# Evaluation "The conceptualization of robust production systems" (WP-083)

November 2010

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**Duration:** January 1, 2008 – December 31, 2010

## Introduction

After the Second World War agriculture in Western Europe has changed dramatically from a countryside with many small mixed farms to a continent with fewer big and specialized high productive farms. However, this type of agriculture has become vulnerable to many disturbances and is not durable. In addition, traditional breeding with a dominant focus on such efficiency and production has resulted in plant varieties and life stock adapted to these sensitive production systems that, although highly efficient and productive, are vulnerable for external disturbances. The idea is that by adding robustness as a goal to production and breeding systems helps to solve these connected sustainability problems.
This project focuses at 1. if possible, a better definition of robustness, and 2. the social aspects of the scientific development of robust agricultural production systems as a step in the transition to a more sustainable and social acceptable agriculture.

## Research

This PhD project was set up as an interdisciplinary project. During the first period, research was focused on an analysis of the role that robustness and robust production systems might play in a transition towards a more sustainable and social acceptable agriculture. A desk-study into literature on robustness with a focus on the social aspects has been performed.

The case-studies with TransForum scientific projects were:

- Stacking functionally expressed apple genes for durable resistance to apple scab in order to reduce fungicide use during apple production. The robustness factor here is introduction of durable fungus resistance in existing high quality varieties by genetic modification with cisgenic resistance genes.
- SynErgie: This project aims at the development of energy-poor or even energy-producing greenhouses. It has identified a number of barriers that obstruct the development of this more sustainable concept. An adapted robust plant production system is needed to reach that goal. In addition the produced energy by the greenhouse system will be marketed
- Robustness of animal production systems: concept and application. The project tries to reach a breakthrough in animal welfare and to gain societal acceptance by establishing new alliances.

## Results

The result of this study suggests that robust systems are neither vulnerable, nor stable, and that robustness is not a clear cut system feature. Rather, robustness relates to an intermediate sphere, in which aspects of vulnerability and stability are mutually exchanged to optimize a systems capacity to cope with both ordinary and occasional disturbances. Robustness is thus a strategy to cope with specific aspects of vulnerability in the absence of specific stability properties. We distinguish three strategies, that have found applications in current agricultural systems, in which resistance is representing robustness in a narrow sense and avoidance and resilience in a more broad sense:

1. Resistance: is based on reducing a system's sensitivity to disturbance by increasing the inherent resistance of systems. Recognizing that exposure to some disturbances can not be avoided, this strategy aims to develop systems that can resist exposure to these disturbances without structural damage. It is particularly relevant with respect to disturbances that cause unacceptable and irrepairable damage, such as apple scab. The scientific project "Stacking functionally expressed apple genes for durable resistance to apple scab" is an example of this robustness strategy;
2. Avoid exposure: is based on precautionary measures or system integration in a larger whole that provides shelter or reduces largely the likelihood of being exposed to particular disturbances. Focusing on the relationship between system and perturbation this strategy has lead to highly protective, constant and intensively controlled production environments, such as closed-greenhouse farming. The scientific project "SynErgie" is an example of this robustness strategy for an optimized plant growth in such a system;
3. Resilience: is based on increasing a system's capacity to respond and recover after being disturbed. This strategy does not aim to avoid or resist disturbances, but uses the capacity of systems to respond and recover to cope with disturbances instead. It is relevant with respect to disturbances that cause temporary, repairable and acceptable damage, such as temperature fluctuations or changing feed quality. The scientific project "Robustness of animal production systems" is an example of this robustness strategy.

**Implications for Metropolitan Agriculture (MA)**
Robustness is also an important issue for transition to all kind of durable MA production systems. Starting point is social acceptance of these agricultural activities which has to be balanced with the needs in urban areas. For example, 1. robust organic agriculture combined with all kind of other services, such as care farming, could best be organised near urban areas; 2. energy producing greenhouses have to be improved and properly positioned in our landscape, and 3. durable resistance of apple and potato to important diseases can bring back apple into and near the cities and keep potato as main cash crop in our metropole.

**Implications for Connecting Values and Agro-Innovations System**
Robust and social accepted agricultural transitions have to be the base for bringing added value to the farmer in many production systems. Behaviour of more and more consumers is not only focused on prices nowadays, so that more attention can be paid to other aspects of agricultural (fresh) products and the way they are produced. New added values of such products are: honestly produced, healthy, animal friendly and durable. Many more farmers have to be convinced to listen to consumers and even sometimes to allow consumers to participate in determining circumstances of production. The Rondeel egg is a recent example of combining animal friendly circumstances with the higher price of eggs.