Evaluation of sustainability performance of Transforum projects -Nieuw Gemengd Bedrijf-

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June 2010

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giving shape to sustainability

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1. Introduction

1.1 Sustainability mapping approach

This document evaluates the sustainability performance of the Transforum project "Nieuw Gemengd Bedrijf" according to the approach that is described by Blonk et al. (2010). In 2008 an extensive assessment of sustainability and innovation was accomplished (Kool et al. 2008). The results and insights of that assessment were put into the framework of the approach described by Blonk et al. (2010) and completed with new insights from the MER (environmental impact assessment) which was available in a draft version (Arcadis, 2010).

A full description of the approach that is used to evaluate the sustainability performance of Transforum projects can be found in the methodology report by Blonk et al. (2010). A short introduction to the applied methodology is described in chapter 2.

Paragraph 1.2 gives a short description of the Transforum project "Nieuw Gemengd Bedrijf" (roughly translated as *New Mixed Farming*; in the rest of the document referred to as NGB). Chapter 3 describes which baseline scenario is used to determine the sustainability performance of NGB. Chapter 4 evaluates the total sustainability performance of NGB. Chapter 5 closes with discussion and conclusions summarized in a SWOT analysis.

1.2 The initiative: Nieuw Gemengd Bedrijf (NGB)

Here we describe the NGB's planned design in short. For more detail, we refer to the previous assessment report (Kool et al., 2008). NGB is an initiative in which pig and poultry farming, manure processing and energy production is combined. The location for implementation is the Agricultural Development Area (*Landbouwontwikkelingsgebied* or LOG) Witveldweg in Horst aan de Maas (North of Limburg province). The initiators are four entrepreneurs (two pig farmers, a poultry farmer and a producer of equipment for processing manure and production of organic manure). The initiative includes a closed pig farm with about 33 thousand pigs (sows and slaughter pigs) and an integrated broiler production chain with a stock of more than 1.2 million chickens. The integrated broiler chain (Korte Keten Kip) includes the hatching egg production, hatching, fattening and slaughtering of broilers on one location. The animal manure is processed with additional pig manure from other farms and co-products of the other companies. This processing at the so called Bio Energy Centre (BEC) results in energy, organic fertilizer and drainwater suitable for sewage disposal. The energy (heat and electricity) is mainly used within the NGB and remaining energy is sold outside. The organic manure is exported abroad. The slaughter waste is purified in another route.

The actual realization of the NGB depended on the outcome of the sustainability research of NGB by Kool et al. (2008). The report was the basis for decision making by the municipality Horst aan de Maas for establishing NGB within the LOG Witveldweg. The preconditions were that all required permits would be issued. For application of these permits, an Environmental Impact Assessment (*Milieu Effect Rapportage* in Dutch abbreviated MER) is necessary. At the moment the MER is in an end phase and a draft version of the report (Arcadis, 2010) has become available for this analysis to complement the sustainability research of BMA with recent insights and calculations.

1.3 System definition: added value through connection

NGB can be characterized as animal production connected by manure processing and an integration of the broiler production chain on one location. The connection in the form of manure processing provides added value as energy and organic fertilizer is produced and sold.

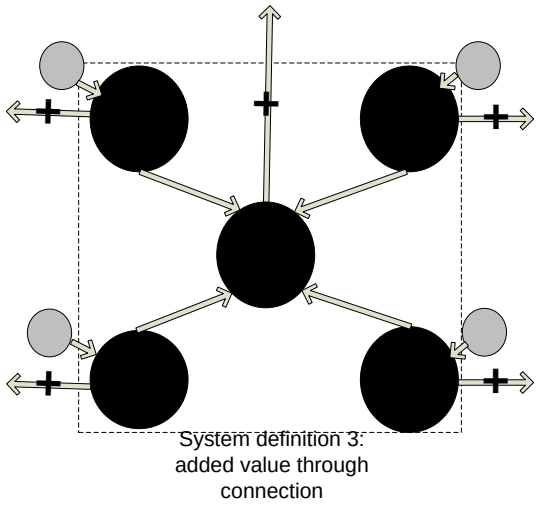


Figure 1.1 system definition of NGB as described in Blonk et al. (2010).

2. Methodology

This chapter gives a brief overview of the methodology used to evaluate the sustainability performance of initiatives. More information about this methodology can be found in Blonk et al. (2010).

2.1 Evaluating initiatives on sustainable performance

Sustainability is a very broad concept dealing with ecological, social and economic consequences of our actions. Absolute sustainability doesn't exist or at least very hard to define. A more workable concept is sustainable development which implies that we are able to define more sustainable directions and thus be able to measure a more sustainable performance. Sustainable development includes nature and environmental aspects (planet), social aspects (people) and economic aspects (profit). It refers to a an ongoing process of finding balance between these aspects.

It is often not easy to evaluate the performance at a glance because the implications of an initiative do often not result in an improvement on all different sustainability aspects. Moreover there are many effects and actors involved on different locations and with different timeframes.

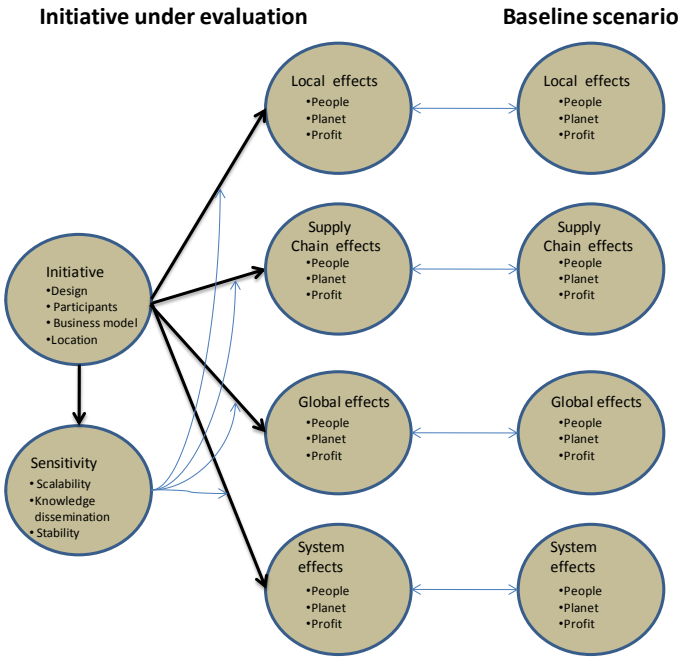


Figure 2.1. Outline of applied evaluation methodology

For evaluating the TransForum initiatives a specific evaluation methodology needed to be developed because existing methods do not cover the total spectrum of effects related to a new initiative. Each initiative generates people, planet and profit effects for different actors and different scales These effects are divided in this methodology in local effects at the initiative, local effects in the supply chain, global effects, and system effects. The ultimate impact of an initiative is also the result of the resilience of the deigns, the potential for upscaling and the knowledge spreading mechanisms involved. Scoring the sustainability performance is only possible in relation to a baseline scenario (figure 2.1).

Our method for measuring sustainable development performance of initiatives is based on a combination of three existing approaches of :

- Lifecycle assessment (Guinee, 2002)(ISO14040, 2006)(ISO 14044, 2006) (ILCD 2010) (SLCA guide 2009)
- Environmental Impact Assessment *(a.o. EU directive 85/337/EEC amended in 1997)*
- Supply chain and company Reporting of Sustainability (Global Reporting Initiative)(ISO 14064, 2006) (Poverty footprint of Oxfam Novib draft 2010)

LCA methodology gives the framework for making a sound evaluation of environmental and (partly) societal impacts over a production chain of products and gives directions how to evaluate the consequences of changes or improvements in lifecycles. EIA methodology is primarily involved with local effects and provides different working methods for evaluating a combination of qualitative and

quantitative information. Furthermore a sound definition of the baseline and alternative scenario's is one of the most important aspects of EIA. A third approach can be qualified as reporting sustainable performance of companies and their supply chain. The Global Reporting Initiative and the poverty footprint methodology of Oxfam Novib set the framework. All these basic methodologies are under continuous development which means that our sustainability mapping methodology is also

The evaluation is preferable carried out in a iterative and interactive way, using a sequence of five steps per round:

1. Define the initiative.
2. Define the baseline scenario.
3. Score local, supply chain, global and system effects.
4. Visualize the scores within the sustainability map *(for an example see figure 4.1)*.
5. Evaluate the results of the evaluation with the main stakeholders.

These steps are explained in the next paragraphs.

2.2 Defining the initiative

Before an initiative can be evaluated on sustainability a clear understanding of the initiative is needed. Which parties are involved? What are the boundaries of the initiative? What are the sustainability propositions (aims)? What's the location of the initiative? Some initiatives must be defined further to come to a business case that can be evaluated. This can be the case when an initiative is still in a preliminary stage of design.

2.3 Defining the baseline scenario

To evaluate the sustainability of an initiative it is necessary to define a baseline scenario. The baseline scenario differs for each initiative and is based on the business as usual for the initiative and the participants. Leading question is what would have been the situation, in a couple of years, if the initiative does not take place?

There are several types of developments relevant for defining the baseline scenario:

- What would the entrepreneurs do if the initiative does not take place?
- What would happen at the location if the initiative does not take place?
- What happens to other locations because of the initiative?
- How would the (environmental) performance of the product autonomous develop if the initiative does not take place?

Which developments are important to include and to what extent depends on the initiative. Sometimes the local aspects are very important and sometimes it is a minor issue.

2.4 Definition of effect categories

This paragraph briefly describes the different sustainability aspects (3P's) with the corresponding sustainability indicators of local, supply chain, global and system effects. A description of all sustainability indicators, and how these indicators are scored, can be found in Blonk et al. (2010).

2.4.1 Local effects of the initiative

Local effects are divided into scales: The first scale is the initiative. The second scale is a regional scale, referring to the surroundings of the initiative. Sometimes a third scale is involved, for instance a national scale when specific themes are interrelated with national governance. Regional and national scales are

relative terms and depends on the type and extension of each specific initiative. These scales have to be defined for each individual initiative.

Initiative
A part of the effects of the initiative are located within the physical borders of the initiative. On the initiative scale there are people, planet and profit effects defined:

- People effects for employees, entrepreneurs and animals (e.g. work conditions and animal welfare).
- Planet effects at the initiative site (e.g. landscape, physical environmental quality and biodiversity)
- Profit effects of the initiative (e.g. balance, investment costs and value creation).

Regional
An initiative also influences the direct surroundings and can have people, planet and profit effects on a regional scale. It can affect residents, companies or employees nearby the initiative. People effects are for example changes in opportunities for recreation and community involvement towards the initiative. Planet effects are related to physical or chemical emissions to the surroundings and changes in landscape and biodiversity. Profit effects on a regional scale are considered as a positive contribution to the community.

National (when appropriate)
For some of the local effects it is necessary to take the national perspective into account. On national scale planet effects are important because they have a strong national dimension based on regulations (e.g. regulations on eutrophication). People and profit effects are not evaluated on a national scale because of difficulties in making these effects operational unambiguously.

2.4.2 Local supply chain effects

Besides local effects at the site of the initiative an initiative can also have comparable local effects at the supplying companies. This can be initiated by selective sourcing, setting sustainability criteria for suppliers, developing sustainability improvements with suppliers, etc. The same thematic framework is used as a starting point for evaluating local effects in the supply chain.

In some cases local effects of downstream business (customers) need to be included in the evaluation, for instance in case of forwarded chain integrations.

2.4.3 Global effects of the product(s) of the initiative

A specific category of effects are those effects not depending on the location of operation and/or emissions. These effects include some specific planet effects and major environmental themes like global warming and land use.

The global effects which are scored are:

- Land use. This indicator is related to land conversion, loss of biodiversity, increasing greenhouse gas emissions, increasing competition between agro functions such as food, bio-based materials and biofuels.
- Climate change.
- Depletion of fossil resources, such as use of fossil fuels and phosphate rock.

These global effects are determined on product level so upstream and downstream processes are also included in the calculations. It must be noted that changes in quality or quantity of land do also have an impact on social or economic viability. The effects on local changes in land quality are evaluated under local people effects of the initiative or the supply chain.

2.4.4 System effects

An initiative ultimately generates products or services that may have an impact on other systems related to the usage of the product. For instance the usage of LED lamps reduces costs of energy of the consumer while at the same time it will reduce the environmental impact per unit light and per unit money.

A change in environmental impact (planet effect) per expended unit money (eco-efficiency) is relevant from a sustainable consumption perspective. A consumer can only use its money once and it is assumed that a lower impact per euro is better. A change in the amount of money expended per function is relevant for determining rebound effects related to the change in costs and behavioural adaptations. System effects of products related to health and improving knowledge of agricultural and/or sustainable production are also scored.

2.4.5 Potential of the initiative

The potential of an initiative refers to the scalability, stability and spreading of knowledge of an initiative. A first question to be answered is whether it is possible for an initiative to be copied at other locations and by other entrepreneurs or is it a one time operation or a specific niche market? The main question to be answered for evaluating "*Spreading of knowledge*" is whether the initiative aims to spread knowledge and/or includes mechanisms to do so?

2.4.6 Critical success factors

Finally, the evaluation gives information on specific parameters in the design or the surroundings of the initiative which are determinant for the realization and up scaling potential. These critical success factors give the actor(s) involved with the initiative essential information on risks and opportunities and can be used for strengthening the design or defining the conditions for (further) investments and making the initiative operational.

2.5 Visualizing the effect scores: "mapping of sustainability performance"

To make interpretation of the results easier we developed two visualizations.

1. A dashboard where the effects are categorized along the following qualification:
   - positive in relation to the baseline scenario
   - neutral in relation to the baseline scenario
   - negative in relation to the baseline scenario
   - not relevant for this initiative
   - relevant, but lack of data

2. A circle diagram which shows the relative amount of scoring positive, neutral, negative or relevant but lack of data.

3. Description of the baseline scenario

In the sustainability study of the NGB (Kool et al. 2008), two baseline scenarios are defined. These mainly differ in the reference situation for animals, which is based on additional animal holding rights obtained by processing the manure[1]. The first baseline scenario assumes that the animals kept in NGB with additional animal holding rights replaces animal husbandry outside the Netherlands. The additional animal holding rights are based on a legal arrangement, which implies a possibility for growth in number of animals if the manure is completely exported or processed outside the Dutch agriculture. For this arrangement, the demand was higher than the availability; so, if NGB will not make use of this arrangement, probably another company will. Therefore, the second baseline scenario is based on the assumption that if the additional animal holding rights are not used in NGB another modern NGB like company in the Netherlands will claim these additional animal holding rights.
In the first baseline scenario, it is assumed that the manure is applied in the Netherlands in the traditional way (liquid manure is injected and solid chicken manure is applied on the soil surface). In the second baseline scenario, we assumed that the solid chicken manure is incinerated.
The methodology report for the present sustainability analysis (Blonk et al., 2010) gives a clear delineation for the reference scenario. The reference is not a representation of the actual situation, but of a hypothetical situation in five to ten years from now if the project would not be implemented. Concerning the location, not only the future situation of the location of the project should be considered, but also the future situation of other locations. Also, alternative activities of the project initiators should be considered.

The second baseline scenario that was described in the sustainability study of the NGB (Kool et al. 2008), is in line with the demarcation as described above, because that scenario is based on further development of animal husbandry with poultry manure incineration and use of additional animal holding rights in the Netherlands. Kool *et al.* (2008) mainly focussed on the effects of NGB development in the LOG Witveldweg in Horst aan de Maas. According to Blonk and Scholten (2010), we will consider the situation without NGB filling this LOG with (intensive) animal husbandry[2]. With other words for both situations (realization of initiative and the baseline) an increase in number of animals in the LOG Witveldweg[3] is assumed.

The reference scenario of a modern animal husbandry farm according to the sustainability study of the NGB (Kool *et al.* 2008), can be described as a modern animal husbandry farm that anticipates on future legislation on environment and animal welfare. In this paragraph, we describe several important characteristics of this reference scenario. For further details, we refer to Kool *et al.* (2008).

For animal feed use, data on average feed use in recent Dutch practice were gathered. For pig farming in the reference scenario, the use of wet co-products in fifty percent of the farms was assumed. The amount

[1] In the Netherlands the amount of pigs and chickens are limited by the so called system of 'animal holding rights'. To produce pigs or poultry a farmer has to obtain animal holding rights. NGB will obtain additional animal holding rights (additional to the animal holding rights bought from other farmers or brought in by the entrepreneur) by processing and exporting the animal manure outside the Dutch agriculture. This is part of a limited regulation from the Dutch government to stimulate manure processing and export.
[2] The municipality of Horst aan de Maas has defined conditions for development of the agricultural development area Witveldweg. One of the pre-conditions is that this area is suited for six intensive farms. If NGB is not realized another intensive farm will take that place.
[3] As researchers, we are aware of the concerns of the local community close to the LOG Witveldweg about, for instance, increased environmental pressure (ammonia, odour), health risks and traffic caused by NGB. In this study, we assume an increase of animal husbandry in the LOG Witveldweg, which implies an increase on these aspects. The local discussion whether such increase is desirable is beyond this study.

of ammonia emission was assumed to meet future legislation (AMvB norms). Additionally there is a trend of increasing use of air washers, assuming an application of air washers at 25 percent of the animals. In the baseline, the animal manure is supplied conventionally as rough manure to arable farms in the Netherlands. This also applies to additional pig manure from outside the NGB for processing. No processing of pig manure was accounted for, because this only occurs on a very small scale. Poultry manure however is extracted from the agriculture to a large extent in the Netherlands. 25% of the poultry manure produced in 2005 in the Netherlands was processed and extracted from Dutch agriculture. Recently, a poultry manure incineration plant has been started at Moerdijk, which can incinerate about one third of all poultry manure production in the Netherlands. The baseline assumes that all poultry manure will be incinerated for electricity production. The NGB will use co-products (for example: residual flows from food industries) to increase the energy production in the first processing step (fermentation). The baseline assumes that these co- products would be composted.

NGB produces not only pig, poultry and organic manure but also energy, electricity and heat. It was assumed that NGB will partly consume its generated electricity and will sell the remaining electricity to the electricity network. The sold electricity replaces the average mixture of electricity sources. It was assumed that produced heat is used efficiently in the NGB (heating the stables) and that remaining heat is used externally.

Table 3.1 Important NGB baseline characteristics

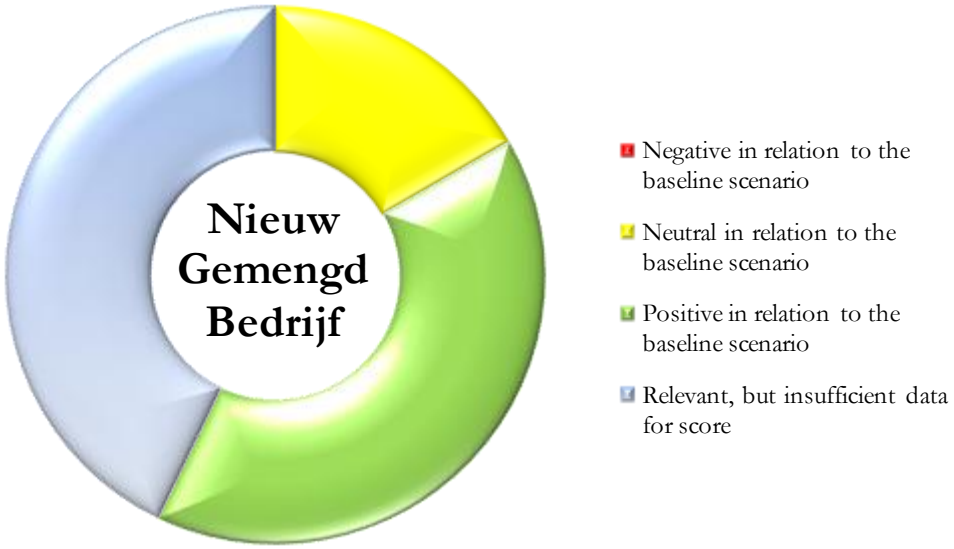
Aspect	Baseline assumption
Feed use per kg pig growth	Average Dutch use in 2007
Feed use per kg poultry meat	Average Dutch use in 2007
Wet co-products	50% of the pig husbandry farms
Ammonia emissions in stables	25% of the farms applies air washer, the rest conform legislation (AmvB housing)
Manure supply and processing	Rough pig manure is supplied to the market Poultry manure is incinerated to produce electricity
Processing co-products for energy production	The co-products that are supplied to NGB are composed (outside agriculture)
Electricity and heat production	Electricity that NGB supplies to the grid replaces the average production mixture (from power plants using natural gas, coals, *et cetera*). Producing heat replaces heat production with natural gas.

4. Sustainability of Nieuw Gemengd Bedrijf (NGB)

In this chapter the sustainability of NGB is presented top-down design. In paragraph 4.1 the overall figure, the sustainability map, is shown which is assembled out of a more comprehensive table, the sustainability table, from paragraph 4.2. This sustainability table contains 50 scored sustainability indicators and the critical success factors. The arguing of the scored sustainability indicators is described in paragraphs 4.3 till 4.7. The critical success factors are described in paragraph 4.8.

4.1 Sustainability map

Figure 4.1 shows the sustainability map and figure 4.2 shows the sustainability profile of NGB compared to the baseline scenario as described in chapter 3. A comprehensive description of all scored sustainability indicators can be found in the following paragraph of this chapter. Figure 4.1 is assembled out of the relevant sustainability indicators from table 4.1. We did not apply a weighting of relative importance of each indicator .



Critical succes factors
- Economic feasibility of BEC and poultry slaughterhouse
- Social basis for large scale animal production

Figure 4.1. Sustainability map of Nieuw Gemengd Bedrijf.

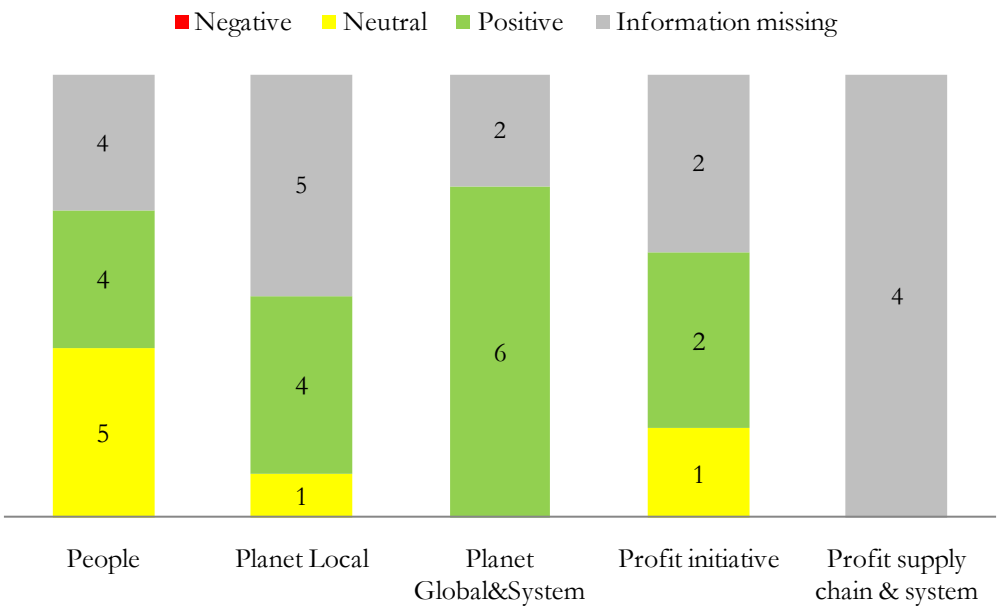


Figure 4.2: Sustainability profile of Nieuw Gemengd Bedrijf

Figure 4.2 is assembled out of the relevant sustainability indicators from table 4.1. A weighting of importance of each indicator has not been applied.

A red score can refer to many different situations of which three are of special importance:

- Red (negative) for economic indicators of the initiative (column 4)
- Red for global planet indicators (column 3)
- Red for system effects (column 3)

If the green scored area in the donut is relatively low, one may wonder if the initiative must be qualified as a sustainability initiative. It depends, however, greatly on what the relative weight of the green area is. A well thought initiative is aware of these hot spots of sensitive sustainability issues. The relative contribution of the "grey area" (relevant, but not enough information) gives information about the extent of issues that could not be evaluated. In this area there may be possible threats as well as opportunities. (For further explanation see Blonk et al. 2010).

4.2 Sustainability table

Table 4.1 shows the sustainability map of NGB compared to the baseline scenario as described in chapter 3. A detailed explanation about this format and the selection of the specific sustainability indicators can be found in the methodology report (Blonk et al., 2010). The explanation of the scored sustainability indicators is described in paragraphs 4.3 up to 4.7. The critical success factors are described in paragraph 4.8.

Table 4.1. Sustainability table of Nieuw Gemengd Bedrijf

1 .Local impacts of the production system

		Indicator	Initiative	Supply chain
People	In Company	1.01 Human rights	(blank)	grey
		1.02 Labour conditions	green	grey
		1.03 Animal welfare & health: pigs	yellow	yellow
		1.03 Animal welfare & health: poultry	green	green
	Community negative	1.04 Human health (other than emissions)	yellow	grey
		1.05 Animal disease risks	green	yellow
	Community positive	1.06 Development	(blank)	grey
		1.07 Involvement	yellow	(blank)
Planet	In Company	1.08 Environmental quality	(blank)	grey
		1.09 Biodiversity	(blank)	grey
		1.10 Landscape	(blank)	grey
	Surroundings	1.11a Emissions affecting ecosystems and human health: local	yellow	(blank)
		1.11b Emissions affecting ecosystems and human health: national	green	(blank)
		1.12 Environmental quality	green	(blank)
		1.13 Biodiversity	green	grey
		1.14 Landscape	green	grey
Profit	In Company	1.15 Balance sheet	green	grey
		1.16 Investment	grey	grey
		1.17a Value creation: pigs	yellow	grey
		1.17b Value creation: poultry	grey	grey
		1.17c Value creation: BEC	green	(blank)

Legend

Legend
green: **Positive** in relation to the baseline scenario
yellow: **Neutral** in relation to the baseline scenario
red: **Negative** in relation to the baseline scenario
white: **Not relevant** to the initiative
grey: Relevant, but **insufficient data** to score

2. Global (non local) impacts of the product per functional unit

Planet	2.01 Land use	grey
	2.02 Greenhouse gas effect	green
	2.03 Depletion: fossil energy use	green
	2.04 Depletion: phosphate rock	green

4. Potential of initiative

Upscaling potential	grey
Knowledge dissemination	green

3. Functional (system) effects related to product consumption and use

People	3.01 Health	(blank)
	3.02 Other welfare aspects (individual)	(blank)
	3.03 Welfare of the community	(blank)
Planet	3.04 Land use	grey
	3.05 Greenhouse gas effect	green
	3.06 Depletion: fossil energy use	green
	3.07 Depletion: phosphate rock	green
Profit	3.08 Money budget	(blank)
	3.09 Time budget	(blank)
	3.10 Prosperity community	(blank)

5. Critical succes factors

1. Economic feasibility BEC
2. Economic feasibility poultry slaughterhouse
3. Declining social basis large scale animal production

4.3 Local impacts of production chain - Initiative

This paragraph describes the local sustainability indicators 1.01 to 1.17 of NGB which are scored in Table 4.1. Sustainability indicators which were not relevant (blanc in table 4.1) are not addressed.

1.01 Human rights

In this study it is assumed that in Western companies human rights are sufficient incorporated. Therefore this indicator is not relevant.

1.02 Labour conditions

In NGB though working circumstances are avoided like collecting broilers by hand, hanging living broilers on slaughter hooks and cleaning animal houses. No change is expected on the exposure to particulate matter in the animal houses. Because of the large scale of the farm, employees will have more specialized work. This can be found negative (less variation) or positive (more immersion).
In summary, this sustainability indicator is classified as positive compared to the baseline.

1.03 Animal welfare & health

Especially in the poultry meat production section of NGB, positive aspects concerning animal welfare are incorporated: large reduction in broiler transport (young broilers from nursery to broiler production farm and full grown broilers from farm to slaughterhouse), lower mortality rate at rearing and the use of a less unfriendly way of slaughtering compared to conventional poultry meat production. The animal housing welfare attributes (surface per animal, furnishing, *et cetera*) in NGB are beyond current legislation and anticipates on future legislation. However, as described in Kool *et al.* (2008) this is evaluated as neutral compared to the development in Dutch modern animal husbandry. The intention of NGB is to use conventional fast growing broilers, unless there are disadvantages for animal welfare. On this aspect, NGB is not different from the baseline . Considering these aspects and different importance of each aspect, the indicator animal welfare & health is considered positive for chicken meat (1.03a) production and neutral for pig production (1.03b).

1.04 Human health (other than through emission)

Two aspects concerning human health risks were considered in the previous study: MRSA and particulate matter emissions. Although the particulate matter emission do have impact on human health these emissions are analysed together with other emissions in paragraph 1.11 'Emissions'.
MRSA (Methilicine Resistant Staphylococcus Aureus) is an antibiotic resistant variant of the Staphylococcus Aureus bacteria. MRSA occurs in pig and veal husbandry and people that work in these husbandry farms and are in direct contact with pigs and calves can be infected with this resistant bacteria. Carrying this bacteria is not dangerous at first, but may induce complications for patients on the intensive care department in hospitals or for people with skin problems. The risk for people living next to pig houses to get infected with MRSA are negligible. It is very plausible that it will not make any difference if, instead of NGB, another pig farm will start in LOG Witveldweg. Therefore, this indicator is evaluated as neutral to the baseline.

1.05 Animal disease risks

The integration of separate stages of broiler production on one production site reduces strongly the direct or indirect contacts with other poultry farms. This reduces strongly the risks of contamination with diseases. This integration is an obvious positive element for health risks compared to the base line where the broiler production chain is separated in different stages. On the pig production site several measurements are taken to avoid contact with outside and contact between animals in different production stage. Examples are: The principal of 'schone weg – vuile weg' is used, the dead bodies of the

animals are stored in a cool place and transported to the processor in one way without collecting on other farms and the multi site approach is being used which involves the separation of animals from different age groups to avoid spreading of diseases between those groups. The occurrence of a road between the pig houses is used as a natural barrier for this principle. For both animal production the score is positive relative to the baseline.

1.07 Involvement

The entrepreneurs are putting a lot of effort in communication and knowledge spreading towards the community to obtain a social support for realization of NGB. Involvement is a step further than a social support . The extra element of involvement above social support is that people are also acting in the initiative, are more active by handling and less active as shareholder. As this is not the case in both NGB and the baseline, so the score of this indicator is neutral.

1.08 Environmental quality, 1.09 Biodiversity and 1.10 Landscape

From the perspective of the methodology defined in this project[4] these indicators are not relevant for a company without use of land for production like NGB.

1.11a Emissions affecting ecosystems and human health *local*

With realization of NGB the emissions of ammonia, particulate matter and odour decrease on the site where the pigs are housed and increase on the site with poultry and the Bio Energy Centre (BEC) (Arcadis 2010). In the concept MER it is calculated that for instance the deposition of ammonia on a nearby nature area will decrease with the realization of the pig site of NGB compared to the situation with the recent pig farm on the same location. The ammonia emission from the poultry and BEC site will give a slight increase of the ammonia deposition on the same nature area. Together it will give a slight decrease in ammonia deposition on this nature area. (Arcadis 2010).

Compared to the baseline this indicator is scored neutral. Concerning emissions of minerals and metals from a local perspective there is no difference in export of unprocessed manure to other regions in the Netherlands or processing manure and export of the end product to other countries. So this indicator is scored neutral as well.

1.11b Emissions affecting ecosystems and human health *national*:

On national level, there is a significant reduction in ammonia, odour and particulate matter emissions because the best available techniques for emission reduction in ventilation air are being applied. Moreover the application of minerals and metals in manure is reduced to zero, because all processed manure is exported. Hence the indicator is scored positive.

1.12 Environmental quality

The manure is processed and exported and used as an organic fertilizer. This means that the supply of manure on the surplus manure market in The Netherlands is partly released which will reduce contamination of both ground and surface water and soil with minerals and metals. The efficiency of use of the organic fertilizer abroad will be higher compared to non –processed manure in the Netherlands because abroad there is a demand of manure and the product itself results in lower emissions with application. The indicator is scored positive.

[4] This approach differs from the methodology of the MER (environmental impact analysis) where the in company impact on soil, water, biodiversity and nature etc is being assessed. Nevertheless it is assumable that these impacts do not differ from the impacts in the baseline.

1.13 Biodiversity

The impact on biodiversity in LOG Witveldweg is small as can be concluded from the MER. A positive impact of the NGB will be that several locations of animal production which are inside or close to area's with a high nature value will be closed. The indicator is scored positive.

1.14 Landscape

Closing several locations of animal production will have a positive effect on the landscape on a national level.

Moreover the following two aspects can be mentioned concerning landscape:

1. The animal housing in NGB differs from conventional animal housing for pigs and broilers, because multiple living layers will be used (two for pigs and a multiple floor system for broilers). This means a reduction in land use for building compared to conventional animal housing, where only one layer is used. In contrast to the reduction in build surface the animal houses in NGB are higher than conventional animal houses and this may be experienced as negative.
2. The entrepreneurs involved in NGB incorporated landscape in the design for NGB by setting up a landscape vision by a landscape architect. These aspects concerning landscape are not unambiguous to assess so therefore only on basis of the first argument this sustainability indicator is evaluated as positive compared to the baseline.

1.15 Balance sheet

Although quantitative information is not available it is expected that the balance of the initiative and the underlying production units of pigs, poultry and organic fertilizer production is positive.

1.16 Investment

NGB incorporates new and far-reaching techniques for instance to maximize the reduction of atmospheric emissions . These techniques require high investments, however the economy of scale could reduce this. No quantitative information about these investments is available, so no evaluation on this indicator can be made.

1.17 Value creation

Concerning profit three units are distinguished: pig, poultry meat and organic fertilizer production. Although NGB is one initiative these production units can be evaluated separately for profit indicators because these units are managed by separate entrepreneurs.

NGB produces separate products: living pigs, slaughtered broilers, organic fertilizer and energy. The living pigs produced by NGB do not represent more economic value than pigs produced in the baseline (1.17a). The pigs are not marketed as a special brand or something like that. They are sold to a slaughterhouse like each other produced pig in The Netherlands.

Concerning poultry it is the intention to market it through a private label from a supermarket carrying their own sustainability label. The entrepreneurs want to position this poultry in the luxury and basic+ part of the market and the also want to obtain value for all parts of the chickens and not only for their breasts. Following the strategy creates a maximum added value.

Furthermore the entrepreneurs focus on long lasting contracts with clients.

These intentions are positive but not further founded so for this moment the score on this indicator for poultry is grey (relevant but not enough data).

NGB processes animal manure and by-products to organic fertilizer and energy. The energy is partly used at the own site and partly sold to the electricity network. The organic fertilizer is exported and sold to farmers in France. A clear value is added to manure by processing it into energy and organic fertilizer.

4.4 Local impacts of production chain - Supply chain

The supply chains taken into account are feed and (breeding) animals. The supply chain of broiler production is mainly incorporated in NGB. Specific positive aspects from the broiler production of the initiative will therefore be valid for the production chain. But that positive change is now part of the initiative and no longer part of the supply chain. This is reflected in the positive score for 1.03b.
For pigs the supply chain of breeding animals will be comparable to the baseline which is reflected in the neutral score for 1.03a animal welfare pigs.
For the remaining supply chain of animals (pigs) the impact of NGB on the animal disease risks is evaluated as neutral (1.05).

Concerning feed the pigs in NGB will be fed partly with wet by-products which replaces compound feed. It is not clear yet which amount wet by products will be used and which compound feed ingredients will be replaced. Nevertheless these are the details which determines the score in sustainability of wet by-products compared to compound feed. The uncertainty about the amounts means that there is not enough information to evaluate the impact on sustainability. Also in the baseline a significant part of the pigs will be fed with wet by-products. It is concluded that this indicator is relevant but significant information is missing. .

This is the same for the intention to lower as much as possible the amount of protein from soy by another protein source.
For that reason the aspects 1.01, 1.02 1.04, 1.06, 1.08, 1.09, 1.10 1.13, 1.14, 1.15, 1.16 and 1.17 are scored grey because they are relevant but there is not enough information to evaluate.

4.5 Global Effects

2.01 Land use
The main factor determining land use is the amount of feed used and the specific composition of the feed. In paragraph 4.2 it is described that there is not enough information available about the specifics of feed (including wet by-products) used. Also about the amount of feed used per unit product (pig or poultry meat) in NGB no information is available yet. Because of insufficient information this aspect is evaluated as grey (Relevant but not enough data)

2.02 Greenhouse gas effect
Two main aspects reducing the greenhouse gas effect of NGB compared to the baseline can be distinguished: 1) The production of renewable energy from manure and co-products with co-fermentation, which replaces fossil energy and 2) the reduction of methane emissions from pig manure management by implementing co-fermentation (which is the first step of manure processing in NGB). This aspect is evaluated as positive compared to the baseline.

2.03 Depletion: fossil energy use
NGB produces a significant amount of renewable electricity and heat. The amount differs between the scenarios for organic fertilizer production (composting and drying), but the main result is the same; from the total amount of energy used in the chain of feed production, transport and animal production, 60 to 85% is compensated by the production of renewable energy. Even if the produced heat is not applied usefully, there remains a significant production of renewable energy. The amount of renewable energy produced by NGB is much more than the amount produced by incinerating poultry manure in the baseline. About 90% of the renewable energy that is produced, originates from the imported co-products. The baseline for these co-products is composting without energy production. Kool *et al.* (2008) states that

besides this baseline, these types of products are probably used for producing renewable energy by an alternative process.

Other (with less impact) positive aspects on (fossil) energy use are the reduction of transport in the chicken meat production section and the use of wet co-products as pig feed. The reduction in energy use in the chain of feed production and feed use is evaluated as uncertain. In summary, the aspect of energy use is, mainly due to the high production of renewable energy, evaluated as positive compared to the baseline.

2.04 Depletion: phosphate rock

The aspect of declining phosphate sources is not considered in the previous study. Nevertheless the following qualitative evaluation can be made. The use of fossil phosphate in the production from compound feed at NGB can be assumed as equal to the baseline, because the feed used (amount and composition) will not differ significantly from the baseline. Besides that NGB uses relatively more wet by-products which have in general a lower phosphate input than compound feed[5].

Phosphate comes available from NGB in the organic fertilizer which is sold abroad. The organic fertilizer will be applied abroad in arable farming (for instance wine cultivation) and will (partially) replace mineral fertilizer. In the baseline poultry manure is incinerated and pig manure is applied at Dutch arable farms. Compared to both routes of phosphate use in the baseline the demand of phosphate in organic fertilizer abroad can be evaluated as positive. The incineration of poultry manure in present installations does not foresee in the reuse of phosphate in the asses (Kool, 2007). The application of pig manure on Dutch arable farms contributes to the surplus of minerals applied on Dutch soils which leads to inefficient use and losses.

In summary, the aspect of phosphate is, due to the export of organic fertilizer, evaluated as positive compared to the baseline.

4.6 System effects

The indicators concerning 'People' and 'Profit' are not relevant for this initiative and are not addressed.. For the same reasons as described under 2.01 land use as system effect (3.04) cannot be evaluated due to insufficient information.

The indicators greenhouse gas effect (3.02), depletion fossil energy use (3.03) and depletion phosphate rock (3.04) are evaluated positive compared to the baseline because a positive score on global level (indicators 2.02, 2.03 and 2.04) and the fact that customer prizes will be comparable to the baseline (pigs) or even higher (poultry).

4.7 Potential

Upscaling potential

NGB is a unique combination of pig farming, poultry meat production and energy production from animal manure processing. To evaluate the potential of NGB regarding scalability, we first consider the distinct parts. The pig production in the NGB as a separate part is not unique in implementation (closed husbandry of sows and finishing pigs is conventional and also in implementation of housing it does not deviate strongly from conventional husbandry), but is unique for the Netherlands in size (more than 30 thousand pigs). Because of the conventional husbandry, implementing this part in other initiatives is not a

[5] This lower phosphate input is due to relatively low (economic) allocation of phosphate use in the crop cultivation phase to the wet co-product.

problem. The production of chicken meat is mainly unique because of the short chain approach: the integration of different parts of the production chain (from maternal animals, egg hatching, broilers to slaughtering) . In the present Dutch conventional situation, these chain parts are separated in different companies at different production locations. Compared to the general trend of growth, the size of the poultry slaughtering is relatively small. Besides this integration, the NGB makes use of new techniques and husbandry systems, such as Patiostal that was developed by the entrepreneur in cooperation with the producer. The potential for implementing this specific type of chicken meat production in other initiatives is can be considered as small mainly because the short chain approach is a completely different arrangement and requires different knowledge, insights and approach of the entrepreneur (husbandry of different animal species, alignment, *et cetera*) than in the current sector.
The husbandry systems (Patio stable, *et cetera*) are developed by the entrepreneur in cooperation with the producer, but will be applicable to other initiatives.

The manure processing in the so-called Bio Energy Power Station (in Dutch Bio Energie Centrale or BEC) is common practice regarding the applied techniques. The potential for up-scaling will mainly depend on the economic feasibility (paragraph 3.5.4). So, apart from the economic feasibility, we evaluate this part as positive.

The combination of pig husbandry, poultry meat production and manure processing and energy production is unique in the Netherlands. The combination is mainly based on the joint processing of manure in the BEC. There are currently more initiatives in which entrepreneurs jointly process manure. So, this combination is not necessarily a restriction for scalability. An important precondition is that entrepreneurs need to be able to find each other in networks for starting a viable cooperation.

Summarizing there may be aspects that can be evaluated as positive or negative for scalability, but as a whole more information is needed to evaluate whether this initiative is feasible to implement on other initiatives.

Knowledge dissemination
Two aspects are determining the positive score of this indicator. The entrepreneurs are paying a lot of attention to communication with citizens about the specifics of the initiative. By doing this the entrepreneurs are trying to obtain a social support for realization of NGB.
In addition the entrepreneurs within the NGB are open for other entrepreneurs to join the NGB. Additionally, they want to set an example with the NGB for development of husbandry and communicate this to colleagues and other people that are interested.
Summarizing, the NGB is evaluated positive for this sustainability indicator.

4.8 Critical success factors

Economic feasibility BEC
The Bio Energy Centre (BEC) functions as a central processor, processing manure from the pig and poultry production and producing energy which is used for animal production. With the specific features of the BEC the majority of the 'Planet' indicators for NGB are evaluated as positive. Omitting the BEC would mean that many positive aspects of the sustainability performance evaluation disappear, for example, the reduction in greenhouse gas emission and energy use. Moreover, part of the animal stock depends on animal holding rights that are based on manure processing. If the manure processing is omitted, the animal holding rights of more than one third of the pigs and poultry cannot be obtained without considerable costs. And if this part of the NGB is omitted, the company only produces pig and

poultry meat in two separate parts of the farm. The only remaining unique feature of the NGB concept is the short chain approach in the poultry meat production part.

Operation of the BEC strongly depends on a number of external factors. First of all, the developments on the market of alternative energy production affects the cost of energy production. The supply of co-products largely determines the revenue of energy production in the BEC and thus also determines the financial results of this business. Kool *et al.* (2008) describe the price effect of increase in demand on the raw material market for food and biomass. Existing initiatives for energy production from biomass already have to cope with operational losses and investments in biogas production decline. A second factor that affects energy production of the BEC is that co-digestion is not profitable without subsidies. This dependency on government support makes it hard to believe that the system is resilient. A third factor is that the financial success of manure processing depends on the manure market. Manure processing costs a certain sum per cubic meter. Unless the costs of marketing rough manure is lower than the processing cost, it is financially more attractive to market rough manure.

Economic feasibility poultry slaughterhouse

The operational feasibility of the poultry slaughterhouse within the NGB was not evaluated by Kool *et al.* (2008). The balance is evaluated as positive but a critical success factor will be the value creation of the end product (poultry meat). If the slaughterhouse is omitted from the NGB concept, positive evaluation of some sustainability indicators related to animal welfare (no transport of living animals and less cruel slaughtering) disappear.

Declining social basis large scale animal production

The third critical success factor is the social support for the initiative. In the Dutch society the trend can be seen that the social support for large intensive animal farms is declining. In many regions citizens revolt at initiatives for new large intensive farms (or expanding existing farms to a very large scale). On a national level the discussion has started about the desirability of those large scale farms (in Dutch: megastallen). As an example in the Province Brabant more than 33 thousand citizens signed an initiative against large scale farms which is presented to the Province government. As a result of this growing social resistance to large scale farms some Provinces like Groningen prohibit the realisation of those mega farms. Concerning NGB on local level there is also resistance to the realisation of NGB. For instance organised in 'Behoud de Parel'. Although the local government tolerates an initiative like NGB within several conditions the social support for such large scale animal production can be seen as a critical success factor .

5. Discussion and conclusions

To interpret the conclusions on the sustainability performance of NGB in this study the following has to be taken into account. This study evaluates the sustainability performance of the initiative Nieuw Gemengd Bedrijf (New Mixed Farming or NGB) at different integration levels (local – global, chain – system), based on the methodology that is described by Blonk and Scholten (2010). Within these levels, different sustainability indicators, which are ordered in the three categories people, planet and profit, are evaluated at different geographical scales (within the initiative, local, national and global). The total evaluation of the sustainability performance depends on each sustainability indicator and the importance (relative weight) of each indicator. A weighting of importance of each indicator has not been applied in this study.

This evaluation in study only holds to the NGB and therefore does not evaluate the Dutch (intensive) animal husbandry as a whole nor does it evaluate the (legal) frameworks within which the NGB could develop (such as the legal implementation of the LOG Witveldweg in Horst aan de Maas).

The results of this study are based on the plans about the facility arrangements of the NGB. If the implementation deviates from those intentions, this could have consequences for the sustainability performance evaluation. Also, the management of the implemented NGB will partly determine the final evaluation. Both aspects can have either positive or negative effects on the final evaluation. If such deviations from the original plan and intentions occur, this needs to be evaluated before conclusions can be drawn about sustainability.

Strengths

From the sustainability evaluation the conclusions can be drawn that the sustainability indicators in which NGB can distinguish itself in a positive way, in comparison to the baseline, are:
- positive animal welfare & health, labour conditions and animal disease risks. All due to the integrated poultry meat production chain.
- the 'planet' indicators for the surroundings at national level due to the fact that animal production spread over the nation, sometimes in or near nature areas is concentrated at on site;
- the global 'planet' indicators (greenhouse gas effect, depletion of fossil energy and phosphate rock) due to the processing of manure and production of 'green' energy by the BEC;

Weaknesses

There are no sustainability indicators on which the NGB is evaluated as less sustainable than the baseline.

Opportunities

Some opportunities for NGB to develop more sustainability are:
- Setting requirements for the supply chain (compound feed producers) such as the inclusion of sustainable produced raw materials (e.g. EKO/Milieukeur/sustainable soy).
- improving animal welfare for pigs

Threats

The main critical success factors are the economic feasibility of the BEC and the poultry slaughterhouse. The economic feasibility of the BEC depends on external factors like subsidies and price developments of raw materials for bio energy production and on the manure market. If BEC and/or the poultry slaughterhouse cannot operate any more the positive evaluation on several sustainability indicators will disappear.
Another threat is the declining social support for large scale animal production.

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