

To re localise & re cultivate plant breeding and genetics

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As incipit, a quote ...

'There is little doubt that genomic will have a powerful impact on the improvement of food security crops in coming decades'.

... a recurrent conclusion made by most of plant molecular science papers.

But actually the majority of plant geneticists is not very aware of the fact that biological science must include mandatorily the protection of nature.

Questions addressed in this paper

Why geneticists are poorly interested in implications of their research in global science and for nature protection?

Why plant genetics research is a targeted for predation by private interests, world Bank and US philanthropy?

What are the ongoing consequence for biodiversity and the seed sector for the South Development?

Illustration: the case of seed policy and regulation in Africa

Genomic and Post-Modernity

Genetics is part of the myth of 'triumphant modernity' (Alain Touraine, Critique of Modernity, 1992) who claims autonomy because it would be sufficient for itself. Moreover ADN is mentally associated with revelation of the secret of nature

This probably grounds the intellectual position to justify **of reversing the research paradigm on which biological sciences were built**: in the so called 'biotechnological revolution', knowledge did not born from observation and experimentation but is part of (digital)creation as 'Commanding the Nature'

Why molecular genetics is a sensitive area ?

High technology lead innovation (for agriculture as well as for health) has inherent characteristics that deals with the postmodernity conception (no sooner is a technology available than its successor is already in sight)

not conceptual nor reflexive (tools evolve faster than thinking)

timely : past research is viewed as obsolete

not involves empirical observations depreciated as being too broad too long or qualitative

auto referring :limits inclusion of other research fields and disciplines

Agricultural science is more and more confined into the laboratories

In the new forms of techno-science-society interactions, in which non-scientists work with scientists to produce knowledge (Callon, 2003), the notion of 'research in the wild' is coined by opposition to the 'confined research' (laboratory research)

Callon examines the role of genetics in the case of human myopathy. Faced with the failure of laboratory research, strategies open to patient is that they turn it back against a science considered to be distant, normalizing, and reductive, or they decide to develop their own capacities and to set up collaborative research with scientists and clinicians

At the roots of the citizen criticism against science there are the not acceptance of symmetry between expertise in the wild and laboratory expertise and also the intrinsic system of research evaluation that valorize formatted academic publications.

Blindness of the technical complexity

Genetic research in the modern agronomy subordinates individual researchers with technical codes of such complexity that make them unable to communicate with other fields of science.

Many papers disappoint the readers beginning with fuzzy shortcuts as *'There is a strong correlation between agricultural productivity, hunger, and poverty . Seventy-five percent of the world 's poor live in rural areas and make their living from agriculture ...'*

following by a highly technical description of a particular 'new' punctual gene thought to be associated with a plant physiological trait (i.e. response to hydric stress) [the core of the paper but not understandable except by hyper specialists] ...

ending by a abrupt return to general like *'Plant breeding, aided by genomics, will play an important role in the endeavor to reduce hunger and poverty.'*

Domestication and selection are concomitant with the invention of agriculture

Darwin and Mendel has proved that genetic modifications is a permanent long term processes. This process have occurred from Neolithic and during the course of plant domestication thanks to variation in the descendances and selection (natural or not). Genomes are then the expression of the evolution.

Evolution is fundamentally dynamic i.e. depends on temporality and on the constant evolution of the environment context that produces (biological and cultural constraints

Genes have been studied by geneticists for 30 years in a fixed manner and continue to being. This paradox conducts to opposite trends in research orientations

Epigenetics and the plant evolution

Evolutionary biology is structured by the natural selection mechanisms theorized by Darwin and based on his around world empirical observations.

Evolution of genotypes occurs by aleatory natural mutations of DNA (genetics factors) and by epigenetics factors (not exclusively related to DNA). The epigenetics science developed by mid-80, gave evidences of epigenetics factors (DNA modification by methylation, RNAs fragments outside of nuclear or histone modifications). They are heritable, can modify genomes (DNA expression) and can skip generations (transgenerational).

Epigenetics responses act as a stress memory activated in the progenies if the external constraint re appears. They generate phenotypic and genotypic biodiversity and are assumed to be a powerful adaptation mechanism when the environment of plants and animal is under pressure.

Fixist genetic and epigenetic views of evolution bottlenecks

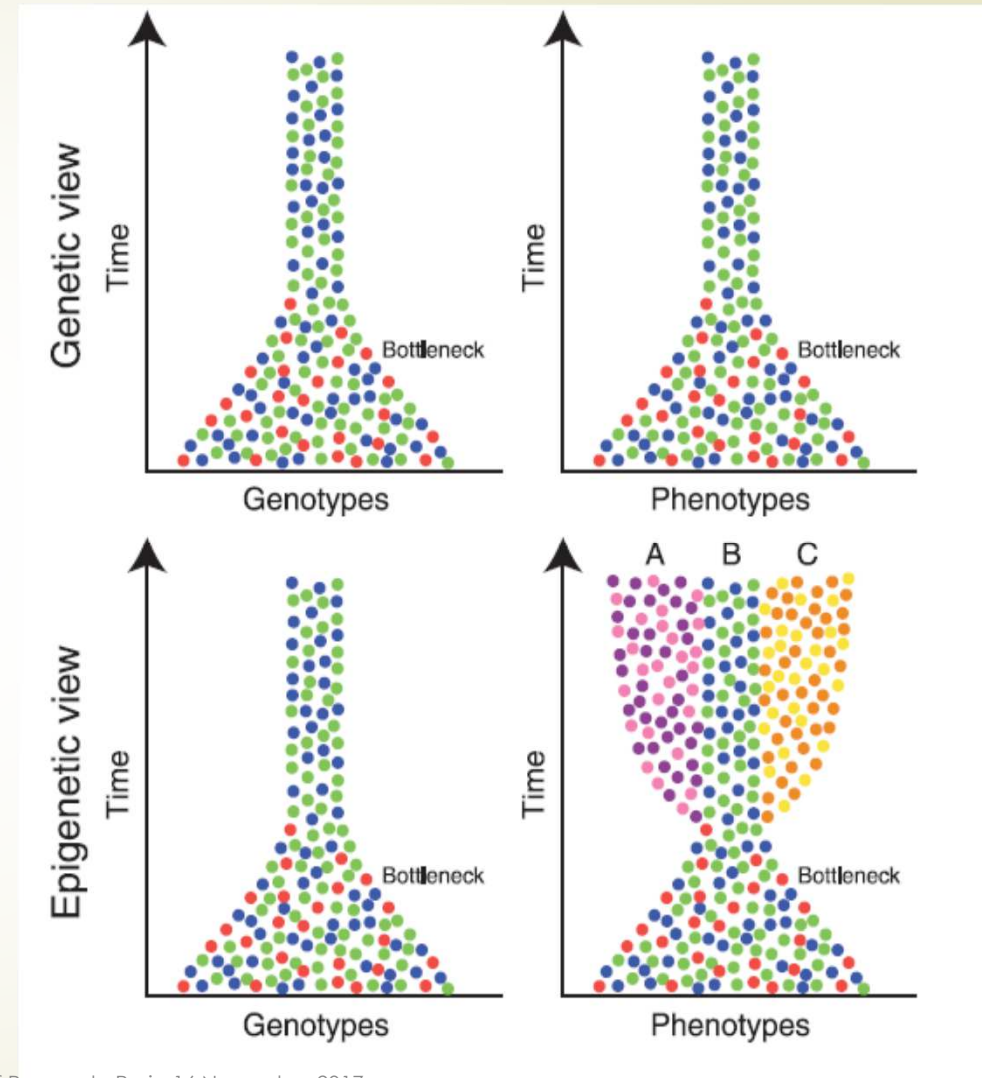
Above:

From a traditional (fixist) genetic perspective: a bottleneck occurs in genotypes and their phenotypes according to the requirements of natural selection and drift : loss of diversity at both the phenotypic and genotypic levels

Below :

From an epigenetic perspective: phenotypic diversity is ameliorated by epigenetics mechanisms possibly mediated by genetics events (mutation, hybridization) but more frequently by environmental selection or ecological change

(New Phytologist, 2005)



Enthusiasm on gene editing (transgenese) in the biomolecular sphere

'CRISPR clearly stands out as a novel chapter in the major biotechnology revolution which our century is witnessing' (French Society for Genetics, 2016)

'Genome editing' means direct manipulation of the genome (DNA). CRISPR/Cas9 technology is an engineering tool for DNA modification that allows to transform genome (DNA) in an accurate, rapid and easy manner

Massive support by both the private sector (Pharma and Agri), pro-business organisations (Gate's Foundation) and also by more generalist one as ERA-Net (UE) that are less or not at all interested in the epigenetics.

Consequences : ever-growing successful usage of the CRISPR/Cas9 in the plant genetics blossoming fast in many academic laboratories and start ups

Why the private sector is interested in genetics?

Techno-sciences and genetics are confined. This confinement makes it particularly sensitive to standardization, delocalization and pre-emption by private interests.

A classical bias in techno science is to define problems from available technologies or preexisting solution → Delocalization of research → Standardization

These biases are relatively insensitive to the hitches of contemporary research :

- Research by projects: predetermined and scheduled way of producing findings

- Short term strategy (difficulty to get funds continuity)

- Low contextualization

- Competition logic masked by apparent collaboration

- Unstable research assemblages and precarity that disturb the creativity

Looking for patenting objects in agriculture

Since DNA was deciphered in 1930, patent rights on living organisms have been pushed everywhere. When modern selection biotechnology rise, it became possible to patent genetic combinations within plant varieties.

And when seed industry become dominant (post-war) science was continuously pushed to breed patenting seeds (plant populations were replaced by hybrid and lines in many arts of he world)

Later, the genetically modified organism (GMO)* was a perfect patenting object: stabilized genetic tags give the possibility to have a traceable commercial value

→ GMO* instability (= unstable expression of transgenes) in the Nature is now proved by advanced epigenics.

**GMO* is a misnomer since it supposes that before genetic engineering there were no 'natural' genetic modifications whereas genomes are continuously changing , *transgenic plant* would be a more appropriate term.

Illustration: seed policy under the influence Africa

The post-war agricultural revolution organized and deployed the marketing in Europe of selected and homogenous varieties (hybrids). This generalization was such that today most of farmers no longer have the right to dispose of the seeds of very diverse ancient varieties that they have selected over time (before 1950).

In the agricultural model, the forefront of modernization has been the **generalization of hybrid varieties or pure lines created to perform well in artificialized growing conditions**. This intensification has gone together with strong public policies, agronomical research and regulatory mechanism specially focused on breeding programmes (Bonneuil and Thomas, 2008).

The legislative regulation mechanism was formulated internationally (UPOV) and tailored to a single varietal type (fixed genotypes) unlike the population varieties cultivated in the past.

As this intensive farming model has now proved its cost in terms of erosion of biodiversity, energy and water consumption, pollution and climate change it should be logically applied with drastic restrictions to the agriculture based economies in the South.

But the contrary is occurring in Africa

Powerful groups of donors influence African agricultural policies and seed regulation

Sub-Saharan Africa has stayed away from this 'green revolution', and family farming has continued, using plant varieties of the same type as those that have now almost disappeared in Europe.

Today, neo liberal institutions (WB) arranged with seed multinationals (Syngenta, Monsanto, AGRA) and very powerful private foundations (B and M Gates, Rockefeller), are mobilizing massively to promote the rapid development of a seed market in Africa based on the Western model (UPOV).

Insisting on the fact that '*the agricultural seed sector and market in African countries is under developed*', the assemblage is hard working of developing actions to push seed market : funds are widely available for research and political institutions in order to elaborates and implement seed laws in different countries of the continent (Clavel, 2016)

Strategy and discourses of the 'no alternative' supporters

Create the conditions of a 'free' Market of seeds:

- Push States to modify the seed laws in favor to the 'logic of copyright' instead of the actual predominant 'logic of commons'
- Push National Research towards patentable products

Organize 'globalizing' communication that actually ignore alternate, past and human research :

- modernization of agriculture (Green Revolution for Africa/AGRA) is mainly based on modern varieties and 'certified' (=normalized) seeds
- clutter the agendas of stakeholders on predetermined topics (i.e. 'access to seeds')

Neutrality of science can no longer be claimed

In the Michael Polanyi conception 'Pure Science' does not need to serve practical (economic, social, political) interests and needs.

This idealistic description of a community of free intellectuals who are passionately committed to seeking the truth is countered by the idea that today's science is summoned to be useful for societies in crisis

However that usefulness has longer been reduced to the 'global' economic profit instead of human progress (liberty, equality)

Science is not neutral. Science is in fact at the service of economic power and need money to do that.

Trouble in triumphant modernity

Environmental disaster point out that laboratory knowledge cannot absorb all the complexities of the world.

Even though patenting is powerfully process pushed by seed industry everywhere, another pathway is considered as possible provided that the scientists agree to leave their laboratory and agree to consider the symmetry of knowledge whatever their origin and how they are produced

A minority of scientist generally associated with organizations from civil society is claiming for 'decolonization' of the knowledge from the occident model.

Relocating plant genetic means to relocate studies in the fields implies :

- formulate the research questions according to the local particularities: resources, knowledge, stories , culture and beliefs

- promote skills created from other sources than those from instantaneous technological science.

So we think that Plant genomics must be re located and re cultured



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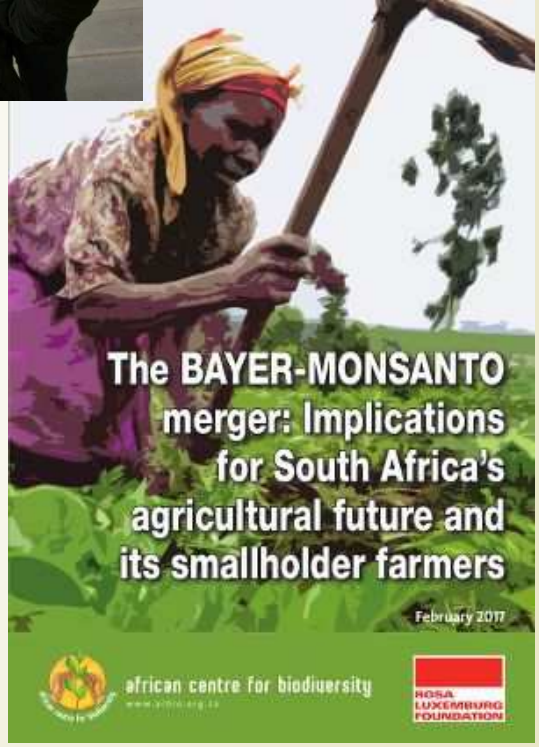
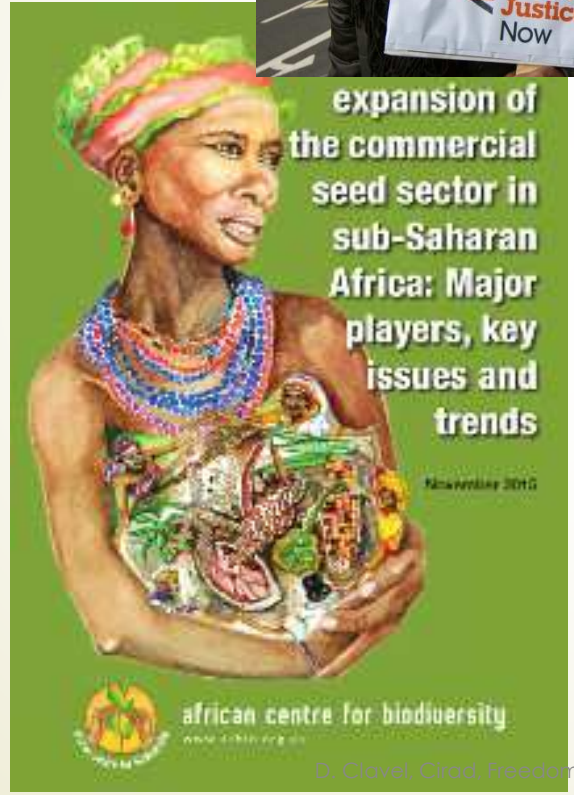
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