distribution of value added to the farmers.

⁴¹A face and a story are far easier to offer with simple, "real" food than with processed and constructed food.

⁴² For a brief summary, see: *Een welvarend PLATTELAND begint in de STAD – Aanbevelingen van de Community of Practice "Naar een nieuwe generatie stad-land relaties" - A prosperous RURAL ENVIRONMENT starts in the CITY. [Recommendations from the Community of Practice. "Towards a new generation of urban-rural relationships]* www.multifunctionelelandbouw.nl/download.php?file_id=942

⁴³One television show that must be mentioned is *Farmer seeks wife*, which has broken viewing records in the Netherlands on several occasions. This is due to a number of factors: blossoming relationships between men and women but also relationships between non-farming individuals on the one hand and farmer/livestock/ agriculture/nature on the other. It does not seem likely that "Carpenter seeks wife" or "Bank clerk seeks wife" would have attracted as many viewers. It should be noted that the relationship to food was rarely mentioned.

⁴⁴ Social media could perhaps also play a role in solving the social dilemma or the "tragedy of the commons". This occurs in respect of natural resources that are shared by all: common pool resources. Each individual attempts to use the largest possible share of the resource, but if all individuals were to do that, the resource would be exhausted. Standard solutions are nationalisation or privatisation. The American Elinor Ostrom - in 2009 the first female winner of the Nobel Prize for Economy - demonstrated on the basis of international research that subject to certain conditions, a third route is possible: common management. Conditions are:

1) clear demarcation of the group, 2) rules of play, 3) high percentage of users, 4) monitoring by recognised monitors, 5) sanctions, 6) dispute procedures, 7) recognition by higher authorities. http://en.wikipedia.org/wiki/Elinor_Ostrom. Social media can also play a role in monitoring.

Box 1. Regionalise or globalise agriculture?

There are good ecological and social arguments why food from your own region is, in principle, preferable to food from further afield:

1. The involvement and sense of responsibility of the consumer often decrease with distance.
2. Transport costs energy and therefore results in CO₂ emissions. Transport by ship consumes less energy than by aircraft, but en route, preservation is often required by refrigeration that also costs energy and/or gassing with toxic substances.
3. Overseas transport involves the risk of bio-invasions: the introduction of harmful plants, animals and microorganisms from a different biological region. In Europe, this risk is greatest during transport from other moderate regions such as Eastern Asia and North America.⁴⁵ Traders often limit this risk by applying toxic gases but thereby replace the biological risk by a chemical risk.
4. Production of food and animal feed overseas more often takes place at the expense of nature areas than does production in Europe, where due to the continued rise in productivity, more and more agricultural land is abandoned.
5. The more basic foodstuffs and animal feed we purchase overseas, the more susceptible we become to the whims of geopolitics.⁴⁶

On the other hand, not *all* food would need to come from our own region. Only few consumers would for example wish to abandon coffee, tea, chocolate or tropical fruits. Of those products that can be produced both in the tropics and in the Netherlands, the footprint of food from overseas is sometimes specifically *smaller* than that of a comparable product from the Netherlands. This for example applies to certain products from our still energy-intensive greenhouse cultivation. In addition, greenhouse cultivation on substrate⁴⁷ has largely been disconnected from nature; and in the future this even more applies to hydrocultures with LED lighting in vertical systems. As for communication, this is possible over huge distances using modern ICT. The key factor is the question whether consumers or their representatives are able to establish a relationship with producers and thereby feel shared responsibility for the production and its sustainability. This is partially achieved with Fair Trade coffee and chocolate.

⁴⁵The most harmful (pest) organisms from the tropics cannot survive in Europe in the open air, or possibly only in greenhouses and buildings. The extensive system of international trade rules for plant, animal and human safety does not prevent diseases and pests regularly occurring in new areas. Recent example: in spring 2011, more than 50 people died in Germany and more than 4000 people became sick following the import of fenugreek seeds from Egypt that were contaminated with an EHEC bacteria.

⁴⁶ Platform Landbouw, Innovatie en Samenleving 2011 [Platform Agriculture, Innovation and Society 2011]. *De kwetsbaarheid van het Europese landbouw- en voedselsysteem voor calamiteiten en geopolitiek (2011-2020)* [The vulnerability of the European agriculture and food system to disasters and geopolitics (2011 – 2020)]. A realistic risk is for example that China could buy up all soybean available on the world market, in the event of a sharp rise in domestic food prices. This would lead to a crisis in substantial parts of European – above all Dutch – livestock farming.

⁴⁷On the other hand, greenhouse cultivation is a frontrunner in the field of biological pest control. In that respect, this sector is in fact closer to nature.

For developing countries, too, regionalisation of food production could be a wise strategy. There are various examples of exports to Europe at the expense of local food production and/or water management. For example, the production of beans in Kenya imposes demands on scarce water supply, on which livestock farmers are dependent. Prawn farming in Southeast Asia occurs at the expense of mangrove forests, on which local fishermen are dependent. Conversely, the import of rice from Vietnam and the US (the US production is in fact subsidised) have been found to be at the expense of local rice farming in Ghana, Honduras and Indonesia. In the same way, the import of chicken wings from the EU has pushed poultry farmers in Ghana out of the market.

African agriculture has enormous potential for growth.⁴⁸ Agricultural development could be served if Africa were to protect its markets against cheap overseas imports with import duties. In addition, institutional support for agriculture is necessary in the form of market development, protection of land rights, the issuing of credit and extension. Using similar policies, the European Union modernised and improved the competitiveness of its agriculture after World War II. The World Bank and IMF should offer more space for such policies and not immediately threaten to withdraw loans, as they have done on several occasions. Instead, African countries could reduce tariff walls between them and their neighbours. What would also help is if the EU were to bring an end to the so-called tariff escalation, whereby primary agricultural products are imported at a low rate, but processed products at a high rate. Levelling these rates would offer more opportunities for the establishment of a food industry in African and other developing countries.⁴⁹

In summary, a rule of thumb for food production could be: regionalise where possible and globalise where necessary.

9. **As much as possible, food should be obtained from the local region.** More precisely: from as close as possible, and as far away as inevitable. For arguments, see Box 1.
10. **Agriculture is more than food production.** Traditionally, agriculture has also contributed to energy supply, the production of raw materials (such as fibres and dyes), the production of medicines, etc. For these non-food products there is renewed interest in the framework of the *biobased economy*. This development deserves support as long as it is not at the expense of soil fertility, food production and nature. There is also increased recognition of the *common goods* and *ecosystem services* provided by agriculture, in particular landscape, clean water and such services as tourism and care.⁵⁰ There are growing public and private monetary resources available for these

⁴⁸ Interview with Professor Rudy Rabbinge in NRC Handelsblad newspaper, 24 November 2011.

⁴⁹ This is already the case for the poorest developing countries, for which the EU operates a zero tariff (with the exception of weapons).

⁵⁰ Agriculture can also contribute to biodiversity, but broadly speaking that contribution drops as production per hectare rises. Under sound management, there are worldwide opportunities in field margins, in wet rice fields, in coffee and cocoa plantations, etc. In the Dutch provinces Groningen and Drenthe, certain farmland birds have returned thanks to field margin management. The number of geese

elements. This development also deserves support, all the more because it establishes new links between food production and society. With that in mind, multifunctional agriculture also has better opportunities as the distance between producers and consumers is reduced. Individuals feel most involved in their own regional landscape.

11. **External costs, in particular environmental costs, should be integrated in the prices of agricultural products.** This could help make sure that the market mechanism does not result in a *race to the bottom* but rather a *race to the top*. Internalising costs can be difficult on a global scale, but is possible within the EU.
12. **Agricultural markets must be protected to the level required for sustainability.** First, this is favourable for the essential relationships between producers and consumers. Second, we must prevent a situation in which markets where external costs are internalised in the prices are swamped with cheaper products from countries where this is not the case. Both global and regional treaties (for example with the Mercosur countries⁵¹) must be assessed on this point, naturally in both directions. Developing countries must be given an opportunity to protect their farmers through import restrictions against invasions of cheap products from rich countries.⁵²
13. **The position of farmers in the chain must be strengthened.** This for example calls for more transparency in margin distributions in the chain and adjustments to competition law so that market parties are given more freedom to establish pricing agreements in favour of a more sustainable production method.
14. **Greater coherence is required between the policy fields of agriculture, food, the environment, nature, energy and public health.** This applies both to the Netherlands and the EU. For example: the reduction of antibiotics can contribute to animal health, the environment, food safety and public health. A varied menu can contribute to health, to biodiversity, the resilience of agriculture and to landscape variation. And less meat and dairy consumption can contribute to health, energy saving, the environment, climate and the preservation of nature areas.
15. **More research, information and education is needed on the aforementioned relationships and systems and healthy consumption patterns.** Knowledge of these subjects must be integrated in regular education. Research should not only integrate multiple disciplines (ecology, economy, social and nutritional sciences) but should also

on grassland and arable land has also increased considerably, to such an extent in fact that they have become a pest to farmers and to Schiphol airport. For a worldwide overview see: W. van der Weijden, P. Terwan and A. Guldemond 2010. *Farmland birds across the world*.

⁵¹ Mercosur: Brazil, Argentina, Uruguay, Paraguay and Venezuela.

⁵² In the WTO, developing countries have space to protect their farmers against cheap imports, but if they wish to make use of those freedoms, they are often whistled back by the World Bank and IMF. A. Paasch et al. 2007. *Trade Policies and Hunger – The impact of trade liberalisation on the right to food of rice farming communities in Ghana, Honduras and Indonesia*. Ecumenical Advocacy Alliance, Geneva.

focus on the links in the food chain⁵³. A larger proportion of research will have to take on an interactive character, with participation by farmers and the general public. Also in research, diversity is essential, and above all diversity in visions and connected production systems and food chains investigated.

Objectives and resources of the Council

Given these principles, the Council views its task as contributing to the coherent development of integral sustainable agriculture and healthy nutrition. The Council wishes to do this by:

1. **Increasing awareness** of the relationship between sustainable agriculture and healthy nutrition via publications, debate, education, information and advice;
2. Promoting **research** in support of this development. For an initial research agenda, see the next paragraph;
3. Promoting **networks, practice and policy** that contribute to this development;
4. Any other suitable means.

As its first specific activity, the Council has drawn up a research agenda.

⁵³ Such integration was recently urgently called for by the Standing Committee on Agricultural Research of the European Commission. See: The 3rd SCAR Foresight Exercise 2011, *Sustainable food consumption and production in a resource-constrained world*.

A research agenda for integral sustainable agriculture and nutrition

Below, the Council presents a number of questions for research:

1. *Agro-ecological relationships*

- How do **biodiversity and the resilience of the soil** affect the health of crops and livestock, the quality of food and the health of the consumer? Can **modern growing systems such as hydroponics achieve a sufficiently high level of resilience**?
- Conversely: what are the effects of biological and socio-cultural **diversity of diets** on sustainability, resilience and health of soil, crops, livestock and consumer?
- Which **natural mechanisms** can (better) be used to make agro-ecosystems more self-regulating? And how can that use be promoted?

2. *Social relations*

- What is necessary and possible to recover or improve relationships between **consumers and food**? What are the effects of those relationships on the eating behaviour of the consumer?
- As above for the relationship between **consumer and farmer**?
- As above for the relationship for the relationship between **farmer, livestock and agro-ecosystem**?
- Which **methods of communication** are most suitable? There is already plenty of experience with labels but less with blogs, websites, webcams and social media. Are these applicable only in short chains or also in long or even global chains? Are intermediary players in the chain an obstacle or can they in fact contribute to transparency and communication? How can tracking and tracing, as increasingly implemented within the food chain for food safety, also help bring food out of anonymity, give it a face and a story, and make it more sustainable?
- What effects can be expected from restored or improved relationships **on the minds and actions of consumers and farmers**? Will they feel more responsible for one another and the ecosystem? What are the effects on farm management, on eating habits, health and wellbeing?

3. Institutional relationships

- What role do **intermediary stakeholders** play between farmer and consumer in the development of the agricultural system and the food chain, including input industries (pesticides, feed, fertiliser, veterinary drugs), banks, accountants, cooperatives, food industry, retail and research? Where do they contribute to alienation and where to establishing links? What changes are needed in these areas to improve opportunities for sustainable agriculture and healthy diet?
- How can the **margin distribution in the chain** be made more fair, in combination with further steps towards sustainable agriculture?
- Which **institutional changes** are needed to promote an integral approach, relationships, diversity, resilience and innovations? Possibilities include changes in networks, organisations for chain management, financial incentives, regulations, agricultural policy and trade policy. The current institutions are still single-mindedly focused on economies of scale, cost price reduction and uniformity.
- How can a **tunnel vision in research** – in particular within the domains of agronomy, ecology and nutritional sciences - be overcome?
- How can knowledge of systems, relationships, resilience and sustainability be integrated in **curricula in agricultural, biological and nutritional scientific education?**

Answering these questions could make an important contribution to integral sustainable agriculture and nutrition, based on respect and mutual relationships between consumers, farmers, livestock and ecosystems.

Appendices

The appendices contain specific examples to illustrate the outline, and the more abstract analysis and vision of the RIDL&V. These examples are very concise and have been written in simplified language, leaving out details and nuances.

Appendix 1 Damage to health, nature and agriculture itself from mono-dimensional agriculture focused on short-term productivity

Agriculture that is merely oriented on short-term productivity can harm public health, nature and agriculture itself. Below we give a number of examples.

Economies of scale in livestock farming

Economies of scale are still encouraged by the Dutch government and banks as an important strategy for livestock farming for saving costs and ensuring continued survival. In this way, ever larger breeding grounds for viruses and bacteria are created. The result is increased threat of infection, increased use of antibiotics and vaccinations, and the occurrence of new, more virulent pathogens. A recent example is a new variant of *Coxiella burnetii*, the bacteria causing Q-fever, that succeeded in spreading rapidly in the Netherlands between 2007 and 2010 as a result of growth and scale enlargement of goat farming. Approx. 3,500 people became ill, 14 of whom died.

Another effect of economies of scale is standardisation, whereby diversity in the ecosystem and in products is perceived as increasingly burdensome. This development is at the expense of the resilience of the system, the attractiveness of the landscape and the choices available to the consumer.

Antibiotics

Antibiotics are not only used curatively to make sick animals well, but also preventively to stop them becoming sick, to accelerate growth and hence to increase production. In the Netherlands, use of antibiotics has grown explosively over the past 10 years. It is not uncommon for a poultry farmer who discovers a handful of sick animals to immediately administer antibiotics via the drinking water to the complete stock of 10,000 animals.

This development has meant that more and more types of bacteria have become antibiotic-resistant. This represents a serious health risk to the livestock, the livestock farmer and the consumer. In the Netherlands, a pig farmer admitted to hospital is placed in isolation because he represents a risk to doctors, nursing personnel and fellow patients. In certain villages, the children of pig farmers are becoming socially isolated. Multi-resistant ESBL bacteria from the poultry industry have not only been discovered in chicken meat, but also – via manure and surface water – in vegetables and fruit.⁵⁴ This is not only a direct but also an indirect health risk: it can have negative consequences for the consumption of fruit and vegetables, which on average is already at a lower than healthy level.

Antibiotics also negatively influence the diversity of intestinal flora in humans. Intestinal flora play an important role in the control of pathogenic bacteria. As diversity decreases, the flora are believed to be less capable of resistance, thereby increasing the risk of infections.⁵⁵ This probably applies in equal measure to the intestinal flora of animals and the rumen flora of ruminants. In the human body, recovery of diversity in intestinal flora requires at least two months.

⁵⁴ESBL is a variety of the commonly occurring intestinal bacteria *E. coli*. Another strain, the virulent EHEC bacteria, was discovered in spring 2011 in vegetable sprouts in Germany and France. It contaminated more than 4,000 people and led to 49 deaths. According to the EFSA, this was probably imported with one or more batches of fenugreek seeds from Egypt. Contamination there probably took place through contact with animal or human faeces. Even in the latter case, livestock could have been the primary source. The multi-antibiotic resistant *Klebsiella pneumoniae* bacteria, that recently led to deaths in the Rotterdam Maasstad Hospital, was probably imported by a patient who had been hospitalised in a foreign hospital, and may there also have originated from livestock farming. *K. pneumoniae* is common in dairy farming, also in the Netherlands, and multi-resistant strains have for example been found in turkeys, beef cattle and chickens in the US ((Journal of Food Protection 2005 68: 2022-29).

⁵⁵Microbiologist Prof. W. de Vos, cited in: N. Beintema, *De darmflora bedreigd [Intestinal flora under threat]* NRC Weekend 5 November 2011.

It further seems unavoidable that the use of antibiotics will also – indirectly – affect soil life. Little is known as yet on this subject, but it has been noted that resistant bacteria also occur in the soil.⁵⁶ It is also a known fact that cow manure containing antibiotics integrates far more slowly into the soil, and results in less biodiversity, including less food for meadow birds.⁵⁷ American research has also demonstrated that the antibiotic chlorotetracycline, if entering the soil via manure, can be absorbed by the crop and hence return to the food chain.⁵⁸ It seems feasible that it could also enter animal feed via this route. This implies additional risks for resistance development, and hence for the human and livestock health.

Meat and bone meal

Offal from slaughterhouses has for centuries been used in pig feed. In the 1980s, the British government decided to also allow its use for cattle feed. This is unnatural, since cattle are strict herbivores. Cattle rapidly started to become ill from BSE and subsequently a number of consumers who had eaten beef from contaminated animals also died. The cause, it emerged, was not viruses or bacteria but proteins, so-called prions. The total damage to the economy amounted to several billion euros and is still rising. The British government and the EU responded with a total ban on the use of meat and bone meal in cattle feed.

European cattle feed manufacturers then went in search of a new, protein-rich alternative: soybean. The import of soybean rose by 50% between 1999 and 2007. This went hand in hand with huge ecological damage; estimates suggest that approximately 10 million additional hectares of savannah and rainforest were reclaimed in South America.⁵⁹

In this way, lack of respect for the (herbivore) animal led to damage to public health and extreme damage to livestock farming, the economy and the natural habitats overseas.

Fungicides

In arable and market gardening, fungicides are used on a large scale. As a result, certain types of fungus have become resistant to certain fungicides. Over the past few years, for example, resistant strains of the fungus *Aspergillus fumigatus* have increasingly been found in hospitals. These fungi are resistant to azoles. It is true that these same agents are also used in hospitals themselves and in domestic products such as soap, disinfectants and paint, but in far smaller quantities. Hence, the likelihood of resistance originating there is relatively small. The fungus has been identified at various locations in the environment, including in compost. One estimate suggests that on average one patient a week dies from this fungus in the Netherlands.⁶⁰

Fungicides can also kill useful fungi, in particular mycorrhizas, root fungi that are able to promote the growth and robustness of crops. They can therefore weaken the resilience of the crop.

Insecticides

It was already determined in the 1950s that insects can become resistant to DDT and other insecticides. As well as environmental damage, this was one of the reasons for halting the use of DDT.⁶¹

⁵⁶ C.W. Knapp et al. 2010. *Evidence of increasing antibiotic resistance gene abundances in archived soils since 1940*. Environmental Science and Technology 44: 580–87.

⁵⁷ K. van Veluw 2011. *Binnen vijf jaar is een antibiotica-arme sector haalbaar [A low antibiotic sector can be achieved within five years]*. Ekoland 6-2011: 14-15.

⁵⁸ K. Kumar et al. 2005. *Antibiotic uptake by plants from soil fertilised with animal manure*. Journal of Environmental Quality 34: 2082-85.

⁵⁹ Elferink, E.V., S. Nonhebel and A.J.M. Schoot Uiterkamp 2007. *Does the Amazon suffer from BSE Prevention?* Agriculture, Ecosystems and Environment 120: 467-69.

⁶⁰ J.W.M. van der Linden et al. 2011. *Clinical Implications of Azole Resistance in Aspergillus fumigatus, the Netherlands, 2007-2009*. Emerging Infectious Diseases 17: 1846-54.

⁶¹ It is also possible for a pest to become resistant to a natural enemy, but then the enemy itself – via the same evolutionary mechanism – may sooner or later break down that resistance.

In arable and market gardening, a new class of insecticides has been in use since 1991: neonicotinoids. These are extremely effective. They are persistent agents that may have contributed to the decline in the honeybees and other insects. This in turn backfires on agriculture itself since bees are important pollinators of many crops including apples, cauliflower and onions. Neonicotinoids therefore weaken the self-regulating capacity of the agro-ecosystem.

Worming agents

Over the past few years, strains of gastrointestinal worms in cattle have been identified that are resistant to worming drugs. The same applies to agents used to tackle coccidiosis in poultry. Such evolutionary responses are often only a matter of time. New agents are rarely, if ever, placed on the market. In addition, repeated use of worming agents disrupts the diversity of useful insects and as a result the decomposition of organic matter in the manure and soil.⁶²

Fertilisers and pesticides

It has been determined in England that the levels of phosphorous, copper and iron in vegetables, fruit and meat have dropped considerably between 1940 and 1990. The same applies to the level of selenium in products from certain areas.⁶³ This is all the more relevant because information from the Dutch National Institute for Public Health and the Environment reveals that on average, food eaten by the Dutch population contains insufficient phosphorous, copper and selenium, and the risk of iron deficiency is fairly large in growing children and pregnant women. The explanation for the decline in level seems partly to be one-sided fertilisation, and partly the use of other cultivars.

Fertilisation and crop protection can also have negative effects on the levels of antioxidants in vegetables. High nitrogen levels reduce the levels of "defensive" antioxidants, secondary metabolites produced by the plant to defend against natural enemies. Conversely, organic agriculture -which uses no artificial fertilisers – has higher levels of antioxidants.⁶⁴ Also in the Netherlands, it has been determined that vegetables from organic farming on average contain higher levels of antioxidants than those from "mainstream" agriculture.⁶⁵ This can possibly be explained from the fact that organic farmers use little pesticides. Hence the crop needs more defensive metabolites.

Another disadvantage of high nitrogen addition is that crops have more problems from lice. As a result, farmers often turn to insecticides.

Fine dust particles

Livestock farming is a major source of fine dust, bacteria and endotoxins. This represents a health risk to livestock farmers and local residents. For that reason, the Dutch municipal health services (GGD) recently suggested maintaining a minimum distance of 250 metres between (new built) intensive livestock farms and housing.⁶⁶

⁶²A.B.A. Boxall et al. 2003. *Are veterinary medicines causing environmental risks?* Environ Sci Technol 37: 286A–294A; Geiger et al. 2010. Persistent negative effects of pesticides on biodiversity and biological control potential on European farmland. Basic and Applied Ecology 11: 97-105.

⁶³ D. Thomas 2003. *A study on the mineral depletion of the foods available to us as a nation over the period 1940 to 1991.* Journal of Nutrition Health and Aging 7: 85-115.

⁶⁴ K. Brandt et al. 2011. *Agroecosystem Management and Nutritional Quality of Plant Foods: The Case of Organic Fruits and Vegetables.* Critical Reviews in Plant Sciences 30: 177-97.

⁶⁵L. van de Vijver et al. 2009. *Voedselkwaliteit, veiligheid en gezondheid van biologische producten – Update van de literatuur [Food quality, safety and health of organic products – Update of literature].* Louis Bolk Institute and Rikilt. Organic products also have other nutritional pluses: more vitamin C, less fungal toxins, less nitrate and less residues of pesticides. Organic milk contains more omega-3 and CLA fatty acids. On the other hand, organic grain contains less proteins, but of better quality, while eggs from organic chickens contain more dioxins as a result of their free range habitats.

⁶⁶ <http://www.ed.nl/specials/veehouderij/9713141/GGD-250-meter-afstand-tussen-huis-en-stal.ece>

Narrowing spectrum of crops

The diversity of crops for consumption has been reduced. From a historical viewpoint, people have consumed some 80,000 edible varieties, 3,000 of which are widespread. With the development of agriculture 10,000 years ago, that spectrum has shrunk drastically. Agriculture increased the quantity of food but reduced its diversity to a handful of crops. This may help explain why people grew less tall (and probably less healthy) in the transition period.⁶⁷ It is for example conceivable that in addition to infectious diseases⁶⁸, food-related chronic diseases have increased as a result of reduced or one-sided consumption of fruit and vegetables.

Over the course of the centuries, the spectrum of crops has widened enormously, but over the past century increased paucity seems to have returned. This at least applies to the US, where today two-thirds of all calories consumed originate directly or indirectly from just four crops – maize, wheat, rice and soybean. The question is whether Americans are able to obtain all their essential nutrients from such a one-sided menu.⁶⁹

Apart from that, it seems obvious that economies of scale and monoculture have narrowed the biodiversity in agriculture and made agriculture more vulnerable to epidemics of contagious plant diseases.

Gene technology

Gene technology in principle offers possibilities for more productive, efficient and resilient crops. On the one hand, "genomics" can accelerate traditional plant breeding. By using molecular markers as a selection tool, breeders can select very specifically for individual characteristics, without having to wait until the plant has matured. This technique has been broadly accepted. On the other hand, genetic modification (GM) makes it possible to insert a desired gene (related to a plant trait) directly from the genome of a different species into the genome of the plant. This technique is controversial, because natural crossing barriers are broken and because the uncertainties and biosafety-risks are considered to be larger than with traditional breeding. There is also resistance among many consumers and – whether justified or not – concern about possible health risks of GM food.

Furthermore, GM technology is broadly controlled by multinationals, supported by patents. This is a threat to innovation by plant breeders, and as a result may be at the expense of crop diversity. In the long term, that could then be at the expense of productivity, efficiency and resilience of agriculture. The livestock sector also runs similar risks.

GM is above all applied in crops that can be grown on a very large scale with just a few varieties such as cotton, maize and soybean. The result can be undesired resistance among other species. The large-scale spraying of *Roundup Ready* soy with the herbicide glyphosate (Roundup) has for example led to the occurrence of glyphosate-resistant weeds that are more difficult to tackle. It also recently emerged that maize root beetles in Iowa have become resistant to the transgene Bt-maize, leading to crop damage. The occurrence of such resistances is often only a question of time; that is simply how evolution works. Because marker-based breeding takes far less time and money than the development and marketing of a GM crop, the argument of a large scale use is a less urgent condition here.

⁶⁷ Lucas Reijnders 2005. *Eetpatronen - De evolutie van ons eetgedrag [Eating patterns - The evolution of our eating behaviour]*.

⁶⁸ The development of agriculture went hand in hand with the emergence of the cities, where infection levels were high. See: J. McNeill 1998. *Plagues and peoples*.

⁶⁹M. Pollan, 2008. *In defense of food*. Strictly speaking, such macro-figures do not actually say much about the diversity of the menu of the modal consumer. More detailed research is required.

Appendix 2 Partial solutions can have adverse effects on sustainability

Fish consumption

Food experts have reached the conclusion that the majority of consumers eat too little fish, above all because of the essential omega-3 fatty acids contained in fish. The recommended standard is to eat fatty fish twice a week. However, if the whole world were to do this, global fish stocks will rapidly become exhausted. The alternative is to massively expand fish farming, but that engenders risks in terms of eutrophication, disease levels, use of antibiotics, etc. It would appear more sensible to produce omega-3 fatty acids using algae.

Bio fuels

More and more countries are attempting to reduce the consumption of fossil energy in order to become less dependent on import and/or to reduce the emissions of the greenhouse gas CO₂. Simultaneously, attempts are also being made to support farmers' income. One of the alternative sources is biofuel from energy crops such as sugar beet (Brazil), maize (mostly in the US) and rapeseed (mostly in the EU).

However well-intentioned, this method is often relatively ineffective. With most energy crops, the energy balance is barely positive. The emission of greenhouse gases is also barely reduced or even increased. In addition, energy crops in certain regions are in competition with food, feed and nature. For that reason, calls are being sounded for "second generation" biofuels extracted from organic waste. This too could, however, be harmful to sustainable agriculture, because a proportion of organic waste is needed to maintain soil fertility levels. Biogas production from animal manure is at the expense of the carbon content of the manure, and thereby can be at the expense of the organic matter in the soil.

Concentration of livestock farms

Many Dutch nature areas are overloaded with ammonia from livestock farms in the local vicinity. For that reason, some provinces have created Agriculture Development Areas (LOGs). Livestock farmers are encouraged to relocate their farms from close to nature areas to one of these LOGs.

This policy can indeed unburden nature areas, but has two side effects:

- In the LOGs, the farms cause additional air pollution (odour nuisance, fine dust, ammonia) and increased road traffic. In various regions, the local population is opposed to the introduction of these farms.
- Veterinary infection pressure increases because the farms are brought closer together, and the manageability of contagious animal diseases is reduced. This is a risk to livestock farming and public health.

Put briefly, partial solutions are not always effective and can generate unwanted side effects for agriculture itself, for public health and for nature.

Appendix 3 Natural partners of the farmer

In crop protection, nature (diseases, pests, weeds) is often treated as an enemy or competitor. This is partly justified and understandable. However, nature is not only a Pandora's box, but also a treasure trove of potential partners. More understanding of this fact has emerged over the past few decades. We provide a few examples.

Natural antagonists⁷⁰

Every organism has natural enemies. Crops and livestock are permanently under attack by pathogens and pest organisms. For that reason, agriculture and livestock farming are not possible without disease and pest regulation. For 120 years, active use has been made of the fact that pathogens and pest organisms have their natural enemies, too. For farmers, these are potential natural partners.

A wide range of organisms have been deployed: insects, predatory mites, fungi, viruses, bacteria, birds, etc. Worldwide, on 7000 occasions, species from other regions have been introduced; of these 10% have proven effective. In addition, 170 species have been produced on a commercial basis for the regulation of more than 100 diseases and pests on a total 350 million hectares (10% of the global area of land under agriculture). The total economic value of all *natural* biological pest regulation delivered by ecosystems is estimated at \$400 billion per year.⁷¹ In addition, there are contributions to food security, food quality, the environment, biodiversity and the maintenance of other ecosystem services.

As compared to chemical pest control, biological pest control enjoys lower development costs, a higher success percentage for tested agents, a better cost/benefit ratio, more specific effects, less risk of resistance and less harmful side effects.

In one area, biological pest control scores less well: the risk of unwanted bio-invasions. A recent example is the Asian lady beetle *Harmonia axyridis*, introduced into Europe to deal with aphids, which since then has outcompeted indigenous species of ladybird. For that reason, the admission requirements for natural enemies have been tightened up.

The potential of biological pest control is tremendous. Nonetheless, the industry is more interested in chemical pesticides because they can be patented, while there is no patent on natural enemies. It was therefore important that the Dutch government in 1990-2000 gave priority to biological and integrated crop protection in its research policy. After that time, the focus was lessened. What also fails to help is that the Netherlands no longer aims to occupy a leading role in environmental policy in Europe, but is focusing on the establishment of a level playing field. According to the CBS (Statistics Netherlands), the consumption of pesticides has in fact started to increase again: from 6.6 kg per hectare in 2004 to 6.9 kg in 2008.

In the EU, the prospects for biological pest control are favourable: the registration requirements for pesticides have been tightened up, a rising number of agents are becoming less effective because diseases and pests are becoming resistant, and supermarkets are imposing ever stricter demands on residues in fruit and vegetables. However, a new threshold was recently raised for the introduction of natural enemies from other continents: the Nagoya Protocol on Access and Benefit Sharing (ABS), signed in 2010 in Nagoya on the basis of the Convention on Biological Diversity. A country is now able to demand money for the export of useful organisms. Where necessary, governments in the EU could make financial contributions, also in the framework of innovation policy.

In the Netherlands, kestrels are used against mice, predatory mites against mites, ichneumon wasps against insect larvae, ladybirds against aphids and fungi against nematodes and insects.⁷² Above all in

⁷⁰Broadly based on: J. van Lenteren 2010. *Ecology: cool science, but does it help?* Retirement speech Wageningen University. And: P. Leendertse, CLM, in e-mail.

⁷¹R. Costanza et al. 1997. *The value of the world's ecosystem services and natural capital*. Nature 387: 252-260.

⁷²Fungi were also recently found that are effective against the type of biting midges that transmit the virus causing African horse sickness. M.A. Ansari et al. 2011. *Entomopathogenic Fungus as a Biological*

greenhouses, these agents have become increasingly common. In the growing of flowering vegetables natural enemies are in fact already used in more than 90% of land under agricultural. In ornamental and tree growing, too, natural enemies could be used far more widely. Even in livestock farming, natural enemies are now being deployed, namely predatory mites against poultry red mites in chicken sheds. In the US, bacteriophages are used to tackle Salmonella in poultry farming. Investigations are underway into the possible use of phages in the preservation of food.

Chemical "cries for help"

Plants attacked by herbivorous insects sometimes secrete signalling agents (so-called synomones) that attract carnivorous insects. For example, cabbage plants attacked by caterpillars of the cabbage butterfly attract ichneumon wasps. This mechanism was discovered by the Wageningen-based Professor Marcel Dicke, who received the Dutch Spinoza Prize for his research. It was recently discovered that these ichneumon wasps also help the plant in another way: by making it less attractive to the cabbage moth that arrives later in the season.⁷³ There are important new opportunities for pest regulation and reduction of the use of insecticides.

Immune system

There are not only natural antagonists in the ecosystem but also *inside* organisms themselves: in plants, animals and man. Above all the immune system of animals and man is a remarkable example of self-regulation. There are two systems: the general, innate or "natural" system and the specific, adaptive system. For two centuries we have actively been using the specific system by vaccinating people and animals. Over the past few years, immunologists have increasingly been focusing on strengthening the general immune system. There is a world to be won when it comes to the resilience of man and livestock.

Insects as pollinators

Farmers are not only assisted by natural antagonists but also by natural *partners* of the crops. Worldwide, insects are responsible for the pollination of agricultural crops, above all vegetables and fruit. The total economic value of this "ecosystem service" in 2005 was estimated at € 153 billion, or 9.5% of the value of agricultural production for food.⁷⁴ In Europe alone, bees are responsible for the pollination of an estimated 84% of the 264 agricultural crops, including apples, pears, plums, asparagus, cauliflower and onions. The economic value is estimated at € 22 billion. In the Netherlands alone, the estimated value is € 1.1 billion. Not only the honeybee but also numerous other bee species contribute to pollination.⁷⁵ We should therefore cherish bees, not damage them with insecticides.

Symbiotic bacteria

Plants are unable to fix nitrogen from the air, but certain bacteria are able to do so. A large number of plant species, including the Fabaceae family, have initiated symbiosis with Rhizobium bacteria. The bacteria deliver nitrogen, in return for which the plant supplies other nutrients. Agricultural crops that also initiate similar symbioses include clover, lupine and soybean. Organic agriculture makes the most intensive use of these relationships, and therefore requires no artificial nitrogen fertilisers. In reverse, the use of artificial nitrogen fertiliser can halt biological nitrogen fixing.

Control for an Important Vector of Livestock Disease: The Culicoides Biting Midge. PLoS ONE 6(1): e16108. Fungi can possibly also be used against the type of midge that carries bluetongue (a disease affecting sheep, goats and cattle).

⁷³M. Kouwen 2011. *Rupsenparasiet beschermt plant tegen vraat [Caterpillar parasite protects plants against attack]*. Bionieuws 26 November.

⁷⁴N. Gallai et al. 2009. *Economic valuation of the vulnerability of world agriculture confronted with pollinator decline.* Ecological Economics 86: 810-821.

⁷⁵J. Scheper et al. 2011. *De relevantie van wilde bijen voor de bestuiving van landbouwgewassen [The relevance of wild bees for the pollination of agricultural crops]*. De Levende Natuur 112: 124-125.

Over the past few years, indications have also been found that certain bacteria – in symbiosis with plants – can tackle harmful fungi. This possibility offers interesting opportunities for making crops resistant and reducing the use of fungicides.⁷⁶

Symbiotic fungi: mycorrhizas

Many plants live in symbiosis with root fungi, known as mycorrhizas. These fungi are able to absorb from the soil minerals such as phosphate that plants have difficulty in accessing. As a "reward", the plant delivers sugars and other nutrients.⁷⁷ Mycorrhizas can increase crop production, make the plant more resistant to drought and pests, and as a result can in part replace the use of pesticides. These are characteristics that are also strived for through GM technology. The fact that the agrochemical industry is more interested in genetic technology than mycorrhizas is due to the fact that GM crops are patentable, while mycorrhizas are not.

In summary: the art lies not only in excluding nature wherever necessary, but also in, wherever possible, including and activating natural partners.

⁷⁶Mendes et al. 2011. *Deciphering the rhizosphere microbiome for disease-suppressive bacteria*. Science 332: 1097-1100.

⁷⁷ Evolutionary biologists have often wondered why fungi do not "abuse" symbiosis by absorbing sugars but releasing little or no phosphates. The question was recently answered: parts of plant roots measure how much phosphate they receive and reward more phosphate with more sugars. Conversely, the fungi force the plant to cooperate by only delivering more phosphate once they receive more sugars. See: T. Kiers et al. 2011. *Reciprocal rewards stabilize cooperation in the mycorrhizal symbiosis*. Science 333: 880-882. In this way, nature has found a solution to the free-rider problem, also well-known in the economy and agricultural cooperatives.

About the Scientific Council for Integral Sustainable Agriculture and Nutrition

The Scientific Council for Integral Sustainable Agriculture and Nutrition (Wetenschappelijke Raad voor Integrale Duurzame Landbouw en Voeding, RIDL&V) has set itself the main task of bringing forward proposed solutions on the basis of scientific and social ideas that will result in developments towards an integral approach to sustainable agriculture and nutrition, linking sustainable agriculture and healthy nutrition. In the first instance, the Council will focus on the Netherlands, taking into account that the Netherlands is part of an international community. The Council comprises an interdisciplinary think tank of individuals, independent, and not bound by any instructions, but who can contribute proven expertise in integral system thinking in this field. The Council established itself in June 2010.

Working method

The Council will draw up recommendations and advice, both solicited and unsolicited, with the intention of tackling the abovementioned issues over the long term:

- The Council will focus in particular on initial studies and the concept phases of recommendations from others
- The Council will focus on the transforming of these concepts into a future-based research agenda.

In addition, the Council intends to feed current political and social debate on the sustainability of agriculture and healthy nutrition

Steps

- The Council will actively reach out to contact advisory bodies and organisations in the field of agriculture and nutrition. Initial discussions have been held with the Dutch Health Council, the Scientific Council for Government Policy, the Council for Rural Areas and the Netherlands Organisation for Health Research and Development .
- The Council will present ideas on how science can contribute to an integral approach to sustainable agriculture and healthy nutrition, and how the ideas can be transformed into research agendas.
- The members of the Council will participate in (inter)national conferences on policy and science in respect of this theme. Members of the Council have contributed to a working conference on Good and Sustainable Food, organised by the Dutch Health Council.
- In the future, the Council wishes also to organise its own activities in this field.
- The members of the Council will actively attempt to enter dialogue with researchers, professional groups and the broader public.

Composition of the Council

Chairperson:

Prof.dr Edith Lammerts van Bueren, Professor by special appointment for Organic Plant Breeding, Wageningen University, and Louis Bolk Institute

Secretary:

Dr. Theo Jetten, Secretary of the Research School Production Ecology and Resource Conservation, Wageningen University

Members:

Peter Blom, CEO Triodos Bank

Prof. Klaas van Egmond, Professor Geo Sciences, Utrecht University

Machteld Huber, MD, senior researcher food quality and health, Louis Bolk Institute

Prof.dr. Ludwig Lauwers, scientific director Agriculture and Society Unit, Institute for Agriculture and Fisheries Research and visiting Professor Agricultural Economics, University of Ghent

Dr. Ben van Ommen, Head of System Biology, TNO

Anton van Vilsteren, MSc, organic grower Marknesse, chairman of the Nautilus cooperative

Wouter van der Weijden, MSc, Director of the Centre for Agriculture and Environment Foundation

Prof.dr. Herman Wijffels, Professor of Sustainability and Social Change, Utrecht University

Prof.dr. Akke van der Zijpp, Emeritus Professor Animal Production Systems, Wageningen University.

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