

## SOIL VALUES

Proposal in response to the **Soil Fertility Grant Program** submitted to  
Netherlands Directorate-General for International Cooperation

10 August 2023

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### Overall judgement

The proposal is worthwhile to become the program to be implemented. The theory of change and the proposed approach have shown already effectiveness in the region and elsewhere:

- The introduction and use of chemical fertilizers in an integrated soil fertility (ISFM) context, leads -at least in term- to (much) higher and more sustainable yields than organic- or chemical fertilizers on their own.
- Working through convincing and supporting others has a much favorable value : costs ratio than by doing it yourself .
- While farmers have to adopt the technology, this adoption will only occur when policy makers and business people create the required conditions; three main groups have to be convinced and involved.

To become successful, the key program staff members have to be very good organizers, who can listen can convince and are full empathy. The present unrest in the region is an argument for launching the implementation as soon as possible. It is my conviction that sustainable use of fertilizers can contribute to peace, by improving food security and income and by triggering socio-economic development through agricultural development.

Indeed, starting as soon as possible and using the inception phase for improvements of the proposed approach. The proposal is optimistic -indeed, typical for a proposal-, but it will be far from easy to reach results. What will have to be done why, when and where has to be clear as soon as possible. Suggestions are presented below.

### Suggestions for improvements. To be elaborated during the inception phase

#### 1. Country profiles

The proposal presents two indispensable sets of data, a) the soil maps on p. 12 and the related information elsewhere, and b) all the potential partners of the three pathways and their responsibilities, activities and projects. The latter makes the country profiles in the annexes of high value. However, much of the other presented information in the country profiles is rather general and sometimes arbitrary. It is useful to describe the four countries in a more specific way, to be able -with the program in mind- to identify key differences between countries that may request different approaches, activities and/or accents. I could imagine that this will lead to differences in approach for Niger, for Nigeria, and for Burkina Faso plus Mali. As far as

agricultural development concerns<sup>1</sup>, Niger is a class 5 country (no significant development; cereal yields<sup>2</sup> since the sixties of last century 500 kg/ha or less), Nigeria a class 4 country (just starting development, showing an average cereal yield increase between 10 – 15 kg/ha), and Burkina Faso & Mali being class 3 countries with an average annual yield increase of 20 – 40 kg/ha!

This reality goes hand in hand with a whole series of other important differences, having three different origins:

- *The mentioned difference in agricultural development.* Farmers in Niger do not use fertilizer<sup>3</sup> yet, and the productivity of their land is about 500 kg/ha. Farmers in Burkina Faso and Mali, where fertilizer use reached about 20 and 40 kg/ha, saw their yields grow from 400 to 1,200 and from 700 to 1,700 kg/ha. In Nigeria, where at present 20 kg/ha of fertilizer is used, the yield increased from 750 to 1,650 kg per hectare.
- *The North-South rainfall gradient.* In spite of the fact that the drought of the last decades of the twentieth century has moved the gravity point of livestock raising from the semi-arid Sahel to the sub-humid savanna, the aptitude of dryland for livestock and of more humid regions for crops is still very visible. Pastoral people dominate in the Northern parts of all four countries, but livestock is the most important in Niger and Mali, with more than 0,6 tropical livestock units (TLU)<sup>4</sup> per capita, followed by Burkina Faso with 0,5 TLU/cap. and Nigeria with less than 0,15 TLU/cap. Arable farming dominates Nigerian agriculture, while in the other three countries livestock raising is also of key importance.
- *Socio-economic development outside agriculture.* Besides crops and livestock production, the exploitation of oil reserves allows for socio-economic development in Nigeria; the agricultural added value as % of the GDP is with about 20% the lowest of the four countries, while it is the highest in Mali and Niger with about 40%. Consequently, the degree of urbanization is the highest in Nigeria. Almost half of its population lives in cities, a figure that even does not reach 20% in Niger. With urbanization, the relative importance of farmers decreases, and the farmers that rest have to feed more other people than their own families. This is favored by agricultural development and the related yield increase. The data of Breman & Schut (footnote 1) show that (about one decade ago) Nigerian farmers were not able to feed the citizens, and the situation was deteriorating! In Niger, without agricultural development and very low yields, in spite of the extremely low urbanization, the food self-sufficiency was not guaranteed and still deteriorated. In average years in Burkina Faso and Mali the population could be nourished and the situation was even improving.

To stress the importance of good insight in these data and the differences between the countries from the start, still two aspects. The gross national income per capita is 5,700 \$/year

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<sup>1</sup> Breman, H., A.G.T. Schut & N.G. Seligman†, 2019. From fed by the world to food security. Accelerating agricultural development in Africa. Wageningen University.

<sup>2</sup> Cereal yields are a good measure for the productivity of the land.

<sup>3</sup> Here and below, the word fertilizer equals chemical fertilizer.

<sup>4</sup> 1 TLU is a theoretical animal with 250 kg of liveweight, expressing the total here the total national herd of ruminants, cattle, goat and sheep.

in Nigeria, 1,500 and 1,600 \$/cap./year for Burkina Faso and Mali, and only 900 \$/cap./year. In spite of its limited agricultural development, Nigeria is in principle able to feed its population, but Niger isn't, in spite of one of worlds' largest uranium deposits. What make things worse is the fact that Niger has also one of the worlds' largest fertility rates: the average 7 births per woman<sup>5</sup> cause at present a population growth of 4%!

## **2. Fertilizer use in the context of ISFM. Complex set of practices**

The goal of the program is made clear, more fertile soils with a higher soil organic matter content and -consequently- a greener landscape with productive fields and lush vegetations. How to reach it technically becomes less clear; information is too much spread over the document and frequently rather vague. It concerns, indeed, a "complex set of practices". Shouldn't it be useful to elaborate an overview of the known technologies, with information how they may contribute to sustainable results?

For example, the proposal is mentioning frequently the importance of "climate smart agriculture" without defining and describing it. Only here and there, one encounters a characteristic, such as a higher soil organic matter content and crop varieties with a shorter growing cycle. What is the theory of change for tackling -in relation to arable farming and livestock keeping<sup>6</sup>- the mentioned expected increase of temperature with 4 °C, the increased irregularity of rainfall and the decrease of rainfall in the Southern part of the region?

It becomes clear, fertilizers have to be used in the context of ISFM, but from the numerous instruments only compost and manure are frequently mentioned. Other ways and tools exist to improve and maintain the soil fertility.

The use of trees is one of such tools and it receives some attention, mainly in relation to Niger: "farmer managed natural regeneration". What are its conditions; will it be useful in the other countries?<sup>7</sup> Is secure land use right a condition? Are the existence of the "commons" and the free grazing livestock not serious bottlenecks<sup>8</sup>?

Agroforestry is mentioned as a tool for soil improvement. I like to stress that the use of trees among crops, often promoted with the argument that less or no fertilizer is required ("extensive agroforestry"), decreases worldwide crop yields with an average 25%. It is in the

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<sup>5</sup> Against 5 – 6 in the three other countries. As elsewhere in the world, the fertility rate of women decreases in Africa with income; the lowest value of 5 births/woman is found in Nigeria, the country with the highest national income per capita.

<sup>6</sup> "The inherent resilience of (agro-)pastoralism to respond successfully to climate shocks is progressively undermined by mobility constraints." Proposal p. 15

<sup>7</sup> Restoring African drylands. N. Pasiecznik & Chr. Reij Eds., 2020. ETFRN News no. 60, Tropenbos International. 266 p.

<sup>8</sup> Recently, I combined data about the dynamics of forest cover by country with the use of fertilizer on fields. It appeared that worldwide during the last 3 decades the forest cover decreased with 15% where fertilizer use was still negligible, like in the program region. From 100 kg/ha onwards, countries exist where the forest dynamic are positive, but for the world as a whole the decrease was still 3% and the fertilizer use 145 kg/ha.

interest of farmers to promote trees for more efficient fertilizer use, the so called “intensive agroforestry”!<sup>9</sup>

### 3. Conflicts and violence

In a recent study<sup>10</sup> related to present and future risks of violence and migration as response to “environment-related food self-insufficiency”, West Africa is identified as one of the key hotspots! Nigeria is identified as one of the most risky countries worldwide as far as the expected number of people in violent conflicts, starving or migrating.

The proposal pays serious attention to the risk of conflicts and violence, e.g. “Security protocols for staff, assets, and field operations are in place. Staff and partner security training materials are readily available, and security coordinators continuously monitor the security situation in all implementation countries through trained national staff...”. It mentions frequently as cause of the regional instability tensions between pastoralists and farmers, provoked by growing populations: “In addition to transnational conflicts, the reduction of grazing areas due to extensive farming is at the heart of conflicts between farmers and landless pastoralists.....”.

For effective risk monitoring and adaptive management, it is in my opinion useful to recognize two other, more complicated causes:

- A particularity, worldwide, in case of growing tensions between pastoralists and farmers is a) *the preceding dominance of pastoralists as long as the population pressure is low* and both production systems occupy their most favorable environment, with only a limited overlap, that is exploited in the interest of both, and b) the fact that growth of populations of farmers is much higher than of pastoralists, having mainly a crop diet where in case of pastoralists plants serve first ruminants. When population growth starts creating conflicts related to the lack of productive land, farmers own increasingly livestock, often obtained from pastoralists during periods of drought for next to nothing! During the Sahelian drought at the end of last century, the point of gravity of livestock raising moved from the semi-arid Sahel to the sub-humid savanna<sup>11</sup>. The farmer populations finally always win, and it will take one or more generations before the pastoralists are able to accept the loss of former dominance. The jihad created an opportunity to try to regain the former reality, and part of the pastoralists are using it<sup>12</sup>.

Today, from the almost 90 million people in the Sahelian countries, about one quarter are pastoralists. Also Nigeria has an important pastoral population. But for the region as a whole, the relative importance of pastoralists and farmers in decreasing going

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<sup>9</sup> Breman, H., 2018. Trees to avoid or trees to support the use of fertilizers on crops? Proceedings of the 4th European Agroforestry Conference Agroforestry as Sustainable Land Use. Published by the European Agroforestry Federation and the University of Santiago de Compostela, Spain. p. 17 – 20.

<sup>10</sup> Brink, B. ten, P. Giesen & P. Knoope, 2023. Future responses to environment-related food self-insufficiency, from local to global. *Regional Environmental Change* 23:87. <https://doi.org/10.1007/s10113-023-02069-4>

<sup>11</sup> Keulen, H. van & H. Breman, 1990. Agricultural development in the West African Sahelian region: a cure against land hunger? *Agriculture, Ecosystems and Environment*, 32, 177-197.

<sup>12</sup> Modibo Ghaly Cissé, 2020. “Understanding Fulani Perspectives on the Sahel Crisis”. [africacenter.org/spotlight/understanding-fulani-perspectives-sahel-crisis/](http://africacenter.org/spotlight/understanding-fulani-perspectives-sahel-crisis/)

from North to South, as does their influence in the society and in politics. It seems that in Niger, the country with the most space both for pastoralists and farmers<sup>13</sup>, the herder-farmer conflicts are the most limited, while they appeared being the most severe in Nigeria.

- Another cause are the increasing efforts “*en finir avec l’ancien colonisateur. Le pillage des richesses du continent par des multinationales appuyées par les gouvernements occidentaux*”<sup>14</sup>. Think about what is happening between France and its former colonies in the region. It is accompanied by “la faillite politique de castes de dirigeants corrompues et irresponsables souvent cooptées et téléguidées depuis des capitales occidentaux.” The military take overs and protests and actions are dominated by the youth!

This reality has to imply that “conflict sensitivity and do no harm” will be accompanied by specific program action. As far as the first mentioned supplementary cause concerns, the program could or should promote and support livestock production intensification, beside or instead (region dependent) of helping to maintain the relicts of nomadism and transhumance. The latter have been very productive livestock systems, exploiting mobility as key tool<sup>15</sup>, ensuring that the quality of feed in course of the season stays as high as possible. The program proposes “livestock corridors, and operational pastoral waterpoints” as way to maintain the past as good as possible. Much more effective would be a program focus parallel to the focus for farmers: intensification.

Mixed crop-livestock farming systems will give at present in many regions the best rate of return for fertilizer use in the context of ISFM<sup>16</sup>! A recent testimony from a Dutchman with 50 years of experience in the region: "Sedentary Fulani I come across, often do very well thanks to the large amounts of manure they produce; they are self-sufficient in grains, and earn very well from their livestock farming". Other useful technologies, of which the first is mentioned in the proposal: urea and molasse to improve crop byproducts like straw, the use of high quality industrial food byproducts, ranching while reinforcing fodder with concentrates, etc. One has to realize that at present the productivity of pastoral livestock is low, while linear improve of the nutrient concentration in feed leads to an exponential increase of productivity. As additional advantages, animal health care and genetic improvement become much more remunerative.

Using fertilizer for intensifying both crop- and livestock production increases the chance that agriculture will become successful in triggering socio-economic development while suppressing conflicts and violence. Fertilizer for peace!<sup>17</sup>

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<sup>13</sup> 1 ha/cap. of arable land, against 0.5 ha or less in the other countries.

<sup>14</sup> Courrier international no. 1710, août 2023. pp. 10 – 13.

<sup>15</sup> Breman, H. & C.T. de Wit, 1983. Rangeland productivity and exploitation in the Sahel. Science 221, 1341-1347. French version available.

<sup>16</sup> Food security in Africa requires more-productive livestock. Breman, H. & W. van der Weijden. Foodlog, in press.

<sup>17</sup> “Kunstmest brengt vrede” Emiel Hakkenes, 2016. Trouw 11 maart.



Internationale Samenwerking (DGIS), 2007

Than the other sign of instability, military coups. As stressed above, it is the youth who does not accept any longer the post-colonial exploitation of the continent. Besides the already mentioned articles in *Courrier international*, it was Babah Tarawali who wrote about it in *Trouw* of August the 10<sup>th</sup> : *The youth of Africa has been awakened*. He mention the vested interests of the EU and the USA in the uranium deposits in Niger, and wonders if their military presence in the country is unselfish.

I still have some Facebook contacts with children from my former Malian students, and I follow their support for the recent events in Niger: “God is with them!” is what they believe. One may wonder if the Soil Values consortium approach -build on its experience GESI and the specific context in the Sahel, to fully integrate youth into the proposed activities and ensure that they also benefit from the project- is enough. One may wonder also if the present Dutch win-win approach in development cooperation is considered a post-colonial intervention.

**4. Small-scale food producer**

The “small-scale food producer” is nowhere defined in the proposal. But in view of the expected results -the 1.5 million farmers with more sustainable use of 2 million hectares- donor and consortium think about average farms of 1.33 ha. But Ken Giller et al.<sup>18</sup> insist that the majority of farms are less than 1 ha in sub-Saharan Africa, while on p. 23 of the proposal annexes the small-scale producer Oumar Koné has 15 ha. In the proposal it is also mentioned that “the region is highly dependent upon subsistence farming”.

It should be clear, subsistence farming will not have the financial means to invest in the heart of the required technology for more sustainable agriculture, fertilizer use in an ISFM context. Only market oriented production is able to do so. In other words, it is useful to obtain a global

<sup>18</sup> K.E. Giller et al., 2021. Small farms and development in sub-Saharan Africa: Farming for food, for income or for lack of better options? *Food Security* (2021) 13:1431–1454

idea of targeted farmers. It will not simply be a question of farm size, soil and climate will play a role, as well as the output market, the distance to markets, and so on.

I remember a study from the eighties of last century, wondering which farmers in India were eager and effective in adopting green revolution agriculture. The conclusion: not the real small farmers nor the big ones did; it concerned the farmers with medium sized farms who wanted to become big.

## 5. Financial feasibility

The consortium does not seem to worry about the financial feasibility of fertilizer use in an ISFM context. I do so and I am not the only one: “It’s hard to be green when your finances are in the red!<sup>19</sup>”. A friend, a Dutch farmer, decided not to use fertilizer on his pastures for the last two seasons (too expensive), and he saw his fodder harvest drop to one third of last year. And I remember the large differences in the financial interest for farmers using fertilizer in Burundi, DR Congo and Rwanda. I am convinced that it should be crucial to obtain during the inception phase a rough idea where the conditions are sufficiently favorable for fertilizer use in view of present and expected prices.

I am eager to know the financial feasibility of using fertilizer in the program watershed area in the Soil Values consortium target countries. Fertilizer costs come with the costs of two other external inputs, those of improved seeds and planting material and of crop protection products. Together they will become easily one quarter of the total costs, three quarters being internal costs, land, labor and manure or compost.

At the introduction of fertilizer in Africa during the “green revolution”, the latter were neglected and replaced by fertilizer, in term the cause of a failed green revolution<sup>20</sup>. The same risk to happen with the other internal costs, land and labor. It is favored by the fact that the negative effects of using fertilizer on its own, without soil improvement and maintenance, appear only after a considerable period. And once it becomes visible, for example in a dry year, and the crop fails, the farmer is obliged to sell his/her land.

Another key reason of knowing where and for whom the Soil Values “bundles” are to be promoted, is the competition of products from since long developed and intensified agriculture outside the continent. Sub-Saharan Africa’s agricultural development lags behind by the dominance of low productive soils x climates<sup>21</sup>, combined by centuries of slave trade<sup>22</sup>. Population growth started much later than elsewhere, as did the related development of infrastructure and transport, making external inputs expensive and local production not competitive<sup>23</sup>.

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<sup>19</sup> Joe Stanley from “Farm to Fork” (EU)

<sup>20</sup> Chr. Pieri, 1989. Fertilité des terres de savanes. Bilan de trente ans de recherche et de développement agricoles au sud du Sahara. Ministère de Coopération & CIRAD-IRAT. 444 p..

<sup>21</sup> A natural production potential of less than 800 kg/ha of cereal equivalents, against -for example- 1,100 kg/ha for Asia, 1,400 kg/ha for Europe and 1,650 for North America. P. Buringh and H.D.J. van Heemst, 1977. An estimation of world food production based on labour-oriented agriculture. Centre for World Food Market Research, Wageningen.

<sup>22</sup> ..... Prof. E. Frankema, WUR

<sup>23</sup> Breman, H. & S.K. Debrah, 2003. Improving African food security. SAIS Review vol. XXIII (Winter-Spring) no. 1, 153 – 170.

Knowing that the adoption phase of using fertilizer is also a learning period, characterized by low fertilizer use efficiency, and realizing that the learning period of using fertilizer in an ISFM context is even longer, the Soil Values consortium should realize that initiating and supporting efforts to obtain protection of farmers against food imports during the adoption phase will be a *conditio sine qua non*. “Convening on a global scale” (chapter 5.5 of the proposal) will be, indeed, an indispensable part of the program. It may be interesting in this context to identify the donor(s) who convince stakeholders in Niger not using fertilizer, a reality that became clear during the preparative meeting with representatives from that country. And the Netherlands and the EU can actively support said developments, by adapting their trade policy and by supporting necessary investments with knowledge, technology, and co-financing<sup>24</sup>.

## **6. (Women) farmers organizations**

The proposal is somewhat unbalanced by the limited attention for farmers organizations and cooperatives as partners for success. Sorry to say it bluntly: Farmers are the people to be supported and trained, business people and policy makers will make it happen. This impression comes from reading the proposal, where farmers organizations are only twice mentioned, besides being present in the outer ring of 5.5 of figures 14 – 18, the ring that is not treated as such. But, I agree, in the annexes farmers organizations are present.

Nevertheless, the proposed program can be improved by paying special attention to the need to partner with farmers organizations and cooperatives, and to include promoting and supporting farmers organizations. Not only it will accelerate the adoption of using fertilizer in an ISFM context, it helps also ensuring that in value chain development farmers will obtain a reasonable part of the cake. This is only once and only indirectly mentioned<sup>25</sup>.

Also under the heading “gender equity and social inclusion” I feel a certain imbalance. Both for the already mentioned youth (point 3) as for women, the proposed program will pay a lot of attention in interesting them as well as the society to become involved in the planned activities, but they are not yet considered and treated enough as partners! A particular attention should be given in the GESI approach for working with and strengthening of women farmers organizations. It may be true that as an average in the region women farmers have 20 – 30% lower yields (p. 15), the opposite is well possible. In the CATALIST project, it have been the women farmers organizations who triggered agricultural intensification in Eastern DRC<sup>26</sup>. In my personal theory of change, women farmers organizations play a crucial role!

## **7. Land use rights**

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<sup>24</sup> Do Not Fear Fertiliser in Africa (5) - The Netherlands and the EU Can Help Improve Soil Fertility in Africa - Foodlog (agrifoodnetworks.org)

<sup>25</sup> p. 30, presenting the QUALIRIZ project: “... and marketing their produce collectively”

<sup>26</sup> One of the women farmers leaders was known as “Madame Huit Tonnes”, being the first who succeeded in obtaining rice yields of 8,000 kg/ha.



Indeed, securing land use rights is also a *conditio sine qua non* for program success. The proposal is mentioning it, but it could be worthwhile elaborating it more from the start. As support the text below:

**A/ AU NIVEAU DU GOUVERNEMENT:**

— *Il y a lieu de poursuivre les mesures d'urgence en faveur des éleveurs sinistrés;*

— *d'élaborer et mettre en œuvre un Plan d'Action et Régional d'Aménagement du Territoire;*

— *de procéder à la délimitation des périmètres viables pour la pratique intégrée des activités agricoles et pastorales en y installant les populations d'éleveurs en voie de sédentarisation;*

— *de veiller à un juste règlement des conflits entre éleveurs et agriculteurs dans un esprit de justice sociale;*

— *de faire agir la solidarité nationale en mettant à la disposition des populations d'éleveurs des terres viables;*

— *d'intensifier l'agriculture.*

**B/ AU NIVEAU DES INSTITUTIONS  
DE LA SOCIÉTÉ DE DÉVELOPPEMENT**

— *concrétiser l'idéal de la consultation, la concertation et la participation des éleveurs aux actions de développement par l'accélération de la mise en place des structures coopératives en zone pastorale;*

Débat National sur l'Élevage (Niger, 1984)<sup>27</sup>

This text is a small part from the recommendations out of the report of a “national debate about livestock raising” in Niger, in which I participated. The recommendations have several elements in common with the present program proposal, much more than the suggested role for policy makers. Another similarity concerns the character of the policy makers: It has been the “Président du Conseil Militaire Suprême, Chef d'État”, who decided that the debate had to be organized, during his annual country round trip for the evaluation of the agro-pastoral campaign.

The land tenure action plan of the program should be derived from existing country studies. E.g., what has been done in Niger during the last 40 years; what are the successes, what failed and why?

The example above stresses the need to do it with the interests of farmers and pastoralists, of fields and pastures in mind. Too often those of the latter are neglected. It will be far from easy to reach the 2033 versions of the panels developed by participants in the in-country workshops -a greener view with a diversity of crops and trees, healthy soil, happy people, and well-fed cattle (fig. 10)- with an exclusive view on the fields, where the “fertilizer use in an ISFM context has to happen”. Indeed, without secure land use rights farmers will not invest in their fields. But the required organic manure for building soil organic matter, will mainly come from livestock grazing on natural pastures around the villages. In the history of Dutch

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<sup>27</sup> Analyse des conditions de l'élevage. Propositions de politiques et de programmes. République du Niger. H. Breman et al., 1986. OCDE/OECD – CILSS, Club du Sahel, Paris. 194 p.

agricultural development they are called the waste lands (“*woeste gronden*”), which before the use of fertilizers were increasingly exhausted and degraded by the transport from nutrients to the fields by livestock and through cutting sods. It was causing gully and sheet erosion and drifting sand over hundreds of thousands of hectares. What happened in the Netherlands till the nineteenth century, is happening today everywhere in Africa<sup>28</sup>. I had the opportunity to study desert control in China in the mid-eighties of last century, trying to understand how erosion control in the Sahel could be tackled. And I realized that the tools as such, soil works, planting trees and sowing vegetation are relative easy, creating the conditions for doing it in a sustainable way is THE challenge<sup>29</sup>. We had king Lodewijk Napoleon who obliged us to solve the problem of the commons, can the program play a role in the Sahel?

Not only the land use right of fields has to be secured, the problem of the ‘commons’ has to be solved. Agroforestry and reforestation are a hell of a job with free roaming livestock. And the owners of free roaming livestock are in general farmers, not pastoralists.

I am astonished not finding any indication of the Inner Delta of the Niger in the country document of Mali. Its importance for the economy of Mali is well known, and it presents a typical example of competition between pastoralists and farmers, with on the side of pastoralists the fishermen, studied by a Dutch-Malian project<sup>30</sup>. A relative recent involvement of the Netherlands Commission for Environmental Assessments MER, regarding Malian plans to double at least the area of irrigated land, illustrates how easily the interest of farmers dominate, neglecting the land use right of others. One has to realize in this context that the Inner Delta of the Niger has a central role in the high productivity of Malian pastoralism.

Guiding with Leo Zwart a Malian MER team, we estimated that doubling of Mali’s irrigated land should have as consequence the loss of 30% of the yearly inundated floodplains of the Inner Delta, damaging pastoralism and fisheries<sup>31</sup> in an unbelievable way. The Fulani pastoralists had figured it out already. During one of my MER missions, a large Fulani delegation came to see the Governor of the Segou province and told him: “*If the project will be realized, we will come with all our cattle, and we have hundreds of thousands animals, and we will destroy all the works. And, be warned, if it does not have the expected results, we have also Kalashnikovs!*”

An information in the interest of the present program, Leo Zwart has been involved in the elaboration of a model by Altenburg & Wymenga Ecologisch Onderzoek B.V., OPIDIN<sup>32</sup>, that is since several years already exploited to estimate and predict, based on rainfall input, the water heights and flows of rivers and the extension of the flood plains of the Inner Delta. The populations in the region are informed by the Malian radio in 4 languages. The Malian partner

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<sup>28</sup> Breman, H., B. Fofana & A. Mando, 2007. The lesson of Drente's 'essen' Soil Nutrient Depletion in sub-Saharan Africa and Management Strategies for Soil Replenishment. In: Braimoh, A.K & P.L.G. Vlek, 2007. Land use and soil resources. Springer Media B.V., p. 145 – 166.

<sup>29</sup> Breman, H., 1987. The struggle of the green against the yellow dragon. The Chinese approach to desertification control and its usefulness for the Sahel. CABO, Wageningen. 62 pp.

<sup>30</sup> Competing for limited resources: the case of the fifth region of Mali. CABO-DLO, Wageningen & ESPR, Mopti.

<sup>31</sup> Mali has the most important inland fisheries of entire Africa, with an average annual production of 100,000 Mt of fish.

<sup>32</sup> One of the reason for developing the model has been the interest of the Inner Delta for European migratory birds: Living on the edge. Wetlands and birds in a changing Sahel. Leo Zwart et al. 2009. KNNV Publishing Zeist. 564 p.

of Altenburg & Wymenga is using the model is the Direction National Hydraulique (DNH). Altenburg & Wymenga have to stop using the model by lack of funds, while the DNH does not seem to be able yet to use the model on its own. The DNH is mentioned in the proposal as future partner. It would be useful considering support for handing over the OPIDIN model<sup>33</sup>.

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<sup>33</sup> The level of the river at Mopti for this year <https://www.opidin.org/en/floodviewer/flood-forecast> , and information over the present rainy season <https://www.opidin.org/en/rainfall>