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Peace Education through Agroecology and Organic Farming

Edukacja dla pokoju poprzez agroekologię i rolnictwo ekologiczne

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Abstract: In this paper, the challenge of peace education appears as an emergent cultural need in a context of conflictual relationships among human beings and between human beings and their life environment. All sectors of human activity, including agriculture, can potentially contribute to building a cultural barrier to a mounting wave of wars. The ecological approach to agriculture through the ecosystem concept is suitable for unveiling the power of cooperation in developing symbiotic relationships between and among agroecosystem components for attaining a balance of ecosystem services (supporting, provisioning, regulating, and cultural). Enhancement of biodiversity within and between cultivated fields is key for the maintenance of sustainable agriculture, land management, and viable rural community. Scaling up cooperation among hierarchical levels of agriculture organisation (field, farm, and regional, national, international landscapes) appears as the most promising solution for developing a coherent framework consistent with building a peaceful attitude for managing both land, food systems, and friendly relationships among human beings. Organic farming is already a certified and appreciated method of agriculture production that has a potential for improving a peaceful attitude when supported by the core principles of Agroecology.

Keywords: sustainable agriculture, agroecosystems, cooperation, ecosystem services, evolutionary development, cultural change, ethics

Streszczenie: W niniejszym artykule poruszono temat edukacji dla pokoju, która jawi się jako wyłaniająca się potrzeba kulturowa w kontekście skonfliktowanych relacji międzyludzkich, jak również relacji między ludźmi a środowiskiem, w którym żyją. Wszystkie obszary ludzkiej działalności, włączając w to rolnictwo mogą przyczynić się do budowy bariery kulturowej mogącej zatrzymać narastającej falę wojen. Ekologiczne podejście do rolnictwa poprzez koncepcję ekosystemu może unaocznić moc współpracy w rozwijaniu symbiotycznych relacji między elementami agroekosystemu w celu osiągnięcia równowagi usług ekosystemowych (wspierających, zaopatrujących, regulujących i kulturowych). Wzrost bioróżnorodności na polach i pomiędzy polami uprawnymi stanowi podstawę zrównoważonego rolnictwa, zarządzania gruntami i żywotności społeczności wiejskich. Zwiększenie współpracy między poziomami hierarchicznej organizacji rolnictwa (pola, gospodarstwa rolne oraz obszary lokalne, krajowe i międzynarodowe) wydaje się najbardziej obiecującym rozwiązaniem dla opracowania spójnych ram zgodnych z budowaniem pokojowego nastawienia do zarządzania zarówno ziemią, systemami żywnościowymi, jak i przyjaznymi relacjami między ludźmi. Już teraz, rolnictwo ekologiczne certyfikowaną i cenioną metodą produkcji rolnej, która może wspierać pokojowe postawy, gdy jest oparta na podstawowych zasadach agroekologii.

Słowa kluczowe: zrównoważone rolnictwo, agroekosystemy, współpraca, usługi ekosystemowe, rozwój ewolucyjny, zmiana kulturowa, etyka

Introduction

Peace is not only an objective but also a humanitarian project not yet accomplished. Moreover, the destabilising times we live in of looming wars with apocalyptic effects call for the indispensable endeavour to set up a protective barrier of peace education useful for the present and future generations. We sadly have to admit that we are culturally guilty of neglecting this need since a time that at least dates back to the end of the World War II, a period of 80 year-silent war ("cold war") which has yielded an astonishing proliferation and accumulation of nuclear weapons and devices worldwide. Peace education concerns every human activity system, has no disciplinary boundaries, and aims to benefit both human beings, materially and spiritually, and the biosphere, locally and globally. Peace education is a win-win activity exclusively dependent on the human decision-making process, whereby we only need to trust, project and disseminate it worldwide in order to promote its implementation.

Among the main human activity systems (agriculture, industry, urbanisation, logistics, etc.), agriculture is by far the most comprehensive in dealing with all ecosystem components, whether biotic (plants, animals, micro-organisms) or abiotic (air, water and soil physical components). All that, under the designed organisation of both farmers and interested stakeholders in different areas of: a) administration (policy, economy); b) research and tuition (science, technology, extension service); c) input supply and output transformation (mechanical, chemical and food processing industry); d) marketing and distribution to human consumers (transport and commerce). The science of Agroecology, as the word's etymology suggests, is the science of ecology applied to the practice of agriculture (Altieri 1985; Caporali 1991). It adopts an ecosystem-based approach and therefore is able to focus on the meaningful relationships that link the various components in a *unity of interdependence* that is defined as *agroecosystem*. According to Norgaard (1981), "Agroecology is uniquely distinguished by its acknowledgement of social and ecological coevolution, of the inseparability of social and ecological systems". As to its epistemological foundation, "farm systems are the fundamental units of study, and in these systems, mineral cycles, energy transformations, biological processes and socioeconomic relationships are investigated and analysed as a whole" (Altieri 1985, X). When a well-balanced interdependence of components, we can say *cooperation*, is achieved with a minimum supply of external input of energy-matter (costly and polluting) and a stable capability of production, an agroecosystem is *sustainable*, i.e. able to regenerate ecological services (production, support, regulation, culture). From this holistic perspective, Agroecology is a science of *sustainable agriculture* (Gliessmann 2014; Caporali 2008). Cooperation among components is key to make an agroecosystem sustainable, which means organising structure and agroecosystem functioning according to the principles of *ecological complementarity* in such a way that mutualism and symbiosis prevail on competition and conflict, in brief, a *peaceful agroecosystem* able to persist.

As to the practice of agriculture, an international movement (IFOAM – International Federation of Organic Agriculture Movements) started in the early 1970s to challenge the conventional industrialized way of production in agriculture based mainly on agrochemicals (synthetic fertilizers and pesticides) by advocating an alternative method of farm management and food production (Organic Farming). This method grounds more on the use of internal natural resources and processes than on external inputs. In 2005, IFOAM adopted the four strategic principles (Health, Ecology, Fairness and Care)[1] that inspire the practice of Organic

1 The General Assembly of IFOAM approved the Principles of Organic Agriculture on September 28, 2005.

Farming worldwide according to an accurate procedure of certification approved by international and national laws. By including the principles of Ecology into the certified method of production, Organic Farming recognises Agroecology as the scientific framework for its legitimation. Together, the four principles of Organic Farming constitute a cultural and ethical basis for developing at the same time a sustainable agriculture (Caporali 2021) and a peace education process aiming at re-establishing harmony within the planet's living community (see points 2 and 3).

1. The Challenge of Peace Education

In the prospect of systems thinking, peace and peace education are both a question of relationships, where the relation's hub is an individual or an institution. The problem is how to stay in harmony with your inner (internal) and outer (external) environment, and the challenge is how to cultivate your inner and outer peace, respectively. A special issue of the UNESCO journal "the Courier", devoted to the "Dialogue among civilizations" (UNESCO 2001, 41), reported extracts from a radio interview on the topic "Can we educate for world peace?" released by Archibald MacLeish[2] on 12 December 1945, one month after the establishment of UNESCO:

"Of course we can educate for world peace. I'd be willing, from my own part, to say that there is no possible way of getting world peace *except* through education".

"Peace is something a great deal more than the absence of war. Peace is positive and not negative. Peace is a way of living together which excludes war, rather than a period without war in which people try to live together".

"Since wars begin in the minds of men, it is in the minds of men that the defences of peace must be constructed".

The meaningful manual on peace education by Loreta Navarro Castro and Jasmin Nario-Galace (2019) presents a clear vision of peace as a holistic concept and state of being suitable for connecting people in their local and global context, in order to recognise their intrinsic poly-dimensionality, from which one can draw suitable attitudes for cultivating personal, social and cosmic peace altogether. Their approach allows a vision of peace as a whole system of interconnected sub-components in a hierarchical fashion (Fig. 1). The personal and institutional awareness of the connection in a web of relationships from the local to the global is the basic argument of an emergent ecological conscience that has the power to change the vision of both the world and the human role in it (Caporali 2024). Ecological conscience is a scientifically adapted creed, before a more responsible framework of sustainable development, involving two interdependent steps:

1. Understanding nature organisation.
2. Acting in it in line with responsible behaviour.

The ethical value of ecological conscience in relation to peace had a prophetical announcement by American Catholic theologian Thomas Merton (1968) who advanced the following assumption:

"The ecological conscience is also essentially a peace-making conscience. A country that seems to be more and more oriented to permanent hot or cold war-making does not give much promise of developing either one."

Indeed, "structural and state-centric approaches are crucial when it comes to the problem of peace", and "the reality of human conflict cannot be reduced into the personal dimension but must also be considered from the point of view of unjust structures and power relations" (Feliciano and Maboloc 2022).

Progressing toward an ecological conscience received a consistent impulse with the publication of the epochal encyclical letter *Laudato si': On Care for Our Common*

2 Chairman of the Committee which drafted the Preamble to UNESCO's Constitution.

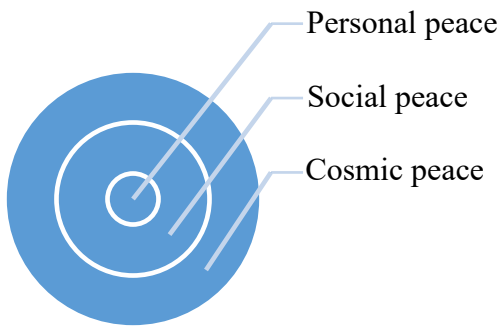

Figure 1. The poly-dimensionality of peace – simplified after (Navarro-Castro and Nario-Galace 2019)

Home (LS) (Pope Francis 2015), the value of which had an immediate feedback and appreciation worldwide (Cobb and Castuera 2015). More recently, Jame Schaefer (2018, 1) was able to list from LS the basic characteristics of an ecologically conscious person as follows: "open to awe and wonder, grateful, humble, respectful, cooperative, compassionate, responsible, courageous, and contemplative", the practice of which is needed for the transitioning from negative to positive attitudes and actions, individually and collectively. These characteristics are consonant with those advocated by Navarro- Castro and Nario-Galace (2019) as necessary for building a culture of peace. In their representation of a culture of peace, we can appreciate the operating interplay among the system components, where inner peace and outer peace feed each other. Environmental protection (main outer peace component), that is currently under attack of wars, pollution and natural resource depletion, is the most limiting factor for achieving the minimum threshold of security and safety needed for ensuring inner peace components (personal and family integrity, human rights and democracy, poverty eradication), whereby promoting intercultural understanding and solidarity through dialogue is indispensable.

2. The Ecosystem Concept as Key to Unveil the Power of Cooperation in Nature and Agriculture

The ecosystem concept is truly an epistemic innovation suitable for inducing a change of knowledge and understanding of the reality we live in and for re-setting human roles in it (Golley 1993). Since its introduction in the English language by Arthur G. Tansley (1935), it identifies life as a crossroads of processes made by organisms (man included) temporarily present in a permanent biophysical environment, yet able to organize more durable communities (or local ecosystems) within the whole system (planetary ecosystem or biosphere) permanently living through the succession of evolving species. In this complex, evolving and persistent scenario each organism (microbe, plant, animal, man) is a knot of the web of life on the Earth, which is in continuous flowing since 4 billion years. Biodiversity[3] has currently been recognized at different hierarchical levels of organisation (gene, cell, organism, species and ecosystem), but each level is necessarily cooperating with the upper and lower level around for its existence. The ecosystem concept unveils the success of life on this planet as the triumph of cooperation over competition, although competition is essential in creating the conditions of well- balanced

3 Biodiversity – The total variability among organisms and the habitat in which they live, including three components: species diversity, genetic diversity, and ecosystem diversity (Prance 1995).

communities of interdependent species and organisms locally and globally.

The distinction of specialised functional components within ecosystem, such as *producers*, *consumers*, and *decomposers*, underlines the trophic dependence between them, i.e., a creative phenomenon of *ontological and cooperative feeding*. Complementary biological forms coming out of solar radiation flow, absorption and conversion into biomass by producers, and succeeding ingestion of fresh biomass by consumers or necromass by decomposers, cooperate into a regenerative, self-sustaining pattern of feeding (Owen 1980). *Biodiversity* renewal is the persistent outcome of solar radiation supply and nutrient re-cycling, which altogether allow *biosphere's sustainability*, a cosmic astonishing event contrasting the entropy law in the universe. Moreover, creativity in ecosystems goes beyond the material confinement of biological forms, reaching out to the level of spirituality with humanity's capability of connecting things and thoughts in different symbolic languages. Science, philosophy, humanities and religion, are body of rational knowledge for generating practical and meaningful actions into technology, policy, economy and arts, each of which and altogether are fruits of meaningful cooperation of ideas for the realisation of projected goals. In its history of evolution, life has yielded a sequence of nested steps with a cumulative power to express emergent properties until the development of the current auto-recognition level, i.e. the *ecological conscience* that man manifests (Caporali 2024). Alfred Lotka (1925), a precursor of ecosystems ecology with a transdisciplinary attitude of enquiry that is typical of a systems thinking approach, was able to advance one century ago the kernel of the ecological conscience as well as the current human predicament in the following terms: "Thus, in the light of modern knowledge, man is beginning to discern more clearly what wise men of all ages have intuitively felt – his essential unity with the Universe […] A race with desires all opposed to nature could no longer endure; he that survives must, for that very fact, be in some measure a collaborator with Nature. With extending knowledge must come awakening consciousness of active partnership with the Cosmos" (Lotka 1925, 433).

2.1. Biodiversity maintenance for sustainable agriculture and land management

If one wants to discover and point to examples of cooperation in nature, one only has to look around in the environment, chose a fraction of it as an area of enquiry (a forest, a prairie, a farm or a crop, or the whole landscape you see) and search deeper for its structure using the ecosystem lens. It is obvious that the ecosystem concept operates as an innovative, epistemic tool in that it concerns the search for relationships and processes that link the ecosystem components in a unitary, functional pattern conferring the property of sustainability to the whole system, i.e. its capability of self-organisation, self-regulation, self-maintenance and evolution, with or without human intervention. Scientifically, this methodological approach started at the international level with the UNESCO's programme "Man and Biosphere" (MAB 1971) in order to reach the outcomes reported in Box 1.

BOX 1. Scope, methods and objectives of the MAB programme – synthesis after (MAB 1971, 7-8)

DEFINITION

Man and Biosphere Programme is an interdisciplinary programme of research which emphasizes an ecological approach to the study of interrelationships between man and the environment.

IMPLEMENTATION

It will be implemented in close co-operation with the organizations of the United Nations concerned and the competent international non-governmental organizations.

OBJECTIVES

The Programme is intended to develop a limited number of projects:

- to study and compare the structure, functioning and dynamics of natural, modified and managed ecosystems;
- to promote environmental education in its broader sense;
- to promote the idea of man's personal fulfilment in partnership with nature, and his responsibility for nature.

According to the inaugural message of Rene Maheu, Director-General of UNESCO, at the International Co-ordinating Council of MAB, the Programme would be "a venture of co-operation" in the following terms: "A means of mobilising the energies of the international scientific community for the purpose of defining fundamental ecological principles for the more rational use and better conservation of the resources of the biosphere, for improving the general relationship between man and its environment, and, lastly, for foreseeing the consequences of his present actions for the world tomorrow" (MAB 1971, 36).

As an aftermath of MAB's ecological approach in the field of agriculture, a new scientific journal appeared in 1974 by Elsevier Scientific Pub. Co. titled "Agro-ecosystems", providing the official acceptance of the concept of agroecosystem as a shared focus and forum for research and tuition in favour of sustainable agriculture. In one of the first contribution to the journal, Anton J. Jansen (1974) summarized its message as follows:

"The transformation, through a technological revolution, of traditional peasant farming into a modern technology and a specialised, market-oriented production process has contributed to a rapid deterioration of the natural environment. The development of well-balanced agro-ecosystems, which respond to various societal needs, requires global, comprehensive and long-term agricultural policies."

In the meantime, Spedding (1971) had already advanced important guidelines for instruction in agroecosystem scholarship suggesting four epistemological pillars (System approach; Model building; Recognition of parts and Wholes; Agroecosystem as the object of study) for revealing the *processual organisation* of agriculture as a *socio-ecological system* at every level of spatiotemporal scale. In such a way, connections and scaling up between the local and the global, and the past, the present and the future would operate for delimiting an ethic of sustainable development (Caporali 2021, 93-94). In figure 2, a representation of agriculture as a spatiotemporal process of nested phases (domestication, colonisation, trade) denotes the development of agriculture since its starting point to the present. In the prospective of figure 2, agriculture development accounts for the history of a *co-evolutionary process* between man and nature (Noorgard 1984a). This opens up a truly new agro-ecological horizon for both understanding agriculture as practical co-operation of socio-ecological components and projecting its future development and management.

According to Gepts (2004), who dealt deeply with the topic of "Crop domestication as a long-term selection experiment", agriculture is a "mutualistic" process of relationships between man and nature that started 10 thousand years ago and that is still operating, although with alarming drawbacks brought about in the recent development phase of agriculture industrialisation. Viewing agriculture as a temporal succession of phases, analogically similar to the ecological succession dealt with in ecosystems ecology (Odum 1969), helps a lot to unveil the intricacy of relationships between man and nature developed during the whole process of human civilisation (Norgaard 1984b). The nested phases of agriculture development denote that the process is cumulative, whereby the older phases are still present, although in less perceivable effects. Agroecologists recognise that agriculture is, basically, a process of ecosystem management: "They learn about ecological systems by studying how traditional farming systems have coevolved. Traditional farming systems represent a resource of co-evolutionary

knowledge which can be augmented with scientific knowledge and which, to some extent, can be used to improve the sustainability, productivity, and stability of modern agricultural systems" (Norgaard 1984a, 166).

According to Gepts (2004, 3), "domestication is the outcome of a selection process that leads to increased adaptation of plant and animals to cultivation or rearing and utilization by humans". It started in different "centers of origin", where the "presence of wild progenitors was also a logical feature" (Harlan 1995, 51). From the above-mentioned assumptions, the first phase of agriculture development is a cooperative, intentional endeavour promoted by man who selects an element of nature (a plant) in a local environment, with typical climate and soil, and uses a vegetative part (seed, tuber, or other propagule) to bring about its regeneration by ploughing it into the soil. All that is a complex initiative of linking different environmental components (biotic and abiotic) in a harmonious organisation, a new *biotechnology* (in part conscious and in part unconscious), made operative through a rudimental tool (a stick, a worked stone) to cut the soil (Cesarini and Lundborg 1995). Domestication is the revolutionary process that signs the transition from the hunting-gathering system to agriculture, marking a switch in subsistence patterns during the Paleolithic with a diet richer on vegetative parts, particularly grains (Gepts 2004). With domestication, a new mutualistic relationship has established between man and nature, with benefits on both fronts for the emergent, unitary pattern of organisation later defined as agriculture (BOX 2).

The last element mentioned in BOX 2, agriculture sustainability, has today mounting relevance as a major component of the general framework of sustainable development required by UN (2015) with the attainment of 17 specific goals (SDGs). Without the attribute of sustainability, agriculture misses its historical identity of symbiotic relationships between man and nature and risks to compromise the ancient covenant of co-evolutionary development that has lasted for ten thousand years. Sustainability is like a coin with two sides, one is the biophysical side and the other is the socio-economic one. It is ecologically correct to argue that maintaining the biophysical side is necessary for developing the socioeconomic one, in that human work has its ground on the natural context and its capacity of regeneration of both biotic and abiotic resources. Therefore, sustainable development will require for instance that the use of energy and chemicals be

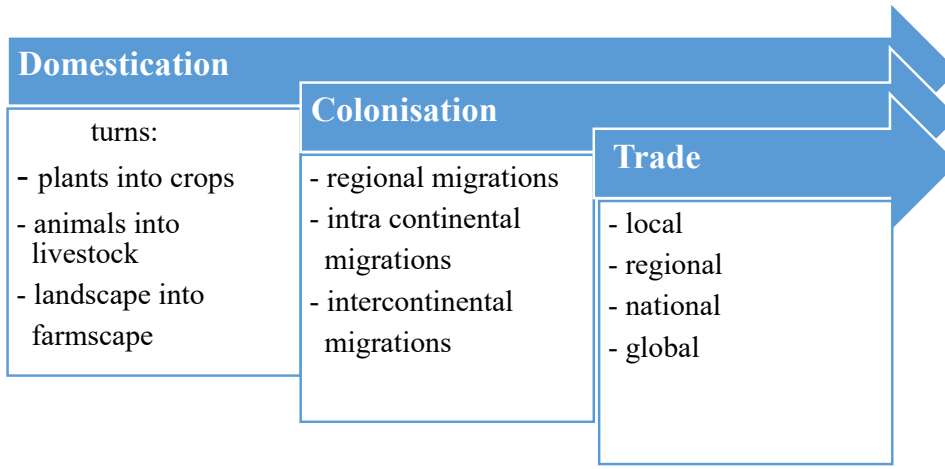

Figure 2. Nested phases of agriculture development (arrows denote an increasing spatiotemporal dimension)

subservient to ecosystem maintenance (Norgaard 1988; Kallis and Norgaard 2010).

BOX 2. Benefits of agriculture as a symbiotic and creative process between man and nature

a. Agriculture is a new emergent step in the biosphere evolution concerning all levels of biodiversity organisation, from genes to species and ecosystems.
b. domestication involves genetic changes in populations (of both crops and livestock) aimed at conferring more increased fitness for human – modified habitats and less fitness for natural habitat (Harlan 1995; Gepts 2004).
c. new "domesticated" ecosystems (agroecosystems) appear emergent in a matrix of natural biomes, first locally and then, after human migrations and colonisations, expanding regionally and continentally (Caporali 2021).
d. fully domesticated plants (crops) and animal breeds (livestock) cannot survive on their own without humans, but also "domesticated" men through domesticated crops and livestock would hardly survive without their domesticates (Gepts 2004).
e. agriculture has become the pillar for a new era of civilization still running, which provides surplus food for sustaining villages, cities and megalopolis of today, and for allowing diversification and specialisation of other human activity systems (industry, transport, trade, culture).
f. agriculture sustainability is key to maintaining the symbiotic relationships between man and nature established by traditional methods of agriculture worldwide (Caporali 2021).

2.2. Scaling up cooperation for sustainable agriculture

Scaling up means intentional dissemination of principles of organisation along a spatiotemporal hierarchy of socioecological systems. This hierarchical approach applies in agriculture as both a land governance system and a food activity system. Hierarchical systems in agriculture have been easily identified as a sequence of nested agroecosystems including the levels of field, farm and landscape (local, regional, national and international, until the final dimension of planetary biosphere) (Caporali 2021). All these levels are interconnected and influence each other. The kind of reciprocal effects are largely dependent on the choices concerning the agroecosystem organisation (structure and functioning) made by stakeholders interested in territorial or political control. General principles of agroecological organisation, consistent with the paradigm of *harmony-with nature-development*, date back to Richard B. Norgaard's concept of co-evolutionary development (Norgaard 1984a). BOX 3 reports some arguments of his "co-evolutionary model of agriculture development".

BOX 3. Concepts and principles for co-evolutionary development in agriculture – elaborated after (Norgaard 1984b)

STARTING CONCEPT

"Coevolution in biology refers to an evolutionary process based on reciprocal responses of two closely interacting species" (Norgaard 1984b, 528).

CONCEPT EXPANSION

"The concept can be broadened to encompass any feedback process between two evolving systems" (Norgaard 1984b, 528).

EMERGENCE OF THE RECIPROCITY PRINCIPLE

"For agricultural social and ecological systems, man's activities modify the ecosystem while the ecosystem's responses provide cause for individual action and social organisation" (Norgaard 1984b, 528).

"Thus, agricultural development can be viewed as a co-evolutionary process between a sociosystem and an ecosystem that, fortuitously or by design, benefits man" (Norgaard 1984b, 528).

THE VALUE OF ENVIRONMENTAL SERVICES

"The nature and importance of these services require further exploration" (Norgaard 1984b, 537).

"We need to learn how services change, specifically how some can be augmented, and others more effectively replaced within the ecosystem or indirectly through socio-system change" (Norgaard 1984b, 537).

The concept of "environmental services" mentioned in BOX 3 recalls "the social benefits of ecosystem functioning" dealt with by ecologist Walter E. Westman (1977) in a seminal article in *Science*. He listed a series of them, such as "the breakdown of pollutants, the cycling of nutrients, the binding of soil, the degradation of organic waste, the maintenance of a balance of gases in the air, the regulation of radiation balance, and the fixation of solar energy". These are "the functions, in short, that maintain clean air, pure water, a green earth, and a balance of creatures". These, as well, include "functions that enable humans to obtain the food, fiber, energy, and other material needs for survival". In the agriculture context, these functions were defined as "ecological services" by Miguel Altieri (1999) and later, more specifically, as "ecosystem services" in MEA (Millennium Ecosystem Assessment) (2005). They identify the work and the worth of nature in sustaining human activity systems of every kind, particularly agriculture, which organises all its components into a unitary pattern of management called agroecosystem (Costanza et al. 1997).

As recognised by Jacob Weiner (2017), the relation between man and nature realised through agriculture is extremely relevant: "No human activity is more essential to our species and has greater effects on the environment than agriculture. Agriculture is mankind's most important technology. […] Yet, agriculture can also be as a source of eutrophication and greenhouse gases and may undermine its own resource base by promoting biodiversity loss, soil deterioration and soil erosion. The big challenge for humanity is how to make agriculture more sustainable, i.e. to make agriculture as a whole a truly 'ecological service' for both man and nature."

2.3. Cooperation, ecosystem services, and sustainable agriculture

The hierarchical structure and functioning of nature show that "cooperation is needed for evolution to construct new levels of organization", as Martin A. Novak (2006) convincingly explains: "We observe cooperation on many levels of biological organization. Genes cooperate in genomes; chromosomes cooperate in eukariotic cells; cells cooperate in multicellular organisms. There are many examples of cooperation among animals. Humans are the champions of cooperation: from hunter-gatherer societies to nation-states, cooperation is the decisive organizing principle of human society."

Novak discusses five mechanisms for the evolution of cooperation (kin selection, direct reciprocity, indirect reciprocity, network reciprocity, and group selection) and, for each mechanism, derives a simple rule for identifying whether natural selection can lead to cooperation. He concludes that:

a. "Evolution is constructive because of cooperation."
b. "Cooperation allows specialisation and thereby promotes biological diversity."
c. "The most remarkable aspect of evolution is the ability to generate cooperation in a competitive world."
d. "We might add 'natural cooperation' as a third fundamental principle of evolution beside mutation and natural selection."

Agriculture is surely a cooperative activity between natural and manmade components that manifests itself through different levels of organisations in different production systems adopting different technological means and practices. Following the agroecological approach for a sustainable agriculture, Stephan Parmentier (2014, 5) advances the following suggestions:

a. "Realizing agroecological principles consists primarily in mimicking natural processes, thus creating beneficial biological interactions and synergies among the components of the agroecosystem, instead of depending on external inputs."
b. "The technological forms through which agroecological principles can be made operational depend on the prevailing environmental and socioeconomic condition at each site."
c. "The concrete realization of these principles always requires context-specific solutions, since they must adapt to local realities."

In designing a framework for transforming food systems through agroecology, Gliessman (2016) envisages five levels of increasing complexity and organisation for an itinerary of conversion from conventional (or industrial, level 1) to fully sustainable (or polyfunctional, level 5) agriculture (table 1).

Moreover, the complementary way of considering agriculture not only as a food system, but also as a land governance system, setting a particular focus on the ecosystem services provided by the five levels of organisation of Table 1, would allow a more balanced vision of the relationships between man and nature more consistent with the "reciprocity principle" mentioned in BOX 3. In this regard, a meaningful contribution of Comberti, et al. (2015) highlights the usual lack of appreciation of societal dependence upon natural ecosystems, arguing that the concept of "ecosystem services" (ES) should be paired with the reciprocal concept of "services to ecosystems" (SE). A detailed description of closing the gap between nature (providing ES) and human culture (providing SE) in the prospect of agriculture as a sustainable activity system appears in Figure 3. Ecosystem services are free of charge and flow spontaneously from nature benefitting not only man but also the renewal of the whole community of life on Earth assuring these services, locally and globally. This recognition, i.e., the emergence of an *ecological conscience* (Caporali 2021; 2024), should promote designing and managing agroecosystem components and organisation in order to provide reciprocal, co-evolutionary "services to ecosystems", such as those listed in Figure 3 (supporting, protecting, enhancing, restoring). Comberti, et al., (2015) advance the following definition of Services to Ecosystems: "Actions humans have taken in the past and currently that modify ecosystems to enhance the quality or quantity of the services they provide, whilst maintaining the general health of the cognised ecosystem over time."

The concept of "Services to Ecosystems" has important ethical implications and helps bridge the gap concerning "the lack of recognition of the roles of humans in actively cultivating, improving and positively contributing to Ecosystem Services" (Comberti et al. 2015). Adopting the interesting notion of ecosystem *controllers*, introduced by Paul R. Ehrlich and Harold A. Mooney (1983) in a seminal article on ecosystem services and ecosystem organisation, it is evident that the most relevant *controller* in agroecosystems is man. Not only the farmer, but also the other stakeholders who partake significantly in agriculture as a human activity system, such as politicians, researchers or extension services agents. In ecosystems, two main sets of *controllers* are recognised: "The most crucial is the one through which solar energy and carbon and other nutrients enter living systems (the producer trophic level). The other set consists of those that release the nutrients bound up by production for reuse (the decomposer trophic level). Loss of either of these sets brings the collapse of the entire system" (Ehrlich and Mooney 1983).

In the agroecosystem typology listed in Table 1, the substitution for natural processes, e.g., plant nutrition and biological control[4], with synthetic chemicals (fertiliz-

4 "Biological control" is commonly used to describe the regulation of pest populations at innocuous

Table 1. Levels of organisation for increasing complexity and sustainability in agriculture as a food system – elaborated based on (Gliessman 2016) but adjusted according to the author's concept

Levels	Means	Goals
1. Mono-cultural	On-farm solution: *Precision agriculture*	To use industrial input more efficiently reducing consumption of costly and polluting inputs.
2. Mainly mono-cultural	On-farm solution: *Organic agriculture*	To replace risky external inputs with natural, renewable and more environmentally sound products, and organic practices (e.g. green manuring).
3.Poly-cultural and mixed	On-farm solutions: *Organic agriculture + mixed farming*	Reintroduction of diversity in farm structure and management (crop rotations, intercropping, agroforestry, and the integration of animals with crops).
4. Poly-cultural, mixed, and participatory	On-farm solutions+ local food solutions: *Organic agriculture + mixed farming + local food webs (consumers cooperatives, marketing arrangements)*	Re-establish direct connections between producers and consumers at local level for a new culture and economy of food system sustainability.
5. Poly-cultural, mixed, participatory, and inspiring values	On-farm solution + local food solutions + cultural services: *Global mental change towards basic beliefs, values, and ethical systems (food security and peace education)*	Promotion of a new global food system, based on equity, participation, democracy and justice, that helps restore and protect the Earth's life and peace.

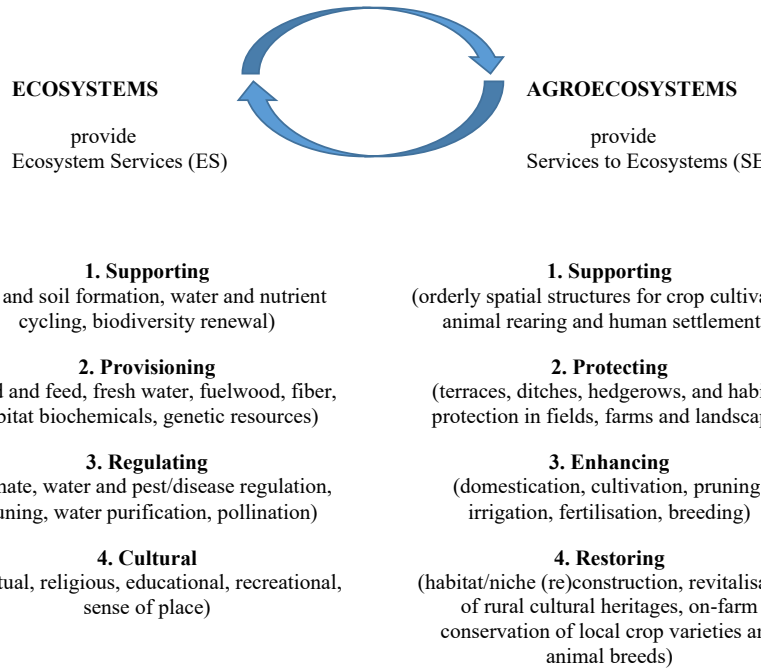

Figure 3. The closed-loop reciprocity between Ecosystem Services (ES) from nature to agriculture and Services to Ecosystems (SE) from agriculture to nature in the prospect of sustainable land governance agroecosystems – elaborated on (Comberti et al. 2015)

ers and pesticides) is dramatically high at the mono-cultural level 1 (largely adopted in industrial, conventional agriculture), and progressively decreases with the parallel increase of biodiversity achieved at its maximum at the level 5. Starting from level 3, characterised by crop rotations, intercropping, agroforestry, and the integration of animals with crops, bio-diversified farming practices contribute significantly to the services of supporting, protecting, enhancing and restoring the two sets of basic *controllers*, i.e., *producers* (crops) and *decomposers* (biological soil community). In practice, assuring more biodiversity in agroecosystems reveals itself as a means of *cooperative sustenance* of the "ecosystems services" provided by nature through the "services to nature" provided by culture, which is beneficial for both man and nature.

3. Organic Farming as a Social Contract for Cooperation and Peace at Local and Global Level

Organic Farming is a practical method of sustainable land governance and food production, defined by law in Europe as follows: "Organic production is an overall system of farm management and food production that combines best environmental and climate action practices, a high level of biodiversity, the preservation of natural resources and the application of high animal welfare standards and high production standards in line with the demand of a growing number of consumers for products produced using natural substances and processes. Organic production thus plays a dual societal role, where, on the one hand, it provides for a specific market responding to consumer demand for organic products and, on the other hand, it delivers publicly available goods that contribute to the protection of the environment and animal welfare, as well as to rural development" (EU 2018).

densities by their natural enemies" (Berryman 1995).

This definition, allows us to recognise the institutional intention of the social community to establish a legal consensus with the organic farmers and the other stakeholders on the crucial issue of reconciling environmental protection with food production, recognising that both aspects are inseparable in the prospect of agriculture as a sustainable human activity system. On the basis of common recognition and interest, human operative cooperation is possible which is consistent with the basic agro-ecological strategy of the *harmony-with-nature development*. The turning point of this process of recognition has been the declaration by IFOAM (2005) of the four principles of Organic Farming (Health, Ecology, Fairness and Care) that imply both an ethical and a scientific commitment to preserve the intrinsic values of the natural resources in view of their use for human benefits. This sounds like a rational covenant between the trophic human needs and the supporting natural resources, the integrity of which is the indispensable condition for sustaining the reciprocal flow of ecosystem services within the Earth's biological community.

Organic agriculture is not only limited to on-farm processes, but also involves the whole system used to produce, process and deliver the product to the final consumer. A very useful tool to understand the extension and complexity of agriculture as a process of globalisation is FAO/WHO's *Codex Alimentarius* (*Latin*, meaning Food Law or Code), which is a collection of internationally adopted food standards presented in a uniform manner to facilitate international trade. The preface of the Codex (FAO/WHO 2006, iii), reports that "food labelling is the primary means of communication between the producer and seller of food on one hand, and the purchaser and consumer of the other", whereby: "The Codex Committee on Food Labelling developed the Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods in view of the growing production and international trade in organically produced

foods with a view to facilitating trade and preventing misleading claims" (FAO/WHO 2006, iii). "Organic food handlers, processors and retailers adhere to standards to maintain the integrity of organic agriculture products. The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals and people" (FAO/WHO 2006, 2).

This orderly process of international cooperation, set up to facilitate production, environmental protection, food processing, food exchange and market development, for the benefit of human food safety and security, is an astonishing case of intentional symbiosis between man and nature, mediated by human ingenuity transferred into law. It shows that it is possible to establish peaceful relationships in the living community of the Earth on the basis of good will, rational respect, reciprocal trust and responsible commitment.

Conclusions

The ecological approach yields many benefits for both theory and practice, particularly when its application concerns agriculture, the most ancient and pervasive human activity system worldwide. In this essay, a tentative effort has started to show how the science of ecology applied to the practice of agriculture has provided first a transdisciplinary field of enquiry with a science named Agroecology and then a practical method of cultivation named Organic farming. Moreover, agriculture being an evolving biotechnology constitutive of the universal trophic link between man and nature, its importance for a sustainable development in today context has inevitably emerged. Humanity bears severe responsibility for a vast horizon of relationships concerning security, safety, health, justice and peace for both the environment and the human beings.

In this looming time of mounting wars, responsibility for peace education emerges as a priority for erecting a cultural barrier against an irresponsible State-centric political drifts that disregards the ecological evidence of a common belonging to a whole system that is a common good. Scholars of Agroecology and operators of Organic farming can contribute their knowledge, competence and skills to pragmatically show how cooperation operates better than competition in agriculture and in the planetary community of living beings. In calling for this challenging task, the precious suggestions and comments of two anonymous reviewers to this introductory paper help in inviting potential authors to contribute to the expansion of crucial issues such as:

a. an integrative theory of peace education and its connections with agroecology and organic farming;
b. the link between peace and environmental resource use and misuse;
c. presenting agroecology as a science, a practice and a movement to make agriculture really sustainable from environmental, social and economic perspectives.

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