THE ROLE OF DIVERSITY AND DIVERSIFICATION FOR RESILIENT AGRICULTURAL SYSTEMS

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ABSTRACT

Biodiversity is a unique and precious heritage: generic but also cultural, social and economic. Its drastic curtailment, however, puts at risk the survival of local farming systems, and this is even more so in fragile socio-economic contexts where it risks translating into conditions of food insecurity and poverty. From the elementary level of the gene, rising in complexity up to the ecosystem, it is therefore a central element in defining first the resistance and then the resilience of the system, and by the first term meaning the degree of resistance to a disruption that distances it from the initial state of equilibrium and by the second the capacity of a system to return to guaranteeing minimum standards following a disturbance, the capacity to get back on ones feet after a fall.
It seems to be crucial, then, at a time when cooperation development projects that operate in various ways to safeguard and promote biodiversity are far more numerous, to intervene to preserve and restore the local biodiversity in order to avert future problems, and even curb them ahead of time, using resilience as an approach for managing the system we are dealing with (natural or heavily affected by human activity). In any event, this is a passage that is not routine, which makes it necessary to look at the ecosystem, at its various components, both natural and human. In the light of these preliminary remarks, the article will analyse the potentiality for applying, also in the field of development cooperation, the theoretical approach including empirical methods and instruments represented by the Diversified Farming Systems DFS), where the starting point is diversity and diversification as functional elements in the construction of resilient farming systems.

INTRODUCTION

Biodiversity is central to defining a system's state of health. An ecosystem with species depletion, characterised by few individual species belonging to the most resilient groups, is more vulnerable and more subject to risks like desertification, colonisation by exotic species, an interruption in the supply of fundamental natural services, and food uncertainty, with serious consequences and repercussions especially in fragile socio-economic contexts. The management of the stresses is controlled by complex genetic systems, which involve the interaction of large gene systems and the connection of the plant/animal and its environment.

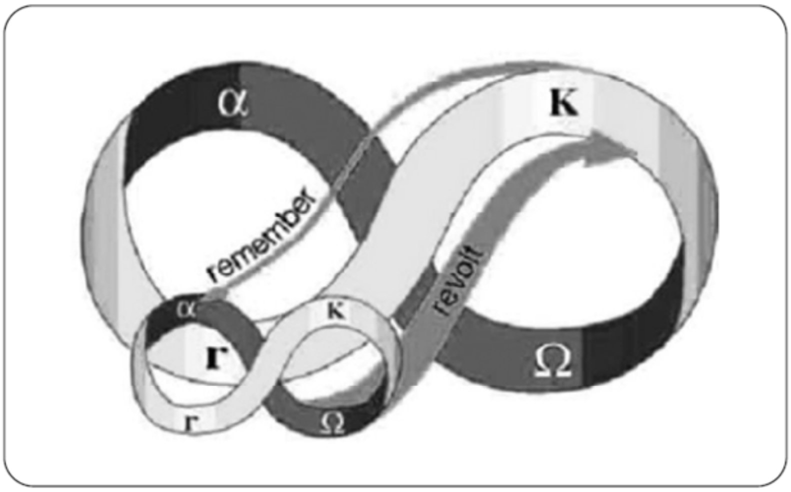
Biodiversity (from the gene, at the elementary level, increasing in complexity to the ecosystem) is therefore a key element in defining first the resistance and then the resilience of the system; by the first term we mean the degree of resistance to a disruption that distances it from its initial state of equilibrium, and by the second term the capacity of a system to return to guaranteeing minimum standards following a disturbance, the capacity to get back on ones feet after a fall.

In the face of harvests lost because of the Brusone disease of rice, farmers in the Chinese province of Yunnah, who have adopted a farming system using different varieties of rice, registered an increase in production of up to 89 per cent. At the same time these farmers have conserved the traditional genetic diversity of the local varieties and reduced the use of fungicides [1] [2]. Also in Italy we have seen that a high level of genetic diversity provides greater protection against drought for wheat harvests [3].

It would seem crucial, then, to work to preserve or restore the local biodiversity to avoid problems in the future, and actually stem them ahead of time, using that same resilience to construct models/projects that allow us to successfully overcome future crises. In this sense, more than an objective, resilience is an approach for managing the system we are dealing with (natural or affected by human activity). Sensitivity regarding these issues is slowly growing; not surprisingly, the recent report of the High Level Panel on Global Sustainability, advocated by the Secretary General of the United Nations, Ban-Ki-Moon, in its title and contents takes up the concept of resilience: *Resilient People, Resilient Planet: A future worth choosing* [4].

This means using biodiversity and the richness of ecology to decide how to prevent hydrogeological instability, to manage the consequences of a catastrophic event like an earthquake or a pollutant spillage, how to manage a low impact disinfestation campaign on parasites, how to use local resources to stem an economic crisis, without disturbing the general dynamic state, composed of various levels of equilibrium that are interspersed with adaptive cycles, within a perennial transient state. According to this thesis developed by C.S. Holling [5], populations and, by inference, ecosystems have more than one state of equilibrium, and following a disturbance often a different equilibrium to the previous one is restored and they depend on the influences of the states and dynamics that occur at the levels above and below the system itself [6] (*Fig.1*).

Fig. 1 - Relations between several phases and adaptive cycles [7].



In numerous development cooperation projects aimed at the conservation and sustainable use of the ecosystems and habitats containing a high degree of diversity, as well as the preservation of genome types and genes of social, scientific or economic importance and the fair division of the benefits deriving from the use of genetic resources, a genuine protection and valorisation of biological diversity can occur exclusively through inter-sectorial action, which looks at the ecosystem in all its diverse components, both natural and human.

For cooperation projects in the agronomic context, a particularly interesting approach in this direction is the theoretical framework of the Diversified Farming Systems (DFS), recently drawn up by a group of researchers at the University of Berkeley in California. These are models that agree upon the attention to local production, to farmers' knowledge and practices, to approaches capable of limiting the negative environmental externalities, whose goal is the improvement of the sustainability and resilience of farming systems, and thereby making a significant contribution to fundamental issues like food security and health [8].

BIODIVERSITY AS A STARTING POINT

The DFS model is innovative in that it goes further and reconstitutes in an original way the now abused concepts of sustainable, multi-functional and biological agriculture, in an attempt to create a common denominator through meeting minimum objectives from among the various approaches that seek to achieve farming that is capable of providing sufficient food and maintaining the ecosystem services for present and future generations, in an era of climate change, increasing energy costs, social unease, financial instability and growing environmental degradation. All this also in light of the diversity of the ecological, socio-economic, historic and political contexts in which farming systems developed and are still evolving.

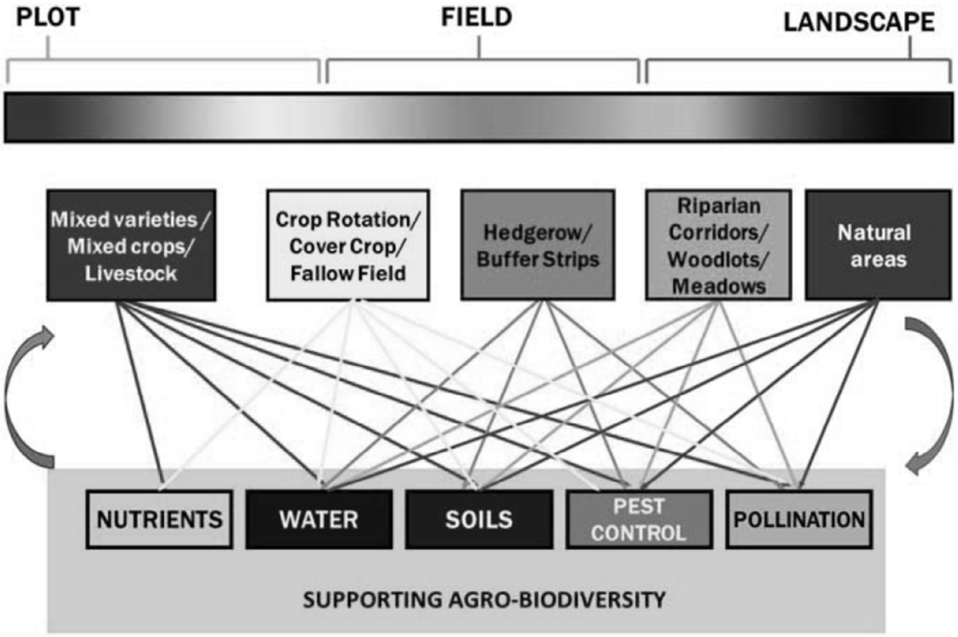
So, rather than starting with a vision from which a pre-defined model follows, the approach is that of operating on a series of attributes, which necessarily should possess a system that you want to define as sustainable for working on a strategy of farming production capable of inverting the negative externalities produced by erroneous farming technologies and about which an article published in the International Journal of Agricultural Sustainability [9] sought to draw some attention to, where the following main characteristics were identified:

- the employment of local varieties and breeds, so as to bring out the **genetic diversity** and improve adaptation to changing biotic and environmental conditions;
- avoid the unnecessary use of agrochemistry and other technologies that have a negative impact on the environment and on human health (like heavy machinery, transgenic farming, etc.);
- the efficient use of resources (nutrients, water, energy, etc.), the reduced use of non-renewable energy to limit dependence on production factors outside the company;
- the valorisation of agro-ecological principles and processes, like the cycle of nutrients, nitrogen fixation, biological control using the promotion of diversified farming production systems, and the agroecosystemic optimisation of **functional biodiversity**;

- innovation through recourse to human capital in the form of scientific knowledge and traditional and modern skills, and the promotion of appropriate innovation and technology networks thanks to the use of social capital and respect for cultural identity;
- the reduction of the ecological footprint of the production, distribution and consumption system, so as to reduce greenhouse gas emissions and keep pollution of the ground and water to a minimum;
- the promotion of practices that can increase the availability of drinking water, carbon sequestration, **the preservation of biodiversity**, soil and water;
- the capacity to adapt to change based on the possibility to respond quickly to disturbances, pursuing a balance between the capacity to adapt in the long term and short term efficiency;
- reinforcing the resilience of the farming system **by preserving the diversity of the agroecosystem**;
- the dynamic preservation of the socio-cultural legacy of the farming heritage, permitting social cohesion and a sense of pride and belonging, reducing migration.

These attributes often focus attention on biodiversity (highlighted in bold) as a crucial ingredient of the resilience of the agroecosystem. The approach of the DFS is positioned within these assumptions and identifies in diversity the starting point, including it intentionally and functionally in the various spatial (from field to landscape) and temporal scales of reference [8]. In this way, maintaining and preserving diversity assumes the function of a flywheel for maintenance and balance (intended in the dynamic sense) of the services of the input ecosystem of farming (soil fertility, control of pathogens, pollination, the efficient use of water resources).

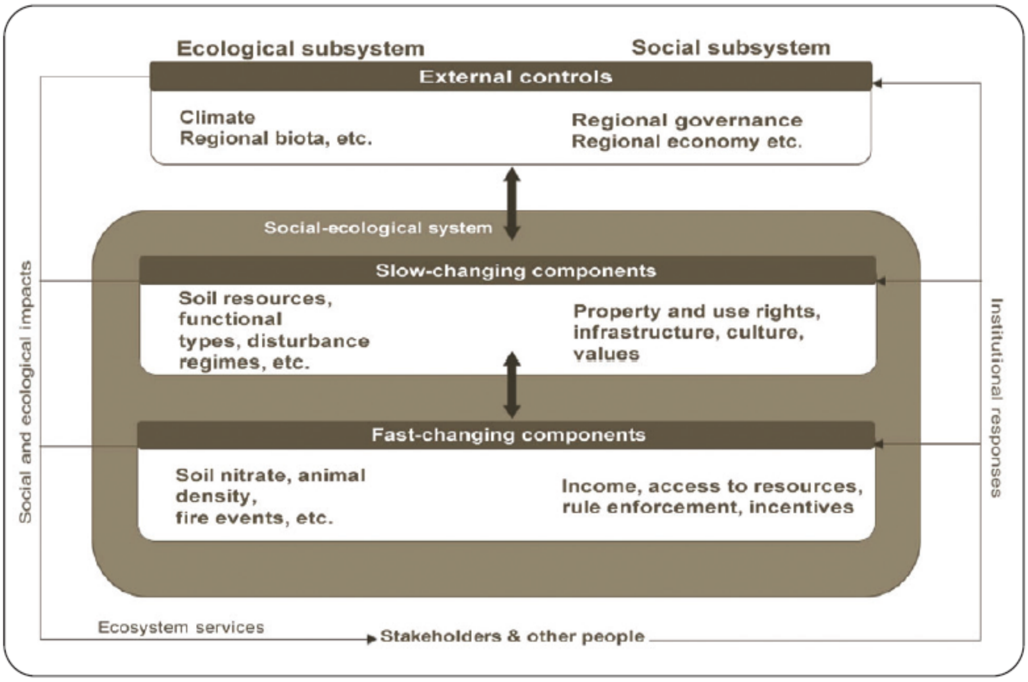
Fig. 2 - Conceptual model of a diversified farming model [8].



In this way, biodiversity is located within a strategy characterised by resilience as an approach and not as a mere end, the first functional unit of a complex system, where the role of the social component should not be undervalued. Recognising, according to one's view of human ecology [10], that ecosystems are heavily interconnected with the social fabric in which they exist, and that this is particularly so for farming as the result of the perennial connection between human societies and ecosystems, the result of a co-evolution between nature and culture (*Fig, 3*), particular importance is given to aspects like:

- the interdependence between social, economic and ecological systems;
- the social factors and processes that influence and maintain the processes of an economic nature;
- the social structures, values and hierarchies assigned to some identity markers like ethnic background, class and gender;
- the decision-making processes, the construction of alliances and governance.

Fig. 3 - Conceptual model of integration between ecological / social components in the ambit of a farming system [11].



THE POTENTIALITIES OF THE DFS APPROACH FOR DEVELOPMENT COOPERATION

Research in the field of the sustainability, the resilience, and the vulnerability of socio-ecological systems is becoming ever more important and is significant also for the political and economic sphere, and it is our hope that they can contaminate in a positive sense the world of development cooperation (research and practice). In this sense, we feel that the DFS approach has some potentialities and some points to reflect upon regarding the objectives of development cooperation. Once again, not as much as biological diversity, in that it is the object of cooperation projects and interventions, but the way in which we work on diversity, through an approach to resilience, to attain development objectives that necessarily have to take into consideration the reference socio-territorial context, in terms of institutional analysis.

In fact, knowledge of social institutions is crucial, namely the combination of regulations that human beings use to organise interactions of a repetitive and structured nature, including those within the family, the neighbourhood, in the market, in the factory, in church, of organisations and government at all levels [12] to understand how to deal with biodiversity so that it can generate a resilient system. This is the result of collective, long-term action, where the benefits and the positive externalities associated with the maintenance of the agro-biodiversity are evident to all.

It seems to be especially important how to integrate scientific knowledge and traditional and modern skills, and to promote innovation and technology networks suitable for the use of social capital and for respect for cultural identity within a process that includes diverse stakeholders including farmers, engineers, researchers, local governance, where the cooperation projects should stand as facilitators, where traditional knowledge can integrate with that deriving from scientific and technological innovation.

We can observe, then, in the DFS theoretical model a series of ideas that should be examined more closely through training and occasions for discussion in an academic context, through a necessarily interdisciplinary perspective and with operators of the cooperation sphere, especially regarding the potentiality of the DFS approach as a process for education, training and technology transfer that can better take into account the complexity and the diversity of the systems, in a context like that of cooperation projects, where cultural diversity is a fact, and which could, however, be a further value added.

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