

Setting the record straight¹

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To the reader

In what follows we will make an extensive use of the broad historical and scientific literature because the subject at hand does not allow a more limited treatment. Much of that historical literature was neglected or even completely forgotten during the post-war era in which the Green Revolution agronomy became dominant. Its use sheds ample new light both on this specific agronomy and on the alternatives neglected by it. To guarantee the readability of the present Report the references have been collected in the Bibliographic Essay that accompanies it.

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Introduction

The past years we saw the need for food for some 9 billion people in 2050 emphasized time and again. That statement has rightly been criticized for its largely political instead of scientific character. More often than not it is immediately followed by the statement that only large-scale, industrial agriculture can provide all this food. Yet, connections of the spokesmen with big transnationals are only too apparent, so it is evident we cannot trust those pronouncements at face value.

In the meantime important if not decisive international research projects of the past decades pointed, directly and indirectly, to the unsustainable character of post-war 'industrial' agriculture. The Biodiversity Convention with its ensuing projects (e.g. in in-situ maintenance of farmer varieties), the Millennium Ecosystem Assessment, the International Assessment of Agricultural Science and Tehcnology for Development, NitroEurope as the project integrating research into reactive nitrogen in Europe, and of course global Climate Change science all brought also the need in focus to ecologize agriculture, with a strong reduction of industrial inputs an essential aspect.

So the role of big transnationals in food provision in 2050 appears doubtful at best. Still, they are adamant that only the 'package' that they have in the offering can ascertain high and sufficient crop yields in 2050. There is a multitude of local agricultural systems that provide ample food without high external inputs, yet, it is stated that only this industrial 'package' is applicable everywhere and so is sure to effect large-scale food provision. The industrial argument still impresses policy makers everywhere in spite of the fact that proof is lacking, and the small farmer experiences his marginalization as a consequence. Yet, agriculture is an eminently local activity and true logic asks us to consider if it's local care by the local farmer rather than expensive external inputs from transnationals that will prove the answer to food provision in 2050.

As indicated there is a vast amount of eminent research which we can (and will) consult. We will add to it the research needed to position the Green Revolution package in its historical context – the only way to trace its true contents and deficits. When then we regain a vision of the local soil and ecology and of the central position of the local farmer we will be in the position to give a balanced answer to the 'food for 9 billion' question.

Part I: General aspects

Ch.1: Before starting development, rise above the road

'Growth' and 'development' are concepts that in their origins are closely connected with biological life. When after WW II they assumed meanings¹ that with their 'continuous growth' denied biological circumscription we could be sure that this was not just 'newspeak'. Widely different religions like christianity and Buddhism teach that growth is only then truly

human when it has a lifestyle of sufficiency as its counterpart². This teaching invites explorations of technical and national growth that are in accord with biological life³. Yet, after WW II concepts of human and national growth were subordinated to the a-biological concept⁴ of ongoing quantitative growth of production. The prophets of this decidedly otherworldly religion were policy makers as assisted by a crowd of newly engaged researchers.

Yet, in the postwar era there were only too few who indeed 'looked before they jumped' and governments everywhere set out to re-invent nature and society⁵. When in those years of strong convictions ecological and social problems rose everywhere they found us first full of disbelief, next increasingly baffled, and only gradually ready to start evaluations. In the meantime there's an enormous backdrop in evaluations, not only as to chemical compounds of which an enormous number (and quantities) got introduced without adequate environmental and toxicological evaluation⁶, but as to nearly all of our postwar projects of reconstruction of nature and society⁷.

With the 'industrialization' of agriculture a core project of postwar 'development', its evaluation became extra difficult because it figured as a most prominent example of progress. In a way it was the 'gold standard' that was applied to judge how far nations were on the road to modernity⁸. Moreover, communist, mainline socialist, and capitalist countries were here of one accord, so agriculture's 'industrialization' was considered a regime-independent hallmark of progress⁹. Recent agricultural history was refigured as the trajectory-towards-modernity and in the course the links with historical versions of agriculture as well as with research that had been connected with them were largely lost. Recovering history (of what often seems a 'lost continent') then is a decisive phase on our road to discover perspectives for agriculture. That explains its prominence in the present Report.

1.1. Administering growth?

This Report aims to compare perspectives for livelihood development based primarily on local resource use and development with the change-over to the agricultural package designated as the 'Green Revolution' and its present-day descendants¹⁰. The latter package is still (very) popular with governments everywhere as it expresses the assumption that agricultural growth can be centrally administered by supplying the right inputs (seeds, fertiliser, irrigation, pesticides). Yet, the social and ecological repercussions of this administration have proved immense¹¹, and it even intensified the impoverishment of small farmers and rural regions¹².

Such impoverishment has its historical parallels, from excessive tribute extraction under oppressive regimes of old (e.g. Ottomans in the Balkans) to the low prices for agricultural produce versus industrial products of the industrial era¹³, the 'scissors'. Colonial practices in the past and neo-liberal practices in the present are related phenomena¹⁴, all working to enrich a 'centre' at the cost of 'peripheries'. We will not pursue those lines of investigation because they would

evidently take us too far for this Report. Yet, they prove that wider introspection is clearly needed for anybody aiming to assist in the 'development' of other regions or countries. There is especially no reason to start from the naive assumption that the Green Revolution as a 'technical package' is neutral¹⁵. We need to take a close technical look at its contents before we can decide anything.

The Green Revolution as a package rose to dominance due to centralized R & D that in post-war decades focussed at developing agriculture the big-industry way¹⁶. The local environment with its resources and communities was considered a thing of the past and in its place came an (imagined) factory-like environment where high external inputs were to lead to high outputs (yields)¹⁷. So the package has a highly specific character: at its core are (semi-)dwarf varieties, temporal and spatial homogenous high-density seeding/planting, and selection for response to industrial fertiliser plus irrigation. It was developed for highly specific conditions and so there is a world to explore when we leave the imagined factory and return to the local ecology and community:

(1) other and especially genetically richer (composed) crop varieties can be bred and flexibly used in the changing local conditions (2) temporally and spatially varying low-density seeding/planting can be introduced (3) local organic a.o. resources can be used for soil fertility enhancement under rainfed conditions. For easy reference as to low-density planting think of the difference in tree morphology of a free-standing tree as compared to close-planted equals. For a prominent example of organic fertility enhancement think of vermiculture, the earthworm-based processing of organic materials. With farmer initiative and local resources in that way once more placed at the centre of agriculture there open up perspectives that were not even visible in the post-war technocratic era that aimed to replace (a) natural resources with industrial ones and (b) local initiative and creativity with centralized direction and research.

In fact there is a wide array of projects exemplifying those 'new' perspectives, yet, because they are real-life they typically depend on the local farmer and ecology. Government officials often are sympathetic to those individual projects, yet, as to the big economy remain convinced that only technocratic approaches can work even when they are aware of the harm to the environment. As a result individuals and organisations focussing at agricultural development find themselves in a confusing situation. They hear and read much about the need of the farmer in developing countries to work primarily with local resources, interacting positively with the local ecology and community. Yet, when speaking with their big donors – governments first of all – it seems that in spite of sympathy for small-scale projects preference is for refitted versions of post-war 'industrial' agriculture for the really big choices.

When the International Assessment of Agricultural Science and Technology for Development IAASTD after thorough consultations of a large number of experts came up with its reports that emphasized the need for a re-ecologization of agriculture because the post-war 'industrialization' of agriculture had proved unsustainable the reaction of the World Bank and most governments was one of hardly concealed disbelief. Most continued on the neo-liberal path and granted

the big agro- and food industries a increasing role in their Food Authorities instead of creating space for agro-ecological and 'slow food' initiatives.

Many governments had earlier on already signed the Biodiversity Convention and similar documents that imply the need for a biodiverse and re-ecologized agriculture. More recently other requested reports like NitroEurope (on reactive nitrogen in the environment) emphasized once more the need to change course first of all as to agriculture. Yet, apparently unmoved the European Patent Office recently proposed new plant variety regulations that promise to bring total food power to the few transnationals that dominate the seed, agriculture and food sector and will hardly leave any place to biodiversity-based alternatives. But note that all through history agriculture worked primarily with natural and local resources and it was that local character of resources that put concentrations of 'food power' within natural limits. But now those big economic actors skirt issues like biodiversity and local use of organics and are adamant that a truly modern agriculture uses 'improved' seeds, fertilisers, and pesticides as inputs, the package that puts total food power in their hands.

Still the dictum 'power corrupts, absolute power corrupts absolutely' is as true as ever and thorough research has documented the twisted ways in which those big economic actors influence food-related law and policy. What complicates matter greatly is that since long they finance research working with concepts and methods that are of little use in spotting and explaining problems and can easily be used to 'prove' that all is well. Though part of it is of recent origins and specifically introduced to fend off more probing research, much of it simply continues working with concepts and methods that since long are part of 'industrial' agricultural research and hardly helpful in tracing the world outside this 'factory'.

1.2. Enter history

A case in point is the exclusive focus at mineral nutrients that the explosives/fertiliser industry has in the offering. Because researchers had neither concepts nor methods for uptake and metabolism of organic nutrients by plants those phenomena were 'unthinkable' and 'invisible'. Recently it became apparent that this stalled research in soil-based plant nutrition (with organic nutrients at the very core) for nearly a century. It was still an active research subject in the second decade of the twentieth century but got marginalized with the ascent to power of the explosives/fertiliser industry in the wake of World War I. With ample finances next going to research into industrial fertiliser application and hardly any to research into soil-based plant nutrition the first was magnified completely out of proportion. A process of 'knowledge erosion' set in and before long new generations of researchers were no more cognizant of other approaches to soil fertility and crop nutrition than the fertiliser-centered ones. This lack of knowledge became acute when in the 1960s in many countries crop nutrition research was shifted from soil science departments to plant nutrition institutes that henceforth worked exclusively with mineral nutrients (that were central to the Freedom from Hunger campaign of the 1960s). When in the course of the 1970s and 1980s the complex character of soil fertility re-surfaced – with its organic, soil structural, microbiological, and soil faunal aspects - researchers

found it far from easy to find concepts and methods that are really fit to study complex soil fertility.

Evidently even the discourse about plant nutrients has a strongly historical character. That makes us pause: what's there more in the discourse about agricultural development that needs a close historical look before we jump? Surely for a long time already doubts have been sounded about the faith in 'modernity' that was at the very core of most approaches of development. Gradually also its Europe-centered character got analysed and found less than convincing. Yet, the general belief that the 'progress of science and technology' ultimately was not subject to historical contingencies precluded probing of this core element of post-war policies. R & D after the example of big industry was a core element of the ideology of the age (*'Science the endless frontier'*) because it promised failsafe growth. And so government-approved projects that organised R & D for the all-out transformation of nature and society were ideologically (not just politically) safe from criticism. With the 'industrialization' of agriculture a core project everywhere its criticism was for non-enlightened people...

Note that this faith in 'science' was a life buoy of post-war societies that clung to it when the horrors of two world wars threatened to engulf them. *'Science the endless frontier'* showed the way out with its conviction - to which communists, mainline socialists, and capitalists adhered - that re-shaping the socio-economy after the example of big industry (the shift to 'factory methods') would open the door to a 'world of plenty'. Because it was accompanied by policies that strove for equity and social justice - including free primary and secondary education for all - post-war societies experienced a unique pace of recovery. Remember that after the horror and destruction of the Thirty Years War and the Napoleonic Wars recoveries lasted much longer: economies stagnated because wealth stayed concentrated in a few hands and the population at large found themselves both greatly impoverished and burdened with taxes. When then in our post-war decades people in many countries experienced that poverty and want got pushed back already in the 1950s it became customary to point to 'science & technology' as the engine of all this 'economic growth'.

But of course the industrial focus meant that all seemed well with concepts and methods that 'fitted within factory walls': the isolation of the factory precludes industrial operations' direct impacts on society and ecology. And so a system of agricultural production was developed that conceptually and methodically was in line with factory production but unaware of agriculture's very base in the local ecology ('ecosystem services') and unprepared for the environmental and health problems that followed from its introduction. Yet, these are *problems of design* and as such oblige us to return to the drawing boards.

But note that the impact of the post-war project on our socio-economies has been massive. Alternative approaches to 'development' found themselves excluded and a 'mono-culture' was introduced that had exclusive prerogatives both in laws and at the institutional level. It proved a level road to power for big economic actors when the mixed economy of post-war decades gave way to a neo-liberal economy. But note their power does not extend to soil and ecology: bees and earthworms are deaf to orders from government or industry. Soil and

ecology are the matrix of agricultural production and ecosystem services of bees and bats are fundamental to its results. Our designs are embedded in them – or they fail. The wide material presented by the IAASTD leaves hardly any doubt that as to post-war's 'industrialization' of agriculture we have to return to the drawing boards. The urgency of it all follows from e.g. pesticides' ecology-wide immunodepressive effects on wild fauna – bees, birds, bats, amphibia – that threatens to leave us without essential ecosystem services.

1.3. A caveat: less than ideal

Agriculture's 'industrialization' was a centre piece of the postwar ideology, so if we want to 'rise above its road' there's more to probe than practical matters only. As to 'industrial' agriculture's defective character it is well to consider that defective systems are a common denominator of human history. Yet, mosttimes they left people still some space to choose for (or against) care for their neighbor and local ecology. It is only when powers get outright demonic qualities, as under Nazism, that even life at the local level becomes impossible to live in a human way. As to post-war decades it's evident that good and evil were as mixed as ever in history, with the emphasis on equity a commendable aspect of those years. From which it is evident that we cannot draw the mistaken directions of the epoch in black-and-white: they did not prevent people doing some good with its products.

An example is the central role of the diesel motor in the accelerated growth of truck and car traffic. When recently the WHO came with incontrovertable evidence of carcinogenicity of diesel exhaust governments nevertheless refrained from taking action, evidently because the consequences are massive. Now note that the fact that the product – the diesel powered truck or car – is a dead end did not prevent people (or governments, at that) doing some or even much good with them. Truck mechanics have done much 'good work & good works' and car dealers were not all that bad. Still governments that in the present do not take their responsibility to change course can rightly be said to act irresponsible.

In the same way we have to acknowledge that people (and governments) have done certain good things with 'industrial' agriculture even though it's evidently not sustainable and has induced power concentrations that prove 'absolutely corrupting'. But note an important difference. When hoaling urgently needed food aid into a truck we're not with that disrupting local people's ecological resource base that they need for sustainable local agriculture and food security. Both the use of the truck and the use of food deriving from 'industrialized' operations can be the right choice. But there are clear limits. The 'food aid' from US industrial agriculture sources brought to Haïti after the recent catastrophe had such social and agricultural consequences that it evidently was the wrong choice. That reminds us of the fact that food never is a 'neutral' subject but always has strings attached to its origins. Life is not that easy that we are happy that we still can do good with problematic means: we can do also evil with means that seem perfectly good, like food.

Agricultural development, then, requires us to do some thorough evaluations before we start running. We can choose the wrong road simply because we are

naive and convinced that along that road so much good has arrived to people in need. When we're less naive and explore alternative roads we still can be surprised by roadblocks we didn't expect. But surely the most sorry scene is when we drag our own roadblocks along. Yet, with evaluation overdue for at least half a century, in many subjects pertaining to food and agriculture, such dragging-along is far from impossible (we'll encounter an important example in Ch.3). For the evaluation of those subjects we have to take some time to consider what exactly happened in all those years in which we were lazy enough 'to let progress run its course'. In Ch.2 we will chiefly look at subjects impinging on agricultural economy, especially the technocratic convictions of the age as it issued into the managerialism of the present.

The 'Green Revolution' package is a typical product of the post-war era in which governments and most of their citizens were convinced that re-creating nature and society with the means of big industry was the door to a world of plenty. Since then the faith in e.g. upscaling for 'efficiency' has only grown, if we consider the neo-liberal policies that brought us our inhospitable mega-schools and mega-hospitals. The example teaches us that the post-war era of technocracy is not over but instead passed over in the managerialism of our time. Its unfounded claims are also at the roots of the present recession, so to be of any use to the poor farmer and rural community we are advised to consider its connections with agricultural policy and development. The agricultural and livelihood focus of the present Report cannot do without at least some evaluation of both technocracy and managerialism that are only too current in the dealings of government and big business with the small farmer and rural community. Just yielding to them is still less advisable than plain resistance, but of course by far the best is to empower the poor farmer to find maximum space to work with his local resources. That then is the focus in our short analysis of technocracy and managerialism.

Ch.2: Have we been accelerating on the wrong road?

'Productivity growth' was the dominant post-war goal of economic policy, with industrial production the gold standard. Dippel and others pointed out that we thus aimed at the increase of machine productivity. Activities like nursing and teaching that have human relations and not machines at their core – they depend on direct contact nurse-patient and teacher-student – cannot be approached with such policies. Though technical developments can be usefull medically or educationally they cannot substitute for the human relation that's at the very core of the discipline. Moreover the 'machine' is no Trojan horse with which 'factory methods' can be introduced everywhere. It is itself embedded in a world that transcends our technocratic projections and partakes of its complexities and uncertainties. We'll now first look at that aspect.

2.1. Looking back at a technocratic era

At the 1986 Symposium '*Predictability in science and society*' the gathered top-level academic economists had to face the limited scope of predictability also in

the physical sciences as presented by Sir James Lighthill with his essay '*The recently recognized failure of predictability in Newtonian dynamics*' in which he explained the ease with which the physical pendulum can be induced to 'chaotic' behavior. For Lighthill this example only added to the well-known fact that also most physical systems (not just the biological ones) are complex and nonlinear and as such allow only limited predictability. But for mainline economists Newtonian mechanics was still the prime example of scientific rigour and they had been sure since Jevons in the 1880s that their discipline could be transformed after it. No less an economist than Nobel Prize winner Jan Tinbergen started from this assumption with his economic modeling and national accounting, and he was credited (together with Ragnar Frisch) with implementing the 'natural science way of thinking' in economics. Tinbergen's social convictions formed a counter weight to his reductionist approach but did not change his and others' concept and method development.

That is quite typical of the generation of economists after the war - Leiden economist Weststrate among them - who worked hard to help restore their economies from the ravages of war but shrank back from following the consequences of pre-war discussions about contents and method of economics (that had intensified after the Crash in 1929). Willing to consider e.g. the Just Price concept - that included the cost of family living in the wages and prices received - in their advice to government, they nevertheless did not open up their theoretical system to those notions. Instead, concepts and methods that had been devised for big enterprise and big industry saw themselves 'generalized' everywhere without consideration of the specifics of the divergent socio-economic realms.

As to agriculture the 'factory idea' took hold simply because governments and the population at large trusted in the technocratic 'upgrading' of nature and society. World War II had seen the economy transformed into a war production machine, with the American example of immense industrial war production re-igniting the old dream of a world of plenty thanks to all-out industrialization. In all countries that had experienced a war economy the wartime bureaucratic apparatus and regulations of wartime centralized economy were still at hand. Government bureaucracies and their powers had been greatly enlarged during the war and many of officials were quite ready to partake in the technocratic make-over of the post-war economy.

That the 'factory approach' was not a neutral choice becomes evident when we recall that in former centuries livelihoods plus relations within the local household had been at the centre of considerations. Note that long ago the 'economist' was the steward whose first role was to oversee material and agricultural production and distribution *within* the big 'household' (that included servants, relatives, etc). No doubt absentee landlords tried als then to extract more from their possessions than was just, so the economist's role has never been an easy one. But for a very long time it was unthinkable to remove the notions of livelihoods and relations within the household from the core concepts and methods of the economic discipline. To defend the neglect of such notions with the argument that rise of economics as an autonomous discipline made it obligatory is a shallow solution for a deep problem.

It stands to reason that the Crash of 1929 signalled for many academics the need to re-integrate those notions for example by way of the Just Price/Wage concept. Post-war economics in its close involvement with government policy did not use the opportunity and instead 'generalised' the monetary balances known from big industry to the national economy (GNP etc). That had its own logics: economists (e.g. Tinbergen in the Netherlands) wanted to provide 'neutral' information to policy makers and they considered following the supposed natural science example the best they could do. Yet, with the benefit of hindsight we see that they shared the technocratic aspirations of the age and shaped their concepts and theories accordingly. Experts like Tinbergen's colleague Van Cleef found themselves increasingly marginalized because their stance did not conform to this technocratic point of view. They emphasized that we need to start with the analysis of economic presuppositions to get a clear view of the values contained therein. We can only make rational choices after it because choosing between those values will make a huge difference in the outcome also of calculations.

Of course such an approach would oblige economists to re-open concepts and methods to fundamental information about people and ecology. Instead, they excluded this information - in opposition to Karl Polanyi's 1944 *'The Great Transformation'* and similar works that emphasized the need to take a thorough historical approach that acknowledges people and places. Had they included it they would have valued the variety of rural economies in their own countries and the diversity of non-western economies. Instead they decided to do without and soon (1951) had the atrocity to 'disprove' Boeke, the leading expert on non-western economies. Their denial inflicted a heavy blow to peasants and non-monetary economies everywhere who henceforth were conceptually excluded from the 'real' economy, next to see themselves deprived from their 'traditional' resources also. It is only because equity considerations had an important role in post-war policies that results were not outright destructive everywhere. Yet, when equity considerations eroded-away mainline economics contracted to monetary considerations that knew neither man nor ecology. Without internal constraints to counter the construction of an 'economy of productivity/success' the huge costs of this 'success' got externalized on nature and man. Rural regions and the peasant suffered most.

The lure of technocracy was strong and in post-war decades governments everywhere yielded to it even when they had overt sympathies towards other approaches (the outcome of the Nehru-Gandhi controversy is a case in point). Technocracy displaced all sort of 'Ghandian economies' and we entered half a century of 'economic growth' from the assumption that the economy could be transformed big industry-wise with unlimited inputs and an equally unlimited absorption capacity of ecology and society for waste.

At the 1986 Symposium this technocratic model had reigned supreme for nearly four decades. All the time mainline economists had prided themselves about their 'neutral' stance that, so they had been convinced all along, followed from their 'scientific' approach. Hardly strange that the reactions of the top-level economists to Lighthill's presentation were thoughtful while at the same time they skirted Lighthill's central thesis of the irreducible complexity of physical

systems (let alone of biotic and social systems). This thesis implies that even at a physical level there is no valid way to abstract from the local system: it resists complete analysis & direction from a distance and always requires close specific consideration (including its specific history).

Note that by 1986 'heterodox' economics were in the ascent with institutional economics aiming to be historically and sociologically informed and ecological economics specifically focussing at the inclusion of concepts and methods won in close contact with real-life ecosystems. Yet, mainline economics stuck to its 'experiments' in terms of 'rational choice' of its 'homo economicus'. It distanced itself always more from the real world of real people and ecosystems and had no internal constraints to the exclusive focus at profit maximization that was in the ascent since the 1970s. When in 1990 BÜRGENMEIER (Basel) published his rebuttal of all common theorems of mainline economics there came hardly any response. Galbraith (e.g. 1992) warned that mainline economists refused any real discussion simply because they were content with their place near to government and big capital and didn't want to be found out. In the end the bankruptcy of mainline economics became perfectly manifest with the recent economic recession. It clings to its 'monetary policy' with its massive injections of money – that then get used to pump up the next bubble of projects promising two-digit gains. It is urgent that 'heterodox' economics that aims to be informed by real people and ecologies takes its place: everybody willing to study the publications from the disciplines of ecological economics, industrial ecology, and care economics will soon perceive that we need not approach the manifest problems empty-handed.

2.2. From technocracy to managerialism – and out

But note that in Europe and the USA neo-liberalism still rejects any discussion and appears more aggressive than ever. It still boasts of its enterprise-like approach that with its 'efficiency' is sure to bring the best results even though its failures have reached global proportions (for a high-level academic analysis see McKinley's 2007 *Economic globalisation as religious war*). This *managerialism* that carries 'efficiency' as its banner took over even in industries that formerly had known 'management by walking around' that allowed people on the floor considerable room to devise creative solutions to problems (that do not ask permission from management to pop up). Managerialism in contrast led to greatly diminished room for problem solving at the floor (or in the field) Its results were directly visible even to outsiders especially where problems impinged on the public realm (e.g. disruptions of train schedules or electricity provision).

But problems go deeper than that. First because where 'success/efficiency' is applied as the exclusive but non-specified measuring rod the core value of enterprise in its provision of materials and services that are valuable for man, society and ecology is in fact displaced by short-term profit maximization. Delivering things & services of that are of real value to people and biota is in conformance with 'fruit bearing' as the goal of human life, while 'success' and 'profit maximization' are too near to greed and strife to offer any true prospects for man and society. Directly connected with this first problem is the second one: managerialism tries to displace 'good work' as understood by the workers

on the floor by 'efficiency' in direct connection with profit maximization (more often than not for the management). Historical examples abound, with the capitalist Taylor system and the Stalinist Stachanov approach remembered both for their oppressiveness and for the rigidity they imposed on the production system.

Not allowing the worker to shape 'good work' means denying his creativity, that is, denying an essential part of his humanity. For a short time it is 'safe' for management because now the system seems predictable – until real life takes its course and the creative worker on the floor proves decisive for resilience and other essential aspects of the system. This central role of the creative worker decides about the propensity of certain industrial systems for uncontrollable disaster (Perrow). Fukushima faced us with the fact that there are industrial systems where the experienced worker on the floor cannot change the course of events when disaster looms. Worse still, the loss of automatic control now puts impossible responsibility on the shoulders of those who have to remove the spent fission elements from the cooling basins: it is hard to imagine how this can be done without very major accidents.

With agriculture wide away from the factory both spatially and conceptually the need to take a close look at local ecological specifics and the central roles of the local farmer is crystal clear. Yet, because 'runaway reactions' here take more time to develop neo-liberal actors in the seed- and food-sector trust they have everything under control. Their aim of complete control of agriculture and food processing and distribution is not conformable to the free creativity of farmer and biota at the local level. Though it is well documented that local biodiversity and farmer initiative are decisive for food security those global enterprises push their packages unrelentingly that allow farmer and ecology only a role in the margins. In short, there is ample reason to evaluate the reality-value of their approach. In the next chapter we will first of all focus at the (lack of) physical base, for now some last remarks about the economic side of it all.

As indicated most academic economics around the war in some way was connected with trade and big industry. In Russia the economic school of Chayanov that focussed at family farming and the small farm had fallen in disgrace and authors like Boeke who were conversant with this type of theory development found themselves excluded from policy-related economics after the war. For some decades some social balance – but not ecological balance – would derive from the inclusion of e.g. equity considerations in economic policy, but a lack of inclusion of knowledge of other phenomena than that of big industry meant that concepts and methods of very limited applicability got imposed everywhere. The focus at money instruments prevailed, with alienation from other economically meaningful quantities and qualities as a result. Those that are central to ecology and agriculture are among them: note that e.g. *ecosystem services* are not provided for money and the organisms providing them are insensitive to orders from government or big enterprise (earthworms!). Lacking such concepts and methods that could help to relate to the world outside - of the factory and big trade - 'traditional' farming in its immense variety was largely invisible to mainline economists. E.g. 'breeders law' could develop the way it did because the industrial commodity concept was

imposed on crop varieties and economists and lawyers concerned were strangers to the essential connections of crop varieties with farmers and ecologies. They were likewise oblivious to the fact that breeders worked nearly exclusively with farmer varieties plus some wild varieties - none of them 'commodities' because they were/are embedded in their local ecologies.

Evidently present-day agricultural policy and agri-business and their products are path-dependent, deriving from a specific historical course of events. With the explosives/fertiliser industry at the core of the 'government-industry-complex' it co-directed agricultural policy and research in the technocratic era in which high fertiliser input was considered the guarantee of high output. Non-industrial modes of agriculture that were embedded in local soil and community were considered a thing of the past. The 'package' provided by the Green Revolution agronomy was conceived without them and so is ill fitted for 'ecological intensification' (for which it even lacks the concepts). When Arturi Virtanen, the leading expert in biological nitrogen fixation (BNF) in crops, in 1953 stressed that agricultural intensification ought to be based on BNF-intensification there was no reaction at all from this government- and industry-directed agronomy. When after the introduction of high fertiliser inputs we were faced increasingly with phenomena like nitrate leaching, reactive nitrogen problems, loss of soil structure, and fast increase in fertiliser prizes, it became very evident that following Virtanen's lead would have been sensible indeed.

In a way also those failures of the technocratic project next intensified the rigidity with which it was pursued, for the chief 'solution' considered was further intensification of controls. As to the nitrate problem the system itself - with its dominance of industrial fertiliser - was not doubted but great effort went into its 'perfection'. Yet, spatial and temporary variation of soil properties plus the certainty that neither plant roots nor soil micro-organisms will listen to our orders preclude technocratic 'precision agriculture'. The nitrate problem cannot be solved with the concepts and methods of 'industrial' agriculture. More generally, because local physical, biotic and human reality deviates essentially from technocratic assumptions our efforts to 'direction from a distance' are futile. No doubt projecting a plant that is passively waiting for the mineral nutrients that industry has in the offering is very comforting for technocracy, yet, plant and soil biota are active participants of whose local presence and roles we are largely ignorant. They are emphatically not confined to the nutrients prescribed by technocracy, yet, the massive introduction of industrial fertiliser can easily disrupt the soil fertility-conserving nutrient cycles in the soil-plant system (e.g. massive introduction of mineral-N fertiliser leading to soil organics 'mining').

We know for sure that we know still very little about the soil biota and their interactions with plants, and our awareness of how little we know has grown considerably with the application of the tools from molecular biology. Carefully working with central actors of agriculture, the local plants and soil biota as embedded in their local ecology, is the best we can do. But the technocratic approach, managerialism, and products of big enterprise are strangers to such careful work. We first of all need the experienced local farmer and his initiatives, and governments as well as NGO's do best when re-locating decisions and

method & product development to the local level of farmer and rural community. The next chapter looks especially into the physical and biological reasons for that decision.

Part II: Core aspects

Ch.3: Reconstructing nature – or constructing roadblocks?

Central to postwar's efforts to 'industrialize' agriculture were fertilisers, pesticides, and the so-called high-yielding varieties, all presented as 'commodities'. The high 'productivity' of 'advanced crop varieties' was at the core of post-war policy and now is used to substantiate the property claims of transnationals. What is lacking is an evaluation how this biotic entity got dislodged from the farmer's fields where it originates (the farmer varieties) and how after being 're-packaged' it was legally imposed on farming. Is this 'advanced variety' indeed crucial to the ongoing development of agriculture, or is its legal position more of an impediment to that development? In other words, have we maybe constructed a roadblock that we now carry along? Only historical analysis can tell and it is to such analysis that we now turn.

3.1. Crop varieties as historical constructs

At the 1931 Congress of the *Association internationale des sélectionneurs de plantes* (International association of plant breeders) a resolution on the maintenance of landraces was accepted unanimously, after incisive discussions. I give the text of the resolution as published by the journal *Der Züchter* of March 1931 (=3. Jahrgang Heft 3) that gave a complete account of the Congress:

“Die in Berlin tagende Association internationale des sélectionneurs de plantes ist der Meinung, daß die Erhaltung der Landsorten unserer Kulturpflanzen heute eine der wichtigsten pflanzenzüchterischen Aufgaben darstellt.

Die Mehrzahl der Sorten ist heute infolge der Verbesserung der landwirtschaftlichen Kultur im Gefahr des völligen Aussterbens. In diesen Landsorten steckt aber für die weitere Pflanzenzüchtung ein geradezu *unschätzbares und unersetzliches* Material. Die Vertreter der einzelnen Länder werden dringend gebeten, bei ihren Regierungen dahin vorstellig zu werden, daß jedes Land, die in seine Grenzen heute noch vorhandenen Landsorten sammelt und erhält.

Zu diesem Zweck sollen erstens im ursprünglichen Anbauggebiet durch geeignete Landwirte oder Anstalten genügend große Flächen auch weiterhin mit alten Landsorten nach den alten Bestellungsverfahren angebaut werden. Zweitens soll aus den Landsorten eine möglichst große Zahl von den in ihnen erhaltenen morphologisch und physiologisch verschiedenen Linien isoliert und in den geeigneten Instituten weiter erhalten werden”.

Ongoing in-situ culture of landraces with the original farmers' methods was the first aim of the resolution. Its background is evident from extensive accounts of landraces collection by leading breeders of those years who never speak deratingly about (small) farmers breeding but stress the ecological adaptation and special characteristics of the farmer varieties and their decisive importance for institutional and private breeding. Even at the 1937 Pflanzenzüchter-Tagung Mayr summarizes his previous painstaking research into 'Alpine Landsorten in ihrer Bedeutung für die praktische Züchtung'. To no avail, for by then the Nazi government has clamped down on food and agriculture as the ultimate way to control society (the Reichsnährstandgesetz of 13-09-1933 is the apotheosis of policies that started immediately after the Nazi putsch). Farther to the East the Soviet government had, following a party resolution of 1931, accelerated the displacement of landraces with their officially endorsed advanced varieties as a core element of the 'socialization' of agriculture.

From their very first days in power the Nazis constructed their top-down directed and controlled Reichsnährstand that very soon left farmers no choice but produce prescribed crops with seeds from a small list of allowed varieties. The 1934 'Grundregel für die Anerkennung landwirtschaftlicher Saaten' was accompanied by a 'Sortenbereinigung' that outlawed most crop varieties – including farmer varieties – and restricted plant breeding to a small band of recognized firms/institutes. Likewise the Soviets confiscated all farmer-owned seeds, sure the miracle seeds from their imposing network of breeding institutions would do much better. That confiscation was a trigger of the great famine among peasants (especially in the Ukraine) of those years.

The Nazis were completely open about their totalitarian aims. The Zeitschrift der Akademie für Deutsches Recht in 1935 published an issue on Reichsbauernrecht where we read for example 'Die gesamte Rechtsordnung des Reichsnährstandes dient dem Ziel der Entfaltung von Höchstleistungen'. 'Der Reichsnährstand ist nicht nur dazu berufen, dem Bauer helfend und beratend zur Seite zu stehen, sondern seine Aufgabe ist in erster Linie auch, die ständische Zucht zu wahren und dem Willen der Führung bis in den kleinsten Hof Geltung zu verschaffen'. Technocracy in the service of totalitarian power. The Nazis spent big money on their centralized agricultural research, but discontinued e.g. peasant-friendly plant breeding (Harwood). At the same time the implementation of their ideology and the costs of their extreme control added to the burdens of the farmer and left most of them little to live on. As to the Soviets, the all-out impoverishment of the peasants in those 1930s is only too well known. With Eastern Europe coming under communist rule at the end of the war it was not just the big farmer who was disowned in those countries: with breeding and seed provision soon centralized the small farmer saw a decisive part of his resources taken away.

But what about the rest of Europe after the war? Here the two countries where the war Administrations in 1941/42 had faithfully copied the Nazi regulations in connection with food and agriculture, to wit Vichy France and the Netherlands, after the war became leaders in the lasting implementation of totalitarian plant breeding laws. In both countries the Administration was adamant that its wartime regulations had been 'for the good of the people' and used post-war

food shortage to leave those regulations (including production, distribution, and control) essentially intact. In the Netherlands the State Committee Occupation Law that worked to remove the Nazi totalitarian regulations from the body of law never succeeded in reaching regulations of food and agriculture and the Administration re-worked them into 'neutral' technical regulations of 'new' laws.

With the need for a directive economy in those post-war years of scarcity clear to everybody it was not easy to distinguish temporary measures from regulations that, though apparently of a technical character only, embodied a totalitarian redirection of food and agriculture. Although details in France and in Germany itself differed from those in the Netherlands, those three countries had in common the prolongation of war regulations stemming from the Nazi 'laws' by government officials that had administered those regulations in war too. An example can illustrate this.

A high official of the Dutch Ministry of Agriculture at the 1954 European Workshop 'High quality seed, its production, control and distribution' explained the role and organisation of variety selection and control in the Netherlands. From the introduction of the Breeders' Decree in 1941 on 'it was only permissible to trade in seed and seed potatoes which had been approved by [the government]' and he added that 'It meant drastic encroachment on individual liberties'. In plain fact the farmer's resources had been taken from him, with close control to prevent him from trying to revive his farmers' rights of ages. Then this official explained the structure in which the Minister of Agriculture was on top and had power over everybody and everything right into the farmers' fields. Though brought in technocratic parlance it was the wartime Führer structure...

The Nazi/Sovjet, the wartime, and the post-war laws had an identical approach: (a) disown the farmer as to seeds and crop breeding and (b) deny the need for local crop diversity maintenance. Note that both were in discord with the 1931 breeders' declaration on the in-situ maintenance of landraces, just quoted in extenso. It is also evident from the last German account of developments in breeders' rights just before the Nazis took over that hardly anybody expected those far stretching measures (we see the same in the Netherlands when the Nazi laws are introduced in 1941/42). As we indicated some breeders then tried to bring in-situ maintenance on the agenda again, without results. Before long most breeders adapted to the new working situation, focussing at institutional breeding with collected 'genetic resources'. With both the Nazis and the Sovjets sure that the peasant and his/her ways had no place in future society what was left for breeding were de-ecologized genetic resources, disconnected that is from their social and ecological connections. Note that the 'certainty' that the peasant had no place in 'modern' society was a cornerstone of post-war agricultural policy in the Western world and a cornerstone of agricultural development emanating from there. There are some troublesome historical connections at the very core of our long-standing policies...

Reading the broad scientific literature up to the 1930s we soon perceive that most botanic and breeding researchers adhered to the heritability of (some) acquired plant characteristics: they were neo-Lamarckians. Though only some

names are remembered in the present – e.g. that of Blaringhem – there were in fact very many of them, but their opinions on the decisive importance of local interactions were not solicited by the powers of age and research into the subject soon was limited financially and institutionally. Compounding this was that genetic determinism anyway was part of the broader culture in which eugenics for decades already had a prominent position. Remember in this connection that historical relations of what ultimately became genetics with eugenetics were close indeed. But as to plants, not having a separate germline they induce it anew every time and that gives their ‘genome’ ample opportunity for interactions with the environment. Indeed that the interactive character of their ‘genome’ was at the base of farmer variety selection for the local environment was perfectly clear to leading breeders of the first decades of the 20th century. But research into the subject came to a standstill when the relevance of farmer-centered breeding got denied.

After more than half a century of a standstill research was revived, especially from the 1990s on, when interactions of the organism with its environment proved decisive indeed also for posterity. With research in microbiology leading the way the inheritance of (certain) acquired characteristics proved thus massive that a return to neo-Lamarckism was the only choice left. When researchers recently started to look closely into the inheritance of acquired characteristics like drought resistance and salt resistance the reality of those phenomena soon became perfectly clear. The news of it all was not exactly welcomed by the transnationals that since the eighties had been inching in on taking possession of plants and other organisms by way of their genes. With the complete overhaul of the gene and genome concept that we experienced during the past decade – from the ‘blueprint’ to the ‘read-write memory’ - these economic actors lost their grip on the organism.

At this point it is well to sound a warning again: also this subject is part of human history with its mixed character. Many researchers and institutions that still worked within the ‘old’ post-war paradigm did their best to serve farmers and population at large by seeing to it that ‘the best’ crop varieties were supplied, plus the other inputs that brought out their ‘superior qualities’. Even now this is the approach of programs in India that stem from the (forced - by the USA) introduction of ‘high yielding varieties’ in the 1960s. Though the intent to supply it to the farmer largely free of charge got often frustrated by corruption we have no reason to doubt the enthusiasm of many of the researchers involved with those programs. The IMF Structural Adjustment Programs that were imposed on many governments in the 1980s brought the end of similar programs in most African countries without providing alternatives. The shortages that next crippled those countries come of course on the IMF’s account. The fact that it also accelerated the reconsideration of farming with local resources is surely not of that institute’s making.

3.2. ‘Freedom is the road’

Bill Gates topped the Wall Street Journal on 25th of Januari 2013 with his ‘*My plan to fix the world’s biggest problems*’ in which he stressed ‘*what’s missing is often good measurement and a commitment to follow the data. We can do better*’.

No doubt about the intentions, but where's the evidence that real life - personal life, the socio-economy, ecology - is fit for this measurement-and-regulation approach? Is it really more than a hangover from half a century of technocratic dreams?

Consider for a start the natural sciences. There the very limited range of this approach has been demonstrated because chaos and complexity are everywhere (even the physical pendulum is easily brought to chaotic behavior). That natural systems - from cells to soils to watersheds - are in many respects indeterminate is known far longer still. The need to consider both generalities (laws) and local history (contingency) when endeavoring to explain phenomena in physical geography is known for decades. There is always this decisive input at the local subject level that defies specification and regulation according to centrally devised protocols. Even plants and humics are true individuals...

Enter humans. Most parents are keenly aware that family life ultimately can't be designed or measured, these are just the wrong concepts for this core structure of human life. Likewise teachers and doctors are keenly aware that at the very core of evidence-based practice are their relation with their pupils/patients, with input from those people's narratives co-deciding about the strategy to follow. Professional practice implies admitting complexity and individuality at the subject level and emphatically so at the pupil/patient level. So how could any socio-economic or socio-ecological systems that are complexer still be fit for the measurement-and-regulation approach? Quite to the contrary: when 'ecological management' threatened to become a panacea Ludwig published his *'The era of management is over'*.

Problems start where 'measurement' is used as a self-evident phrase. In analytical chemistry it surely is not: the chemist knows he has to adapt his methods to the specific matrix - the individual soil, tissue, plasma - in which the determination is to be executed. It is simply no use issuing standard protocols that deny this decisive role of the chemist in responding to the individual problem at hand. Then pass over to disciplines where we've not just a 'matrix' with its own individual history but an active agent on its own. Soil microbes and plants already qualify, with e.g. 'plant neurobiology' and 'plant intelligence' presently research frontiers. Measurement is important here but then as part of qualitative assessment that acknowledges the individuality and creative (non-determinate) roles of the research subject. Stopping short of that means that our measurements are not focussed at the research subject, so make no sense.

Enter once more humans. Here careful & creative freedom is at the very core of the subject, with regulation only then qualifying when it maximizes this positive freedom. Educating children in the family is the primary example. Efforts at measurement-and-monitoring - except for weight and length - are not just to no avail but show that parents are on the wrong track. Likewise the teacher and the doctor aim not for a standard pupil/patient but at the educationally/medically qualified well-being of the person in his/her personal situation. When governments or non-governmental organisations start prescribing protocols implying standard pupils/patients teachers and doctors need to resist. The

memory of eugenics with its aim to improve people and the nation both by weeding out 'misfits' and by guaranteeing 'positive breeding' is still with us.

That historical example suffices to show that our subject is far from neutral. 'Measurement' and 'monitoring' was at the core of eugenics and similar efforts to ascertain human progress - and brought us destruction instead. But then, its 'measurement' was used to deny human value and human rights. Still, at least part of such research under the Nazis was transferred to post-war decades, as demonstrated by recent historical investigations. Evidently it's not that easy to recognize destructive science when we meet it.

It is fair to say that the post-war human rights movement aimed at curing us from this past by putting human worth first, both in private and in public spheres of life. Yet, it inadvertently had to face a new opponent, technocracy that soon became the common denominator of communist, mainline socialist, and capitalist government policy. Because it focussed at 'production' - think of the Marshall Plan - it was easy to miss the fact that it submitted man to the machine and was only too willing to treat him as a part of it. Ellul was one of those who exposed it from the second half of the 1940s on, but there were few who listened. When during the past decades nursing and teaching got decried as 'unproductive' because they could not follow the growth of machine productivity in industry we started to sense that indeed something was greatly wrong.

Surely agriculture in a way is synonymous with complexity. There are so many aspects to consider and none is really fit for 'technical' isolation. Still we tried a complete make-over of agriculture after WW II, with specialized institutes focussing at its 'applied technology' aspects. When this 'industrialization' of agriculture landed us in a growing number of environmental and other problems it baffled researchers because their specialism did not allow them to look at social and environmental contexts.

Next the rediscovery of ecosystem services and agroforestry system implied the re-admission of complexity, already at the physical/biological level in agriculture. For a time this re-admission shocked spokesmen of high-input agriculture, with Norman Borlaug as an example who rejected the re-introduction of the soil quality concept because he was convinced that all we had to do was focus at a sufficient supply of industrial fertilisers. Why return to 'vague concepts' when we've found the answer in Green Revolution's high-input agriculture? 'Choose concepts and protocols that have measurement at the core and we can guarantee progress, if we really want'. Bill Gates still echoes people like Borlaug who they for decades figured as the spokesmen of progress.

3.3. Perspectives everywhere

Yet, in the present most agriculture-related researchers will admit of complexities where they formerly had thought that the most important aspects had been solved. To mention just a few of those complexities that changed our view of agriculture completely (note that for now we look only at the physical/biological side of agriculture):

(1) the baffling diversity of local soil microbes while we're sure that we know only a fraction of a percent of them. Not only are new species described every day but even whole new families and – it stands to reason – new functional roles. It means an expanding soil microbial universe not only quantitatively but also qualitatively and that, of course, implies the need for new concepts and methods. Especially in the face of our Green Revolution agronomy that was developed without any soil microbial focus at all

(2) not only with animals (and gut microbes) but also with plants we've something like a meta-genome of organism-plus-microbes with endogenic and associated microbes co-determining plant life. If only for that reason already plants are singularly local and individual in character: microbes prove extremely adapt in evolving in response to circumstances, a fact that's now at the roots of a complete overhaul of evolution theory

(3) more especially there are many examples of symbiosis in which physiological and metabolic plant properties change strongly, for example enhanced photosynthesis following sink relations with mycorrhizae (root-fungi). This specific discovery made researchers realize that there can indeed be considerable gains in crop-mycorrhizae symbioses. Yet, this enhancement is typically of a local character and as to agricultural application dependent on locally knowledgeable soil treatment

(4) the re-discovery of the plant also 'on its own' as an active agent in interactions with the local environment, with especially the subject of 'plant neurobiology' in full swing. It is easy to see that the local farmer has a decisive role in guiding the right kind of interactions (as e.g. in the Systems of Crop Intensification). Note that this flexibility of the plant in its interactions with the environment fits not with the presumed 'fixity' of crop varieties of Breeders' Law and Intellectual Property Protection. Reason why the Breeders' Law prescribes a very specific, largely artificial, environment for variety selection and admission. In other words, it forbids the farmer to explore local interaction and adaption...

(5) still we rediscovered the inheritance of (some of the) characteristics acquired in the plant's interactions with its local environment. 'Evolutionary breeding' for the specific environment is perfectly normal and the local expert, the farmer, of necessity has an important role in this breeding and adaption of crop varieties. Breeders' Law and Intellectual Property Protection are impotent here. Because they shrunk crop breeding to an artificial environment dictated by industrial inputs and denied the decisive importance of GxE interactions they have little to contribute to biodiversity-based sustainable agriculture and food production

(6) re-discovery of hierarchic soil life, soil organics, and soil structure as central to soil fertility. Because these are typically dependent on local history far more than 'general laws' there is no way in which soil fertility can be reduced to 'mineral nutrient delivery' or similar concepts. It is a 'holistic' property that cannot be known without local, historical experience. The 1960s saw the politically induced shift of crop nutrition research from soil science departments to separate institutes working exclusively with industrial fertilisers.

Expectations were great – until it dawned that the connections with soils and soil fertility had been ruptured and we needed to return to the study of the soil-and-plant dyad.

(7) re-discovery of organic plant nutrition, that is, of the plant's uptake and metabolism of a wide range of organic compounds and complexes. We discovered that post-war agronomy not only discarded soil microbes and soil quality when it focussed at agriculture's 'industrialization', but even the organic and bio-chemistry of soils. We re-discovered that plant uptake of organic phosphorous compounds from the soil is perfectly normal even though they are 'invisible' with the official tests. More incisive still is the complete overhaul of the soil-and-plant N-cycle that we see in the present, with the focus now at mobilisation and uptake of organic nitrogen compounds from soil organic matter by the plant (as assisted by microbes etc). Apparently the industrial mineral fertilisers are a side-track, yet, for more than half a century they were offered as central to plant nutrition.

It is important to realize that with most of those subjects we have not only new developments – indeed there are plenty of them – but also the re-discovery of sizeable amounts of knowledge and research that have been forgotten with the all-out effort to arrive at 'industrial' agriculture after WW II. A puzzling example is the near-complete discard of the extensive body of research in connection with soil organics and soil quality dynamics: much of it was in the pre- and post-war issues of the *Zeitschrift für Pflanzenernährung*. Likewise the near-complete neglect of soil microbiology at the attempted introduction of 'industrial' agriculture had nothing to commend. Yet, for decades microbiologists found a deaf ear with mainline agricultural research.

With other subjects the course of history was still more confusing. The rise to power of the explosives/fertiliser industries in the course of two World Wars – in which governments financed them lavishly and promoted them to their leading positions – had their historical rise to financial and programatic dominance in agricultural experiments as a consequence. It stalled research into the organic nutrient sources of soils as well. When after WW II the call to end hunger by applying greatly increased amounts of industrial fertiliser to crops was issued by governments and industry together it found a listening ear with an impressed public. Researchers were only too proud to be part of the project. For a long time any other option seemed backward if not irresponsible and we needed many decades of adverse environmental and other consequences to realize that something was fundamentally wrong. It dawned only very gradually on us that we'd shifted the financial and political power over agriculture and food production to what Eisenhower called the Military Industrial Complex...

As we saw already, more depressing still is the historical course of the dispossession of farmers from the plant resources that for millennia had been developed by them into genetically rich crop varieties. Recently we started to realize something was really amiss when it dawned that the loss of biodiversity that was part of it all demolished the foundations of sustainable agriculture and food production. More recently still we became aware again of the heritability of (part of) acquired characteristics with plants, as such reviving the notion of the

decisive importance of local adaptation. Only then it dawned that the monopoly over crop variety recognition in the hands of government-appointed committees was in fact largely negative in character, with its prohibition of farmer- and local ecology-centered breeding and of farmers' seed exchanges petrifying crop development (in a changing climate).

A common denominator in all of this complex history is the post-war denial that our Second Thirty Years War – the two world wars interspersed with the rise to power of totalitarian states and the arrival of an unparalleled recession – was more than a deplorable hold-up on the path of western progress. Psychologically understandable up to a point, it was this that was at the roots of the lack of evaluation of the impact of wartime on our post-war laws and institutes. As to Germany research showed that it prolonged wartime injustices, and it's quite sure that especially for agriculture France and the Netherlands fall in line.

Ch.4.: Resources and creativity – from denial to re-installment

There is a historical parallel between the post-war growth of the Green Revolution and that of the car fleet: with both there was an industry aiming at the development of the product *together* with the infrastructure that would guarantee its dominance. That infrastructure was projected in an exclusive mode, with little attention to weaker parties (like children who now were excluded from the streets that had been their playground). Projects like those of road infrastructure and re-allotment works for a time impressed policy makers and the broader public and suggested our conquest of nature and its substitution by technical infrastructure. Thus comfortably sure that context problems had been solved research could be guided by *functional rationality*, with an exclusive focus at the most 'efficient' development and introduction of the products. With this orientation research was a stranger to *substantial rationality*, for that respects contexts (rather than wishing them away).

Environmental and other problems that showed up in the post-war half century derived from this *contextless rationality*. It is clear from leaded petrol and diesel exhaust's carcinogenicity that truly rational evaluation was not part of the car's development. What strikes most is the car's inherently non-sustainable character: with an energy efficiency of not even 2% the car is not going to survive Peak Oil. Likewise an agronomy that made us 'eat oil' – even for its bio-ethanol from maize - and saddled society with the consequences of eutrophication can hardly claim to be the foundation for all future approaches to food production. There is ample reason to evaluate the Green Revolution infrastructure-and-products very carefully and make a search for alternatives that are not prefigured by it.

4.1. Agronomy and creativity

The presentation of the Green Revolution agronomy as the most advanced version, with other versions obliged to build on its solid foundations, has no

historical content. It skips that agriculture as a long-term endeavour has foundations that reach far back in time: it is for example always building on the soil that former generations left us. The rediscovery of agroforestry and related advanced-local systems has been going on for some decades now and has taught us that rural communities need not be resource-poor at all. We furthermore start realizing that small-scale rural industries using semi-artisanal methods fit for the natural resources at hand were common before our 'industrialization policies' wiped them out. Interbellum agrarianism had quite a toolkit for the realization of its multi-faceted proposals for rural rejuvenation. It needed colonial and next technocratic policies, totalitarian regimes, and the worst wars in history to make this toolkit disfunctional.

As to the Green Revolution, its yields are not sustainable even under its highly artificial circumstances, with e.g. yield pro kg fertiliser declining precipitously since the 1960s, and little the farmer can do about it because the system's disconnection from local soil and ecology leaves farmers and farm hands few resources with which to remedy problems. When pesticides fail because the pest organism develops resistance it is really very late to build resistance the biological way and anyway the farmer has been de-skilled by long-time use of pesticides. It is exactly the relative rigidity of the Green Revolution agronomy's precepts as issued by centralized design that causes its lack of resilience. Efforts to arrive at more flexible designs with the help of models that use some local 'variables' are nevertheless focussing at introduction of the Green Revolution products. It is still 'flexible production' as we know it of e.g. the car industry: it cannot provide true alternatives for the chief product itself, the car, and depends for its 'success' on massive efforts to build an extensive road infrastructure that pre-empts the search for other, more sustainable solutions. Likewise modeling is no way out of a lack of resilience of post-war agronomy. Note that even industry depends for its resilience squarely on the experience and creative freedom of people on the floor. The following example can help to understand how this works.

Communism with its planned economy showed unmistakable 'productivity' in its factories, yet, this depended decisively on a kind of flexibility that was not an official part of the plan-economy. Every factory had two people who were not with their factual qualifications on the wage lists. One was a 'dealer' who knew what spare parts his factory could exchange for parts it lacked with factories in the wide region (and who on his journeys brought also some presents with him for the managers). The other one was a jack-of-all-trades able to change those parts and make them fit in the process within his own factory. When the delivery date approached and production was behind because machine parts had worn out etc, the dealer went on his way and after his return the jack-of-all-trades mended the machines. So the plan-economy worked up to a point – because of the creativity of people. The decisive factor, allowing the creative activities of man a minimum of space in the factory process, was nowhere in the textbooks. To be honest, it was neither in the communist nor in the capitalist textbooks. Neither of them was ready to scrutinize the technocratic assumptions that made them convinced of their strength. That the real-life world is not fit for technocracy with its orders and designs issuing from its centres of policy and research

was unthinkable for an era that put all its hopes in production the industrial way.

Likewise farming systems ‘worked’ through the ages not because they were ‘the best’ but because there were some creative people who locally knew how to change problems into opportunities. Different from industry there is no automatism in agriculture and the creative input of plants and farmers is all along quite decisive for its outputs, even though little of this is in textbooks of modern agronomy (note the farmer’s creativity is in the leading historian Joan Thirks’s account of farmer initiatives through the ages in her *Alternative agriculture*). Note also that as to the plant’s ‘creativity’ this is e.g. part of the recent image of the genome as read-write memory of the plant in its interactions with its environment (Jablonka, Shapiro, a.o.). It needed the rediscovery of creativity of people and plants to open up to perspectives arising from working with local resources. Furthermore, recent comprehensive reviews like the *Millennium Ecosystem Assessment* and the *International Assessment of Agricultural Science and Technology for Development* leave little doubt that only an agriculture that is environmentally and ecologically sound can offer sustainable food security. It needs the dynamic adaptation to e.g. changing climate that only local plants and people that are at work as free agents can offer. The 2008 UNEP-UNCTAD Report *Organic Agriculture and Food Security in Africa* likewise emphasized this central role of local actors and resources:

‘Organic and near-organic agricultural methods and technologies are ideally suited for many poor, marginalized smallholders in Africa, as they require minimal or no external inputs, use locally and naturally available materials to produce high-quality products, and encourage a whole systematic approach to farming that is more diverse and resistant to stress’.

Decisive has been the re-discovery of essential, local ecosystem services in food production, after the post-war decades in which policy everywhere focussed at intensification of agriculture with industrial inputs and excluded the obvious local resources from consideration. It is the subject of the next paragraph.

4.2. Rediscovering ecosystem services

The post-war neglect of ecosystem services is something requiring historical explanation: from Charles Darwin’s treatise on earthworms and humics up till Thomas Barrett’s 1948 *Harnessing the earthworm* the need for earthworms’ ecosystem services in building soil structure and fertility was widely known. Next it was completely neglected by the new agronomy with its exclusive focus at industrial inputs. Looking back its enthusiasm and commitment are evident, but so is its lack of consideration of soil/soil life and ecology. There is no clearer evidence in the matter than the personal testimonies of Green Revolution icons like Borlaug (Borlaug 2007). Keeney & Hatfield’s account in *‘The nitrogen cycle, historical perspective, and current and potential future concerns’* (2008) is disarming in its honest enthusiasm:

‘The TVA [Tennessee Valley Authority] began a demonstration program in the late 1940s to facilitate information on proper N fertiliser use and established a state-of-the-art research facility at its Muscle Shoals, Alabama, facility. Cooperative

research programs in key U.S. agricultural colleges also helped forward the TVA research program and enabled scientists to fund research and graduate students in the areas of N fertiliser use and N cycle reactions. This cadre of soil chemists and biochemists made up the bulk of the research community in N cycle reactions during 1950-1970. The senior author was privileged to share in this particular period. It was an era never to be repeated ... This program accomplished the goal of increasing N fertiliser use. The use of N fertiliser became the mainstay of modern World agriculture'.

Building a 'final' agriculture the industrial way was the goal to which those resarchers committed themselves. Its lack of connection with the soil&ecology-based systems of agriculture that went before was not considered a weakness but an indication that it was on the right track. These were the years in which quite generally only 'industrial solutions' were considered worthwhile. When hydrobiologist Käte Seidel from her thorough experience with and knowledge of common reed proved its mixotrophy – use of both mineral and organic nutrients – and started developing reeds-based systems of phytoremediation of polluted water she met bland disbelief with administrators and policy makers. Her path-breaking discoveries were rejected out of hand, with only some environmental engineers taking note and ultimately bringing them to fruition. But by then Käte Seidel was no more alive.

Ironically the chemical industry was the first to bump into the limits of it all, when its nylon shirts proved completely inferior to natural fiber-based ones and the efforts to harvest food protein from algae proved mistaken. Yet, by then the technocratic '*dream of the age*' (Butterfield) had penetrated everywhere.

When the first successes of 'productivity growth' the industrial way became apparent for the common citizen and material shortages diminished greatly it became only more 'self-evident' that only fertiliser-based crop production would do for e.g. India. That, then, was the rationale of the '*Freedom from Hunger*' campaign of the 1960s that was financed by the fertiliser/explosives industry and implemented by FAO. The use of local soil- and ecology-based resources is nowhere in the enthusiastic FAO plans and designs of that decade. It was only when problems grew strongly because this resource base deteriorated quickly that serious evaluation set in. But by then the technocratic approach to agriculture had been institutionalized everywhere, as indicated also by the shift during the 1960s of crop nutrition studies from soil science departments to new plant nutrition departments that henceforth focused only at industrial fertilisers. Before long there were hardly any memories with the 'new agronomy' of crop nutrition in 'traditional' agriculture. As a result authors like Keeney & Hatfield are convinced they write about the history of their subject when in fact they back-project their own concepts and methods in a past that worked along completely other lines.

For more than half a century technocracy ruled both the minds and the laws, as is only too clear from the consecutive CAP [Common Agricultural Policy of the EU] documents. Among high officials and agro-industry it was unthinkable that reality would not conform to their power structures - and their dependance on those structures made it impracticable to change course.

Yet, as a matter of fact the soil structure and soil fertility building services of earthworms and soil microbes and the pollinating services of a wide array of pollinators do not lend themselves to technocratic manipulation and intensification and only respond positively to local care by knowledgeable farmers. With technocratic policy and institutionalization riding rough shod over those local resources, problems like soil structure deterioration could only grow, up to the present near-zero infiltration capacity under maize or potato. There is no technocratic way out, only a biologically-based approach will do. But - how did policy makers and public at large fail to see those innumerable earthworms and pollinators that we need – and need to caress? And why did governments brush aside the high-level research that already around 1950 emphasized the decisive roles of soil microbes in the formation and maintenance of soil structure and fertility?

Descending into the rhizosphere where plant nutrition and crop growth are really based we need to magnify some 2500x to meet the interplay of root hairs and microbes that enables nutrient provision and uptake. Especially where the mycorrhizal and similar symbioses have not been disturbed by adverse agricultural practices this micro-scale plant-soil interface integrates to a very large total surface. Nutrient supply at low (natural) concentrations is thus perfectly conformable with well-nurtured plants and good crop growth: the integration over the very large interface is the solution. This rhizosphere process moreover compares thermodynamically favorable with processes in big industry that do just the opposite, forcing high throughput through limited interfaces. We see that all field-grown food is 'slow food', and all ecologically thoughtful agriculture focusses first at all at the rhizosphere where the local farmer can stimulate processes that are beyond the powers of governments and agro-concerns.

When soil organics expert Lal writes: *'Minimizing food systems risks threatening the global poor with low purchasing power depends on soil resources and their resilience'* he definitely does not mean those poor have only the 'non-advanced' resources at their disposal. Quite to the contrary: these local resources are at the very core of sustainable agriculture everywhere. When governments allow the local poor to handle those resources with care for their own food provision this means that they allow them to provide a public service that is essential to the population at large.

4.3. Biodiversity, evolution, and crop varieties

Agriculture is a complex endeavour and it is far from easy to do justice to its many complex features. A publication that does exactly that by comparing farming systems for biodiversity and ecosystem services is Kremen & Miles' extensive 2012 *'Ecosystem services in biologically diversified versus conventional farming systems: benefits, externalities, and trade-offs'*. Its focus at complex biological features is distinct from most post-war studies that focussed at very specific aspects of the grand goal, agriculture's 'industrialization', to the neglect of vital biological (e.g. micro-biological) and socio-economic aspects and that were apparently oblivious to the central position of ecosystem services. The balanced character of Kremen & Miles' review is apparent also from the following part of their summary:

'We found that compared with conventional farming systems, diversified farming systems support substantially greater biodiversity, soil quality, carbon sequestration, and water-holding capacity in surface soils, energy-use efficiency, and resistance and resilience to climate change. Relative to conventional monocultures, diversified farming systems also enhance control of weeds, diseases, and arthropod pests and they increase pollination services; however, available evidence suggests that these practices may often be insufficient to control pests and diseases or provide sufficient pollination. Significantly less public funding has been applied to agroecological research and the improvement of diversified farming systems than to conventional systems. Despite this lack of support, diversified farming systems have only somewhat reduced mean crop productivity relative to conventional farming systems, but they produce far fewer environmental and social harms'.

A central problem is the near-complete dominance also in 'organic' agriculture of crop varieties bred for response to industrial fertilisers under a blanket of pesticides. As Kremen & Miles remark (and document painstakingly): *'Yet, recent studies have shown that such varieties lack important traits (e.g., pest and disease resistance) to produce optimally under organic and/or low-input production conditions. Their use by organic producers may negatively affect nutrient use efficiency, tolerance for mechanical weed control, pest resistance and crop nutrition, thereby reducing crop yield in organic systems and contributing to the reported organic to conventional yield gap'*. Molecular biological research has consolidated that there are essential differences between protein expression (including nutrient transporters) under organic versus mineral crop growth, as well as essential differences between organically and conventionally bred crop varieties. An important example: Tanaka et al (2010) showed that e.g. IRRI rice varieties had low nitrification inhibition while older upland cultivars were far superior. That means that both leaching and denitrification losses are less under those 'less advanced' varieties, with higher nutrient use as well as lesser ecological and health consequences as a result.

Most important is that landraces are not 'frozen' entities but continually evolving under the local farmers' guidance in response to changing circumstances. To thus evolve is legally forbidden (!) to the recognized varieties under the Breeders' Laws that are ordered to stay 'distinct, uniform, stable'. Moreover, those Breeders' Laws explicitly exclude the farmer from breeding, so even those qualities that recognized varieties have for local adaptation to e.g. changing climate cannot be used because the big breeder wants to keep everything to himself. Governments that have committed themselves to take action in the face of Climate Change thus find no help from the big breeders promoting their Breeders' Rights but essential help from local farmers and cooperating breeders willing and able to work with other varieties than the 'frozen' ones of the Breeders' Law.

As indicated before breeding experts spoke a completely other language in 1931 than the big breeders do now: their resolution emphasized the need to maintain farmers' varieties in their regions of origin by the farmers themselves and with their own culture methods. There was no 'wishing the farmer away' from the breeding scene. Even in 1934 one of the leading experts, the Austrian Ernst

Mayr, still emphasized in his thorough overview *The importance of the alpine land races*:

'It is strictly necessary that the maintenance of landraces occurs not only in the experimental gardens of the agricultural institute ... but those varieties need also to be cultured in their regions of origin under maintenance of the old methods of culture'. And as to his own region of research he sketched possibilities that only too soon would be forgotten completely: 'The Alps would become in that way a unique breeding place for many new varieties as well as for rejuvenation and change of breeding direction for existing advanced varieties ... and cereal culture by a pure changeover to "culture of quality cereals" can be made rewarding for the practical farmer'.

Mayr and others warned that without effective and immediate action most farmer varieties and the farming methods bringing out their qualities would soon be lost. Mayr wrote: *'But if in this last hour of opportunity for the systematic maintenance of land races still no attention is paid, then the notes about the results of the research into landraces will ... after one generation only serve to document that conscious neglect prevented the implementation of economic measures in spite of the fact that there will never more come an opportunity to undo this neglect'.* Yet, by wishing the peasant/small farmer with his resources away our 20th century with its total wars and totalitarian regimes indeed missed immense opportunities for agriculture and food security.

Environmental interactions leading also to the inheritance of (some) acquired characteristics are a decisive trait of crop varieties and were recognized as such by Mayer and other leading breeders. We find this same recognition with leading botanists of the age like Blaringhem, Costantin and Molliard in France. What then caused this importance of environmental interactions as a decisive trait also of crop varieties to disappear from consideration, only to re-enter consciousness recently? As to this re-entrance think of e.g. Shapiro and others showing that the genome has the character of a read-write memory for the interaction with the environment and not that of a blueprint. Think also of the designation of 'plant intelligence' and 'plant neurobiology' by Baluska a.o. exactly for the plant's perception of and active participation in its environment. This intelligent and interactive character did of course not disappear in the period between pre-war neo-Lamarckism and its present re-entrance.

Sure enough officially recognized varieties were depicted as genetically fixed in interactions with the environment, yet, it was in fact this environment that got 'stabilized by law'. The new breeders' laws limited variety introduction to those tested in strictly prescribed ways (soon including use of industrial fertilisers and pesticides). They 'standardized' the crop environment, before long leaving only varieties that responded to high fertiliser applications (N-fertiliser especially) and excluding varieties that did best under other approaches and conditions.

When we hear the verdict 'impossible!' about high yields under other systems than that of the Green Revolution this in fact expresses the opinion that only transition to the GR's 'infrastructure' can solicit high yields. Yet, it is exactly this 'infrastructure' that limits real-life possibilities greatly because it hardly leaves any room for the creativity of plants and farmers. Post-war breeding moreover

took a very narrow course when it focussed at the crop varieties for 'industrial' agriculture. Because the subject is greatly underexposed in the next paragraph we will take a closer look at this piece of history.

4.4. A narrow trail to a dead end - CMS hybrids and GM crops

Maize had a crucial position in the post-war 'industrialization' of agriculture in the USA and elsewhere. Yet, up to WW II commercial varieties of hybrid maize were not very prominent in the USA, instead hybrid varieties from Agricultural Experiment Stations bred in cooperation with local/regional farmers for use in rotation with legumes were the leading varieties. Those 'cooperative hybrids' were evidently both 'organic' and adapted to local conditions. Their yields and prices were more often than not preferable to those of fertiliser-responsive commercial varieties. Moreover all hybrid breeding was labour-intensive, something precluding real upscaling of seed production. All-in the post-war growth in commercial, fertiliser-responsive varieties depended on its 'ability' to (1) rupture rotation-based maize farming (2) cut through the cooperation of Agricultural Experiment Stations with their regional farmers (3) make hybrids production (far) less labour intensive (4) and of course fuel fertiliser-responsive maize breeding and growing with cheap industrial fertiliser.

With the production facilities for explosives as based on industrial nitrogen fixation greatly extended during WW II and at the end of it handed over for little money to industry bosses prices of fertiliser were reduced. The choice now facing the farmer was voiced by industry and its researchers as 'either growing or buying your nitrogen', with the low prices making buying self-evident. Yet, many farmers emphasized that they needed the legumes in rotation anyway if they wanted to maintain and build soil fertility. Moreover it was part of the mixed farming that was up till the war the most viable part of US agriculture.

But in the meantime breeding hybrids for fertiliser response was stimulated greatly by the new USDA bosses, after the re-organisation that followed on the victory of the Republicans in the 1942 elections. When then in 1947 for the first time so-called cytoplasmic male sterility (CMS) was used and greatly reduced labour intensity of hybrid production the price of those hybrids declined. The new hybrids were more disease and pest prone than the old ones, but pesticides now could be offered cheap too. They derived from research for war - herbicides like 2,4-D and organophosphorus pesticides - and so the government had paid the bigger part of their development costs.

Quite important private breeders were privileged by the new USDA regime in several ways, to the detriment of public breeding for (and in cooperation with) the local/regional farmers. Before long most Stations were led to limit their work to pre-breeding, especially breeding for disease and pest resistance with results available to the commercial breeders to incorporate in their hybrid breeding. The local/regional farmer was induced to shift to commercial hybrids.

Still the memory of the Dust Bowl with its disastrous results was living enough with most farmers, and especially the Soil Conservation Service under Hugh Bennett emphasized the need for rotations and other organic methods if farmers wanted to uphold soil fertility. This SCS had been set apart by presidential order

of Roosevelt when the Republicans 'attacked' the USDA in 1942 and changed research completely in directions wanted by agro-industry and away from cooperating with the local/regional farmer. Yet, when Bennett retired in 1952 the Republicans appointed Salter, an industry strawman, on his post. Within one year Bennett publicly had to accuse Salter of 'wrecking' the work of the SCS. Research into organic-based methods to guarantee soil erosion reduction and soil fertility maintenance was greatly reduced - and hardly published. A true offensive was opened that denied the need for 'organic' methods, stating that the vigorous growth seen with industrial fertiliser sufficed to maintain soil organics.

As we see there is little 'progressive breeding' in this story of post-1942 USA but much 'political breeding'. The base of agriculture in the close cooperation of Experiment Stations and local/regional farmers was cut, the need for rotation with legumes denied, careless farming methods (as seen by the older generation) promoted, and diseases and pests suppressed with war-derived chemical means. Instead of local adaptation came breeding for response to high fertiliser gifts under irrigation. Once it was that far there followed always denser plantings at always higher fertiliser gifts, regardless of the consequences for soil or ecology.

The 'success' of maize hybrid breeding next was carried over to other crops, until in the present many chief crops are dominated by CMS hybrids. All are disease and pest prone which in conjunction with planting over large acreages means an ongoing threat to harvests and food security because we can be sure that diseases and pests will get resistant to the pesticides. Moreover their pollen is inferior, leading to inferior beebread that is part of the complex causes of bee collapse disorder. Worse still systematic pesticides like the organophosphates (and more recently the neonicotinoids) lead to immune suppression in fauna in the wild, with their number and so their essential ecosystem services dwindling.

The conscious rupture of farmer-breeder cooperation followed in fact the pre-war example of Soviet Russia and Nazi Germany where from the beginning of the 1930s breeding was restricted to central institutes and the peasant saw his landraces as well as his Experiment Station varieties taken away. Both those totalitarian regimes and post-war capitalist breeding in the USA and elsewhere disowned the local farmer and denied the need for local participatory and evolutionary breeding. When after the war this centralistic top-down model was imposed everywhere it induced a precipitous decline in agricultural biodiversity, defective farming methods (as to organics use), weakened crops that undermine food security, and an obligatory use of pesticides that disrupt wild fauna and lead to the loss of the very ecosystem services on which agriculture depends.

Genetically modified (GM) crops are little more than the next station of this dead-end development of agriculture. Their introduction is at least as doubtful as the rash introduction of CMS hybrids. As an example we take a close look at the procedures followed for the introduction of glyphosate and glyphosate-resistant crops (the latter of all GM crops covering the largest acreage):

1. As a rule the Food Authorities concerned accept unpublished industry documents also for e.g. analytical chemical determinations of glyphosate in soils or plants (including derived products). Yet, non-published means

not publicly evaluated by independent scientists and therefore scientifically meaningless

2. The chemical analytic method that Monsanto presented together with its application for an allowance for glyphosate in fact was insensitive and soon proved irreproducible (first of all because of formidable clean-up difficulties). Yet, accepted by the EPA it is at the base of Monsanto's data about glyphosate residues and half lives in soils and plants. Still, obtained with an insensitive and irreproducible method these data are scientifically meaningless
3. There is now a flood of peer-reviewed (environmental and human health) toxicity tests that use publicly screened analytical methods. The results point to serious side-effects of glyphosate on soil organisms, crops, ecology, and man
4. In denying results of this independent research the industry-connected journal *Transgenic Research* took the lead, yet, it got repeatedly found out
5. The introduction of glyphosate-resistant crops brought increased use of glyphosate in its wake, not the promised reduction in herbicide use
6. Glyphosate resistance in weeds is increasing, as predicted, leading to still greater herbicide use, now also in cocktails that are only more hazardous
7. The promise of increased yields has not borne out.

The conclusion is unequivocal:

- 1) glyphosate was allowed without scientifically meaningful analyses and tests
- 2) glyphosate-resistant crops have likewise been allowed without scientifically meaningful analyses and tests
- 3) the result is a greatly increased burden of environmental toxicity (including human toxicity).

When Monsanto applied for glyphosate allowance it was widely known as producer of the notorious Agent Orange. There evidently was ample reason to take a second look at its proposals and data and no reason to trust its analytical method at face value. With the most prominent GM crops introduced along scientifically invalid ways all we can do is to send the subject back to the drawing boards, on condition that this time the work shall be done with true scientific scrutiny, in public and by independent scientists. The trajectory of the past decades evidently was a false one and there is in the present no reason to commend those GM crops to any farmer, let alone the poor farmer in Africa and elsewhere.

For years now there have been lively discussions about the appropriate methods to screen GM crops. Starting point is that the validity – or lack of it - of the screening/ measurements methods decides about the value of the research results. Discussions can only lead to scientifically meaningful results when those methods have proved fit for the problems at hand, yet, we still are in the formative phase. In the meantime there is one real threat and that is government/industry influence upon the Food Authorities concerned. In countries like the Netherlands those Authorities lost the relative political independence they had, during the last decade, and were subjected to direction

from the political top. It stands to reason that after this loss of independence and the shift to 'system control' – that is 'control' by industry itself – the recommendations of those Authorities have political meaning only and are scientifically meaningless.

Part of the confusion about GM crops stems from the fact that among researchers it is not uncommon to jump from the methods of molecular biology that have wide and important application in research to GM crops that then are deemed to be widely applicable too. Yet, the difference between the two is unbridgeable. Molecular biological methods were decisive in the demise of genetic determinism and quite helpful in renewed research in organism-environment interactions (with results that proved inheritance of some acquired characteristics). GM-patents as filed by industry to the contrary all work within the discredited paradigm of genetic determinism and embody a futile attempt to forbid organism-environment interactions. Biodiversity research brought the insight that we need local 'evolutionary plant breeding', with the local farmer at the centre of ongoing crop variety adaptation and evolution (first of all in the face of climate changes). But the GM-patents are a roadblock on this road to farming resilience and food security.

Ch.5: Rediscovering natural resources

Balancing the world on fertiliser plus a few crop varieties – that is what ultimately became of post-war's Green Revolution as administered in the present by transnationals. By way of their well-financed World Food (Security) Conferences they emphasize incessantly that the road to world food sufficiency goes through their laboratories and patents. Yet, if we visualize that picture we can scarcely suppress doubts. Who are they that they suggest they can carry the world on their shoulders? As to the small farmer in poor countries, her prospects are bleak indeed if from now on she is dependent on the expensive commodities of those transnationals. In this last chapter we take a last look at those questions including crop nutrient provision and discover that there are wide perspectives for the poor farmer in her local resources.

5.1. The dis-/re-localization of plant nutrition

The prescription of the Green Revolution package is historically connected with an approach to plant nutrition that only considered industrial fertiliser uptake, also in breeding of 'advanced' varieties. We saw something of its roots in post-war USA, but crop nutrition studies lost also elsewhere its contact with the soil when biotic tests for local soil fertility like the Mitscherlich and Neubauer tests were exchanged for pseudo-chemical tests that had their conceptual background in hydroponics (plant growth in mineral nutrient solutions). These tests were pseudo-chemical only because (1) they lacked speciation of real soil nutrients (2) put the fertiliser industry's mineral nutrients in its place, both conceptually and methodically. The soil infrastructure of agriculture was not transformed, it was simply wished-away...

Åslander's 1958 contribution to the *Handbuch der Pflanzenphysiologie* indicates that the soil was still in focus by then, with Åslander like other contributors to

this multi-volume Handbuch at least aware of the phenomenon of organic plant nutrition. But the 1960s saw the 'Freedom from Hunger' campaign as financed by the fertiliser/explosives industry and executed by the FAO. With nearly everybody convinced that high industrial inputs from then on would ascertain high yields, research and extension got completely focussed at mineral nutrient tests. The change was effectively a political one, because it included the shift of crop nutrition studies from soil departments to the new 'plant nutrition' institutes. Yet, in those years all seemed self-evident. The few who sounded a warning found themselves treated as a curious anomaly.

As indicated the USA had a dominant role in the changes. While most other countries struggled to rise from the desolation of war the US was the only nation that had a large surplus to invest in new research. Expectations had been raised greatly when its war industries proved able to produce enormous quantities of weapons and munitions, and the conviction that now the 'liberated forces of production' would guarantee plenty in peace time was quite general. Yet, as indicated the war had seen great political changes too, with the Republicans gaining majority in the 1942 elections. As to agriculture it's evident there was a rupture in research and extension: compare the 1940 Yearbook of Agriculture with its first post-war equivalent 'Science in Farming'. The 'science' that was promoted from now on was of a very restrictive kind. Gone were the alternative socio-economic approaches to agriculture that commanded such a big place in the 1940 Yearbook. At the side of farming methods attention to organics and legume-based rotations was strongly reduced. Significantly, the contributions in the post-war Yearbook had no more references to the scientific literature, suggesting it covered it anyway while in plain fact it skipped most of it. 'Science in Farming' announced the impending triumphs of the industrial approach to agriculture. Its 'science' was newly constructed technocratic science that had little patience with local circumstances (soils, plant varieties, farmers) – or with research with another focus than its own.

We see its dominance in the Advances in Agronomy volumes of the 1950s, with Joffe 1955 mocking at the soil organics focus of prominent pre-war researchers instead of entering into discussion with them. Other authors are allowed to refer exclusively to post-war publications focussing at agriculture's 'industrialization' without any consideration of broader research. This broader research had anyway been removed from the USDA research agenda, with first-rate research shelved in 1942 by the Republicans and most of its results even locked away in the National Archives. In its stead we had this singular focus at fertiliser responsive hybrid maize breeding. Its first results were promoted aggressively from 1947 on also by way of FAO. Yet, these were rather atypical for grain crops because the big kernels allow the seedling to subsist on its own organic reserves while adapting to the sudden imposition of the mineral nutrient environment. The use of sand and gravel systems in hybrid maize breeding was widely published and was quite effective in suggesting that plant nutrition was best managed with industrial fertiliser. That it effectively depended on the plant's own organic reserves (in the seed) was not so much as mentioned.

There was high-level research focussing at organics in crop production around the war, but this was chiefly published in German and simply passed over by the

new agronomy. This literature established once more mixotrophy in green plants, yet, found a temporary end in e.g. Germany with the policy-induced shift of crop nutrition studies from soil science institutes to plant nutrition institutes working with mineral fertiliser only. Note that this system was self-propagating because only those new crop varieties were allowed that showed a 'better' response to industrial fertiliser. For decades also the important post-war results from e.g. Germany and Japan were forgotten and only researchers into plant nutrition in natural ecosystems stayed aware of possible organic plant nutrition. From their side a counter movement set in when especially research in boreal and arctic plants proved the relative importance of organic plant nutrition. The paradigm shift specifically towards mixed organic-mineral N-nutrition of plants was announced by leading researchers in 2000. From then on a gradually increasing number of publications focussed at the matter, until two recent Reviews (from September 2012 and March 2013) firmly established mixotrophy of green plants as the biological paradigm.

In parallel with this rediscovery of organic plant nutrition the awareness increased that soil's heterogenous nutrient store and supply was an asset for plant nutrition: soil has higher-dimensional possibilities that simply do not exist in our one-dimensional mineral nutrient solutions. Together with the rediscovery of organics in plant nutrition that of soil heterogeneity as an asset made us aware that we in fact have little notion of the 'nutrient sources' that are at the small farmer's disposal.

5.2. Re-entering the world of higher dimensions

The electron microscopic pictures of the rhizosphere by Foster and others are beautiful indeed – and make us aware that this world at the micro level where true crop nutrition takes place is a heterogeneous hierarchy composed of biotic and abiotic entities that eludes all efforts to reduce it to some 'first principles'. Once we are ready to admit just that we can start with a kind of modeling that help us explore all these richness. In fact that has been going on for some decades now, but we'll take a recent example as our starting point. The example is not very technical and so will reward the reader who takes the effort to consider it.

Ushio et al (2009) in their '*Phenolic control of plant nitrogen acquisition*' introduced a '*plant-microbe competition model [that] consists of five compartments: plants, soil microbes, debris, organic nitrogen [compounds] and inorganic nitrogen [compounds]*'. Besides this re-introduction of spatiality in soil they included the plant roots' active exudation of 'phenolics' as a class of organic compounds that can put a brake on the microbe's utilization of (especially) organic nitrogen compounds and so leave a sizeable part of it for uptake by the plant. Yet, the 'brake' ought not to be too strong because those same microbes need to break down polymeric organic compounds in the soil into fragments that are 'palatable' to the plant. As long as the microbes can proceed with their depolymerization work, yet, are inhibited enough [by the plant's phenolics] to leave a sizeable fraction of the organic fragments for uptake by the plant the cooperative system plant-microbes will prosper. Ushio et al. proved with their modeling exercise that this is effective under a broad range of conditions: the 'phenolic control' apparently is not a side-track but central to plant nutrition

with nitrogen compounds. It especially enables the plant to intervene before microbes can bring the processing of the soil organic nitrogen compounds to its mineral end station in ammonium and (next) nitrate. This re-introduction of spatial characteristics of soil at the micro level as combined with introduction of chemical specifics and active plants shows us a world that is invisible to post-war agronomy with its focus at [industrial] mineral fertiliser solutions that are one-dimensional only, an agronomy that neglects chemical specifics and depicts plants as waiting passively for nutrient delivery.

Similar modeling exercises show that already the re-introduction of spatial heterogeneity at the micro-scale allows for the co-adaptation of plants and specific kinds of microbes for mutual profit. Yet, our fertiliser gifts impose a soil solution with mineral ion concentrations far above natural concentrations on this soil world, obscuring the heterogeneity - and wiping out balanced co-adaptation with it. There are indeed solid reasons at the micro-level for the emphasis of leading agronomists around the war to keep fertiliser gifts strictly subject to organic matter management of soils, specifically to green manuring, rotations, and compost & farmyard management. The quite common effort in those years to first 'organicize' mineral fertiliser by separate interaction with organics before it is brought on/in the soil was agronomically perfectly sound and its neglect by the Green Revolution agronomy had nothing to commend. That specific agronomy depended on the conceptual and methodical substitution of a mineral nutrient solution for the real world of the soil, collapsing its many dimensions to one only. As a result plant and farmer are faced with a greatly impoverished soil world that offers little prospect for local resource use and development.

The solution of the problem is straightforward: start with a non-limitative account of the soil and rhizosphere from the micro-level on and evaluate proposed agricultural improvements first of all for their stimulation/hindrance of biotic actors and soil structure at this and higher levels. Of necessity research then will be guided by modesty because we are sure that we know only a small fraction of soil organisms etc. Note that any approach to agronomy suggesting we can skip this starting point of careful consideration of soil and rhizosphere biotics and structures is a non-starter.

Likewise the local above-ground biosphere is many dimensional and its composition of a great number of very different organisms not a burden but an asset. The biodiversity-productivity debate ended up in favor of biodiversity-based agricultural production, yet, still looks only at specific aspects of the complexity that since ages is inherent to agroforestry and traditional home gardens (still a mainstay of human nutrition). Explorative modeling is important here, but technocratic concepts and approaches are of little help because they suggest a world that does not exist.

Post-war technical developments in connection with agriculture cannot change the fact that its core is non-technical as ever: biotic, many dimensional, complex, variable, and heterogenous. Its biotic agents more often than not are only very partially known to us or not at all, and even the ones that are somewhat better known like earthworms and bees do not listen to our orders. Interactions in soil

are very often non-linear and the components not 'parts' in any technical sense at all but 'organs' of a greater whole. The failure of common predator-prey models for example in soil ecology brought to our attention that cooperative interactions are very common in the soil system. Likewise the many forms of symbiosis – of which there show up always more – point to the fact that the dictum 'the whole is more than its parts' (both qualitatively and quantitatively) ought to be the guiding principle in agriculture. They offer prospects that even conceptually are unknown to the Green Revolution agronomy.

But has that agronomy in spite of its shortcomings not brought us greatly increased yields? For even when it has to be admitted that the small farmer only rarely made economic progress under its regime with the expensive industrial inputs, the yields themselves are a fact, and aren't the high fertiliser gifts an important part of their cause?

Early on already the use of ¹⁵N-marked fertiliser brought to the attention that an important part of crop N-nutrition did not derive from the added fertiliser but from the soil organics (in fact there were already clear indications of that fact at the end of the 19th century). The most extensive research in the matter brought recently as its result that the bigger part of the plant's N-nutrition commonly derives from soil and only the minor part from added fertiliser. That means that the added fertiliser induces exploitation of the soil organics and that we neither know its mechanism nor the factual N-nutrients derived from it. We are just sure that the crop in fact arrives at the high yields thanks to the soil organics capital that has been built by former generations of farmers. Yet, in the present this uncontrolled exploitation of soil organics leads to soil structural deterioration and increasingly to soil fertility loss. Apparently soil bacteria start consuming their own exopolysaccharides when confronted with the flush of mineral fertiliser, so its function as a soil aggregate glue is damaged. Extra mineral fertiliser can make up for soil fertility loss for some years, but as indicated already the yield per kg fertiliser has greatly diminished since the first use of the Green Revolution varieties.

We are no less dependent on soil nutrient delivery for crop growth than our forebears, so we better focus at this rich resource instead of its presumed substitute, industrial fertiliser. Its heterogeneous and hierarchical structure and its hierarchical webs of soil organisms and micro-organisms shape also soil fertility and plant nutrition in ways that we have scarcely started to explore. With soil fertility rediscovered as an 'emerging property' of locally unique farming fields we start questioning the expensive product from 'fertiliser' factories far away. The local farmer, soil, and ecology can contribute to this 'emerging property', but distant actors cannot (neither government nor industry).

5.3. The return of soil-, ecology- and farmer-based agronomy

It may well be that this point is still the most controversial because so many agronomists worked for decades with great efforts to supply fertilisers and fertiliser-responsive crop varieties to farmers in hungry regions. Yet - as indicated already - right at the beginning of post-war's intensification of agriculture it was stressed (and explained) at the highest scientific level that

we'd primarily to explore the intensification of BNF (Biological Nitrogen Fixation) and not that of expensive industrial fertiliser supply. By then there was an impressive fund of scientific research on legume-based crop growing, with centuries of practice behind it e.g. in the 'sheep-wheat' rotations (practiced not only in the Mediterranean but in many other European regions as well). In that rotation after the grain crop sheep were grazing (confined) on the leftovers plus newly growing legumes from the field's seed bank, after which the field was ready for the next crop thanks to enhanced soil fertility. But note that most post-war agronomists were either uncognizant or frowned on the practice and judged it ruinous for the soil fertility. Yet, in fact the sheep gut selects for passage of most legume seeds – that by way of manure become part of the seed bank again – and use of weed seeds.

The example reminds us of the fact that after the war we were thus sure that we could reconstruct nature and society that we had little patience in studying 'traditional' agriculture. With it we induced a great rupture in the transmission of agricultural knowledge and experience and missed the opportunity to extend the array of proven farming systems to the new problems at hand. As indicated, the denial of the farmer's central role in 'modern' agriculture and the shift to central direction instead was at the roots of this loss of opportunities. As a consequence of the new restrictive policies also the high-level research that had cooperated with this 'traditional' agriculture was neglected (or even scoffed at). Those massive ruptures were decisive for post-war developments and gave the Green Revolution its defective and unsustainable character.

In plain fact we missed the possibilities to explore natural resource-based agriculture. Of course the longer this lasted the less we still knew of the phenomena. BNF by free-living micro-organisms is a case in point that was widely known from e.g. good yields plus fertiliser-unresponsiveness of many research fields. Even in 1953 Winogradsky's 1927 warning was repeated that applying expensive fertiliser cost the farmer in many cases his free BNF (that is blocked by ammonium and destroyed by nitrate). Recently the search for BNF-genes in the environment with molecular biological methods brought the recognition that the potential for BNF is about everywhere. Of course this does not mean that we know how to use it, but it certainly means that we lost more than half a century of opportunity to explore and develop the phenomenon for increased nutrient delivery to local agriculture.

Similar points can be made for nutrient disclosure and delivery thanks to crop-mycorrhiza symbioses and to nutrient delivery thanks to biological weathering. Those phenomena with prime local applicability were completely out of sight with the Green Revolution agronomy. In former Third World countries there's a boom in research in those forms of local nutrient delivery, but agronomy in the former First World is still too little aware of the *scientific* importance of local (as compared to 'general') phenomena to partake. There is nothing 'scientific' in this because in the study of earth- and soil-related phenomena we *always* need the pole of general 'laws' and that of the local historical-contingent 'narrative'. Physical geographer J.D. Phillips and colleagues did not tire to bring this to the attention of scientists and the wider public from the 1980s on, so there's no scientific reason to adhere to the presumptions of technocracy in agronomy.

We will leave it at this short exposition. We deem it demonstrated by now that an agronomy focussing at development of natural resources-based agriculture can easily rise above post-war's Green Revolution agronomy with its very narrow focus, poor concepts and methods, and very limited and costly means. Helping the small farmer in poor regions to explore and use his local resources is the best we can do for him.

Setting the record straight (2)

Bibliographic annex/background studies

The main Report would become unwieldy and so miss its purpose when interspersed with annotated references. Likewise it would become unwieldy when giving an in-depth treatment of all subjects touched upon in the body of the text. Yet, the reader will at times want both, references/information, and an in-depth treatment of subjects that were just lightly touched in the main Report. To meet those wishes the Bibliographic Essay with its background studies consists of individual essays in which subject treatments and annotated references form a new whole. Annotated references make rarely light reading, but it is hoped that the treatment chosen here will at least be helpful to the reader to probe deeper into the subjects touched upon in the main Report.

A. Where are we and where can we go?

In 2003 Joseph Stiglitz published his *'The Roaring Nineties. Why we're paying the price for the greediest decade in history'*. The book indeed delivers what its title promises. Then in 2007 he published his *'Un autre monde. Contre le fanatisme des marchés'*. Only too soon he was proved right so returned to his 2003 theme in his 16 September 2008 comment in *The Guardian* *The fruit of hypocrisy. Dishonesty in the finance sector dragged us here, and Washington looks ill-equipped to guide us out* and in his 2010 book *Freefall: America, free markets, and the sinking of the world economy*.

Surely Stiglitz was not unique in his predictions, the Dutch philosopher-economist Goudzwaard had published penetrating analyses long before Stiglitz appeared on the scene. His alternative of an economy of sufficiency is voiced by others too, for example by Pierre Rabhi in his 2010 *Vers la sobriété heureuse*. Moreover there is quite a list of recent studies focussing at capitalism, with Ferdinand Braudel's 1985 *La dynamique du capitalisme* already a classic and Richard Sennett's 2005 *The culture of the new capitalism* and Dany-Robert Dufour's 2007 *Le Divin Marché. La révolution culturelle libérale* giving analyses also of recent developments.

In fact the thorough studies start already in the 19th century, with Paul Lafargue's 1887 *La religion du capital* just one of the examples. In Germany in the decades around 1900 the *Historical School* – Gustav von Schmoller, Adolph Wagner, Erwin Nasse a.o. – showed far more depth and breadth than became the norm after WW II and especially had an open eye for the ethics of economics. Next came solidarist/personalist economists – starting from human solidarity as opposed to individual autonomy - with Heinrich Pesch an unquestionable leader with his 1905-1926 five-volume magnum opus *Lehrbuch der Nationalökonomie*. Related is the distributism of Belloc, Chesterton, and their present-day followers,

with Chesterton describing the course of English capitalism (in his 1926 *Outline of Sanity*) as follows:

'they committed their people to certain new and enormous experiments; to making their own independent nation an eternal debtor to a few rich men; to piling up private property in heaps on the faith of financiers; to covering their land with iron and stone and strippin git of grass and grain; to driving food out of their own country in the hope of buying it back again from the ends of the earth ... till there was no independence without luxury and no labor without ugliness; to leaving the millions of mankind dependent on indirect and distant discipline and indirect and distant sustenance, working themselves to death for they know not whom and taking the means of life from they know not where'.

His most vehement book about capitalism *Utopia of Usurers* (1917) is composed of his 1913-1914 articles for the Daily Herald. There he wrote: *The word "rebel" understates our cause. It is much too mild; it lets our enemies off much too easily – By all working and orthodox standards of sanity, Capitalism is insane.* He minced no words about the commodification and financialization of everything and everybody: *Such is the society I think they will build unless we can knock it down as fast as they build it. Everything in it, tolerable or intolerable, will have but one use; and that use what our ancestors used to call usance or usury. Its art may be good or bad, but it will be an advertisement for usurers; its literature may be good or bad, but it will appeal to the patronage of usurers; its scientific selection will select according to the needs of usurers; its penal system will be just cruel enough to crush the critics of usurers; the truth of it will be Slavery.*

Then jump to Stiglitz' May 2011 sketch of the American system (as quoted on the Real World Economics Review Blog):

The Supreme Court, in its recent Citizens United case, had enshrined the right of corporations to buy government, by removing limitations on campaign spending. The personal and the political are today in perfect alignment. Virtually all U.S. senators, and most of the representatives in the House, are kept in office by money from the top 1 percent, and know that if they serve the top 1percent well they will be rewarded by the top 1 percent when they leave office. By and large, the key executive-branch policymakers on trade and economic policy also come from the top 1 percent. When pharmaceutical companies receive a trillion-dollar gift – through legislation prohibiting the government, the largest buyer of drugs, from bargaining over price – it should not come as cause for wonder. It should not make jaws drop that a tax bill cannot emerge from Congress unless big tax cuts are put in place for the wealthy. Given the power of the top 1 percent, this is the way you would expect the system to work.

Surely Stiglitz was not the only author who warned that we were going to pay the price for allowing greed to take over the economy. John Perkins gave us inside information in his 2005 *Les confessions d'un assassin financier*, Marie Paul Virard and Patrick Artus gave us their 2005 *Le capitalisme est-il en train de s'autodétruire?* and Naomi Klein published in 2007 her *The shock doctrine: the rise of disaster capitalism* in which she studied 35 years of 'ultraliberalism'.

There is little doubt about the diagnosis, after all the point that 'money making' is adverse to a true economy was made already by Aristotle and in the Tora. But note that the system is indeed 'insane'. D.C.Hambick and A.J.Wowak 2012 show that 'the new breed of CEOs' *'have more individualistic values, more materialistic values, more narcissistic personalities and less psychological identification with their companies than their predecessors'*. When they emphasize especially that the system's CEOs as a rule are full blooded narcissistic personalities this means also that there is little hope of self-correction or even of ability to see things as they are. See D.C.Hambick & A.J.Wowak 2012 *Whom do we want as our business leaders? How changes in the corporate milieu have brought about a new breed of CEOs*, in: J.E.R.Costa & J.M.R.Martí (eds) 2012 *Towards a new theory of the firm: Humanizing the firm and the management profession*.

Well do these authors aim for a renewal for there is a long list of critical studies of management and business education that mince no words about the situation. In the words of Podolny 2009: *Fact is, so deep and widespread are the problems afflicting management education that some people have come to believe that business schools are harmful to society, fostering self-interested, unethical, and even illegal behavior among their graduates*, see J.M.Podolny 2009 *The buck stops (and starts) at business school*, Harvard Business Review 87, 62-67. That's the reason why J.P.Walsh gave his 2010 Presidential Address to the Academy of Management the title *Embracing the sacred in our secular scholarly world*, see Academy of Management Review 36, 215-234. For the meaning of 'sacred' he gave a quote: *A sacred value can be defined as any value that a moral community implicitly or explicitly treats as possessing infinite or transcendental significance and that precludes comparison, trade-offs, or indeed any other mingling with bounded or secular values*. Walsh and others are perfectly aware that only the internalization of values that are 'sacred' in the sense that they judge and guide the system instead of being bought by it will do. There is no prospect for firms and the overall economy when we stick to 'valuations' in terms of money because that's exactly the core problem.

Yet, post-war decades did not start out proclaiming greed. To the contrary, there was an emphasis on equity in most countries that was not just feigned. As long as this was around 'greed as motor of the economy' was simply neither socially nor politically acceptable. So what then prepared the way for this 'insanity'? Characteristic of those decades was something else: the faith that centrally directed development and application of social and material technology was sure to make a new world. With the benefit of hindsight we can say that this ***faith in technocracy*** was born from despair, after the worst war in history, but it was no less effective for it. Quite decisively the administration was in place to give it a kick start: the war economy had been centralized everywhere with greatly extended bureaucracies with greatly extended powers. Furthermore those bureaucracies had been closely involved with all matters of production (and consumption) and after the war were ready to 'prolong their services'. In the close cooperation of government and industry the big projects were started everywhere that had to effect a complete make-over of society and nature. See J.C.Scott 1997 *Seeing like a state*.

This was full-blooded faith in 'factory methods' where central research and design would lead to 'products' that would be applicable everywhere. Before long the evident need of the times to accelerate production so that life would become at least materially tolerable issued in projections of ongoing 'wealth production'. Yet, if not for the stern faith in technocracy the system could have corrected itself, for it became soon apparent that this 'factory approach' did great harm to social life and the environment. But the faith in technocracy bedevilled the perception of the situation: it made it unthinkable that there would be problems without technical solutions or resources without substitutes. The technocratic faith had intoxicated especially the new breed of experts that worked enthusiastically for the implementation of the centrally developed designs. Social and ecological contexts were simply no part of their research model that had its roots in industrial research for war. For many an expert it proved a painful exercise to become conscious of the real-life problems. An example is their reaction to Rachel Carson's *Silent Spring*. In countries like the Netherlands most experts working for the government-directed reorientation and reorganisation of agriculture reacted negatively: the book's problems were 'unthinkable' within their technocratic paradigm.

The new approach to agriculture was an input-output approach after the example of industry, with high inputs (industrial fertiliser, fossil fuel, etc) sure to bring high outputs (biomass). In it plants were 'physiological machines' and the soil was little more than an inert medium for the reception of industrial fertiliser. There was little role left for soil organics and soil life and anyway proponents of the new agriculture were sure that the higher biomass would take care also of them. Note that there was essentially no foundation for those assumptions, they just followed from the unshakable faith in 'factory methods'. Experts of the 'new agriculture' and other branches of 'production' were sure of the technical inputs and methods and hardly spent a thought on 'non-industrial' approaches that went before. It was in this general atmosphere that long-time leading economists like Solow and Samuelson entertained little doubt that the world can get along without natural resources - mankind was sure to find technical substitutes!

But note that it was conceptual confusion also economically because it confused (human-made technical) capital and (natural) resources. Georgescu-Roegen stressed in his 1975 *Energy and economic myths*, a publication that by now is a virtual classic: *One must have a very erroneous view of the economic process as a whole not to see that there are no material factors other than natural resources*. Yet, leading mainstream economists like Solow and Samuelson took (in e.g. their growth theories) production to be a function of only capital and labor. Nordhaus and Tobin 1972 summarized in their *Is growth obsolete?* (in: Nat. Bureau of Econ. Research 1972 *Economic growth*): *The prevailing standard model of growth assumes that there are no limits on the feasibility of expanding the supplies of nonhuman agents of production. It is basically a two-factor model in which production depends only on labor and reproducible capital. Land and resources, the third member of the classical triad, have generally been dropped....the tacit justification has been that reproducible capital is a near perfect substitute for land and other exhaustible resources*. Daly 1999 exposes the foolishness of it all: *Since the production function is often explained as a technical recipe, we might say that*

Solow's recipe calls for making a cake with only the cook and his kitchen. We do not need flour, eggs, sugar, and so on, nor electricity or natural gas, nor even firewood. See H.Daly 1999 How long can neo-classical economists ignore the contributions of Georgescu-Roegen? In: K.Mayumi, J.Gowdy (eds) 1999 Bioeconomics and sustainability: Essays in honour of Nicholas Georgescu-Roegen.

When Solow c.s. next introduced an extended production function in which capital K, resources R, and labor L – each with its own coefficient – are multiplied, Georgescu-Roegen 1979 showed with a simple mathematical transformation that this function implies that resources R ‘*may be as small as we wish, provided K is sufficiently large*’. But of course *In actuality, the increase of capital implies an additional depletion of resources. And if K goes to infinity, then R will rapidly be exhausted by the production of capital.* The authors of the ‘new’ production function *could not have come out with their conjuring trick had they borne in mind, first, that any material process consists in the transformation of some materials into others (the flow elements) by some agents (the fund elements), and second, that natural resources are the very sap of the economic process. They are not just like any other production factor. A change in capital lor labor can only diminish the amount of waste in the production of a commodity: no agent can create the material on which it works. Nor can capital create the stuff out of which it is made.* N.Georgescu-Roegen 1979 *Comments on the papers by Daly and Stiglitz*, in V.K.Smith (ed) 1979 *Scarcity and growth*.

It is sadly evident that post-war mainstream economics, the ‘foundation’ of present-day capitalism, is ‘not of this world’ and espouses theories that are **insane** because they push mankind not to caress its resources – both natural and human resources - but to exploit them ever more aggressively and, doing that, commit suicide. Note that the extended life span of this insane doctrine and system is not primarily the work of the ‘narcissistic personalities’ mentioned above, because the place that’s granted to these CEOs is first of all a consequence of the insane system itself. An historical reason for the insane doctrine that not ‘*natural resources are the ver sap of the economic process*’ but that money is the paramount factor is in the post-war adoption of the GDP as a sufficient and integrating descriptor of the economy. Here government and mainstream economists met each other in the comforting certainty that this ‘measurement instrument’ gave them the power to steer the economy also in stormy weather and troubled waters. In other words, the GDP was part-and-parcel of postwar technocracy as the ideology that governments and their experts had in common.

But note that right at its introduction clear evidence was given that it was glaringly insufficient for the roles accorded to it. Besides Richard Stone’s *The use and development of national income and expenditure estimates* in D.N.Chester 1951 *Lessons of the British war economy* we find also E.A.G.Robinson’s *The overall allocation of resources* and other contributions about real-life resource allocations etc that explicitly state that money accounts are one aspect only of the real-life economy. Wartime brought the obligation to take a very close look at production and consumption and the true lesson gained from it was that money accounts are not able to give an integrative overview: the real-life economy transcends its one-dimensional accounts.

The social and ecological blindness of post-war mainline economics has been exposed many times and Georgescu-Roegen certainly was not alone in his fundamental criticism of prevailing economic doctrine. Non-mainliners like J.K.Galbraith and Bob Goudzwaard offered thorough analyses also, as well as positive alternatives. An author that Goudzwaard valued as highly as Georgescu-Roegen was K.W.Kapp from Basel university.

To start appreciating Georgescu-Roegen his 1986 *The entropy law and the economic process in retrospect*, Eastern Economic Journal 12, 3-25 is a good start. Though he was consistently marginalized during his life by mainstream economists recently Georgescu-Roegen received increasing recognition, e.g. K.Mayumi 2001 *The origins of ecological economics: the bioeconomics of Georgescu-Roegen* and G.V.Marzetti 2009 *The fund-flow approach. A critical survey*. A leading author in ecological economics in the present is M.Giampietro who explicitly acknowledges his debt to Georgescu-Roegen in e.g. A.H.Sorman & M.Giampietro 2013 *The energetic metabolism of societies and the degrowth paradigm: analyzing biophysical constraints and realities*, Journal of Cleaner production 38, 80-93.

Kapp saw himself likewise marginalized during his life. From own experience in e.g. India he saw early on the social costs of 'development', e.g. his 1965 *Social costs in economic development*. But note that he was prepared to see those costs from his critical analyses of capitalist enterprise, e.g. *The social costs of private enterprise* 1st ed. 1950, 2nd rev. ed. 1963, 3rd rev. ed. 1978 (reprinted 2000). Kapp died suddenly in 1976, but in 1985 J.E.Ullmann & R.Preiswerk edited an anthology *The humanization of the social sciences: K. William Kapp*, with one of the chapters Kapp's 1967 *Zum Problem der Enthumanisierung der 'reinen Theorie' und der gesellschaftlichen Realität*. A quote from the Summary of his 1975 , *Annals of the American Academy of Political and Social Science* 418, 60-71, illustrates why the work of this author is highly valuable exactly in informing policy in the present recession: *The criterion of public policies, including employment, must be the assurance of socio-economic reproduction for the maintenance of human life, health and survival, not maximum output and employment without regard for genuine individual and social needs. Social and environmental indicators and substantive norms, defined in terms of minimum requirements and social objectives, need to be made the guidelines of public action*. L.R.Wray in his 2011 *The financial crisis viewed from the perspective of the "social costs"*, Levy Economics Institute Working Paper 662, showed that we need Kapp's social costs theory to guide policy where the 'efficient markets' hypothesis is hopelessly inadequate. The best introductions to Kapp are those of T.Luzzati, cp his 2009 *Human needs, sustainable development, and public policy: learning from K.W.Kapp (1910-1976)*, Ch.14 of: N.Salvadori & A.Opocher (eds) 2009 *Long-run growth, social institutions and living standards*, and his 2007 *Economic development, environment and society: rediscovering Karl William Kapp (1910-1976)*.

We now summarize this position-finding essay.

The bankruptcy of neo-liberalism/capitalism in the present recession no doubt derives from greed but behind that is (a) its insistence on monetary valuation of

everything and everybody, and (b) its blindness as to the humanitarian and natural resources-basis of the economy as well as to its life-serving calling. In fact these are two sides of what Chesterton dubbed its **insanity**. So when in the present we see transnationals aiming at complete commodification of life and its fundamental resources there's no choice but to resist. See e.g. *Who owns nature? Corporate power and the final frontier in the commodification of life*, **etc** group November 2008. The monetary valuations of those economic actors and their bizarre faith in substitutability (of capital for natural resources) are adverse to life itself. But note that neo-liberalism is wearing the emperor's clothes: its financial capital maybe immense, but its command of ecosystem services of e.g. earthworms and bees is zero. The very resources on which human life on earth depends are outside its power – but at the service of local humans who respect the local soil, ecology and community. Authors like the ones mentioned thus far were conscious of those fundamental facts and developed their practical and theoretical approaches accordingly. What is more, all through the ages people were conscious of the fact and constructed their livelihoods in concordance with it. In the present we experience the re-discovery of both ecosystem services and natural resources at large, as well as agroforestry and other farming systems that proved their worth through the centuries. In other words, the present crisis is surely a deep one, but cannot negate the perspectives that we regained. In the Report and its background documents our primary aim is to use those perspectives, though to do that clear-headed we repeatedly first have to give a close analysis of the assumptions of neo-liberalism and technocracy.

B. Re-evaluating the Green Revolution and its agronomy

1. Re-thinking the post-war era

Famous geographer **Carl O.Sauer** was remarkably prescient about what was to be the Green Revolution in his 1941 letter to Joseph Willits (Rockefeller Foundation):

*'A good aggressive bunch of American agronomists and plant breeders could ruin the native resources for good and all by pushing their American commercial stocks. The little agricultural work that has been done by experiment stations here [in Mexico] has been making that very mistake, by introducing U.S. forms instead of working on the selection of ecologically adjusted native items. The possibilities of disastrous destruction of local genes are great..... Mexican agriculture cannot be pointed towards **standardization** on a few commercial types without upsetting native economy and culture hopelessly'.*

Together with a.o. Lewis Mumford Sauer convoked the 1956 Symposium *Man's role in changing the face of the earth*, the major expression of independent research in those years. Here he emphasized once more that the native Mexicans were fully competent in their own realm:

'In my days of field work in back areas of Mexico I learned to accept confidently the geographic and natural history competence of the native guides. They knew how to interpret the lay of the land, to keep a mental map, to note almost any change in

the scene. They were usually able to identify the plants and were right as to systematic grouping and ecological association'.

Sauer was also a sharp critic of the doctrine of economic growth that after the war was seized upon by the USA to extend its power, next to be followed by most governments in Europe and elsewhere. In his 1951 lecture 'Folkways in social science' he expressed it with the words

'Do we think that we dominate time, as an upward spiral that we have under control, our increasing knowledge confidently shaping its development? Or is this faith that we are shaping progress by material skills and building an ever expanding system in truth the great "phantasm" of our days, the "brave new world"? Have we set up an economy of waste, which we call the miracle of American production? Can we disregard our deficit spending of natural resources because we shall continue the triumph of mind over matter? Are other times and other places of importance only in so far as they can be related to our egocentric and ephemeral position? Are we the cleverest people of all time or the blindest because we think neither whence we came nor whither we are bound?'

Since Sauer's 1951 lecture ***criticism of the economic growth*** concept has been voiced many times. During the past decades it was extended greatly, with N.Kosoy et al 2012 *Pillars of a flourishing Earth: planetary boundaries, economic growth delusion and green economy*, Current Opinion in Environmental Sustainability 4, 74-79 providing a good example. The last sentence of this publication indicates something of our predicament: *'we must embrace a process of decolonization of our minds, and move beyond a way of thinking about the economy which demonstrably ill serves us in the stormy Anthropocene'*. They emphasize that if we start with the assumptions of the still dominant economics we *'cannot get to a flourishing or even sustainable Earth'*.

Industrial agriculture was entirely conceived within this obsolete 'economic growth' model. It brought us the Green Revolution with its agronomy that focussed at industrial and fossil fuel inputs and disregarded soil/soil biota, local resources (especially farmer varieties), and the local ecology. Convinced of its industrial high-input, high-output model it considered 'traditional' agriculture with its resources a thing of the past and acted accordingly. It turned a blind eye to agriculture's dependence on local resources and increasingly demolished the very resource base (with its ecological services) upon which we all depend for food provision. We now are faced with enormous challenges – but also *'with opportunities to rethink and redesign our food system'*. F.Kirschenmann 2010 *Alternative agriculture in an energy- and resource-depleting future*, Renewable Agriculture and Food Systems 25, 85-89.

Central to this re-thinking and re-designing is the recognition that the Green Revolution's technocratic approach to agriculture is not fit for a world where description and analysis of soils and landscapes is bi-focal, of necessity employing both 'generalities' ('laws') and the local historical narratives ('contingency'). Cp physical geographer J.D.Philips' 2004 *Doing justice to the law*, his 2008 *The perfect soil*, and many other publications that show that science pertaining to soils, landscapes, and agriculture acknowledges the decisive roles of the local biotic and human agents. There is not a glimmer of doubt that local

knowledge & experience of local resources & ecology are essential for designs of sustainable agriculture.

Fortunately the rediscovery of indigeneous knowledge and practices now has been with us for some time, after decades in which recognition lingered only with people who were really at home in Third World countries, e.g. many missionaries, and scientists like Sauer. Recently the Indigeneous Peoples International Declaration on Self-Determination and Sustainable Development (prepared for the Rio20+ June 2012 Summit) emphasized once again that neo-colonial (including neo-liberal) approaches are not welcome because they wipe out their bio-cultural existence. For true biocultural design the basic premise is 'that people are creative agents with knowledge, values and skills that allow them to shape their everyday lives', cp. I.J.Davidson-Hunt et al 2012 *Biocultural design: A new conceptual framework for sustainable development in rural indigeneous and local communities*, S.A.P.I.E.N.S 5.2.

As indicated criticism of the economic growth concept – with its unbridled faith in the factory approach – was voiced many times in the post-war era. Some version of an **economics of sufficiency** was often the positive part of this criticism, e.g. with the eminent philosopher-economist Bob Goudzwaard. His 1974 *Shadows of faith in progress* (in Dutch) and 1976 *Capitalism and progress* (in Dutch and in English) had as one of its sequels M.L.A.ter Borg's PhD Thesis of 1982 *Innovation into eternity. Faith in technical progress in discussion* (in Dutch) and soon was paralleled by a positive program for an economy of sufficiency e.g. in B.Goudzwaard & H.M.de Lange 1986 *Enough of too much, enough of too little* (several editions in Dutch and in English). A focus at sustainability and alternatives for the consumer society is in K.van der Wal & B.Goudzwaard (eds) 2006 *Knowing borders. Starters for new thought about sustainability* and in

Other post-war authors likewise presented not just criticisms but alternatives for the dominant approach. In fact from the second half of the 19th century on a rich fund of publications had been formed, but it was completely neglected by mainline economists after the war, cp G.M.Hodgson 2001 *How economics forgot history*. Post-war economics was servant to technocracy as the dominant ideology of the times and it was 'simply not done' to make serious study of e.g. economic systems that did not adhere to the creed. Having subjected itself to technocracy there remained very little space for renewal: mainline economics experienced the petrification (of policy-dominated research) that Karl Mannheim had warned for in his *The problem of the intelligentsia: an inquiry into its past and present role*. Before long renewal was to be found near-exclusively with heterodox economists like J.K.Galbraith and N.Georgescu-Roegen. More recently Hilikka Pietilä offered a fundamental approach in her 1996 *The triangle of the human economy: household – cultivation – industrial production. An attempt to make visible the human economy in toto*, *Ecological Economics* 20, 113-127. The model of the economy that she presents helps us in the 'process of decolonization of our minds' as well as in rethinking our food system and economy at large.

At the core is the **free economy** of care, creativity and reproduction, non-monetary and ill-fitted for attempts at monetarization. It consists of gifts, care

and creativity in human relations, such as care within the family and community activities. It is also at the core of the reproductive economy where fertility and fruitfulness in essence are a gift, as is clearly seen from our dependence on ecosystem services of e.g. bees and earthworms and on soil fertility that's largely mediated by soil micro-organisms that are > 99% unknown to us. Evidently the free economy is also largely the source of the economy overall. It needs time and space for receptiveness and recovery and these are to be provided at the core of the socio-economic system if this is not to deteriorate and grind to a halt.

Other sectors of the socio-economy are essentially relational in character, e.g. teacher-student relations in education and nurse-patient relations in health care. Or they are to provide the first necessities of life for humans and biota, like local food systems/markets and home construction. Here the core activities need to be judged and guided according to their human and social services and not according to some supposed 'market value'. This then is the **protected economy** with protection to come from the local society as backed up by government with its public services. In a model of the economy it can be indicated as situated around the non-monetary core of the economy. Because of its essential character it decides about money expenses – and not the other way round.

Only outside this second circle of the economy there is the sector where money is the quick-and-easy measure of activities and products, in Pietilä's words the **fettered economy**. Yet, because money's evident inability to 'see' what are the life sources and what's essential in the socio-economy it still needs regulation if it's not to derail. After all the economy is at the service of humans and their co-creatures, not at the service of one-dimensional 'economic man'.

Alasdair MacIntyre, one of the most famous philosophers of the past half-century, likewise reminds us that '*to reason about the common good is to reason politically*' (on p. 140 of his 1999/2009 *Independent Rational Animals*). Here economics is subjected to the politics of the common good from the very start: '*I will not be able to find a place ... for dramatic art in my own life ... in a community in which the goods of theater are not given a certain priority in the allocation of communal resources*'. And he emphasizes: '*...economic considerations will have to be subordinated to social and moral considerations, if a local community that is a network of giving and receiving is to survive, let alone thrive*'. Note that economic considerations are likewise subordinated to ecological considerations, as these decide about the provision of fundamental communal resources.

The role of the state is not to define top-down and then to supply the local needs – that's the grievous mistake of our post-war technocratic approach that brought us the welfare state while at the same time disabling local communities and resources. Of course there's no doubt that '*There are numerous crucial needs of local communities that can only be met by making use of state resources and invoking the intervention of state agencies*' (MacIntyre). And as to our present predicament it is only too clear, as the great institutional economist J.K. Galbraith did not tire of warning, that the common good and the public realm are pushed to the margins where a money economy working with capitalist concepts takes over. That type of economy makes public space desolate and strangles communal life – the things that in every 'normal' type of economy form a

primary focus of attention. So in every 'normal' economy the state and its politics, though miles away from the values and modes of participation of local communities, attend (always very imperfect for sure) to it that life at the local level can blossom. And leaves it at that because '*... it is the quality of politics of local communities that will be crucial in defining those [locally decisive] needs adequately and in seeing to it that they are met*'. We all agree that a focus at the local 'common good' implies '*Utopian standards, not too often realized outside Utopia, and then only ... in flawed ways*'. Yet, MacIntyre rightly emphasizes that it's not the flaws but the direction of our efforts that decides if something good can come of it:

But trying to live by Utopian standards is not Utopian, although it does involve a rejection of the economic goals of advanced capitalism. For the institutional forms through which such a way of life [of a local community that is a network of giving and receiving] is realized, although economically various, have this in common: they do not promote economic growth and they require some significant degree of isolation from and protection from the forces generated by outside markets. Most importantly, such a society will be inimical to and in conflict with the goals of a consumer society. But to take note of this directs our attention to the extent to which these norms are to some extent already accepted in a variety of those settings – households, workplaces, schools, parishes – in which the resistance to the goals and norms of a consumer society is recurrently generated. And, where such resistance is found, it is characteristically within groups whose social relationships are those of giving and receiving'.

'Economic growth' and 'consumer society' are post-war concepts that have run their course, disabling both community and ecology and with them the workings of a normal economy. Any 'normal economy' focussing at guarding the common good at the local level will be very imperfect, yet, because of this focus will give some space to local creativity, care and renewal. Exactly because it strangles such space late capitalism/neo-liberalism can in no way be called a 'normal' economic system. In what follows we will therefore stick to a Pietilä model of the economy.

2. Re-thinking the Green Revolution and its agronomy

The process of rethinking and redesigning has been on its way for decades by now. As to the rethinking, Shiva's classic (1991) *The Green Revolution in the Punjab*, Ecologist 21 issue 2, gave ample proof of her opening statement 'The Green Revolution has been a failure'. Yet, agri-food transnationals as well as many governments did not consider such penetrating analyses of the Green Revolution. As a result the disparity between the widely published messages of those transnationals and governments and independent research could only deepen. This became sadly evident with the publication of the IAASTD reports in 2008 (see later).

Then in 2008 the **price rises for food** that resulted in wide spread deprivation as well as food riots proved to be closely connected with **food speculation** and other adverse economic practices. This brought a final turn to **agro-ecological agriculture** and local **food sovereignty** in evaluations that were not dependent on industry finances. Some relevant publications:

Olivier de Schutter (UN Special Reporter on the Right to Food) Briefing note 01 September 2010 *Food commodities speculation and food price crises*

A.Zawojka (Warsaw University of Life Sciences Dept of Economics and Economic Policy) 2010 *Speculative drivers of agricultural price volatility and food security*

M.Pimbert 2010 *Towards food sovereignty. Reclaiming autonomous food systems*, Ch.7: Transforming knowledge and ways of knowing. IIED, London

March 2011 News Release by the UN High Commissioner on Human Rights *Eco-farming can double food production in 10 years, says new UN report*. It quotes Olivier de Schutter 'Conventional farming relies on expensive inputs, fuels climate change and is not resilient to climate shocks. It is simply not the best choice anymore today' and 'Today's scientific evidence demonstrates that agroecological methods outperform the use of chemical fertilizers in boosting food production where the hungry live – especially under unfavorable circumstances'.

Olivier de Schutter's December 2011 *Report on the right to food*, submitted to the UN Human Rights Council. It identifies agroecology as the most desirable mode of agricultural development.

This move towards small-scale, ecology-based agriculture has been strengthened by studies about the **health and other implications** of products and activities of the **agri-food transnationals** after earlier publications on their power concentrations. Some relevant publications:

A.D.Currey, B.P.Hinote 2011 *The evolution of industrial food production: McDonaldization and population health*, Scientia et Humanitas Spring 2011

Oxfam February 2013 *Behind the brands. Food justice an the 'Big 10' food and beverage companies*

M.Joseph, M.Nestle 2009 *The ethics of food*, Medical Ethics 16, Issue 1

Big Food, Big Agra, and the research universities – Interview of Cat Warren with Marion Nestle for the American Association of University Professors, www.aup.org November-December 2010

M.Joseph, M.Nestle 2012 *Food and politics in the modern age: 1920-2012* (Book Chapter)

D.Stuckler, M.Nestle 2012 *Big Food, food systems, and global health*, PLoS Medicine Volume 9 Issue 6, e1001242

Union of Concerned Scientists 2012 *Heads they win, tails we lose. How corporations corrupt science at the public expense*

The global agro-food sector and transnational corporations, International Journal of Sociology of Agriculture and Food 8 (1999) Special Thematic Issue

R.R.Moreira 2001 *The fertiliser industry, the concentration in the pesticides/ grain agribusiness sector and strategies of the firms in the UnitedStates*

But it is the **internal lack of qualifications** that is most disturbing about the Green Revolution and its agronomy.

P.J.Jacques and J.R.Jacques in their 2012 *Monocropping cultures into ruin: The loss of food varieties and cultural diversity*, Sustainability 4, 1970-1997 (they quote Sauer, see above) touch a.o. upon the **destruction of biodiversity** that is part-and -parcel of the Green Revolution.

Many of the volumes published by the Secretariat of the Convention on Biological Diversity show that, different from the Green Revolution approach, biodiversity-based approaches were and are perfectly possible. A beautiful anthology is their 2010 *Sustainable use of biological diversity in socio-ecological production landscapes*, CBD Technical Series No.52.

Another useful volume is the Synthesis report INRA 2008 *Agriculture and biodiversity. Benefiting from synergies*.

Industry spokesmen promote the view that high-input agriculture takes less land and so leaves more for biodiversity conservation, yet, this view is flawed, see:

T.Tscharntke et al. 2012 *Global food security, biodiversity conservation and the future of agricultural intensification*, Biological Conservation 151, 53-59

J.Fischer et al 2011 *Conservation: limits of land sparing*, Science 334, 593

I.Perfecto, J.Vandermeer 2010 *The agroecological matrix as alternative to the land-sparing/agricultural intensification model*, Proceedings National Academy of Sciences 107, 5786-5791

J.Fischer et al 2008 *Should agricultural policies encourage land sparing or wildlife-friendly farming?* Frontiers in Ecology and Environment 6, 380-385

Biodiversity destruction is one of the aspects that is lightly passed over when spokesmen of transnationals emphasize that only large-scale, industrial agriculture can provide all the food that the world will need in the near future. Many more **aspects in which industrial agriculture fails and alternatives are at hand** come to the fore in the anthology: M.Gerwin (ed) 2011 *Food and democracy. Introduction to Food sovereignty*, Polish Green Network.

More specifically the 'New Green Revolution for Africa (AGRA)' that's pushed by the Gates Foundation and Rockefeller Foundation has nothing to commend: A.Mittal, M.Moore (eds) 2009 *Voices from Africa. African farmers and environmentalists speak out against a new Green Revolution in Africa*, The Oakland Institute. The first contribution in that volume documents that the AGRA campaign was largely designed by Monsanto, the company that qualifies as the biggest brake on sustainable agriculture. See Union of Concerned Scientists 2012 *Eight ways Monsanto fails at sustainable agriculture*.

Quite generally big agri-food transnationals evade discussion with high-level independent research but organise their own congresses instead where they repeat their own points of view. The reactions to the **International**

Assessment of Agricultural Science and Technology for Development IAASTD
offer a sad example:

The IAASTD Reports *Agriculture at a Crossroads* were published in 2008. The *IAASTD Synthesis Report* and its *Towards multifunctional agriculture for social, environmental and economic sustainability* are among the wider known IAASTD documents.

M.G.Rivera-Ferre 2008 *The future of agriculture*, EMBO reports 9, 1061- 1066 gives an overview of the IAASTD and exemplifies the appreciation of it by independent researchers.

I.Scoones November 2008 *Global engagements with global assessments: The case of the IAASTD*, ISD Working Paper 313 analysed a.o. the surge of objections and denials,

Next the disputes over IAASTD have been well analysed in S.Feldman, S.Biggs 2012 *The politics of international assessments: the IAASTD process, reception and significance*, Journal of Agrarian Change 12, 144-169

Decisive inside information on the role of transnationals in the process gives A.Hilbeck (ETH Zürich Inst. Of Integrative Biology) *The IAASTD report and some of its fallout – a personal note*.

An overview of some more problems to which agri-food transnationals pay lip service or stay utterly silent follows.

Industrial agriculture is a primary cause of the ***Reactive Nitrogen problems*** that are such a massive threat to ecology and health.

A report that integrates several high-level research trajectories is: M.A.Sutton et al 2009 *Managing the European Nitrogen Problem. A proposed strategy for integration of European research on the multiple effects of reactive nitrogen*, Centre for Ecology and Hydrology/Partnership for European Environmental Research.

The participants of the international conference ‘Nitrogen and Global Change’, Edinburgh April 2011, issued the *Edinburg Declaration of Reactive Nitrogen* in conformance with all actors in high-level research on the problem.

NitroEurope IP 2011 *The nitrogen cycle and its influence on the European greenhouse gas balance* is the final report integrating European 2006-2011 research into reactive nitrogen and climate science.

A focus at climate consequences of the global nitrogen cycle is in: B.L.Bodirsky et al (Potsdam Institute for Climate Impact Research) 2012 *Current state and future scenarios of the global agricultural nitrogen cycle*, Biogeosciences Discussions 9, 2755-2821.

Coupling environmental impact and diet is: G.Eshel, P.A.Martin, E.E.Bowen 2010 *Land use and creactive nitrogen disarche: effects of dietary choices*, Earth Interactions 14 Paper 21 (15 pp.), a physics/geophysics contribution in which they show that nutritionally sound diets requiring a quarter of the active

nitrogen would only need a quarter to a third of the land that the mean American diet needs now.

An incisive evaluation of industrial **nitrogen fertiliser effects in agriculture** itself is inevitable. Valuable because of its historically informed approach is R.Estupinan Silva, B. Quesada 2010 *El proceso Haber-Bosch en la sociedad agroindustrial: peligros y alternativas* in the vol. 'El sistema agroalimentario: Mercantilización, luchas i resistencias'. It is worthwhile to quote the English Abstract in full:

'Rarely, science and politics have been so nearly linked between each other as in the Haber-Bosch process. The industrial synthesis of nitrogen is the basis of agro-industry and actively participates in the war industry, among other aspects of the economy. This article aims to show what is behind the intensive use of chemical fertilizers produced with this process. The consequences go beyond health and welfare of individuals, reaching to communities and future generations. The alternatives exist and are at hand. However, assuming them represents a total rethinking of the means of production and consumption of the Haber-Bosch era and involves legal strategies and social policies at all levels, where the individual must be rediscovered as a political and social responsible subject for the promotion of local, traditional and organic agriculture'

The notion that the world's food supply depends completely on industrial fertiliser is unfounded: **biological nitrogen fixation** can make up for it, see:

C.Badgley et al. 2006 *Organic agriculture and the global food supply*, Renewable Agriculture and Food Systems 22, 86-108. This is known a long time, with Nobel prize winner (for biochemistry and agricultural chemistry) Arturi Virtanen in the January issue of 1953 *Angewandte Chemie* emphasizing that intensification of agriculture ought to be done with intensification of biological nitrogen fixation and not by increasing industrial fertiliser supply.

We find the same emphasis at **low-input agriculture** in e.g. UNEP-UNCTAD 2008 *Organic agriculture and food security in Africa* and in

the KIT-Workshop proceedings R.Meyer, D.Burger (eds) 2010 *Low-input intensification of developing countries' agriculture – Opportunities and barriers*.

That **high-input agriculture** led to **soil deterioration** and other major problems in Africa is a.o. documented by the recent (May 2013) WWF/Heinrich Böll Stiftung report *A soiled reputation. Adverse impacts of mineral fertilisers in tropical agriculture*. The problem is acute for tropical soils but known from elsewhere for more than 60 years – e.g. publications of Sekera beginning 1950s – and its backgrounds were recently investigated in-depth:

L.J.Henao Valencia 2008 *Étude des bases moléculaires de l'agrégation des sols par des exopolysaccharides bactériens*, Thèse Université Joseph Fourier

K.Hartmann et al 2009 *Vergleichende Untersuchungen der Infiltrationseigenschaften von konventionell und ökologisch bewirtschafteten Böden*, Julius Kühn-Institut

C. Le Guillou 2011 *Effets combinés de la qualité des résidus de culture et de la disponibilité en azote minéral sur la stabilisation de la structure du sol par les microorganismes*, Thèse AgroCampus Ouest

R.Alhassoun 2011 *Studies on factors affecting the infiltration capacity of agricultural soils*, Dissertation aus dem Julius Kühn-Institut.

Note that the two German publications emphasize that soil recovery depends on (1) stimulation of ecosystem services of earthworms and other biological actors for which (2) increased application of organics is essential, while at the same time (3) downsizing mineral nitrogen application plus (4) a change to machines with low axle load and (5) reduced tilling are needed to prevent recurrence of deterioration. This means, in effect, that the change-over from 'traditional' agriculture emphasizing organic inputs and local biotic agents to high-external-input 'industrial' agriculture was a failure on all major accounts.

C. Livelihoods and ecosystem services vs commodization/commodification

Commodification

It is tempting to equate ***commodification/commodification*** with offering objects or services for sale. Yet, taking an 'object' out of its context and moving it to another one *at will* seems the minimum requirement for the term to apply. Essential is the willful denial of the relations that in fact belong to it. Slavery is a well known example, but 'hiring' a laborer can also shade into it. A good general discussion is in: I.Kopytoff 1984 *The cultural biography of things: commodization as process*, in A.Appadurai (ed) 1984 *The social life of things. Commodities in cultural perspective*, Ch.2.

Note that under communism not the monetary valuation of a product but the decision to move production from households and artisanal workshops to big industry decided about its 'commodification'. This shows that the concept has a distinct ***political*** character: it implies the denial of autonomous production and distribution of a product by households and artisans. This indeed characterized the pre-war totalitarian systems of Soviet Russia and to a considerable extent also Nazi Germany, and those regimes extended it to the countries they occupied. There is a great lack of studies in this field, but a valuable exception is: Charles Bettelheim 1946 *L'économie allemande sous le nazisme*.

Note that the war economy in all countries that were involved was very directive in character with production and distribution centrally directed 'by force of law'. In most countries this shaded over into the post-war regulated economy, e.g. in France, the UK and the Netherlands. But even in the USA the war brought a sea change, with 30% of total manufacture in 1940 coming from big industry and 70% in 1946, that is with smaller enterprise now relegated a definite secondary place. With 'productivity growth' the singular aim of economic policy in post-war years big industry stayed in focus and smaller workshops stayed out of it. Large scale production uncoupled from local community and resources and from

artisanal labour was favoured. That is, the focus of production was no longer on local people and their community but on 'commodities' instead.

Jacques Ellul saw clearly the rise of this de-humanized society that focussed at things instead of people. In his lecture (for the 1948 WCC conference) *'The situation in Europe'* he emphasized that a *totalitarian* society resulted (the term is his), in conformance with its origin in the war economy. In his 1963 book *The technological order* he gave an extended analysis of our *technocratic* society. First class minds like Simone Weil and Eugen Rosenstock-Huessy pointed to ways out, but their advice fell on deaf ears with post-war governments (Rosenstock-Huessy's advice was partly heeded in some notable industry experiments).

Yet, *'commodities do not escape their origins'* emphasizes Rupert Read rightly. In his 2011 *There are no such things as 'commodities': a research note*, Journal of Philosophical Economics 4, 93-104 he shows that commodification is always questionable – only the extent differs - and that *'we must put commodification into reverse'*. That is what many people who work in the education or health sector are determined to do: teaching or nursing can only exist in the relation teacher-student or nurse-patient. Commodification means abstracting from those relations with an empty 'product' as a result.

More generally it means neglecting the essential relations with people and ecology – to the great disadvantage of everybody and everything concerned. With commodification at the core of mainstream economics it *'is built on a foundation of fallacies'*, explained Korten in his 2011 lecture before the US Society of Ecological Economics. Confusion of ends and means is an important one *'reflected in the convention of treating people and nature as externalities... rather than treating the well-being of people and nature as the purpose of economic activity, suicide economics [mainstream economics] treats people and nature merely as means for making money fro people who have money, a grotesque reversal of means and ends... Serving people and nature is the only legitimate purpose of an economy'*. And rightly Korten speaks of 'suicide economy' because it denies the very contexts and relations that are its well-spring.

Note that commodification is also at the core of the Green Revolution with its suggestion that technical inputs can substitute for the local organic-biotic relations plus the farmer's caring labor that are at the roots of soil fertility. Though presented with an air of supremacy there was in fact no justification for this supposed substitution: a one-dimensional mineral fertiliser solution lacks the biota, hierarchy and structure with its many degrees of freedom that is characteristic of a fertile soil. Researchers after the war in e.g. Germany were not slow to point at the difference but ultimately received a deaf ear with policy makers. With loss of soil structure and fertility after several decades of high-input agriculture only too evident it is sure that also here *'we must put commodification in reverse'*.

It is well known that the Green Revolution was introduced to counter anything that looked like a Red Revolution (one of the reasons it was warmly wellcomed by military dictatorships). It promised a short cut to food sufficiency without

social (and ecological) reform by abstracting from the dimensions and relations that in reality are inherent to agriculture. Industrial fertiliser was presented as a substitute for soil fertility and organic husbandry, 'approved' crop varieties for locally adapted landraces, pesticides for pest-/disease-suppressing crop rotations and co-cultures, and centrally designed protocols for local knowledge and experience. In short an 'industrial' package was supposed to substitute for the local art of farming using ecological and other local resources.

Its promotion 'by force of law' in post-war decades was indeed very effective in disowning and marginalizing the farmer. Yet, real-life agriculture was all the time dependent on real soil and soil life, on favorable crop interactions with the local environment, on an array of local ecosystem services, and on farmers who knew how to re-make unforeseen problems into opportunities. The Green Revolution agronomy with its industrial package was by and large blind to it all and has therefore little to offer for sustainable agriculture and food provision.

Livelihoods and the art of farming

But after decades of strong faith in 'industrial' agriculture that statement is hard to swallow for government officials and industrialists who built their power with Green Revolution means. After the bankruptcy of the financial economy they still turn to the **financialization of food** – about which J.Clapp 2012 rightly asks *The financialization of food: Who is being fed?* (paper presented at the Conference of the International Society for Ecological Economics). The grossly problematic character of it all has been well described in two anthologies and a recent report: B.Lilliston, A.Ranallo (eds) 2011 *Excessive speculation in agriculture commodities: selected writings from 2008-2011*, IATP Institute for Agriculture and Trade Policy. B.Lilliston, A.Ranallo (eds) 2012 *Grain reserves and the food price crisis: selected writings from 2008-2012*, IATP. For the report: N.Hossain, R.King, A.Kelbert 2013, *SQUEEZED. Life in a time of food price volatility*, IDS/GROW/Oxfam.

Indeed in spite of Africa's very real ecological problems adverse international economic policies are still the main threat to food production – see A.Mushita, C.Thompson 2013 *More ominous than climate change? Global policy threats to African food production*, African Studies Quart. Vol.13 Issue 4, 25 pp. 'Land deals' (**land grabbing**) are an important aspect of those threats, see:

L.Cotula, S.Vermeulen, R.Leonard, J.Keeley 2009 *Land grab or development opportunity? Agricultural investment and international land deals in Africa*, FAO/IIED/IFAD. Those 'land deals' are often presented as needed for overriding economic purposes, see M.Levien 2011 *The land question: Special economic zones and the political economy of dispossession in India*, paper read at the Int. Conf. On Global Land Grabbing April 2011. Yet, their practice is that of dispossession, leaving many small farmers in a more precarious situation than before. The real issues have been succinctly formulated by Vandana Shiva 2011 *'The 1991 World Bank structural adjustment programme reversed land reform, deregulated mining, roads and ports. While the laws of independent India to keep land in the hands of the tiller were reversed, the [colonial!] 1894 Land Acquisition Act was untouched. Thus the state could forcibly acquire the land from peasants and tribal peoples and hand it over to private speculators, real estate corporations, mining corporations*

and industry', see Vandana Shiva: *The great land grab, India's war on farmers*, Aljazeera June 7, 2011. For general studies of the phenomena see: W.Anseeuw et al 2011 *Land rights and the rush for land: Findings of the Global Commercial Pressures on Land research project* IIED CIURAD ILC. L.Cotula 2012, *The international political economy of the global land rush: A critical appraisal of trends, scale, geography and drivers*, J. of Peasant Studies 39, 649-680.

In Africa dispossession is often cloaked in enthusiastic stories about 'A Green Revolution for Africa' **AGRA**. An example is the government of Malawi with its fertiliser and maize subsidy program that paid off because of some years of above-average rainfall (without which fertiliser-based maize culture can turn into a disaster), yet, that is sure to bring further land concentration (as expected by the AGRA proponent the Gates Foundation itself). After decades in which access to land became dramatically worse still to continue land concentration and above that stimulate soil fertility deterioration (as a result of fertiliser over-supply, organics under-supply) is to invite disaster. See GRAIN 2010 *Unravelling the "miracle" of Malawi's green revolution*, Seedling January 2010. IRIN Africa April 2012 *Malawi: Without land reform, small farmers become "trespassers"* (IRIN is the humanitarian news and analysis of the UN Office for the Coordination of Humanitarian Affairs).

As the Malawi example teaches us governments are easily seduced to offer 'quick fits' where in fact they ought to initiate true land reforms. Note that it was the pretence of the Green Revolution from the very start that increasing food supply without institutional and socio-economic reforms was perfectly possible. The fly-wheel effect of that false pretence is still with us, the more so because it is tempting for governments subsidizing bags of industrial fertiliser to take on the role of 'dispensers of fertility'. Yet, there is no solution to **food security** than **food sovereignty**. The situation in Ethiopia brings it home clearly. 'In 2010 Ethiopia was home to 2.8 million people in need of emergency food aid; yet this country had concurrently sold more than 600,000 hectares of agricultural land to transnational companies that export the majority of their produce', L.Cochrane 2011 *Food security or Food sovereignty: The case of land grabs*, Journal of Humanitarian Assistance, July 5.

The Scoones group speaks of the 'New enclosures': B.White, S.M.Borras Jr., R.Hall, I.Scoones, W.Wolford 2012 *The new enclosures: critical perspectives on corporate land deals*, Journal of Peasant Studies 39, 619-647. It is a reminder of peasant dispossession in 18th and 19th century England that then supplied the cheap labor force for industry barons with their outrightly criminal behavior. Dickens' *Little Dorrit* pictures something of this destructive epoch. In his 1926 *The outline of sanity* Chesterton had little patience with capitalist concentration: 'The present problem of capitalist concentration is not a question of law but of criminal law, not to mention criminal lunacy'. Economically it is lunacy and humanitarian it is criminal so it makes perfect sense to address governments everywhere to bring justice to their common citizens by bringing the capitalist under the yoke of the law.

Of course the produce of the 'New enclosures' will be part of the monetarized economy, quite different from the produce of the displaced farmers that's mainly

part of the subsistence economy. A focus on 'productivity growth' or on a still more abstract 'economic growth and development' will even be used to suggest an increased food provision where in fact none is to be had. See for a thorough analysis of the concepts: Sabine Alkire 2010: *Development "a misconceived theory can kill"* OPHI (Oxford University) Working Paper No.11, also in C.Morris (ed) 2010 *Amartya Sen* (in the Series Contemporary Philosophy in Focus). R.Costanza, M.Hart, S.Posner, J.Talberth 2009 *Beyond GDP: The need for new measures of progress*, Pardee Papers No.4. If the policy goal is a sustainable increase in food provision the right focus is the local agricultural and living conditions of real people, that is a **livelihoods** focus that includes the peasant's **art of farming**.

The peasant/small farmer's 'indigenous knowledge' is at the core of her 'art of farming'. Some examples: M.Cairns (ed) 2007 *Voices from the forest. Integrating indigenous knowledge into sustainable upland farming*. B.H.Z.Moyo 2010 *The use and role of indigenous knowledge in small-scale agricultural systems in Africa: the case of farmers in northern Malawi*, PhD Thesis University of Glasgow. A rich array of practices provide alternatives to the Green Revolution approach, see e.g.: K.Padmavathy, G.Poyyamoli 2011 *Alternative farming techniques for sustainable food production*, in E.Lichtfouse (ed) 2011 *Genetics, biofuels and local farming systems*. The Systems of Rice/Crop Intensification SRI by now has been well published, see

A useful anthology of publications pertaining to aspects of *Livelihoods* is: *Key readings – FAO*. Joseph Pearce makes a strong case for a general focus in economics at local livelihoods in his book: J.Pearce 2005 *Small is still beautiful. Economics as if families mattered*. The Livelihood focus links up with the local farming household and community and its **peasant unit of production** – for which see especially Jan Douwe van der Ploeg 2013 *Peasants and the art of farming. A Chayanovian Manifesto*. As Van der Ploeg emphasizes in his 2013 *Peasant-driven agricultural growth and food sovereignty*, ICAS Review Paper No.6, 'peasant agriculture has the best credentials for meeting food sovereignty and has the capacity to produce (more than) sufficient good food in a way that can satisfy the (many) objectives of producers themselves as well as for society at large'.

Agro-biodiversity is essential here, e.g. M.Frei, K.Becker 2004 *Agro-biodiversity in subsistence-oriented farming systems in a Phillipine upland region: nutritional considerations*, Biodiversity and Conservation 13, 1591-1610., and E.A.Frisdon, J.Cherfas, T.Hodgkin 2011 *Agricultural biodiversity is essential for improvement in food and nutrition security*, Sustainability 3, 238-253. In this connection the transition from subsistence agriculture to forms of commercial agriculture can easily entail increased vulnerability, e.g. Y.Fu et al 2010 *Agrobiodiversity loss and livelihood vulnerability as a consequence of converting from subsistence farming systems to commercial plantation-dominated systems in Xiashuangbanna, Yunnan, China: a household level analysis*, Land Degradation & Development 21, 274-284.

A technical package-based approach has little to commend, but a local **gender- and biodiversity-based** approach is viable, see FAO 2005 *Building on gender, agrobiodiversity and local knowledge* and FAO/PAR 2011 *Biodiversity for food*

and agriculture. But note that post-war policy rejected use by the farmer of her landraces and equated 'improved varieties' with inputs to a factory process. The adaptive interactions with the environment (including epigenetic inheritance) were largely denied, as was the decisive value of farmer varieties for local 'evolutionary plant breeding'. It was part of the completely unfounded denial of the *peasant's art of farming* (see quote Carl O.Sauer). Yet, it was this denial that was used to sideline the farmer's use of his local resources and push 'industrial' agriculture and the Green Revolution agronomy instead.

So when R.Künnemann 2009 emphasizes the need for *Policies to overcome the marginalisation of African peasant farmers*, this implies rectification of the adverse policies (and laws) that are at the very base of 'industrial' agriculture. Other than the peasant's knowledge and art of farming, 'industrial' agriculture and the Green Revolution agronomy start essentially from negative premisses and their ecological quality is very low at best. Note in this connection that essential differences between agriculture and industry were indicated by authors like Schumacher, but were not considered by policy makers. See R.Naeem *Why small is still beautiful? E.F.Schumacher and his economics in dangerous times*, Proceedings 2nd International Conference on Business Management.

Summarizing we concur with L.G.Horlings, T.K.Marsden 2011 in their *Towards the real green revolution? Exploring the conceptual dimensions of new ecological modernisation of agriculture that could 'feed the world'*, Global Environmental Change 21, 441-452: The peasant's art of farming is a real starting point for a 'real green revolution', but 'industrial' agriculture lacks the ecological and other qualities that are needed for sustainable food provision.