

Accelerating agricultural development in Africa, but how?

Comments on Henk Breman, Antonius G.T. Schut and No'am G. Seligman (2019). *From fed by the world to food security. Accelerating agricultural development in Africa*. Plant Production Systems, Wageningen University, The Netherlands.

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Introduction

Breman et al. (2019) have written an important and elucidating book. They say that a hopeful tendency emerges from their study: "African agricultural development is taking off in response to population growth, as is shown by the cereal yield and fertilizer use adoption trends in many countries" (p.VII). As a tropical agronomist with some 20 years of working experience in Eastern and Southern Africa, I sincerely hope that their hopes come true [1]. In their view the first thing to focus on would be soil fertility improvement (p.6). They say that in 2014 the average world fertilizer use on cropland was about 135 kg/ha/year, while the average use by farmers in sub-Saharan Africa (SSA) was barely 15 kg/ha/year, thus only about 10% of the world average (p.1). Breman et al state that "Fertilizer use, applied in a context of Integrated Soil Fertility Management (ISFM), may be the "silver bullet" for African agricultural and rural development" (p.55). I agree with Breman et al that (moderate) fertilizer use especially in the early stages of agricultural development is an important component of ISFM. Whether it is 'the silver bullet' for African agricultural and rural development is another question, on which I will expound in this article.

1. Fertilizer as a *conditio sine qua non*

According to Breman et al significant increase of fertilizer use is a *conditio sine qua non* for improved food security and for making agriculture contribute to socio-economic development (p.9). In the video interview on the Foodlog website Breman says that their book has a larger political message, which is that agriculture development is required in order to generate broader socio-economic development [2]. In this context he also says that migration control measures are symptom fighting. It makes more sense to remove the causes of underdevelopment via promotion of agriculture development, and more specifically through more fertilizer use. Breman et al categorized African countries in six classes, characterized by the average annual rate of growth of the national cereal yield. The average fertilizer use for the better performing 'class 1-4' countries over the 2000-2014 period was 43 kg/ha/year, and for the poorer performing class 5 and 6 countries it was 13 kg/ha/year (p.22). This shows that the better performing countries are using almost three times as much fertilizer as the above-mentioned SSA average of 15 kg/ha/year. Indeed significant progress, yet 43 kg is less than one bag/ha/year. Many maize and rice farmers in Eastern & Southern Africa, who I met in the past four decades, apply maximum one bag of fertilizer (50 kg) per ha, if they apply fertilizer at all. One bag is what you can transport on a bicycle.

Breman et al say: "It goes without saying that for farmers to adopt the use of all three external inputs [fertilizer, improved varieties and pesticides], input market development is a *conditio sine qua non*. The same counts for access to product markets. Both are necessary for farmers to reach cost-benefit ratios that encourage them to adopt this approach in their search for productivity improvement" (p.61). Input and product market development is indeed crucial, but requires - in my view - above all farmers' countervailing power (economic and political), which in turn requires strong farmer organizations. I have given quite some training courses in cooperative development, but much remains to be done. I will come back to this issue.

Breman et al also remark: "Possibly the most important components of effective input and product market development are road improvement and the improvement of transport logistics in general" (p.61). Yes,

effective and efficient transport facilities are crucial, but expensive. Unless farmers build up more countervailing power, it is questionable whether the African urban elites want to invest in this. Recently the Chinese engage in road building, but the demanded *quid pro quo* is often nontransparent. Thus, more fertilizer use is a *conditio sine qua non* for agriculture and socio-economic development, but as Breman et al themselves indicate also effective and efficient input and product market development is a *conditio sine qua non*. And I would add effective and efficient transport facilities and strong farmer organizations.

2. ISFM

In the **Introduction** Breman et al stated that fertilizer use, applied in a context of ISFM, may be the ‘silver bullet’. They also say: “ISFM is not simply the combination of fertilizer and manure or compost ... It is suggested that crop residue (with typically high C:N ratios) has more potential than cattle manure to enhance the effect of fertilizer” (p.35). Crop residue, as used for example in conservation agriculture, does not only improve soil organic matter content and thus enhance the effect of fertilizer, but also reduces weeding labor. As I will argue later on, labor is often the most limiting production factor in many rainfed farming systems in Eastern & Southern Africa. The delivery to, and spreading of large quantities of manure or compost over, fields in a context of ISFM requires large labor input.

3. The importance of adequate agronomy

Breman et al remark that even without fertilizer use, the two other Green Revolution inputs, i.e. improved seeds and pesticides, can have a significant yield effect (p.42). In the late eighties/early nineties I worked as Farming Systems Research advisor at the Uyole agricultural research institute in the Southern Highlands of Tanzania. I used this working experience as one the four case studies in my PhD thesis (Van Eijk 1998), written 20 years after my MSc [3]. I have put some observations from this case study in an Annex to this article, because they are relevant to the issues discussed here. As shown in the Annex, it is true that improved varieties can have a significant yield effect, even without fertilizer use, but only when crop husbandry (planting date, plant density, weeding and disease & pest control) is optimal. The issue is that crop husbandry is often suboptimal. As Breman et al themselves mention, the so-called “window for seeding and planting” is very narrow (p.46). Coupled to my observation that in many rainfed farming systems in Eastern & Southern Africa labor is the most limiting production factor, not land or capital (see section 4), adequate agronomic crop husbandry is often lacking. I acknowledge that the available suitable agricultural land per capita is decreasing, but in my view labor is at least as limiting.

4. Labor as most limiting production factor

Breman et al refer to Baudron et al. (2015) who indicated “that farm power in East and Southern African countries is declining due to the collapse of most tractor hire schemes, the decline in number of draught animals and the growing shortage of human labour” and insist that “a consequence of low levels of farm mechanization is high labour drudgery, which makes farming unattractive to the youth and disproportionately affects women” (p.46). I fully agree that high labour drudgery makes farming unattractive to the youth and disproportionately affects women, and that animal traction is still quite rare in Eastern & Southern Africa. In an earlier publication I wrote: “A large part of the youth is not interested in agriculture, precisely because of the manual work in this sector. Especially young males move to the cities, enticed by a modern way of life in which manual labour gives little prestige. In general a white-collar mentality prevails: getting dirty hands and feet is avoided as much as possible” (Van Eijk 2010, p.75) [4]. This publication has a chapter titled ‘Work Ethic and Gender’ in which I argue that it is specifically *female* labor that is the most limiting production factor.

Since three decades I visit on average once a year the farm of my Tanzanian family-in-law at the lower slopes of Mount Kilimanjaro. I have this (from an agronomic point of view beautiful and sustainable)

farming system gradually seen deteriorating over the past decades. The following sentences stem from Van Eijk 2010 (p.75/6): “In an increasingly Westernized world the white-collar mentality is understandable, but for some African farming systems it is detrimental since they rely on manual labour. An example is the beautiful farming system at the lower slopes of Mount Kilimanjaro in Tanzania, the homeland of the Chagga. The farming system comprises shadow trees, bananas, coffee, vegetables, fruit trees and some dairy cows which are permanently stabled (zero-grazing system). This varied and ingenious farming system on steep slopes is sustainable: erosion is absent and modest quantities of external inputs are used. However, it demands a lot of manual labour and that is where today the shoe pinches. Most young people prefer city life and only few show agricultural ambitions. Undoubtedly this is partly caused by the low cash income derived from coffee cultivation, but the attraction of city life also plays a big role - as does the growing distaste for manual labour. In this context the introduction of labour-saving technology to alleviate drudgery would be appropriate, but in the farming system on the steep slopes of Mount Kilimanjaro, unfortunately, little or nothing can be mechanized. It will always rely on much hard manual labour. Perhaps only a higher (farm gate) price for coffee and a work ethic which sings the praise of manual labour, can save the Chagga farming system. The industrious nature of the previous generation of Chagga was, at least partly, based on an unequal gender balance and a hierarchical relationship between parents and children. Since free labour from women and children becomes increasingly difficult to extract, an inner urge to engage in manual labour needs to be developed soon. Outer enforcement by older males becomes ever more obsolete”. For a short YouTube impression of this farming system, see Endnote [5].

Breman et al remark that a cheaper alternative [than small, multipurpose two-wheel tractors] is the use of animal traction (p.46). I fully agree, but the ‘modernization syndrome’ with many politicians and researchers & extensionists make that animal traction and so-called ‘intermediate technology’ never really took off in Eastern & Southern Africa (see also the Annex). High labor drudgery continues.

Harry van den Burg reported that in Swaziland the availability of labor for weeding was the biggest bottleneck with regard to the optimal planting date of maize and the planted area [6]. With regard to SRI rice (System of Rice Intensification) in Madagascar, Randriana (2008) reports that it covers less than 0.25% of the million hectares of rice in the country. “Many reasons are offered; insufficient labor in the face of the very high demand is the one most often mentioned. According to Takeshi et al. (2009), the great demand for organic resources is a key reason for farmers who adopt SRI to use it only on a small plot” (p.14). I have seen in Zambia that farmers initially start with only a small plot of ‘conservation farming’, also for lack of labor. At first, this system requires quite some labor, but later on it saves labor because little land preparation is needed (only making planting holes) and weeding labor is reduced (permanent soil cover with crop residues). For an interesting analysis of the potential of SRI, I refer to an article by Willem Stoop [7].

5. Irrigation

Breman et al write: “It is useful to take note of the fact that the opportunities for irrigation are rather limited in Africa. At most about 40 million hectares could be irrigated, against 280 million hectares that can be used for rainfed agriculture ... One does not realize that investments in ISFM are about 750 US\$/ha at most, against 4,000–8,000 US\$/ha for small-scale irrigation, not to speak of the huge investments required for building dams enabling the use of irrigated land for at least two seasons (Breman et al., 2003)” (p.39). In this context Savory (1991:16) indicates that the potentially irrigable area is 1 per cent of all the land in Zimbabwe (the potentially arable area is 10 per cent of the national land) [8]. Irrigation has indeed received unwarranted attention in SSA and this is probably linked to the ‘modernization syndrome’.

My second job in Africa was in the Lower Tana Village Irrigation Program (LTVIP) in the Coast Province of Kenya. Also this working experience was used as a case study in my thesis. The main conclusion there was that “for successful incorporation of irrigation schemes in existing farming systems, change agents require thorough understanding of the farming system and the farmers’ priorities. Change agents need a farming systems perspective, just as the farmers operate with a farming systems perspective in mind. Although improvement of rain- and flood-fed agriculture was included in the initial project proposal, and re-emphasized by an evaluation mission, it was hardly put into practice. The complexity of the local farming system was underestimated, and the scientists’ interpretation of farmers’ attitudes tended towards oversimplification. Farmers’ attitudes toward the introduction of irrigation schemes were not interpreted in terms of *their* priorities. The competition for the scarce production factor (female) labor between flood-fed, rain-fed and irrigated fields, and off-farm opportunities, was not recognized and taken into account during project planning and implementation” (Van Eijk 1998: p.62/3). In the same publication, Box 18 titled ‘*The need for multi-dimensional development: irrigation schemes in Africa*’ (p.189) emphasizes that many dimensions or factors play a role in irrigated agriculture.

Some short-term assignments in 2015-16 to large-scale irrigation schemes with dams in Northern Nigeria, developed in the 1970’s but still not successful, confirmed that implementation of irrigated agriculture in SSA is troublesome.

6. Examples of huge yield increases

Breman et al give examples of huge yield increases, but it is not always clearly indicated how representative such increases are. They say, for example, that in Niger with only 330 mm average annual rainfall in the period 1981-2013 and a natural production potential (NPP) below 0.5 t/ha, using fertilizer can lead to 700% millet yield increase: 2.9 instead of 0.4 t/ha (Fofana et al., 2008) (p.25). Is the 700% yield increase based on actual yields in farmers’ fields, on on-farm experiments, or on on-station experiments? If on-farm experiments, were it researcher-managed/farmer-implemented or farmer-managed/farmer-implemented experiments? How many farmers were involved? Another example is: “Yields of rainfed agriculture can increase three to five times by using fertilizer in an ISFM context. Without irrigation, cereal yields of 5–7 t/ha can be reached on farms in most regions (e.g. Njoroge et al. 2017); with irrigation plus fertilizer, the maximum yield is about 10 t/ha per season (Breman et al., 2003)” (p.39). I have rarely seen rainfed yield levels of 5–7 t/ha in farmers’ fields in Eastern & Southern Africa. Again, if you mention this kind of huge yield increases, some information on representativeness would be welcome [9].

Breman et al present in table-format the results of the Dutch-funded IFDC CATALIST project, which aimed to trigger agricultural transformation in Burundi, DR Congo and Rwanda (2006–2015). The results offer a preliminary indication that the package proposed (fertilizer application in an ISFM context plus implementation of various supporting socio-economic policies) can work (p.64). In the period 2005-2014 fertilizer use increased from 3 to 13 kg/ha in Rwanda and cereal yield from 1.2 to 2.0 ton/ha. In Burundi and DR Congo fertilizer use increased, but cereal yield went a bit down and remained equal respectively. They mention that only in Rwanda the entire package was implemented. Government support was crucial (Breman mentions that it was the minister of agriculture who asked him to come to Rwanda) [10]. They mention also that “the farmers doubled or tripled their yields within two to four years after starting to use fertilizers in an ISFM context (Breman, 2013)” (p.71). This doubling or tripling of yields does not show in the table, not in Rwanda, let alone in the other two countries. Also here the yield increase in Rwanda from 1.2 to 2.0 ton/ha needs more clarification: are we talking about actual yields in farmers’ fields, about on-farm experiments, etc.

Experience teaches that large yield increases can be achieved with a relatively small group of farmers within a short period of time within the context of a well-organized project. The implementation problems often start when one wants to scale-up to much larger group of farmers.

The story of Rwanda reminds me of the book by the historian Roel van der Veen about the development process in Asia [11]. He argues that the success story of some Asian 'developmental states' is due to their pragmatic policy and protection of their emerging agriculture and industry. He also underlines the importance of having powerful, strong-willed leaders.

7. Fertilizer subsidies

With regard to fertilizer subsidies, Breman et al write: "One may wonder why fertilizer subsidies are required in Burundi and Rwanda, in view of the fact that their NPP is far above the African average, thanks to fertile volcanic soils and favorable rainfall, and that they have a very high population density. However, the countries are surrounded by large regions with a low NPP and are separated from import harbors by more than a thousand kilometers of low-quality roads, making external inputs expensive ... Subsidies for fertilizer are controversial ... Huang et al. (2017) mention that Rwanda stopped its effective fertilizer subsidy program in 2014 ... After 2014 the Rwandan yield dropped. The yield in 2016 was 1.5 t/ha" (p.66). Thus, after stopping the fertilizer subsidy program in 2014 the yield dropped in two years from 2.0 to 1.5 t/ha. In the end, the cereal yield in the period 2005-2016 rose from 1.2 to 1.5 t/ha. A 25% yield increase in a period of 11 years is a far cry from 'doubling or tripling' yields. Breman et al also mention that fertilizer subsidies "can help farmers to live through the period with low initial fertilizer use efficiency" (p.67), which is true.

8. Organic farming

Breman et al state: "In spite of the fact that the contribution of organic farming to the total national agricultural production is very small, the organic mindset in Madagascar and Uganda, reinforced by NGOs and other donors, seems to have a negative impact on fertilizer use. This is risky, given the very low availability of arable land, and unrealistic expectations about yields under organic farming in view of the low availability and quality of organic sources for producing manure or compost (Breman et al., 2007; Breman, 2013)" (p.43). The authors seem to have a rather negative opinion about organic farming. To my mind it seems unlikely that an 'organic mindset' in Madagascar and Uganda has a negative impact on fertilizer use, when only 1-2% of the cropland is under organic farming. How can you speak of an 'organic mindset' in a country when such a small group of farmers practices organic farming? Breman et al also write: "*In spite of* the (very limited) area of land under organic farming, Madagascar and Uganda have an overall positive yield growth rate" (my italics) (p.42). The logic of 'in spite of' escapes me: in their line of reasoning it should have read 'thanks to'.

With regard to the lower yields of organic farming when compared to conventional farming, here in The Netherlands as well as in Africa, I would argue that one compares conventional 'apples' and organic 'oranges'. Since the 1950's probably 95% of all the money and human resources in agricultural research and extension has been spent on conventional farming. Only when in the next two decades or so, 95% would be spent on organic farming a fair comparison of yield levels can be made. Of course, this is not going to happen. The current N-crisis in The Netherlands points in the direction of more symptom-fighting, also with many staff members of Wageningen University.

Nevertheless, the above remark of Breman et al about the low quantity and quality of organic sources for producing manure or compost on poor soils in Africa, is fully correct. This problematic issue demands much more research on topics such as agro-forestry, inter- and strip-cropping, crop rotations of cereals

and leguminous food- and fodder crops, use of crop residues, mixed farms combining crops and livestock, and zero-grazing systems with manure application on crops. The last two topics need to be linked to more research on animal traction. As said in section 2, the delivery to, and spreading of large quantities of manure or compost over, fields in a context of ISFM demands large labor input. In all research on manure, compost and crop residues the lack of (female) labor demands attention. In my view low applications of fertilizers in a context of ISFM in organic farming are no problem, as long as no better alternatives to upgrade and maintain soil fertility are developed. In my experience most small-scale farmers in Eastern & Southern Africa apply no or little quantities of fertilizer. They stay on the steep part of the response curve, where the return to each kg of fertilizer is high.

9. Socio-economic factors

As indicated in section 1, Breman et al grouped African countries in six classes, characterized by the average annual rate of growth of the national cereal yield. They used nine socio-economic factors in this classification: fragile state ranking, corruption perception index, annual fertilizer use, food security index, agricultural added value (as percentage of the GDP), gross national income (GNI/cap/year), trade logistics index, annual emission of CO₂ and degree of urbanization (p.28). It is laudable that they used so many socio-economic factors in the classification. It shows that they do not underestimate the importance of these factors. They also write: "A factor left out, because it is so hard to express it in quantitative terms, is the stability of societies ... a correlation exists between stability and agricultural development expressed by the yield growth classes" (p.26).

They identified six policies with the most positive influence on agricultural development and its acceleration. These are: fertilizer & ISFM, input & product market development plus value chain development, favorable cost-benefit ratios of inputs, transport & trade, mixed farming, and peace & social stability (p.61:Table 4). Here we see that the rather 'vague' factor of peace & social stability crops up again. Subsequently they write: "Fertilizer, used in an ISFM context, is presented as the silver bullet for change. To become effective, its promotion has to be combined with at least five other policies, and reinforced by the promotion of improved varieties and pesticides, the ensuring of land-use security, and the improvement of gender equality" (p.63). Thus, here fertilizer in an ISFM context is the 'silver bullet', *but* needs to be combined with five other policies, with improvement of land-use security and gender equality, and with the use of improved varieties and pesticides (thus basically the full technological Green Revolution package of improved varieties, fertilizer and pesticides). It is praiseworthy that the authors recognize that fertilizer use as such is not sufficient, but needs to be accompanied by at least seven other policies.

With regard to gender equality, they remark that maize yields turned out to increase exponentially with increasing gender equality. Most African countries score high on the inequality index. "The average ranking of the 36 African countries is 131 on a list with 160 countries, with an average maize yield of 1.3 t/ha" (p.36). The average maize yield level in the Southern Highlands of Tanzania in 1990 was 1.0-1.5 tons/ha (first paragraph in the Annex). It seems as if average maize yield levels in the past three decades have not risen much. Tanzania is a class 4 country with a tendency towards yield increases, but the average growth rate has been slightly more than 10 kg/ha/year only for the last 15 years (p.14). I do not have up-to-date maize yield levels for the Southern Highlands of Tanzania, but it is clear that average growth rates are small.

Breman et al write: "In order for policies to become effective, policy makers, businessmen and -women, and farmers and their organizations need to collaborate" (p.63). Breman also says that, in addition to 'technical' agriculture development, effective collaboration between government, traders and farmers is

necessary [12]. The last sentence of Dick Veerman, editor in chief of the Foodlog website, in his short description of the book of Breman et al is: "It is all about coordinated development starting from the will to achieve something together" [13]. I think that pretty well summarizes the discussion, but then the next question is *how* to establish this will and achieve this coordination?

It is easy to talk about integrated or holistic development, but it is much more difficult to implement it. This was the main reason I wrote my PhD thesis about Farming Systems Research, also a holistic approach which proved hard to implement at field level. Based on an analysis of four case studies (working experiences in Mozambique, Kenya, Tanzania and Zambia) I identified 15 operational problems, which partly also surface in the book of Breman et al (Van Eijk 1998; p.95). Subsequently I clustered these 15 operational problems in 4 main issues: holism, interdisciplinarity, attitudinal factors and lack of countervailing power with farmers (ibid. p.119).

One can wonder how the emphasis on fertilizer (used in an ISFM context) accompanied by numerous other socio-economic policies, as proposed by Breman et al, differs from the integrated rural development programs from earlier decades? One could argue that today, because of higher population density, less land per capita is available, but will this factor as such necessitate more political will and better coordination? Why would adequate political will and better coordination among numerous stakeholders emerge this time? In my view, beneficial socio-economic-political conditions for accelerated agriculture development at wider scale demand at least more countervailing power of the farmers concerned, the topic of the next section.

10. The political reality of small farmers

Breman et al write: "Africa should draw lessons from the Asian Green Revolution. A key lesson is that 'the political reality of the 1960s forced Asian elites to take the interests of peasant farmers seriously; the development plans for rural areas served to neutralize the appeal of political radicalism' (Vlasblom, 2013)" (p.57). In this context, Breman et al also write that "it is a mistake to assume that peace is a precondition for agricultural development. Improving rural income through higher agricultural productivity will be often the best way to prevent unrest and rebellion" (p.57). Here they contradict themselves, since they argued in section 9 that peace & social stability is one of the policies with the most positive influence on agriculture development. In my view, a two-way interaction exists between social stability and agriculture development, whereby the influence of social stability on agriculture development is probably dominant.

Breman et al continue: "Vlasblom (2013) notes that after independence, the elites in many Asian countries focused on agricultural development, while African governments equated development with rapid industrialization, and saw agriculture as backward. The World Bank (2007) concludes 'that GDP growth originating in agriculture is at least twice as effective in reducing poverty as GDP growth originating outside agriculture'" (p.57) [14]. I am afraid that quite some African governments still see agriculture as backward, not in formal declarations of course, but in their actual deeds. This is related to the earlier mentioned 'modernization syndrome' (section 4).

Breman et al remark: "With the African NPP being significantly lower than the Asian, the question is how the availability of food can be increased in such a way that the food prices and therefore the salaries go down, and peasant agriculture can turn into market-oriented agriculture. What can be done to improve the competitiveness of African agriculture, which has been hampered by the low NPP and by the high transport, food and labor costs due to the low population density (Breman & Debrah, 2003; Pardey, 2014)?" (p.57). Here they emphasize as the main reasons for Africa's lagging agriculture poor soils and low population density [15]. In their view food prices and salaries have to go down in order to improve

the competitiveness of African economies. I am not sure whether it is a good idea to strive for lower salaries (which are already low) in order to be able to compete with, for example, Asian countries in the agriculture and industry sectors. Labor efficiency in many African countries is indeed low, but there is a vicious circle between low labor productivity and low salaries [16].

Agricultural labor productivity in SSA was very low in 1998 (only 0.7% of the one in The Netherlands) and in a period of ten years (1988-1998) it only increased with 3% [17]. Although agricultural labor productivity may have increased recently, the huge gap makes it practically impossible for small-scale farmers in SSA to compete with farmers in rich countries - with or without European agricultural subsidies. There is no level playing field, neither in the political-economic nor in the technological domain. Moreover, increasing agricultural productivity results in fewer employment opportunities in agriculture. Therefore the problem of large scale (rural) poverty can only be solved by creating more non-agricultural employment. The diabolical dilemma in SSA is that with an increase in agricultural labour productivity (for example, through more use of appropriate intermediate technology), the problem of insufficient non-agricultural employment remains. Van den Ban (2002) says that the creation of employment opportunities for the millions of farmers who will be pushed out of agriculture is a huge problem, which has not been solved yet [18]. To my mind, this is the biggest problem with a modernization of agriculture in SSA. What kind of competitive non-agricultural employment can be created for millions of poorly educated farmers? I have no idea. A processing industry of agricultural products will never create sufficient jobs.

Breman et al then make a remark which is absolutely crucial in my view: "Instead of waiting for public and private action plans, farmers should start organizing themselves and creating economies of scale by collaboration (World Bank, 2007). This has been the approach adopted by Dutch farmers one century ago, and it has been effectively used in the Chinese context as well" (p.69). To my mind, the most important contribution to the very effective and efficient Dutch agricultural system (although also with many implicit negative externalities) might have been that farmers started organize themselves in cooperatives already round the year 1900. In 1896 the Dutch Farmers' Union (Nederlandsche Boerenbond) was established, with some regional subsidiaries. From 1896 onwards many local farm credit banks (boerenleenbanken) were founded, often with support from local clergy. In addition to the negotiation for better input and product prices, these farm credit banks also promoted thrift, charity, laboriousness and moderation (Van Zanden & Van Riel 2000, p.375) [19]. In 1917 more than 1000 farm credit banks had already been founded. These new organizations in the countryside had economic (cooperatives) as well as socio-political (farmers' unions with their promotion of political interests) responsibilities (ib.:p.415) [20].

One of the most important insights from Van Zanden & Van Riel (2000, p.25) is that "the ultimate determinants of economic development are not found in the quantitative economic variables themselves, but in the complex interaction between markets and institutions". I have tried to capture the interactions between ecological, technological, economic, political, socio-structural, and cultural & personality factors in a holistic framework for multi-dimensional development, in which these different categories of factors are interrelated but do not carry equal weight (Van Eijk 1998, Diagram 12, p.179; Van Eijk 2010b, Diagram 2, p.87) [21]. In the context of the development process in SSA, the PhD thesis of Oda van Cranenburgh titled *The Widening Gyre. The Tanzanian One-Party State and Policy towards Rural Cooperatives* is interesting [22]. It discusses the problematic relationship between farmers and the formal state, which plays also a dominant role in many other African countries (Van Eijk 2007, p.181/2). The countervailing power of the largest group of 'private entrepreneurs' in the population, the smallholders, leaves much to be desired. In section 1, I remarked that more farmers' countervailing power (in an economic and political sense) requires strong farmer organizations.

11. Expulsion of farmers

Breman et al refer to Niek Koning who says that “without agricultural development, insufficient numbers of people are expected to find decent work and an income high enough to become food-secure (Koning, 2017)” (p.7). They also write: “Food security in Africa increases with income, but decreases with the share of agricultural added value as percentage of the GDP. *The more farmers the less food!* ... The ratio of consumers to farmers has to increase strongly, which means that a lot of employment outside agriculture needs to be created” (p.29). They continue: “It is the urban population that should buy food produced by the rural population, enabling the latter to invest in agricultural development. However, urbanization without industrialization cannot do the job” (p.31). And finally they say: “African policy makers should be warned not to support large-scale industrial agriculture at the expense of smallholder family farming, and not to create a redundancy of agricultural labor before ‘agriculture for development’ has created alternative employment” (p.62). Thus, Breman et al clearly recognize the danger of ‘urbanization without industrialization’ and the urgency of creating a lot of alternative employment outside agriculture. The policy of ‘agriculture for development’ that they advocate, which as such is logical and correct, results into a push-out of farmers and a large redundancy of agricultural labor. This is what I labelled in section 10 the biggest problem of modernization of agriculture in SSA. What are all these expelled farmers going to do?

Breman et al write: “Cheap food imports and food aid attracts people to cities rather than paid jobs. Insufficient urban income, due to limited industrialization, precludes the formation of functioning markets for agricultural products needed to trigger agricultural development” (p.32). Thus we have a vicious circle of: limited industrialization > low urban incomes > cheap food imports and low prices for local agricultural products > limited agricultural development > limited broader socio-economic development > limited industrialization. Whether fertilizer use in a context of ISFM, accompanied by numerous socio-economic policies, can be the ‘silver bullet’ to break this cycle remains to be seen.

12. Protection of agricultural markets

Breman et al refer to Koning (2017) who “insists that the rich and strong countries of the world will have to assist in making this agriculture for socio-economic development possible. It is because of their (partly subsidized) competition on a global liberalized market that agricultural product prices are low, which makes it difficult for poor countries to develop their own agricultural sectors, adopt the use of external inputs for highly productive agriculture and consequently reduce the costs of labor” (p.51). Breman et al remark that a key particularity of the African Green Revolution is that it occurs in an era with liberalized global markets; this is a constraining factor (p.57/8). Koning argues, correctly so in my view, that African countries should protect their markets from agricultural imports. However, in this era of global free-market liberalization, combined with the unwillingness of African political elites to seriously support their farmers, this is unlikely to happen soon.

The title of the last chapter in Niek Koning’s (2017) insightful book *Food security, agricultural policies and economic growth* is: *Where there’s a will, there’s a way* [23]. In the last subchapter titled *The problem of political will* he says that the implementation of his policy recommendations depends on the political will of many actors. In the last sentence of his book he writes that a mental revolution with especially the citizens of the old strong countries is required in order to make progress. He writes: “Designing a set of policies to enable a soft landing of the global biomass economy is one thing. Mobilizing the political will to implement it is quite a different matter. Isn’t the above program simply too complicated for humanity to manage? ... Economic development is associated with a widening of reciprocity norms, empathy and trust, but that widening occurs in circles. Most citizens feel stronger bonds with their fellow countrymen than with strangers. One may deplore this, but it is a fact of life ... Nevertheless, human mentalities are not molded by mental hardware alone. People can adjust their way of thinking when changes in their

existential situation demand it. The historical emergence of plough agriculture was closely linked with the rise of mono- and pantheistic religions that preached trust, justice and compassion within wider communities than the kin networks of tribal societies. This mental transformation made a vital contribution to the forms of social capital that were needed for a more resource-intensive mode of subsistence, which required cooperation and trade on an expanded scale ... We have to become less sensitive to the group-think around us ... [and] we have to become much more modest ... We must learn ... to do our best, even if it means spending a lifetime just making a tiny contribution to what will inevitably be a long and difficult process. Whether citizens of the old strong countries will help build a world without hunger or whether their political and economic behavior will precipitate a crisis, as so often happened in pre-fossil societies, may well depend on the success or failure of such a mental revolution” (Koning 2017:p.215-8).

13. Step-by-step elimination of key bottlenecks

Instead of developing a multitude of regionally tailored solutions, Breman et al are in favor of a step-by-step elimination of key bottlenecks (p.6). They maintain that it is important “to identify the crops and production systems that have the best chance of making fertilizer use remunerative and competitive” (p.59). Whether one is in favor of a multitude of regionally tailored solutions or a more general focus on remunerative and competitive fertilizer use, it could be useful to have a look at the extensive literature on Farming Systems Research (FSR) and more specifically at its use of agro-ecologically and socio-economically delineated ‘recommendation domains’ (Van Eijk 1998:p.110/1).

Breman et al write: “Focusing on fertilizer adoption as the first step for accelerating African agricultural development is not a simple matter. Nevertheless, in order to eliminate obstacles to development, one should start with the most important one. This means starting with soil fertility improvement and maintenance, with a view to closing the yield gap in rainfed agriculture, and doing it in a context of ISFM to make it sustainable” (p.58/9). Frans Aarts remarks that it is necessary to lengthen the lowest stave (plank) of a barrel if you want to increase its content [24]. While this is correct, one has to keep in mind that the barrel has many planks, agro-ecological and socio-economic ones, and that the identification of the most important (most limiting) one(s) is not easy.

14. Concluding remarks by Breman et al.

Breman et al state: “Agro-ecological conditions or technical aspects seem not to constitute major hindrances for agricultural development; the most serious obstacles are of a socio-economic nature. Meanwhile, the low soil nutrient status is evidently a major cause of low crop yields and low livestock productivity in most of Africa; therefore, the adoption of fertilizer use is to be considered as a *precondition* for change and development” (p.75) (my italics). While they consider the adoption of fertilizer use a precondition for change and development, they also say in their concluding remarks that this adoption requires the collaboration of farmers, businesspeople and governments, the assurance of land-use security, the reduction of gender inequality, and the introduction of small-scale mechanization. Moreover, various other supporting policies to be implemented were listed in section 9.

15. My concluding remarks

Breman et al say in section 1 that more fertilizer use is a *conditio sine qua non* for agriculture and wider socio-economic development, but as they themselves indicate also effective and efficient input and product market development is a *conditio sine qua non*. And in later sections more and more *conditio's sine qua non* or ‘preconditions’ or ‘silver bullets’ crop up. One could argue that their specific ‘silver bullet’ of fertilizer use needs to be accompanied by many other ‘silver bullets’ in order to become adopted and be effective. Their approach of ‘step-by-step elimination of key bottlenecks’ (section 13) sounds easy but

the problem seems to be that many key bottlenecks need to be eliminated at the same time in order to achieve results. If so many bottlenecks need to be handled simultaneously, one can hardly speak of a step-by-step approach anymore. Koning raised the question in section 12 whether some programs “are not simply too complicated for humanity to manage?” I have labelled this same dilemma in an earlier publication ‘the illusion of intellectual holism’ (subchapter 11.2 in Van Eijk 1998). It is unlikely that with intellectual reasoning alone we can handle such multi-dimensional or multi-faceted problems. This is also the problem that I faced with FSR, a sound and logical integrated or holistic approach at the theoretical level, but its ever-widening reach (from initially just agronomic and farm-economic issues to institutional issues in the end) made it impracticable or unworkable at field level. *How do you implement* such an all-encompassing approach?

With regard to multi-disciplinary, integrated planning C.T. de Wit (1981) remarked about 40 years ago: “...without a thorough multi-disciplinary analysis of the situation any measure easily results in blunders. The necessity for an adequate analysis should, however, not tempt us to pursue multi-disciplinarily inspired, integrated solutions. Each plan that in order to succeed requires changes in both the technical and socio-economic sphere - changes which must be attuned to one another - is already beforehand a failure, because the knowledge and control for implementation are, at least in the case of poor countries, not available ... Of course, everything is related to everything else, but gaining insight in this connection is so difficult that especially poor countries cannot afford the luxury of integrated planning” [25].

Given the fact that the integrated rural development projects of earlier decades had not been successful, De Wit’s remarks were logical. He (ibid.) is in favor of ‘muddling on’ from different perspectives, in each as such tenable directions, but he fears that this approach stands a poor chance, given “the fashionable preference for tackling problems in a fundamental way at a level of integration that nobody can cope with”. In my view the remarks on ‘difficulties of gaining insight in cohesion’ and ‘levels of integration that nobody can cope with’ are not only relevant to ‘poor’ countries, but as well to the Western world. The persistent problems in, for example, the Dutch agricultural sector show that multidisciplinary, integrated planning has not been adequate here either. The undesired side-effects of modern agriculture (such as the current N-crisis) bear testimony to our inability to integrate technical, economic, and environmental issues. In Eastern & Southern Africa smallholder farming is still a ‘way of life’: many aspects are involved and the need of a farming systems perspective and integrated approach is obvious, yet difficult to realize (Van Eijk 1998:p.151/2). De Wit’s ‘muddling on’ might be similar to what Koning said in section 12: “we have to become much more modest ... We must learn ... to do our best, even if it means spending a lifetime just making a tiny contribution to what will inevitably be a long and difficult process”.

In a video interview on the Foodlog website, Breman says that the main reason to write their book was his disappointment about how journalists handle scientific information. They keep on writing about the drought problem in Africa, while the poor soils are a more crucial factor. Scientific information does not seem to have an effect on their writing [26]. In this context Jan Peter van Doorn wonders why the clear logic presented by Breman et al is not followed or used. He also says that he has no idea how to solve this problem [27]. It is evident that intellectual reasoning alone is not always sufficient or adequate to instigate behavioral change.

According to the philosopher Spinoza, the intellect or reason - the logical cause-and-effect thinking - is not the only or best method to gain superior knowledge. He holds that intuition results in more complete knowledge. The reason needs to be trained to the maximum extent possible, but needs to be complemented with intuitive knowledge [28]. The next question is then whether intuition can be trained? In my view intuition as such cannot be trained since it is ‘beyond’ the discursive cause-and-effect thinking,

it functions at a level beyond the rational-empirical consciousness. However, the receptivity to intuitive processing can be enlarged through techniques for consciousness development, as part of personal development (*Bildung*). Both (natural and social) science and methodologies for personal development, both reason and intuition, both outward- and inward-oriented approaches are required to facilitate integrated development. In order to overcome De Wit's valid remarks on 'difficulties of gaining insight in cohesion' and 'levels of integration that nobody can cope with', we need to pay more attention to intuitive processing [29].

In section 12 Niek Koning emphasized, rightly so, the importance of 'mobilizing political will' and 'enhancing trust, justice and compassion within wider communities'. He also said that these forms of 'social capital' call for a 'mental transformation'. What is the role of governments in this context? Savory (1991:505/506) remarks that governments do not lead but follow, and that, as people change, governments and institutions will change [30]. Here the concept of 'collective consciousness' plays a role. Governments willy-nilly reflect the collective consciousness of their societies.

The core of any societal structure is formed by a set of central ideas and values, which are internalized in the collective consciousness of the members of a given societal structure. Social scientists (such as Sorokin and Durkheim) say that society is something outside and something inside us. Society has an objective aspect (a concrete social structure) and a subjective aspect (a collective consciousness). The collective consciousness is the totality of interacting human minds and the beliefs and sentiments held in common by the majority of a certain collectivity. The collective consciousness and the societal structure are the inner and outer side of the same socio-cultural reality. The collective consciousness is the integrating, inner structure of a society, it is the 'internalized' society. The collective consciousness integrates a society, it is 'the invisible hand' that 'keeps things together', it is 'the glue' that makes collective action possible [31].

A higher 'value' of 'social capital' calls for a 'higher quality' of the underlying collective consciousness, which in turn demands a 'higher quality' of the individual consciousness of the constituting members of a certain collectivity, or what Koning calls a 'mental transformation'. Perhaps the 'silver bullet' for African agriculture and socio-economic development is not so much 'fertilizer use in a context of ISFM', however important, but the 'mental transformation' of large numbers of individual people. Although I do not claim to have the 'ultimate silver bullet', more attention for personal development or *Bildung* seems desirable. Imaginably, the most important 'resource' for development is the 'human resource', the human being as 'silver bullet'?

Annex: Some observations from Van Eijk 1998, Uyole agricultural research institute, Tanzania [32]

The productivity levels of maize in the Southern Highlands of Tanzania were as follows around 1990: in on-station trials 7.0-8.0 tons/ha; in researcher-managed/farmer-implemented on-farm trials 5.0-6.0 tons/ha and in smallholders' fields 1.0-1.5 tons/ha (Van Eijk 1998, Table 4, p.66).

An external evaluation mission pointed out in 1991 that the benefit/cost ratio of fertilizer use was high. The fertilizers, however, did not arrive in time, or only in limited quantities, in most villages. The fact is that after many years of fertilizer demonstrations - the FAO Fertilizer Program, for example, operated since 1979 in the Southern Highlands - most farmers used no or only limited quantities of fertilizer. Why, then, did not farmers adopt such a profitable innovation? Simply because the inputs were not available, the produce could not (always) be marketed, and unrealistic prices were used in the calculation of the benefit/cost ratios. In my view, scientists have to adapt themselves to these realities of farmers' life, not the other way round. One should try to avoid the trap of the 'scientific imperative' which is "creating blindness to practical implementation problems" (Röling 1988:113) (Van Eijk 1998:p.67). Mutsaers (1991:46) remarks that the non-experimental factors in on-station experiments should reflect the management level of smallholders in order to make on-station research more relevant to their conditions. Another factor to be kept in mind is that the fertilizer response in farmers' fields is considerably less than in extension-demonstration plots because overall crop husbandry in farmers' fields is unlikely to be optimum.

An indicator of the focus on high-external-input agriculture was the large percentage of the budget for on-station research spent on testing of varieties and breeding work. One can seriously doubt whether breeding and variety testing should get such a high priority. In a national workshop on agricultural research Semuguruka (1988) asked: "Why continue developing new maize varieties [in Tanzania] at the present rate when there are about 13 varieties on the market and yet the percentage of farmers using these improved varieties is only about 12 percent!" Many experiments have shown that the introduction of high-yielding varieties should follow, not precede high standards of crop husbandry (Acland 1971:130; De Geus 1973:94; Reddy et al. 1989). In Zambia single factor improvements such as early planting, recommended density and appropriate weed control gave a similar yield increase in maize as use of an improved variety, or application of fertilizer (Reddy et al. 1989). Whereas the combination of high standards of crop husbandry and improved varieties gives the highest yields, it is obvious that the majority of the resource-poor farmers in East Africa cannot adopt such complete technological packages. The external inputs (seed and fertilizer) are not (timely) available and/or too expensive, and labor constraints in the peak periods of planting and weeding make optimum crop husbandry impossible. Hitherto, research has provided little advice to resource-poor farmers on how to manage the inevitable trade-offs in their compromised crop management (Carr 1989: in Blackie 1994) (p.70).

"The overall support from international science for the development of high quality crop husbandry research in southern Africa is dwarfed by that for crop breeding - to the detriment of long-term sustained agricultural productivity across a broad base of smallholder farmers" (Blackie 1994). Hybrids and high-yielding varieties are bred to perform well under favorable growing conditions (De Geus 1973:94). It would be more appropriate to call these improved varieties 'high-response' rather than 'high-yielding' varieties, since these varieties, without fertilizer and pesticide applications and under poor crop husbandry conditions, do not always perform better than local varieties (p.71).

The fixation on 'modern' agriculture made that animal power based technology was seen as a step backwards, while in reality the transition from hoe to animal power would be a true revolution at the

countryside, especially for women. A 'modernization' of Tanzania's agricultural system could result in mass unemployment and social chaos. A resource- and job-conserving, low-external-input agriculture would be more appropriate (Gabel & Heiland 1983). A labor-oriented agriculture with maximum exploitation of improved hand tools and animal draught power, eventually followed by mechanization, seems to be a better option (Beets 1990:72). Although much past research has been rejected by African farmers as too labor-intensive, it is also true that populations are growing at 3 per cent per year, about 80 per cent of the labor force finds employment in agriculture, and prospects for urban labor absorption are meager. Research, therefore, should focus on raising yields "in ways that substantially raise the demand for labor" (Lipton & Longhurst 1989:342) (p.72).

With regard to the indifference to actual farming conditions by many researchers, I want to emphasize that agricultural research - and thus also FSR - is only one component in the *mix* of conditions that must be taken care of in order to facilitate rural development. **Other components in the multi-dimensional process of rural development - such as an adequate infrastructure, input supply, credit, marketing, land tenure and price policy - must be taken care of before research and extension can begin to make a difference** (p.72/3) (bold added).

In the Anglophone FSR approach - the common approach in East Africa - one has chosen to adapt research to the external conditions, which are seen as largely given. As a practice-oriented field agronomist I support this choice: what can a resource-poor farmer or a simple agronomist do about infrastructural bottlenecks or inappropriate price policies? After all, it is unlikely that the countervailing power of resource-poor farmers in East Africa rapidly will increase. At the same time, however, it is clear that infrastructural bottlenecks hamper the effectiveness of investments in agricultural research. In recent years the tendency in FSR is to treat more and more institutional factors as potential leverage points. The farming systems perspective is enlarged. Whether the problems of practicability, implied in an enlarged farming systems perspective, can be solved, remains to be seen ... **The question remains how in the rainfed, diverse and risk-prone farming systems of East Africa synergy in the mix can be created** (p.73) (bold added).

Endnotes

¹ Long-term contracts in Mozambique, Kenya, Tanzania and Zambia and some 50 short-term assignments, mostly in Sub-Saharan Africa.

² <https://www.foodlog.nl/artikel/irrigatie-in-afrika-wat-een-nonsens/#reageer>

³ Van Eijk, T. (1998). *Farming Systems Research and Spirituality. An analysis of the foundations of professionalism in developing sustainable farming systems*. PhD thesis, Wageningen Agricultural University, The Netherlands.

⁴ Van Eijk T. (2007). *Ontwikkeling en arbeidsethos in Sub-Sahara Afrika*. Het belang van gedragsverandering en bewustzijnsontwikkeling. Royal Tropical Institute (KIT), KIT Publishers, Amsterdam. ISBN: 978 90 6832 610 9 (in Dutch). [Unfortunately, this book is no longer available. A pdf file can be downloaded at: [VEijk-17febr.](#) A shorter English version is available, see below].

Van Eijk T. (2010). *Development and Work Ethic in sub-Saharan Africa*. The mismatch between modern development and traditionalistic work ethic. Lulu [see Chapter 5: Work Ethic and Gender].

⁵ Ken Giller, Professor of Plant Production Systems at Wageningen University, once visited my family-in-law's farm. See a short YouTube impression: <https://youtu.be/9BQVqkfWsyk>

⁶ Reaction #38 on <https://www.foodlog.nl/artikel/irrigatie-in-afrika-wat-een-nonsens/#reageer>

⁷ Willem A. Stoop (2011): *The scientific case for system of rice intensification and its relevance for sustainable crop intensification*, International Journal of Agricultural Sustainability, 9:3, 443-455.
<http://dx.doi.org/10.1080/14735903.2011.583483>

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- ⁸ Savory A. (1991). *Holistic resource management*. Southern Africa Edition. Gilmour Publishing, Harare, Zimbabwe [First published in 1988 by Island Press, USA].
- ⁹ Of course, I could check the mentioned literature references myself and hopefully get information on representativeness there, but still it would be a good idea to give that information in the main text.
- ¹⁰ Reaction #37 on <https://www.foodlog.nl/artikel/irrigatie-in-afrika-wat-een-nonsens/#reageer>
- ¹¹ Van der Veen, R. , 2010, *Waarom Azië rijk en machtig wordt*. KIT Publishers, Amsterdam (in Dutch). A book review can be found in: Van Eijk 2011, [Achtergrond Aziatisch proces van modernisering](#). Civis Mundi digitaal # 3, April 2011.
- ¹² Reaction #23 on <https://www.foodlog.nl/artikel/irrigatie-in-afrika-wat-een-nonsens/#reageer>
- ¹³ <https://www.foodlog.nl/artikel/irrigatie-in-afrika-wat-een-nonsens/#reageer>
- ¹⁴ On the role of elites in Asian and African countries I recommend the books of Roel van der Veen. See Endnote 11 for his book on Asia. Van der Veen, R. 2002. *Afrika. Van de Koude Oorlog naar de 21e eeuw*. KIT Publishers, Amsterdam (in Dutch). The English version: Van der Veen R. (2004). *What went wrong with Africa? A contemporary history*. KIT Publishers, Amsterdam.
- ¹⁵ In my book [Development and Work Ethic in sub-Saharan Africa](#) (Van Eijk T. 2010) in subchapter 8.2 titled *Differences in geographical conditions* I discuss Jared Diamond's book *Guns, Germs and Steel* (1998). See also Endnote 4.
- ¹⁶ See subchapter 1.5 in Van Eijk 2010.
- ¹⁷ See Table 1, p.17 in Van Eijk 2010.
- ¹⁸ Van den Ban A. (2002). Increasing the Ability of Farmers to Compete in the Market. *The Journal of Agricultural Education and Extension*, 2002, vol. 8, no. 2.
- ¹⁹ Van Zanden J.L. en A. van Riel (2000). *Nederland 1780-1914. Staat, Instituties en Economische Ontwikkeling*. Uitgeverij Balans. See also subchapter 10.6 *Verwevenheid van natiestaat, maatschappelijk middenveld en economie* in: Van Eijk 2007. See Endnote 4.
- ²⁰ Van Eijk 2007, p.179/80.
- ²¹ Van Eijk T. (2010b). [Civic Driven Change through Self-Empowerment](#). Societal Transformation and Consciousness-Based Development. Lulu
- ²² Van Cranenburgh O. (1990). *The Widening Gyre. The Tanzanian One-Party State and Policy towards Rural Cooperatives*. PhD thesis, Leiden University.
- ²³ Koning, N., 2017, *Food security, agricultural policies and economic growth. Long-term dynamics in the past, present and future*. Earthscan from Routledge. A discussion of this book can be found in: Van Eijk, T. (2017b), [Toekomstige voedselzekerheid vereist onorthodoxe landbouwpolitieke keuzes en mentale transformatie](#). Civis Mundi digitaal # 53, december 2017 (in Dutch).
- ²⁴ Reaction #18 on <https://www.foodlog.nl/artikel/irrigatie-in-afrika-wat-een-nonsens/#reageer>
- ²⁵ De Wit C.T. (1981). *Oude wijn in nieuwe zakken*. Landbouwkundig Tijdschrift/pt 93, 10. As quoted in Van Eijk 1998: p.151.
- ²⁶ <https://www.foodlog.nl/artikel/irrigatie-in-afrika-wat-een-nonsens/#reageer>
- ²⁷ Reaction #36 on: <https://www.foodlog.nl/artikel/irrigatie-in-afrika-wat-een-nonsens/#reageer>
- ²⁸ For more on reason and intuition, see chapter 5 *Knowledge as a triptych* in Van Eijk 2019. Van Eijk T. (2019). [Spinoza in the light of spiritual development](#). Lulu. Van Eijk T. (2017). [Spinoza in het licht van bewustzijnsontwikkeling](#). Lulu.
- ²⁹ See chapter 12 *Intellect and Intuition* in Van Eijk 1998.
- ³⁰ See Endnote 8.
- ³¹ See subchapter 9.2 *The consciousness factors* in Van Eijk 1998.
- ³² The literature references in this Annex can be found in my PhD thesis (Van Eijk 1998), which can be downloaded as a free pdf file. See Endnote 3.