Socrates Schouten
Essay for Ethnobotanical Knowledge Systems, 2009

Resilience: the philosophy of socio-ecological leeway

An analysis of contemporary and traditional agricultural paradigms

ABSTRACT – The Green Revolution has imposed a high-input-high-output paradigm that reveals its flaws especially in fragile, instable ecological areas where it is ecologically and economically untenable. Much of the failure in Sub-Saharan Africa and other vulnerable regions can be ascribed to a mismatch both cultural (Western 'master-and-possessor' paradigm versus indigenous holistic cosmology) and ecological (ignorance of ecological complexity and extrapolation of potent farming conditions to marginal areas). Agroecology is a strategy with a range of techniques that may both revitalize or improve marginal agriculture and bring ecology back to intensified, high-input agriculture. It offers scope for agriculture in marginal areas, currently often erosive, to become 'well-functioning' while avoiding that this is accompanied by large increases in external inputs and homogenization. Intensive agriculture can be improved by using more integrated and holistic techniques. To this end, the concerted action of human and nature should form the basis of sufficient, and sustainable, productivity. I propose resilience as an important and potent tool in achieving this. Resilience opens up new opportunities in the foggy path towards a more sustainable world. With keeping 'resilience' and 'leeway' in mind, a valuable asset could be added to society's developmental basket.

Introduction

Many texts on alternative approaches in agriculture start out with crediting the Green Revolution for having doubled world grain output over a 30-year period, and then proceed to point out its erratic side effects in the environmental and social spheres. For the newcomer, the name 'Green Revolution' can raise considerable confusion. In modern vocabulary, 'green' refers to every effort or system that has been tailored to impact the environment significantly less than does its conventional counterpart. The Green Revolution, however, refers to the global effort in global agricultural intensification (or rather, industrialization) from the 1960s onward, accompanied by enormous increases in application of disruptive agrochemicals and reductions in field heterogeneity (Tilman *et al.* 2002, Benton *et al.* 2003). While harmful to many an environment, proponents point out that the levels of intensification achieved during this period, apart from being necessary to 'feed the world', have saved an enormous quantity of natural land from conversion to arable land (e.g. Djurfeldt *et al.* 2005). Agricultural research and extension has generated enormous advances in our understanding of and control over plant growth and morphology, stress tolerance, pathogen resistance, and many such other fields. Without it, especially developing countries would have experienced lower production, lower per capita caloric intake and higher imports (Evenson & Gollin 2003).

Regardless of one's view of how benign the Green Revolution has been over the whole, it is acknowledged that its successes are stalling. Technically, most of the potential increase in productivity has already been reaped: the exploitable gap between yields achieved on the farm and genetic yield potential is closing (Cassman 1999). Practically, the Revolution has not been able to reach and benefit many of the poorest rural inhabitants that remain at risk of food scarcity and economically and physically dependent on national and international agencies (Alexandratos 1995, Lipton 2007). As it is foreseen that by 2050 the world will reach a population of 9-10 billion, diets will contain more land-consuming animal products, and fossil fuels will have been partially replaced by fuels of agricultural origin, this discussion is in no way one of mere retrospection.

This essay delves into the standards of agricultural practice and examines how these deviate from traditional practices, that are finding their way back as 'alternative' strategies. After a treatment of the Green Revolution, these alternatives are elaborated, and then scrutinized against their historical background. A look into such alternative, traditional approaches reveals some interesting characteristics that can be learned from by Western scientists and policymakers. I end with a plea for the adoption of the concept of 'resilience' to further broaden the scope for a sustainable society.

The Green Revolution, a misconceived model of attaining food security?

The coming-to-be of civilization has almost fully revolved around the issue of food production, as appealingly explicated in Jared Diamond's *Guns, Germs and Steel* (1997). Tailoring soils and ecosystems to provide reliably in the needs and wants of the people has been a primary activity for over 10,000 years. Wild plant species have been strongly modified and brought into cultivation; if anything, 'Green Revolution' researchers cannot be blamed for developing high-yielding crop varieties, as this is merely continuation of past practice. However, over two centuries of modernization has done away with many 'local' delicacies and promoted 'one size fits all' solutions.

The development of modern varieties has largely been the work of international agricultural research centres, often complemented with further breeding by national institutes (Evenson & Gollin 2003). While increasing productivity and decreasing risk of famines might have been the major objective, there were also other important forces and motives at work. As Shiva (1991) puts it, "the Green Revolution has been heralded as a political and technological achievement, unprecedented in human history. It was designed as a techno-political strategy for peace, through the creation of abundance by breaking out of nature's limits and variabilities". The argument of critics runs that the Green Revolution was not merely a scientific programme aimed at increasing yields, but a means of strengthening the grip of states and their financial institutions on agriculture, which was to become a global food *industry*.

While this is too powerful a notion of reality for my liking, the praxis of both conventional agricultural research and its extension have indeed been shaped by a dominant development paradigm that concentrated on exerting technological control over nature[1] and

[1] This can be traced back to the roots of modernization. As De Groot *et al.* (2008: 11) write: "Modern Western culture, characterised by the Cartesian image of humans as 'Master and possessor of nature', arose of the convolution of the Judaic and Greek roots, a process in which Judaic voluntarism and Greek hierarchy were merged but without including their two 'inhibitions', giving rise to an unbridled exploitation of nature". ('Cartesian' (referring to Descartes) and also 'Newtonian' are regularly used to indicate analytical, dualist

imposing modernity on those that are behind[2]. Scientifically, positivism and reductionism were decisive currents. Positivist philosophy, which stresses the primacy of empirical evidence and pursues the generation of infallible scientific theories, has dominated scientific research throughout most of the twentieth century. In positivism, reality is driven by immutable natural laws, which should be investigated by experiment and manipulation, performed by a noninteractive, objectivist agent (Tacconi 1998). In other words, scientists aimed to obtain definitive and distinct answers to scientific questions, convinced of their existence. The reductionist paradigm denied natural complexity and favoured technologies that are the most straightforward in terms of management. Conventional agricultural research was market-oriented and focused on maximising production of particular commodities, and not total farm production (Reijntjes *et al.* 1992). In addition to the development of modern varieties, augmented with agrochemicals (insecticides, herbicides, fossil fertilizers) to obtain highest productivity, improvements in efficiency have been sought through homogenization and the scaling up of agriculture. Non-crop species were regarded as weeds or pests, ecosystem dynamics (that might be employed beneficially) disregarded and other ecosystem services ignored. Although plants are living organisms, agriculture was regarded

> *"... as a mechanical process, with inputs being converted into outputs by some fixed formula (...). The relation posited between inputs and outputs is different for mechanical and biological paradigms. In the first, the ratio of outputs to inputs is predictable and proportional, fixed and usually linear. In the realm of nature, on the other hand, relationships are less predictable and seldom proportional. Large investments of inputs can come to nought, while under favourable conditions and with good management, modest inputs have many-times-larger effects."* (Fernandes *et al.* 2002: 29)

The strategy of developing modern or high-yielding crop varieties has established *high-external input agriculture* (HEIA) in most of the world's areas. When productivity is below expected or desired levels, the blame is on insufficient inputs or a technology gap. Evidently, this technological approach has left us with "four equations in need of revision" (Fernandes *et al.* 2002: 30):

1. Control of pests and diseases = application of pesticides or other agrochemicals;
2. Overcoming soil fertility constraints = application of chemical fertilizers;
3. Solving water problems = construction of irrigation systems;
4. Raising productivity beyond these three methods = genetic modification.

Such strategies have clearly succeeded in increasing world grain output, but the strong inherent reliance on inputs has some major disadvantages. Commercial crop varieties and the agrochemicals needed to keep them viable are expensive and require proper infrastructure. If a crop fails and there is little to sell, the costs of the initial investments in technology and inputs can leave the farmer in sudden poverty and debt. Conventional agricultural technologies are usually subsidized or provided for in a development project; however, many such projects are temporary, and the farms unlikely to continue their achievements beyond the period when external inputs are provided.

Differences in ecological circumstances between regions, and the specific crops that are suitable and culturally important in different places, have also received insufficient attention. Rice and wheat have been the two crops that most research has revolved around,

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(science and spirituality are or should be separate), cause-and-effect-centred science or thinking, highlighting the importance of Renaissance contributions to modern thinking.) See also Haverkort and Hiemstra (1999: 12-13).

[2] See for example Blaikie *et al*. (1997: 220, 'The classic paradigm') and Sillitoe (1998: 212, 'modernization').

especially in the earlier stages. After varieties suitable to Asia and Latin America had been successfully introduced in those continents, the same varieties were brought to Sub-Saharan Africa[3], aiming to 'short-cut' the regional varietal improvement process (Evenson & Gollin 2003). The use of unsuitable varieties has led to underperforming or wholly failing crops, while traditional agriculture was in the process of being gradually replaced by modern systems. That being said, the question comes to mind whether traditional agriculture would have been able to develop itself into a viable source of nutrition for a growing population, and via what old or new pathway agricultural sustainability would actually be achievable?

Low-external-input agriculture and Agroecology

In the context of agriculture, "'sustainability' basically refers to the capacity to remain productive while maintaining the resource base" (Reijntjes *et al.* 1992). This means that a balance is needed between inputs and outputs of an agricultural system, that also needs to be economically feasible and has a fit with the cultural setting. When not endowed with considerable capital, practicing *low-external-input agriculture* (LEIA) is inevitable. Hence, LEIA is seen in areas where the commercial infrastructure is insufficient and the physical environment is very variable or challenging. Reijntjes and co-workers draw, in their treatise of HEIA and LEIA, a gloomy caricature of farming in developing (tropical) countries: farmers who pursue HEIA are seeing their investments vapourize; farmers who practice LEIA do so exhaustively, by overpumping and overploughing the land. However, low-input systems have been performing well in numerous areas. The challenge is to develop erosive forms of LEIA into 'well-functioning' ones, while avoiding that this is accompanied by large increases in external inputs and homogenization. To this end, the concerted action of human and nature should form the basis of sufficient, and sustainable, productivity.

In the approach of *agroecology*, an area used for agricultural production, such as a field, is regarded as a full-fledged ecosystem, a "[community] of plants and animals interacting with their physical and chemical environments that have been modified to produce food, fibre, fuel and other products for human consumption and processing" (Altieri 2002: 41). Ecological principles[4] are used to both improve production and to restore or maintain ecosystem services, with an aim of making the agroecosystem as much self-sustaining as possible. As a science, "agroecology focuses on the forms, dynamics and functions of interrelationships among environmental and human elements" (ibid.), and has brought about a fruitful marriage between 'old' (traditional) ecological practices and 'modern' scientific insights. Indeed, while the book that resulted from a 1999 conference on agroecology is persuasively titled "Agroecological *Innovations*" (Uphoff 2002a), the editor is quick to admit that agroecology borrows strongly on traditional, sometimes age-old agricultural practices. Many, if not all, of

[3] Sub-Saharan Africa (SSA) receives a striking amount of attention in literature on agriculture and development. In many cases where scholars generalize on SSA agriculture, it would perhaps be fairer to refer to 'rainfed and marginal areas', since these also occur outside SSA and similar approaches might be suitable to tackle their agricultural issues. Nevertheless, SSA remains the one region of greatest challenge. The Green Revolution's productivity gains have hardly reached SSA, while SSA farmers experienced the same price declines as elsewhere in the world (that did see their productivity go up systematically) and hence suffered actual income loss (Evenson & Gollin 2003). At the same time, SSA hosts the largest number of indigenous tribes, being the cradle of human life. SSA features a rather unique combination of environmental fragility, poor governance, resource-poor rural people and myriad indigenous knowledge.

[4] Ecological principles: enhancement of recycling of biomass, providing the most favourable soil conditions for plant growth, minimizing losses of energy and other growth factors, diversifying species and genetic resources and enhancing beneficial biological interactions and synergies (Altieri 2002: 42).

the examples of agroecological strategies listed in Table 1 have been in use by traditional communities for centuries. Nevertheless, population growth has driven many communities to overexploit their surroundings. Agroecological techniques may both revitalize or improve LEI-agriculture and bring ecology back to intensified, high-input agriculture.

Table 1: Agroecological methods to improve and sustain yields while preventing system-external inputs and maintaining ecological functioning (Altieri 2002, Fernandes *et al.* 2002).

Ecological strategy	**Examples**	**Explanation**
Temporal diversity	Crop rotations	Different crops have different nutrient demands, allowing for better nutrient conservation; also, the life cycles of insect pests, diseases and weeds are interrupted (Integrated Pest Management).
Spatial diversity	Polycultures (mixed cropping)	Mixed cropping can have remarkable synergistic effects (improved yields), but also practical use (e.g. climbing crops are planted against crops with rigid stalks). Seeding a new crop in a standing may enable the use of residual moisture.
	Agroforestry systems	Trees or other perennials are grown together with annual crops and/or animals, to capitalize on complementary relations between them.
Utilizing system-internal inputs	Cover crops and mulching	Nitrogen-fixating cover crops are grown and not harvested intentionally to replenish nutrients. 'Mulching' is the covering of the soil with a protective layer against soil erosion; this layer may also contain nutrients.
	Animal integration	The return of animal manure to the soil, perhaps after having free-ranged in grasslands, increases biomass output.
Biological pest control	Integrated pest management	Besides interrupting life cycles (see Crop rotations), certain plant species might attract natural enemies of pests, and other species might reduce parasitic loads and other diseases of farm animals.
Soil and water conservation	Terracing, contour bunding, improving soil structure	Levelling slopes and building ridges are strategies to prevent soil runoff by water and wind, and to retain rainfall water. Also protective plant cover is possible.

Local and traditional ecological knowledge

LEIA and marginal ecosystems are associated phenomena. Low-input, resource sustaining farming techniques are especially appropriate in fragile settings, and fragile settings have necessitated development of such conservation techniques in the first place (see the examples in Table 1). Local and traditional farmers can reveal a remarkable extent of knowing, understanding and 'wielding' the local environment. It is common to find a traditional people to possess individual and community wisdom and skills in

- indigenous soil taxonomies,
- indigenous knowledge for potential use of local plants and forest products, and animal behaviour and acquired hunting skills,
- local knowledge of important tree species for agroforestry, firewood, integrated pest management, the control of soil erosion and soil fertility, and fodder management,
- indigenous agronomic practices such as terracing, contour bunding, fallowing, organic fertilizer application, crop-rotation and multi-cropping,
- indigenous soil and water conservation and anti-desertification practices (Lalonde 1993: 56).

The high extent of local environmental knowledge is no surprise, realizing that their farming systems developed in dynamic interaction with that environment:

> *"Originally, agriculture (...) depended on local natural resources, knowledge, skills and institutions. Diverse, site-specific farming systems evolved out of a long process of trial and error in which balances were found between the human society and its resource base."* (Reijntjes *et al.* 1992: 6)

The local environmental circumstances form the delineations of how the inhabitants can live. Marginal areas, such as African drylands, are characterized by fundamental instability, or *disequilibrium* (Mortimore 1998), and the state of the agroecosystem is unpredictable from season to season. Periodic extremes are common, but preserving the capacity to absorb them requires considerable labour investment. Given the narrow margin of error that LEIA households experience, resource conservation should be equated with *risk management*. African farmers have developed a wide range of conservation techniques that afford them a "considerable amount of *flexibility* in organizing their production", something that is "wholly alien to commercial agriculture as we know it in Europe and the United States" (Dommen 1989: 36). In the West, risk management is undertaken using financial mechanisms to spread risk and safeguard rural income, and flexibility exists mostly on the side of financial buffers in government budgets. Such mechanisms are very limited in developing regions, and do not exist (as such) in traditional settings. There, indigenous social institutions provide the risk-averting controls and mechanisms for insurance:

> *"Farm management techniques aimed at [resource conservation] are greatly facilitated by the common property regimes that characterize many African rural societies. The influence wielded by paramount institutions such as clans and villages operates to ensure that farmers do not degrade the land resource that is entrusted to them for cultivation or grazing but 'belongs' to the community and its descendants as a whole. Government efforts to transform some of these common property regimes to private ownership regimes have met with failure. Small wonder that Western economists, equating security of tenure with investment in land improvement, sometimes see African common property regimes as an obstacle to development. They may erroneously attribute observed land degradation to the system itself, rather than to the breakdown of the institutional safeguards normally provided by the system under the shock of outside forces like colonialism, central government intervention, or excessive population pressure."* (Dommen 1989: 36)

Ecological conditions all over the world differ greatly, making that peoples in all these localities have developed different and often unique techniques to survival, together with their cultures and beliefs that sprouted along. Where 'modern' societies are predominantly identified by the advanced technological civilization they share, where the world is known rationally and mind and matter are separate concepts, indigenous knowledge stands opposite to such modernity. In indigenous cultures, integration of social, spiritual and natural life is full. Ecological knowledge cannot be seen separate from spiritual conviction; as a matter of fact, "spiritual practices [are] part and parcel of farming activities" (Haverkort & Hiemstra 1999), and the execution of rituals stands on equal foot with 'applied' practices such as in Dommen's quotation above. The world, in indigenous perception, is "a living being, its totality including not only natural elements such as plants, animals and humans, but also spiritual elements such as spirits, ancestors and future generations"; these 'cosmovisions' guide and regulate the whole of the organization of the indigenous people's culture and the way of daily life (Slikkerveer 1999).

The cumulative knowledge-belief-practice complex of a people concerning the relationship of living beings (including humans) with one another and with their environment is referred to as Traditional Ecological Knowledge (TEK). It is an "attribute of societies with historical continuity in resource use practice": those that are nonindustrial or less technologically advanced societies (often, but not necessarily indigenous[5] or tribal) (Berkes *et al.* 2000). TEK may be said to differ from Western 'scientific' or 'cosmopolitan' knowledge in a binary fashion on a number of levels (Slikkerveer 1999 and personal communication 2009), such as:

Western knowledge	**TEK**
Quantitative	Qualitative
Particularistic / reductionist	Holistic
Rational / mechanistic	Spiritual / intuitive
Large-scale	Small-scale
Macro-level	Micro-level
Etic: 'objective'	Emic: 'subjective'
General theories	Specific theories
Empirical	Narrative-based

There has been ample debate on the truth of such a dichotomy (Agrawal 1995, Sillitoe 1998). In my view, the above binary distinctions are conceptualizations rather than accurate descriptions: 'cartoon images' of the far extremes on the spectre of knowledge. These extremes are rarely encountered. On the one hand, Western science has been progressively confounded by acknowledgement of fundamental complexity. On the other, only very seldom indigenous peoples have been truly isolated and dearth of intercultural reflection. As Riej, Scoones and Toulmin (1996: 10) write, "many of the 'indigenous' techniques (…) have their origins elsewhere, derived from migrants living in or passing through the area, learned during journeys to other places or adapted from interventions imposed during the colonial era". Moreover, both western science and traditional knowledge are based on accumulation of observations as a means of acquiring knowledge (Berkes *et al.* 2000), and any human's thought processes, let alone cognitive capacities, are close to identical (Sillitoe 1998). As such, there is no pure demarcation between the modern, the local and the indigenous.

At the same time, the contrast between positivist-originated HEI-agriculture and indigenous agricultural practices is stark. Traditional farmers work their fields to optimize all functions they provide. Dommen (1989) cites the concept of *conservation of equilibrium biomass* (CEB), the maintenance of fertility of a plot, as an explicitly pursued joint output with annual crop production. Hence, the African farmers in his study rank crop production and fertility conservation equally, and their farm management tackles both in concert. Maintaining heterogeneity is part of this strategy. Arable fields are often complemented with some livestock and poultry, home gardens and orchards and perhaps fishponds and hedgerows, and the use of polycropping and crop rotations were pointed at earlier. Western single commodity technology often proved incompatible with such farming conditions because "efforts to improve single components of farming systems are likely to produce limited results unless the interdependence of land use, labour supply and seasonal activities for all of these farm

[5] I maintain a distinction between 'local' people (inhabitants of a rural, relatively modern community) and 'indigenous' people (members of a 'tribal' group, with little or no contact with the 'modern world'). Both types of community share a relatively low degree of labour specialization and depend largely on agricultural or subsistence activities. 'Local' agriculturalists are referred to as 'small(holder) farmers', 'peasants', 'family farmers', or 'subsistence farmers', whichever applies best to the community or individual of regard. They can be distinguished from 'modern farmers' that are more fully integrated in the global, western-oriented economy.

enterprises is acknowledged" (Fernandes *et al.* 2002: 24). Technology that is incompatible does not get readily adopted, if at all. Much of the failure in Sub-Saharan Africa and other vulnerable regions can hence be ascribed to a mismatch both cultural (Western 'master-and-possessor' paradigm versus indigenous holistic cosmology) and ecological (ignorance of ecological complexity and extrapolation of potent farming conditions to marginal areas).

'Alternative' knowledge: from rejection to integration?

From the perspective of the (Western) research and development agenda, a rediscovery of local knowledge has taken place. Several 20th century scientists brought important revisions to the Cartesian materialistic-mechanistic approach, including chaos theory and Gaia-like concepts (Haverkort & Hiemstra 1999). Philosophers pointed at the fundamental presence of uncertainty, ignorance and relativity in science, giving rise to post-normal and constructivist paradigms (Tacconi 1998). Perhaps synchronous with such paradigmatic openings to 'alternative' knowledge, the field of anthropology has experienced an evolution in its view of indigenous knowledge. As Slikkerveer (1999) describes, the progress in "assessment, recognition and emancipation of indigenous peoples and their knowledge (…) has passed from the interest of early ethnologists in the 'exotic', through the colonial and post-colonial concerns over 'primitive' peoples, and on to the currently emerging 'new' ethnoscience focused on indigenous knowledge systems in the context of development and change". The general public also contributed to the current appreciation of indigenous peoples and their cultures and knowledge. The gradual decline in the Church's influence on citizens, particularly in Europe, and the blending of cultures as the world is becoming a 'global village', has awoken cultural and spiritual interest in animistic and tribal cosmologies. This is distinctly expressed in the growing and intensifying affinity with nature experienced by individuals, dubbed the 'new biophilia' by De Groot, Van den Born and co-workers (2002, 2008). That is not to say that such spirituality has ever been lost in entirety; as Haverkort and Hiemstra (1999) write, "in addition to mainstream scientists, agronomists and farmers, there have always been those who maintained a more holistic and spiritual worldview" in the West.

Societal developments such as those summed up above have paved the way for 'participatory' and 'farmer first' paradigms in which local and traditional people are regarded as important stakeholders with valuable knowledge (Sillitoe 1998, Slikkerveer 1999). These strategies, together with the idea of 'sustainability', have since been prioritized by numerous administrative organs, the foremost of which is the United Nations[6]. However, the major reason why participatory approaches are now standard practice is that the old 'top-down' strategies failed and a new way of transferring knowledge to developing countries was necessary. Transfer of knowledge and philosophy the other way around has hardly found its foot in official settings. This is not too surprising, but certainly regrettable. Admittedly, some aspects of indigenous cosmology are too distant from modern society, as will be shown, but others might prove to be very valuable.

Three fields in which lessons from traditional societies can be learned, are those of growth, property regimes and resilience. The first two fields will be dealt with shortly (with a motivation why), while resilience will be the topic of this essay's remainder.

[6] Especially the 1987 report to the General Assembly "Our Common Future", which introduced 'sustainable development', and the 1992 Earth Summit in Rio de Janeiro, which resulted in major binding documents and the establishment of the Commission for Sustainable Development, have been landmark events in prioritizing participatory approaches, conservation of biodiversity and acknowledgement of indigenous lifestyles.

On perpetuated growth

Indigenous people have come to see the world as a living entity, reigned by creating and destructive spiritual forces. Living in that world means maintaining a balance in giving and taking from that world. Although this certainly does not mean that indigenous societies are always in a true, sustainable balance with nature, their philosophy recognizes the finite and cyclical essences of nature.

Messages that the model of perpetuated growth as internalized in the Western society is a fallacy, have been conveyed by the Club of Rome (Meadows *et al.* 1972) and authors such as Herman Daly (1977). Such fundamental throws at the sustainability discourse, however, come after centuries of growth-centred thinking; economic and technological growth are at the very core of our civilization. The greatest value, now, of continuing this discussion is in raising awareness, making people conscious of constraints to perpetuated growth, and dimming the excesses of consumption. An actual changeover to a steady-state economy is a matter of utopia rather than reality in the foreseeable future.

On property regimes

When Garrett Hardin (1968) published his famous Tragedy of the Commons narrative[7], an explanation was found why degradation takes place when a land is not under private (or public) property. Recall that "Western economists, equating security of tenure with investment in land improvement" (quote on page 6), have no good understanding of the common property regimes in which land "'belongs' to the community and its descendants as a whole". The economist thinks in terms of 'rational' men (*homo economicus*), human beings that strictly reason and acts in accord with cost-benefit analyses from the viewpoint of the individual. This denies the existence of other motives in individual reasoning: *homo honoris* as man who wants to be respected for virtues and qualities, and *homo communalis* as man who is part of a community and trusts that others in his community will, as he does, act in the community's interest (De Groot 1992). To continue in Latin, there exists a distinction between *res nullius*, the open-access commons such as Hardin perceives them, *res publica* (state property with regulated access) and *res communis*: local community property, on which social regimes act to maintain their value for the community (De Groot *et al.* 1995). CPT in Hardin's relentless sense thus rests upon abstracted assumptions, which have been closely scrutinized by Brox (1990). He concludes that CPT is merely an *image*, one consistent, non-contradictory set of relations that does not describe the 'real nature' of the phenomena in focus, much like the abstractions of Western-versus-indigenous knowledge on page 6, that are also conceptualizations rather than truths.

If this means that Western countries should adopt social structures like those found in indigenous communities, we would hope for changes as radical as needed in becoming a steady state civilization. Moreover, the modern society comes with financial and juridical mechanisms to deal with risk and inequality that are *different* in scope, but not worse than common property regimes: both system has it merits, and a society as large as the Western needs large and secure regimes (but, its rigidity will come to discussion in the next section). The efficacy of indigenous common property regimes does corroborate 'alternative' lifestyle, which brings balance to the individualistic logic of market economics. It points at the value of

[7] He describes a traditional British commons, a meadow where local pastoralists are free to let their sheep graze. As the meadow is finite in area and amount of browse, there is a limit to the amount of sheep that can graze. A single herdsman can invest in more sheep at constant costs and keep them on the field for free. Hence, given that he gets higher returns on his sheep (meat or dairy products) than another sheep costs him to buy, it is 'rational' to add more and more sheep to the field. This applies to every herdsman who lives near the meadow. However, at some point there will occur overgrazing, and any added sheep will reduce the vitality of the field, and sheep may become underfed and prone to disease. Still, a single herdsman loses competitive advantage when not outnumbering the other farmers' sheep, because he will profit less from the productivity of the field.

community, raises awareness on common (local to global) interest, and shows that the contribution of one to environmental quality is small but essential[8].

Philosophically, indigenous and traditional societies may serve as examples of how 'life' and 'living' can be perceived, influencing people's actions in relation to their social and natural environment. The holistic perspective may percolate through Western society by degrees through the sustained activity of environmental groups, New Age-type movements and progressive media. A more urgent and concrete question is how local conservation practices may be sustainably integrated in the dominant world order. It is on the interface between Western and traditional societies where mutual adaptation and learning provide scope for sustainability. The final section will discuss the major ingredient in this particular recipe.

Five grounds for a focus on resilience

'Resilience' is a quality on the interface of human and environment; it is the "capacity to buffer change, learn and develop (…) in a complex world of rapid transformations" (Folke *et al.* 2002). The concept originated in a branch of ecology that focused on multiple modes of stability in natural systems, then found its way to environmental management, and is now extended to cover the social, ecological and economic domains (Berkes *et al.* 2000, Folke 2006). A resilient ecosystem has a large capacity to absorb shocks without changing in fundamental ways, or may have different equilibriums between which it switches while remaining functional and 'healthy'. A resilient *socio-ecosystem* is the whole of a society and its environment, the latter being managed by the former to maintain its resilience. This means that the society itself has to be resilient: it should have property and (risk) management regimes that enable ecological resilience and are themselves able to respond to changes and to absorb (ecological or social) shocks. I distinguish five grounds for the adoption of 'resilience' as key in achieving sustainability.

A focus on local ecology, knowledge and affinity
Resilient systems are flexible and adaptive. Dommen (1989: 36) stated that indigenous common property regimes allow for such flexibility, while this would be "wholly alien" to modern commercial agriculture. As discussed in this essay, the Green Revolution was chiefly directed at ironing away ecological variabilities, favouring an industrial approach towards agriculture. Besides affecting ecological and socio-ecological resilience, the merits of scaling-up are not evident:

> *"Many studies of farming systems around the world have shown that there are few economies of scale in agriculture that might contribute advantages to farms larger than what a family could operate using its own labour. The lack of economies of scale in agriculture, coupled with the high cost of supervising wage labour, implies that a farm cultivated by an owner-operator without reliance on permanent outside labour - the family farm - is the most efficient unit of production. The few exceptions occur with plantation crops, or where large farms are able to come imperfections in other markets, such as those for outputs, inputs or credit."*
> (Binswanger & Deininger 1997: 11)

[8] I refer to breaching out of the 'prisoner's dilemma', of which Hardin's tragedy is an example. In its combat, the Dutch government in 1990 started a campaign centred around the slogan "Een beter milieu begint bij jezelf" (literally, "A better environment begins at (with) yourself"), to underscore the vitality of individual changes in lifestyle for the betterment of all.

When economically feasible, family-scale farms are preferable over large-scale farms. A local approach utilizes and enhances local knowledge, which contributes to building a mosaic of practices and solutions to challenges. In contrast to agro-industrial entrepreneurs, local farmers have affinity with their location and will act in its broader interest, and economic and ecological functions of land will be reconciled.

Dommen's statement on flexibility will be fiercely objected by advocates of the free market, who swear by the 'spontaneous order' in an economy where individuals compete for social and material resources. In principle, a free market does indeed function flexibly. In case of proper market access and economic equilibrium, specialization and industrial optimization are fruitful, "but the logic of specialization should not necessarily be taken to its extreme because market forces are rapidly changing. Being locked into a single mode of production or output through specialization, even if previously successful, can be economically fatal" (Evenson & Gollin 2003: 18). Then only those enterprises that have claimed a strong foothold in the market can (financially) absorb economic blows. Such 'victors of the free market' (monopolists and oligopolists) prescribe the terms of the game, reducing the degrees of freedom of the system. Hence it is the safeguarding of the highest degree of diversity and flexibility, rather than avoiding external controls that 'put the market on leashes', that should be put the end of obtaining 'freedom' and resilience.

Equity as co-benefit with resilience

While Western countries may benefit from a more resilient mode of production (while remaining of industrial character), resilience is especially a valuable, risk-averting property in marginal or rainfed areas. Traditional societies have experienced erosion of both their environment and their cultures through Western top-down initiatives. A focus on resilience in development and extension practice admits the value of local knowledge and will generate both environmental and cultural benefits. Self- and local-determination are values that are part and parcel of locally developed, resilient agroecosystems and other systems of natural resource management. If land is under local authority, the link (affinity) between environment and inhabitants is strongest and most versatile.

The UN Convention on Biological Diversity contains an article on indigenous knowledge, in which respect and equity for indigenous communities are for these reasons prioritized for biodiversity conservation. In the words of Slikkerveer (1999), such values

> *"cannot be achieved without recognition of the basic rights of indigenous peoples, traditional societies and local communities, including full disclosure about, and Prior Informed Consent for, all activities that affect them. Basic rights include: the right to self-determination for indigenous peoples, right of local-determination for traditional and local communities, guarantees of territorial and land rights, right to development, equitable benefit-sharing, collective rights for communities, and religious and customary rights. It is these rights that underlie the shifts in power necessary to enhance and support local, in situ biodiversity conservation."* (Slikkerveer 1999: 170)

More answers to unknowns, and compatibility with post-normal science

In a complex issue like food production, there are many different possible points of view, and many different answers to many different questions. This may lead to cognitive conflict in policy dialogue, because "differences in knowledge and understanding between stakeholders frame their perceptions of resource use problems as well as possible solutions to these problems" (Adams *et al.* 2003). Scientists and policymakers will agree that permanently securing adequate nutrition for all, now and in the future, would be the key objective. But we

can observe that this logic can, with apparently no cognitive friction, become 'framed' to yield something very different, such as

secure food ≈ maximum food ≈ maximum yield ≈ maximum profits.

Besides questions and answers, theories and events can be explained in different ways. The recent 'food crisis' was hailed as a threat to the poor and their food purchasing power, but also as an opportunity to rural producers who received too little earnings for their produce. Are higher food prices 'good' or 'bad'? That question has no answer, and neither does the question whether economic growth is good or bad: new environmental problems are created, others get solved as a society develops and expands. Many other theoretical statements have been shown to be ambiguous, context-dependent or at least incomplete. Most present-day sustainability problems are analytically complex and high in decision stake, meaning that science and policy have to go beyond the 'normal' 'puzzle-solving' approach: "uncertainty and ignorance can no longer be expected to be conquered; instead they must be managed for the common good" (Tacconi 1998). A common strategy of dealing with risk, that ensues from such uncertainty and stake, is spreading it. This is exactly what resilience is aimed at: not betting on a few, but on *many* strategies and solutions, and allowing the system to move freely between them. As such, it closely resembles *adaptive management*, the "scientific analogue of Traditional Ecological Knowledge" (Berkes *et al.* 2000).

More freedom within a narrowing margin of error

As a developing society creates environmental problems, but also the means to deal with them, technology can be viewed as both a disease and a cure. For the sake of the argument, participants in the sustainability debate (see also the paragraph on growth on page 8) can be divided in 'optimists' and 'pessimists'. Optimists believe that growth and progress are virtuous and environmental problems merely are temporary side-effects. Pessimists believe that growth cannot continue indefinitely and environmental problems, though some might be mitigated, will in general become deeper and force society to a halt, in the meantime generating increasing distress[9]. They criticize the optimists with their refusal to recognize that natural resources are finite and limit growth of the global economy at some point in time. The optimist's rebuttal boils down to the conviction that the global economy is in no way close to such limits, supported by examples of environmental issues that did get solved by technological progress.

Environmental illnesses have certainly taken place, but never has the world come close to what has been prospected. Even now, technological progress may offer us still much leeway for mitigating 'disaster'. However, there are some remarks to be made. First, catastrophes that have not occurred do not prove the optimists right, since they might have stayed out just *because* society reacted to the public attention generated by alarmist uproar. Second, major turning points in the course of civilization are only recognized in retrospect. In the words of social psychologist Harald Welzer,

> *"At times of historical events, man lives in the present. Societal catastrophes, in contrast to hurricanes and earthquakes, do not take place abruptly, but are virtually invisible to the contemporary observer; only with hindsight they are conceived as one concrete, spectacular event, using terms like 'collapse' or 'turning point'."* (Welzer 2008, my translation)

[9] Alarmist messages and crisis narratives are not only from recent times. Famous are the early contributions by Thomas Robert Malthus and Thomas Hobbes, who predicted doom on account of population excess and human egocentric behaviour. Early 20th century crisis narratives mainly involved perceived environmental degradation in colonial areas (Riej *et al.* 1996: 2-7). With regard to Western and global environmental problems, the works of Rachel Carson (1962) and the Club of Rome (Meadows *et al.* 1972) were pioneering.

Even if the extent to which former challenges were successfully combated have caused people to be optimistic about upcoming confrontations, our current challenges are not understood and unprecedented in scale. Our society *itself* is unprecedented in scale. As Thomas Friedman (2008) puts it, the world is becoming "hot, flat and crowded". Hot, because the human economy is growing near equal weights with nature and its emissions heat the atmosphere. Flat, because the earth's populace is becoming one interconnected middle class. And crowded – the number of people is becoming worryingly large for the resource base that is at our disposal. This crowdedness means that there is progressively less margin for error. Trading off growth for resource efficiency and ecological soundness is more urgent than ever: a decoupling between economy and ecology is a *sine qua non* for pleasant life on earth. An academic and political focus on resilience can make that sturdy interface a fair amount more amorphous so that society can be remoulded for the better.

It focuses on processes, not defined states

The previous section concluded with indicating resilience as a tool to turn society "for the better". Obviously, conceptions of what is 'good' and 'better' can vary strongly for different stakeholders. Here, resilience has the advantage of being neutral on the outcome: the objective is not to force, but to *allow* for the greatest diversity – to enable the appropriate response to a situation rather than to pre-define any. The only assumption of resilience, is that flexibility both in system as in thought are advantageous to the end of making more possible. Resilience focuses on the path forward rather than what is, or should be, on the horizon. The primary target is that of 'providing leeway', which is an adaptive process. I have sympathy for the word 'leeway', since it carries the essence of removing friction for actors to engage in what they aspire in common, and for systems to iteratively adapt to changing circumstances. In the definition of the American Heritage Dictionary (4th ed.), leeway is "a margin of freedom or variation, as of activity, time, or expenditure".

Any stakeholder involved in any relevant decision is availed by the question, "does this make the system more flexible, or less? Am I increasing the number of degrees of freedom? How does this choice affect the options of my fellow stakeholders?". Of course, striving for more resilience might act against the interest of major corporations seeking to further fortify their position in the market. Resilience does involve a political choice, in trying to increase scope for the long-term benefit of the greatest number of people, taking into account the degree in which they are involved or affected. In my view, it is essential that local determination over (basic) natural resources should be made *possible*. If an assemblage of people at the relevant scale of management of the resource is fully content with contracting out control over that resource, then that would be the wisest choice.

Providing leeway to become resilient thus rests upon the same logic as true economic liberalism. It has become clear that such liberalism does require conscientious management and a broadening of perspective. With keeping 'resilience' and 'leeway' in mind, a valuable asset could be added to society's developmental basket.

Conclusion

While this essay dealt with agriculture and the historic approaches that shaped it, the last section on resilience was written with a broader scope. This choice was made because agriculture involves (drastically altered) *ecosystems*, which generates the largest conceptual and practical conflict with the modern, *industrial* approach. Secondly, ecosystems are natural resources with a very strong *local* character, directly affecting local people in their livelihoods. On the other hand, environmental issues become progressively intertwined and

linked to the economy. Agriculture deserves centre stage because it has interfaces with all these issues, and involves a primary need of people. An understanding of the paradigms that formerly shaped and currently shape agriculture can assist in the pursuit of a more sustainable world. I propose resilience as an important and potent tool in achieving this. And as much as resilience is a path rather than an end, one should note that also "sustainability is not an intrinsic quality of any technology itself, but of the 'fit' between that technology and the multifaceted context in which it is used" (Uphoff 2002b). We should work on that 'fit'.

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