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Cultivation as Taking Care of Plant Diversity and Global Commons: Nikolai Ivanovich Vavilov's Legacy

Biodiversity and agrobiodiversity are global commons and humans should well understand the necessity of managing natural and farm induced plant variability at world level. In the 1930s, Russian geneticist, botanist and geographer Nikolai Ivanovich Vavilov carried out worldwide researches on plant variety, collecting and storing germplams of all world major crops. His vision on world centers of origin of cultivated plants is outdated, but his scientific ideas on plant geographical diversity preceded the ongoing concerns for loss of plant variability. In fact, even today FAO considers areas originally individuated by Vavilov as global priority genetic reserve locations for wild relatives of 12 main food crops. Both storing and farming will assure societies productive and conservative services, and studying the geographical diversity of plants is a strong necessity for assuring sustainability on a global scale.

Key words: *cultivation, commons, Vavilov's centers, biodiversity, agrobiodiversity*

Introduction: **Biodiversity and Agrobiodiversity**

Prominent scholar Thomas Lovejoy coined the locution biological diversity in the early 1980s, while the word biodiversity appeared in a print publication in 1988 when entomologist Edward O. Wilson used it as the title of the proceedings of the 1985 forum during which Walter G. Rosen first proposed this term (Farnham, 2007). Since then, success in common language was constantly increasing, even though long before many other thinkers, scientists, men, and women of culture and practitioners had placed the concept of biodiversity at the center of their attention.

An empirical observation shows the compelling necessity for biodiversity. Living beings are structured to increase their own capacity to receive the sun energy necessary for life. If receipting beings are multiple and well differentiated, the overall performance of energy increases while in a simplified system performances decrease and vulnerability raises to external unfavorable events. Thus, biodiversity is the most effective expression for a better structural setting strategy in the biosphere. With farming humans have generally reduced biodiversity, focusing mainly on plants/crops more convenient for shorter and easier to manage production cycles in view of increasing productivity. Farming productivity has been until today undertaken through simplification, intensification, and diffusion of monocultures and specialized farms, reducing the complexity of land use and landscapes. Nevertheless, a new dimension of diversity came into being as *agro-biodiversity* (Wood & Lenné, 1999), a term that recognizes the historical value of cultivation, capable of orienting interactions between the processes of natural selection and direct and indirect actions of farming. Cultivation can be cited as the paradigm of human willing to control *and* taking care of nature and biodiversity. In a broad sense the concept of diversity is worthy in all aspects of human life, and whether being ecological, biological, cultural, or linguistic, it is a major cultural value (Maffi, 2005).

In the past, humanity long struggled for achieving a sufficient quantity of food and fiber. Today people fear for the overexploitation of natural resources for producing that stuff. And the current globalization of human relations induces unexpected changes even in food production and consumption at different geographical scales (Coe, Dicken, & Hess, 2005).

Agriculture is the main human activity producing food and fiber but it is also the historical base kindling industrial development and wealth of societies. It shows very diverse social and economic patterns in different geographical areas, yet maintaining some fundamental goals. It should provide both enough energy for an increasing world population and environmental protection. These goals are conflicting is space and time, as the world needs both to run agriculture for feeding the present and future people and maintain biodiversity at as the maximum level as possible for assuring future generations their own rights. Still, after decades from its first statements the sustainable development formula (World Commission on Environment and Development, 1997) seems to be a rhetoric claim (Corinto, 2016) rather than an effective opportunity for maintaining the world capability of feeding all human beings (Munro, 1995).

This paper aims at illustrating the necessity of managing plant diversity at a global level, considering cultural idiosyncrasies, ideologies, and scientific prejudices can actually threaten human progress. For this, the sad story, and happy legacy, of Russian scientist Nikolai Ivanovich Vavilov is narrated as exemplary in order to understand the importance of both conservation and cultivation in managing the global commons. The text of the paper has been structured as follows. In the previous paragraphs, this introducing section showed the origins of terms biodiversity and agrobiodiversity and the contemporary necessity of a modern understanding and harmonization of both ones. Next section will briefly illustrate the life and scientific intuitions of Nikolai Vavilov, considering his private vicissitudes and the ongoing legacy. Section 3 illustrates the nature of biodiversity as a commons and the necessity to have a sound conservation strategy, as intrinsic in Vavilov's scientific work. Section 4 puts in light the necessity of combining biodiversity and agrobiodiversity at the global level, and finally, section 5 reports some considerations and concluding remarks.

Nikolai Ivanovich Vavilov: Sad Story and Happy Legacy

In the 1930s the Soviet scientist Nikolai Ivanovich Vavilov (1887-1943) hypothesized that plant cultivation should have originated in the geographic zones where it was possible to find the largest number of domesticated varieties. Under Stalin's totalitarian regime, his ideas on collecting diverse plants from different places and using genetics for enhancing farming productivity have been rejected as too much costly and completely different from those of other scientists urged by immediate and practical needs of the starving population. His original idea is still fascinating, even if there are doubts whether areas he indicated were the proper "centers of origin" of crops. In fact, North American scientist Jack Harlan suggested the alternative term "centers of diversity", adapting without rejecting the scientific intuition of Vavilov (1926) and thus continuing to stress the importance of diversity (Harlan, 1995).

Today cultivated plants are very different from their wild relatives, and often exploited over the threshold of ecological tolerance, needing a more sophisticated technical farming (Zeven & de Wet, 1982). During the past hundred years, scientists have controlled plants searching for new more productive varieties. Genetic selection has mostly focused on few food and fiber crops and attempting to eradicate diseases and predators owing to their commercial importance. In more recent times, scientists have recognized a more complex role of genetic selection and conservation in defining sustainable farming models. In future, humans must rely also on local knowledge and culture of farmers as irreplaceable determinants of agricultural biodiversity, because their activity is still able – and could be better oriented – to preserve biological variety worldwide. Up until today, agriculture has been managed mainly to provide enough food for the world's rapidly growing population, and notwithstanding the still large presence of the undernourished, it should be charged even with the intentional aim of biodiversity conservation.

The experience of geographer and botanist Nikolai Vavilov, who was living in the USSR during the Soviet regime, is particularly intriguing because he was harshly contrasted for ideological reasons. Vavilov's schematic representation of the historical, geographical, and agronomic biodiversity (Vavilov, 1987) is still relevant today being a powerful theoretical framework for interpreting the complex co-evolutionary phenomena (Rindos, 1984) within the agro-food systems around the world. He was the first scientist to carry out extensive researches on plant varieties worldwide, and his strategic vision reflects the ongoing concerns for biodiversity and agrobiodiversity conservation. This latter concept was a specific scientific interest of Nikolai Ivanovich Vavilov who, at the beginning of the past century, began collecting species from all over the world in order to understand their potential. His interest was pretty scientific in nature, but his duties were practical having deep sociopolitical implications. In the 1920s, Vavilov was commissioned by the Soviet government to initiate a program of profound transformation of agriculture that would contrast starvation and even foster a stronger industrial progress. Vavilov based his ideas on the development of Mendelian theories, according to which the genetic material of a plant provides the mechanism for the transmission of characters from one generation to another. To improve yields, he proposed using all the morpho-physiological characteristics variability both of plant modified by humans and their ancestors, by exploiting the agronomic legacy of many generations of farmers and the natural resources worldwide. He programmed gathering in Russia the germplasm of all world major crops, creating the Pan Soviet Institute of Plant Breeding (VIRV). The VIRV managed also a network of experimental stations in the USSR for giving practical goals to scientific research (Loskutov, 1999).

In 1925 Vavilov began traveling in all regions of Russia, and later in all agricultural areas of the world. Under his direction, the VIRV organized about two hundred expeditions in more than sixty countries bringing back more than 150 thousand specimens of seeds or plants. These trips allowed him to identify plural geographic centers of cultivated plants variability and the parallelism of changes in botanical species and families. The area where the variability of the species was the highest, namely where plants of the same species have diverse shapes, colors, and life cycles, was identified as a "center of origin". It was easy also to notice that getting away from the center of origin, the variability of characters of plants decreased.

His ideas were exposed in *Centres of Origin of Cultivated Plants*, a paper issued in the Bulletin of Applied Botany and Plant Breeding in 1926, and in *Origin and Geography of Cultivated Plants*, a posthumous book edited by VIR in 1987. His most famous book is *Five Continents*, finally edited in English by Leonid E. Rodin, Semyon Reznik and Paul Stapleton (1997).

Vavilov's legacy is a botanic, genetic, and agronomical key idea, which helps also to understand the role of geography in the diversity of plants. Not all his ideas concerning the identification of original centers of cultivated plants have been fully accepted. To the point that one of his close friends and successor, North American scientist Jack Harlan, suggested the term *centers of origin* be replaced by *centers of diversity* (Harlan, 1995). A direct identification between centers of diversity of cultivated plants and centers of origin of agriculture is not allowed, but Vavilov's original idea is still fascinating and practically used for maintaining common gene pools (FAO, 2010).

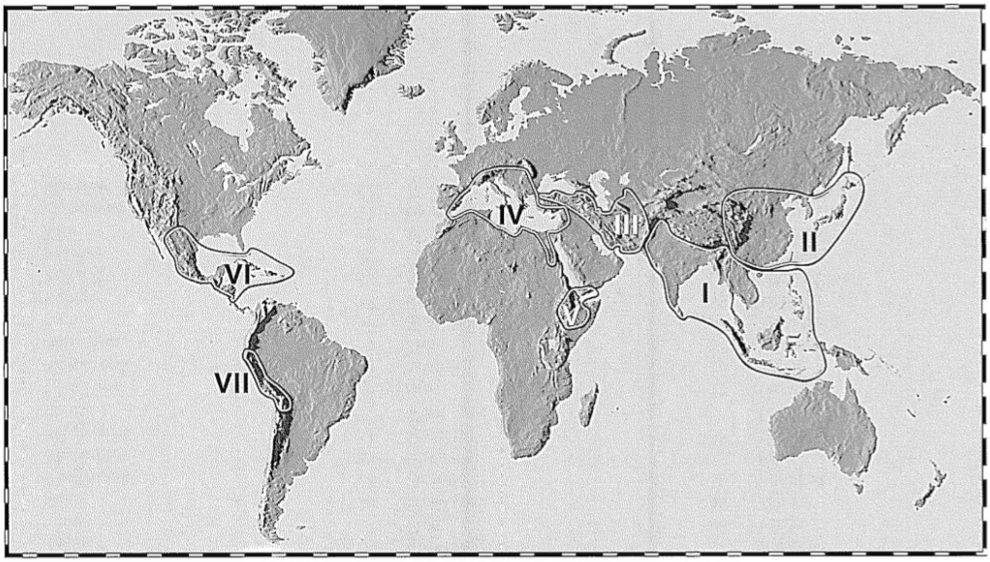
In the 1930s, when Vavilov developed his theories, there were sweeping reforms in the Soviet Union introduced by Stalin's totalitarian regime. Under his dictatorship, all thoughts or ideas at variance with those of the communist party were forbidden (Mosterin, 2008). The general cultural framework in Russia was oriented in fulfilling immediate and practical needs. Poor agricultural conditions, caused by the ravages of the 1915-18 war, forced the Soviet Union to introduce a major program of industrial development reforms. The task was given even to Vavilov, who was charged with founding the V.I. Lenin All-Union Academy of Agricultural Sciences (*Ibidem*). He was spurred on by the order that new varieties be established in less than five years. His rival scientists and political opponents supported a different genetic approach, believing that variation and adaptation in plant species were simply responses to external factors, accordingly to the French biologist Jean Baptiste Lamarck's hypothesis on the transmission of acquired characteristics.

Amongst his opponents, scientist Trofim Denisovič Lysenko (1898-1976) was proposing the vernalization technique for increasing the wheat productivity. The technique seemed to be more promptly effective and Vavilov's scientific approach was heavily criticized for slow advances in the VIR action plan (Crow, 1993). Doctrines of the Lamarckian Lysenko became official dogma for the regime, putting an end to a promising development in Soviet genetics and evolutionary biology (Lewontin & Levins, 1976). The Vavilov-Lysenko confrontation did not take place on a scientific ground. It did actually blast as an ideological confrontation at the Lenin All-Union Academy of Agricultural Sciences meeting in 1936.

The harsh polemic was if the qualitative changes of the nature of plants and animals were dependent on the quality of life conditions acting on living organisms. Mainstream genetics was the real enemy to break down, or what Lysenko termed "Mendelist-Morganist theory". This latter was the genetic theory of heritability of characters, included those induced by casual gene mutations. On the contrary, the "scientific principles" to be followed were only the "Michurin principles", stating the heritability of acquired characters and the right of humans to modify the nature, without waiting any "casual" mutation. Ivan Vladimirovich Michurin based his theory on the practical farming activity of millions of Soviet farmers (Huxley, 1949). His doctrine was based on materialist-dialectics, demonstrating with facts the dependence heritable characters-life conditions. The Mendelist-Morganist doctrine was accused of being "idealist and metaphysics", based only on a few laboratory tests, without any field test, and thus to be refused as unscientific (Lysenko, 1949). Over following years, many Mendelist-Morganist scholars announced their conversion to Lysenkoist theory, and many biological research institutes forcibly closed, stating the abandonment in the Soviet Union of Mendelism and the «enthronement of Michurinism as official doctrine in the sphere of genetics and evolution» (Huxley, 1949, p. 35).

The general tone of the ideological debate was ruthless, culminating in Vavilov's arrest in 1940 on charges of conspiracy and espionage in favor of England. He was given the death sentence but this was not carried out. In 1943, Vavilov died of pneumonia in prison. More than a decade later, in 1955, as a former dissident, he was rehabilitated (Crow, 1993; Pringle, 2008). After his death, scientists in Russia and many others in different parts of the world continued and improved his observations by defining broader geographical connections and mutual relationships between the world's plants (Cohen, 1991). Many scholars, including Jack Harlan, have supported Vavilov's ideas related to the identification of centers of origin/diversity, stressing the importance of studying the site-specific relations between crops and wild relatives.

Figure 1 shows the map of main centers of cultivated plants, as published in *Five Continents* (Vavilov, 1997). These geographical centers soon became known as Vavilov's centers of origin or simply the Vavilov's Centers. Table 1 shows plants cultivated in each center.



MAIN CENTRES OF ORIGIN OF CULTIVATED PLANTS

I. The Tropical Centre; II. The East Asiatic Centre; III. The Southwest Asiatic Centre (containing (a) the Caucasian Centre, (b) the Near East Centre, (c) the Northwestern Indian Centre); IV. The Mediterranean Centre; V. Abyssinia; VI. The Central American Centre (containing (a) the mountains of southern Mexico; (b) the Central American Centre; (c) the West Indian island); and VII. The Andean Centre.

Figure 1. Vavilov's Centers of Origin of Cultivated Plants, Source, Vavilov, 1997

TABLE 1. Vavilov's centers and their cultivated plants

East Asiatic	buckwheat, soy, peach, cherry, onion
Tropical	rice, chickpea, cucumber, mango, orange
Southwest Asiatic	wheat, pea, lentil, vigna bean, rye, alfalfa, Greek hay
Mediterranean	durum wheat, cabbage, lettuce, celery
Abyssinia	barley, millet, flax, coffee, sesame
Central American	corn, Lima bean, cotton, sweet potato, pepper
Andean	strawberry, potato, tomato, pumpkin, pepper

Source: Vavilov 1997: 1-7

In a paper published in *Science*, Jack Harlan (1971) remembers in his *The Living Fields, Our Agricultural Heritage* (1995) he proposed modifying the concept of Vavilov's centers, advancing the theory that there are three world regions in which the domestication of plants originated, each identifiable with a center of origin, and a "non center", namely a not central area that is more dispersed, still interacting with the main center. They are listed in Table 2.

TABLE 2. Harlan's reclassification of Vavilov's centers

Center	Non Center
Near East	Africa
Northern China	South East Asia and Southern Pacific
Central America	Southern America

Source: Harlan, 1995

Jack Harlan identified those centers on the basis of the presence of wild relatives of cultivated plants *and* important archaeological evidence pointing to agriculture in its very early stages. From these centers, it is thought that crops then spread to other areas. From a geographical point of view, the non-centers are much larger than their corresponding centers from which the different crops originated, and they are also independent areas of domestication for new ones. They are so named because the wild progenitors of a specific crop (e.g. millet and sorghum in Africa) are distributed over a wide area, and in the absence of archaeological evidence their domestication may have begun at any point in the area. Nevertheless, in his mapping, Harlan identifies two well-defined centers of domestication, namely Ethiopia and West Africa, suggesting that the way distribution occurred must be attributed to the singular crop, rather than the geographic region (Harlan, 1976). According to this vision, genetic exchange between crops and wild relatives demonstrates the importance of centers of origin as a place for new diversity. However, different species of the same plant may have been domesticated in different areas, or domestication may have occurred simultaneously in separate areas. Consequently, it is not possible to identify a single center of origin for all associated crops. Surely, human intervention and natural evolutionary processes have created secondary centers of origin, with significant variations compared to major centers.

Vavilov's Legacy: A Strategy for Plant Diversity as Global Commons

With the proliferation of DNA analysis and molecular biology, the individuation of centers of origin and diversity of plants has largely evolved. Theories of Vavilov and Harlan are still extremely useful when studying the diversity of plants and domestication of crops because the variability in these centers is a rich source of genetic material. The efforts of preceding scientists to find geographic plant variability are still important acquisitions for conserving biodiversity. Ongoing interest in Vavilov's centers stems also from contemporary debate how best to protect and conserve the genetic variability of plants and crops and distinction between biodiversity and agrobiodiversity.

For humanity, biodiversity should be deemed as a global common good. At its very core, the problem of the commons pertains to relations between humans and the environment and the consequential spatial relationship (Giordano, 2003). Possible scientific approaches are several and giving different but clear variations in defining and interpreting the meaning of the commons. Nevertheless, a uniting theme involves the concept of rights, i.e. economic and social relations indicating the individual position with respect to the production and use of scarce resources. The unbalance between scarce natural resources and the excessive number of users actually determines competition in the appropriation and use of them. Famous Hardin's tragedy of the commons thesis stresses the negative effects of common ownership of resources and lack of private ownership (Hardin, 1968).

> "Common ownership and nonownership, however, are not equivalent concepts. A resource may be held in common within a group, and the group may define rules concerning members' rights and obligations towards the resource's use—cooperatively or otherwise. In such cases, the group members have, in effect, created property-rights conditions amongst themselves, and they may exclude nonmembers from use." (Giordano 2003, p. 3)

Being biodiversity a global common good it is not by chance that problems of conservation are to be addressed between sovereigns through treaties regarding the use of genetic resources worldwide. The entire humanity should be interested in its common ownership and correct management. Theoretically, the type of ownership is positioned at the last extreme of the rightward scale from strictly private to strictly common. This point coincides with the world level of human community overcoming even the national or regional ones. In this ideal world there are no borders and the space is undivided and not political. Regretfully it is only ideal and it actually is a complicated mix of private and public spaces where borders matter.

For social and economic goals, contemporary industrialized agriculture grows few cultivars (cultivated varieties) and since the 1900s three quarters of plant genetic diversity have been lost because farmers worldwide have left their multiple local varieties for genetically uniform and high yielding varieties. FAO (1997; 1999; 2010) reports three-quarters of world food are produced from no more than 12 plants and 5 animal species. Humans actually know 250 to 500 thousand edible plant species but do cultivate only 150 to 200 of them. Finally, only 3 crops, rice, maize, and wheat, contribute nearly the 60 percent of calories and proteins obtained by humans from plants. Animals provide some 30 percent of requirements for food and agriculture and the 12 percent of the world's population live almost entirely on products from ruminants (*Ibidem*).

The importance of geography in agrobiodiversity is then evident as well as the necessity to have both *in situ* and *ex situ* genetic conservation for assuring world food security and sustainable development. Facing an increasing world population, agriculture should maintain a key role in reducing poverty and food insecurity whilst sectorial underinvestment, strong increases in food prices and the long-lasting global crisis have led to a larger spread of hunger and poverty in poorer countries. Furthermore, the urban population is today more than the rural one. All in sum, natural resources are facing increasing pressure from agriculture at the global, regional and local levels. Thus, by the beginning of the twentieth century, plant collection, conservation, and cultivation became a formalized activity supported and controlled by governments in several countries, including the US, UK and Italy (National Research Council, 1993). National crop breeding programs have now become far more important than previously conducted plant explorations, and the introduction of genetics has changed the viewpoint of scientists and helped to identify new feasible resources for more productive crops. In this framework since near a decade, FAO (2010) proposed a global vision for maintaining biodiversity, supporting conservation of genetic diversity of plants both in situ and ex situ, remembering the Vavilov's legacy.

Figure 2 shows the "eight Vavilov centres of origin/diversity of cultivated plants, indicated by the enclosed lines, are likely to contain further priority sites for other crop genepools" (*Ibidem*).

Indeed it is today agreed that natural resources are considerably more abundant in Vavilov's centers, due to the presence of crop wild relatives and where farming is often less industrialized than in most developed countries (Brush, 2005).

The ongoing theoretical dilemma humanity faces is whether biodiversity will be better protected by traditional knowledge of farmers, or by a pool of genes managed by the state or privately owned companies (*Ibidem*). Any practice decision related to crop production and conservation of diversity should not be just so strictly dichotomous as the world complexity requests articulated policies. Even the European Council in 2005 and Organization for Economic Co-operation and Development - OECD (2012) stressed Europe should integrate both agricultural policy and rural development policy, in order to combine farm productivity, protection of environment and knowledge of local communities. Thus, public intervention strives to stimulate farming in protecting both biodiversity and agrobiodiversity.

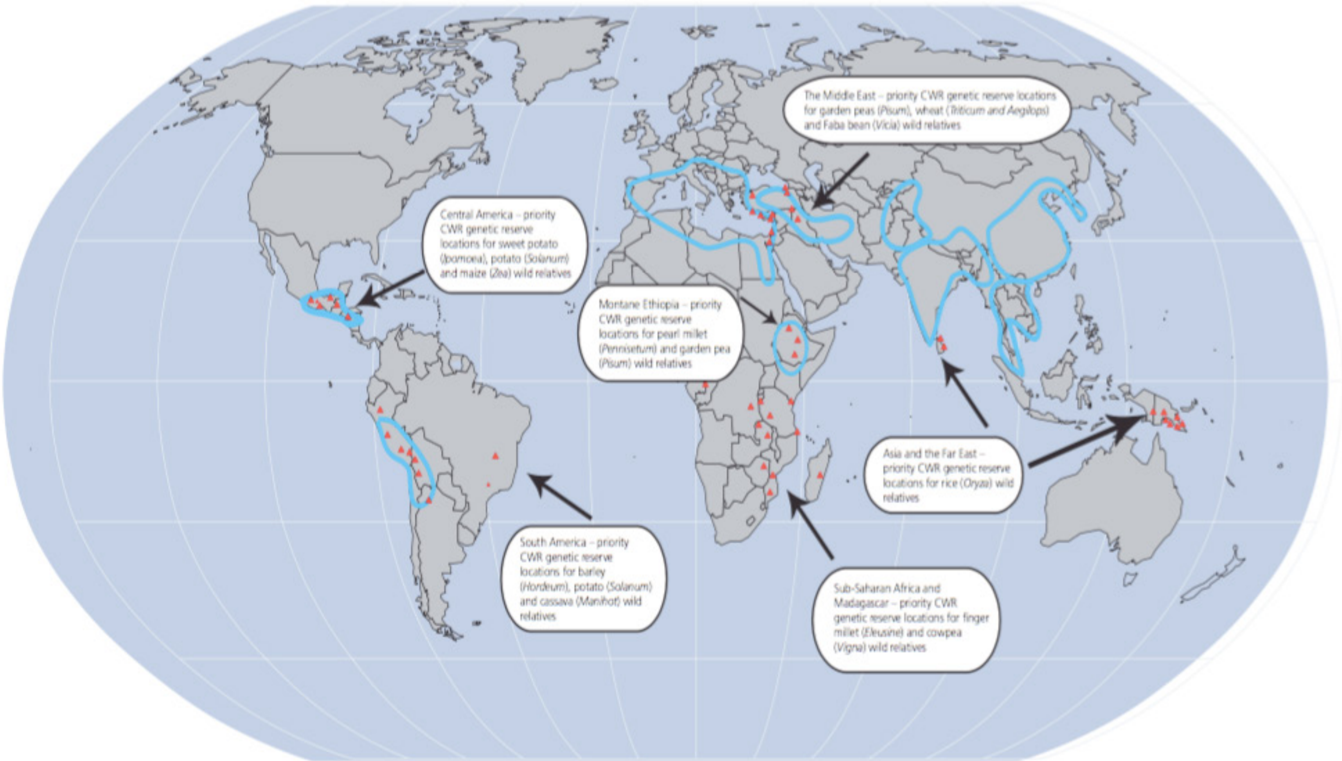


Figure 2. Global Priority Genetic Reserve Locations for Wild Relatives of 12 Food Crops , Source: FAO, 2010

Previously, in 1999 the FAO/Netherlands Conference has been dedicated to the *Multifunctional Character of Agriculture and Land-MFCAL* (1999). The conference enlightened that agro-ecosystem functions are partly determined by the legitimate social goals of humans and depending on circumstances preference of persons are given to short-term maximization of specialized productivity based on a single crop or to the diversity and persistence of production. Their choices factually influence how biodiversity is managed at diverse scales of interaction between human agency and ecological processes (*Ibidem*).

History demonstrates that humans are economically more interested in farming few plants/crops for commercial purposes than protecting biodiversity. However, whether plant species should be conserved for reasons other than that of serving utilitarian purposes has been generally acknowledged, and reasoning on a moral obligation to conserve nonhuman species is possible (Callicott, 1986). Economists argue that human preferences dictate value, and if one is capable of predicting human preferences regarding biological species, then s/he can provide the monetary value of each species as a basis for policymakers (Randall, 1988).

Combining Biodiversity and Agrobiodiversity

Whatever the point of view, internationally agreed norms for regulating and prioritizing conservation strategies are needed, with continuous cost-benefit analyses embedded within the framework of substantial global conservation as declared in 1992 during the Earth Summit in Rio de Janeiro organized by the United Nations.

In this direction, farming will play a key role since global plant diversity is assured also through agricultural biodiversity, which supports the conservation of genetic resources, including those genes that are essential for the artificial or spontaneous evolution of new varieties of crops. Moreover, today cultivated plants are quite different from their wild relatives, being too often exploited beyond the threshold of ecological tolerance. Over the past hundred years, scientists have selected variability of plants in an innovative continuing research for new varieties. Genetic selection has focused mostly on plant foods and fiber crops, owing to their commercial importance, in an attempt to eradicate aspects such as disease, pollination, and predators. All of these aspects have been studied in-depth by geneticists because they are important in determining the economic results of farming, even though, in more recent times, scientists have recognized the essential role of genetic selection when defining sustainable agriculture models. In this regard, local knowledge and culture are irreplaceable determinants of agricultural biodiversity, because the activity of farmers is both site-specific and able to preserve the biological variety of many crops that have already lost their original mechanisms of genetic diffusion.

Following the path traced by Vavilov, several international governments have established programs for the collection, conservation, and cultivation of genetic plant resources, with a view to sustain and increase crop production. More than forty years ago, the International Union for the Conservation of Nature and Natural Resources (IUCN) adopted a framework for the collection, conservation, utilization, and exchange of plant resources through the creation of the International Board for Plant Genetic Resources, and houses some of the world's most important crops at several international agricultural research centers (National Research Council, 1993). FAO monitors the state of biodiversity publishing a periodical Report on the Sustainable Use of Plant Genetic Resources Food Agriculture-PGRFA. Management of diversity can be obtained *in situ* and *ex situ*. The first strives to conserve plant diversity in wild ecosystems, including crop wild relatives (CWR) in and outside protected areas, and on-farm managing of diversity. The second one, i.e. the *ex situ* conservation, consists of establishing and running international and national botanical gardens and genebanks. Worldwide, the number of botanical gardens is now more than 2,5 thousand, conserving and growing around 80 thousand plant species. Many of these are CWR. Furthermore, seed vaults have been established, such as the most famous Svalbard Global Seed Vault (SGSV) on the Norwegian island of Spitsbergen near the Arctic. In Italy, there is one genebank, run by Botanical Genetics Institute of the National Research Council in Bari, Apulia. It currently runs other local sections in Campania, Tuscany, and Sicily.

Besides all this, conservation of plant genes in view of maintaining biodiversity has a more complicated and global dimension depending also from policies linked to productive industries. Many developing countries have reduced their support to public sector crop development, leaving the sustainable use of plant genetic resources to the private sector. Also in developed countries, farmers are vulnerable due to the monopolistic supply of a few high yielding crop cultivars produced by multinational companies. Moreover, the number of accessions in germbanks has increased in all regions but not in all individual countries. A more righteous alliance between farmers and the rest of social community, including policymakers, private industries, and consumers for combining biodiversity and agro-biodiversity is as much complicated as necessary.

Considerations and Conclusions

Biodiversity is a global commons, yet its conceptual dimension is huge and can exhaustively be treated only through diverse scientific disciplines. Furthermore, within its variance of meaning, *crop genetic diversity* is also an endangered commons because farming is usually reputed capable of biodiversity degradation, even because it is a market-oriented private activity undertaken in a scenario of increasing globalization. Russian scientist Nikolai Ivanovich Vavilov in the early 1900s fostered his peculiar intuition of collecting diverse plant species from all parts of the world for improving their farming productivity. He faced a harsh private and public life, contrasted by the Soviet Communist regime in the name of ideology and false scientific acquisitions. The Soviet Union missed the opportunity of scientific progress, but Nikolai Vavilov's cultural legacy is still alive and well in both scientific and political terms. He anticipated the necessity to study, protect and conserve plant variability, which has also many geographical features and cultural implications. Today, the world appears to be smaller and distances narrower, despite nationalistic interests still induce establishing political and cultural borders and separations among humans.

Even in the realm of plants, geography matters because concepts such as space, place, and borders do affect their nature and (why not?) their "phenomenological" appearance. In this sense, geography is capable of treating the complex nature of botanic diversity, also considering any cultural aspect of human behavior and their nature of global commons, which must be cared through the act of cultivation. Over centuries, plants and genes showed their geopolitical capabilities traveling through space and hybridizing themselves, carried by humans or nonhuman elements, and actually breaking the borders. Nowadays farmers and consumers are the beneficiaries of genetic resources taken from very distant geographic areas and mixed by both technology and cultural behaviors. For example, the New World farmers largely grow and eat rice or sorghum originated from the Old World, as well as the Old World farmers grow and eat tomatoes and potatoes after the discovery of America.

For a long period of centuries, diffusion of genetic resources has taken place informally, via exchanges among farmers on a local scale, and by the continuing migration of people all over the world. Many have been and still are the determinants for spreading genes worldwide, such as the pressing search for crops to satisfy nutritional demands of an increasing population, or simply the attempts to satisfy curiosity and changing tastes of modern society. Globalization has only speeded up processes existing from the dawn of humanity. Protecting jointly biodiversity and agrobiodiversity in a shared international strategy requires strengthened regional and international trust and trans-border cooperation (Altieri, 1992).

The life experience of Nikolai Vavilov was both exciting in scientific discoveries and tragic for ideological and personal contrasting hate he faced. His scientific efforts and even his physical person have been defeated by a blind ideology unable to understand the best choice in science and even in everyday life. Besides the scientific legacy of Vavilov also this aspect of his life should be instructive in order to better understand the necessity of taking care of plants (and their genetic heritage) as a global common.

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