AGRICULTURE SYSTEMS

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Different conditions concur in determining the richness of biological diversity of a territory: in the case of the Italian peninsula, the topography, the orography, the soil and climate variability have helped in defining such shifting environmental conditions that the resulting biodiversity has reached very high levels. To this 'natural' high diversity the 'cultivated' one adds up, to the very same extraordinary extent; the latter is found in all the agricultural systems that human history and environmental characters have shaped, and moulded to extremely varied and widespread representations. Nowadays on the Italian territory a large number of different agricultural landscapes coexist, influenced by the millenary interaction of environmental, historical, social, and economic factors.

Over the last few decades, throughout Italy and the rest of Europe, though at a different pace and through different means, agriculture systems have evolved in opposite directions. In those areas with adequate environmental characteristics, serving as hosts to cultivation models and technical equipments of industrial agriculture, and to the ensuing processes of productive intensification and simplification, agriculture systems have stood on subsidiary external energy supplies, which are efficient economically as well as adequate to market globalization, but are also fragile from the ecological point of view and often environmentally damaging. These agriculture systems produce goods with little or no individuality, which are provided with often only apparent quality, and which, moreover, may result to be unfit from the sanitary point of view.

On the other hand, in those areas originally not meant for cultural simplification and productive intensification, as in mountainous territory, a marginalization process has been going on for a long time, characterized by the increase in their extensive range – as in the conversion to pasture land, for example – up to the abandonment of all practices and settlements, followed, in some cases, by reforestation practices or, more frequently, by the onset of spontaneous processes of re-naturalization.

At any rate, the evolution processes of agriculture systems promote differences and changes to the biodiversity over time and space, both in terms of landscape and inside the agrosystems themselves, with effects bearing on their specific and intraspecific composition.

Changes in rural landscapes and effects on biodiversity

Italy is the country of the European Union with the highest percentage of cultivated land: 13,212,652 ha in the year 2001, that is 43.8 percent of the total area, distributed as follows: 45 percent in the mountains, 23 percent in the hills, 32 percent in the plains; this area has been constantly diminishing since the high peak of 1930, with its 26,251,744 ha.

The great expanse of agriculture areas and the distribution over the entire national territory of such widely different morphological conditions are both indications of a great ecological variability, with obvious bearings on the diversity of the agrosystems and on the biodiversity they are concerned with. The polarization process – intensification/extensification – of Italian agriculture, especially worthy of notice since the '60s, comes to be underlined by the increase in the number and dimensions of the large companies – especially in the central and northern regions – by the growth of the small companies – between 0 and 2 ha wide – and by the reduction of the medium size ones – between 5 and 20 ha - (Table 6.9); this also has significant consequences on the biodiversity of the agrosystems and on their influence upon that which is conserved in natural and semi-natural environments.

	N. of companies					
	1930	**1961**	**1970**	**1982**	**1991**	**2001**
Company surface area between 0 and 5 ha	3,296,498	3,278,905	2,904,781	2,589,077	2,085,662	2,131,408
Company surface area between 5 and 20 ha	746,168	849,121	569,401	484,719	346,834	439,471
Company surface area between 20 and 50 ha	106,961	117,391	80,174	85,575	82,816	87,661
Company surface area higher than 50 ha	46,639	48,587	36,845	37,946	36,510	26,071
Used Agricultural Area (UAA)	**26,251,744**	**21,723,498***	**17,491,455”**	**15,842,541**	**15,045,898”**	**13,212,652***
*: chestnut woods excluded; “: ISTAT data, elaborated in Grillotti di Giacomo, 2000						

Table 6.9 - Evolution of a few structural characters of Italian agriculture in relation to biodiversity and landscape changes. Used Agricultural Area: area currently cultivated or non cultivated but nevertheless destined to agricultural scope, including permanent meadows-pastures and chestnut forests for fruit production, to the exclusion of woods and poplar forests.

Nowadays in Italy both monoculture landscapes of industrial agriculture and polycolture ones from traditional agriculture coexist (Figure 6.15). The former are characterized, within regional range variability, by large, homogeneous cultivation units only rarely separated, or joined, by tree rows, hedges, plant barriers, and hosting a minor presence of natural and semi-natural areas – forest belts, wetlands, etc. The biodiversity they contain is also reduced; market necessities and productive organization urgencies – for example, mechanization demands – impose, over time and space, the adoption of monoculture attitudes which are resistant to the maintenance of both permanent and temporary consociations, and to the acceptance of rotations; this leads to the cultivation of a reduced number of species, again represented by a reduced number of varieties or breeds, mostly similar genetically. The connection between agriculture and livestock breeding has broken up in monoculture systems: farm animals no longer play any part (animal traction, recycling of by-products from farming, organic fertilization, etc.), rather they are removed from the farm, into the creation of independent productive units, thus further depleting biological diversity. The performance of monoculture agrosystems is not dependent on the biodiversity it contains: the rarefaction of rotations or of consociations with leguminous plants, the cattle stable confinement leading to the transition of manure treatment from being a resource to becoming a problem, the lack of biological control by birds or insects as a consequence of the rarefaction of green corridors or of other natural areas, all bring around the need for greater use of external energy inputs – for fertilization, for keeping predators, parasites and herbaceous pests under check, etc. The appeal to subsidiary energy is needed because of the reduced effectiveness – brought along by the very diminution of biodiversity – of the natural processes that ensured the system's fertility and productivity, out of which polluting actions may stem and be directed at the agrosystem itself, and at bordering or connecting ecosystems (Table 6.10).

Fig. 6.15 - Monocultures in Sicilian large estates (Photo by T. La Mantia).

If the process of intensification has extended itself to the

Positive effects on biodiversity	Negative effects on biodiversity
Techniques of sustainable agriculture (biological, biodynamical, etc.)	Techniques of intensive agricolture
Mosaic landscape structure	Simplified landscape, elimination of spontaneous vegetation, homogenization
Polyculture, Silviculture	Monoculture
Differentiated germplasm (specific and intraspecific)	Simplified germplasm
Hedges and vegetation different from the cultivated species	Eradication of spontaneous vegetation
Rivers and drainage ditches requalification	Presence of drainpipes and absence of drainage ditches, of embedments and of shielded banks
Rotations, with legumes in particular	Monosuccession
Mulching based on plant or organic material	Chemical weeding > naked soil
Herbaceous intercropping cultures	Homogeneous cultivations
Small size fields surrounded by hedges	Large size fields
Live supports	Artificial supports
No soil cultivation or low soil cultivation techniques	Chemical weeding > traditional plowing
Complex cultivation arrangements	Simplified cultivation arrangements
Striped cultivation	Traditional cultivation
Organic fertilization	Chemical fertilization
Biological control	Conventional chemical control > integrated control
Resistant varieties	Susceptible varieties

Table 6.10 - Effects of agricultural systems characteristics and of agronomical techniques upon biodiversity (PAOLETTI, 1999, modified).

entire national agriculture system, it cannot be overlooked that in a few regions, from Sicilia (CULLOTTA *et al.*, in print) to Friuli-Venezia Giulia (GRILLOTTI DI GIACOMO, 2000), it has taken on enough distinctive features to be turned into an emblem. In the latter case, traditional agriculture landscape, as being designed by small farmer properties and being qualified by the presence of small closed fields that are full of arboreal vegetation, hedges and tree rows, has undergone a drastic radical change over the last two decades, truly assuming the aspect of 'open fields'. Estate re-organization actions have been deemed necessary to reach full operational cultivation efficiency and especially to favour mechanization, thus leading to the elimination of all spontaneous and sub-spontaneous vegetation, in particular all riparian and all tree lines, viewed as obstacles to the movement of the machines. Diffusion of corn monoculture has thus imposed a drastic reduction of natural and agricultural biodiversity, with a drop in vertebrate population density, of birds in particular (FLORIT, 2000).

Natural or semi-natural residual areas in intensive agriculture landscape are impoverished in biological diversity, not only because of the isolation and fragmentation conditions they are experiencing, but also out of the fact that the occurrence of other disturbance phenomena has been adding on top of the effects of pollution on useful fauna; for example, urbanization is one instance of such a disturbance, taking on truly devastating proportions in the case of soil depletion owing to surface artificial conversion.

Industrial agriculture landscape is characteristic of Italian plains. It is also liable to be met on the outskirts of large cities and along communication arteries, where it loses all homogeneous structure to become fragmented; it thus takes on the looks of periurban agriculture landscape, in which the town and the country come together in a mixed hybrid space, devoid of all identity, where agriculture biodiversity not necessarily takes to simpler, rather to more ordinary forms, thereby adding exotic or eurivalent species to the agrosystem (HERMY *et al.*, 2000).

Instead, the landscapes derived from extensification processes find themselves in turn in the middle of two extremes: cultivation abandonment, or the permanence of systems and landscapes proper to traditional agriculture. In the first case, if the man-induced alterations during the colonization procedures of the natural areas have not proceeded to such severity as to block any spontaneous recovery, this takes place over a variable period of time, depending on the preexisting action of disturbance and on the present environmental conditions; the ensuing biological richness may reach out to new heights, even though not necessarily on the same levels it had attained in the traditional polyculture system (BLASI *et al.*, in press).

The landscapes of traditional agriculture, often liable to being reconducted to agroforestal systems, are generally characterized by cultivation units of reduced dimensions and of irregular shape; in essence, they are constituted by a great number of tiles per surface unit, by a great development of margin lines - ecotones –, by the presence of natural and semi-natural areas, and by the prevalence of perennial nonspecialized cultures. They are polyculture systems, where even in present days varieties or local strains are cultivated, responding to environmental characters and to the necessities of agronomic techniques based on the optimal employment of natural resources, of cycles and natural fluxes, and on the use of natural antagonists for biological control of phyto-pathologies. In full agreement with the provisions of the Habitats Directive, their role in the defense of biodiversity's richness does not rest solely upon its conservation inside of them, but also upon their being inter-connected by efficient ecological corridors, represented by linear 'alive' systems such as the 'trees outside the forest' - forest belts, wind barrier hedges, and tree lines - as well as by the dry-stone walls playing a relevant part in the Italian landscape (LA MANTIA, 1997) (Figure 6.16). Moreover, the presence of natural and semi-natural areas warrants a productive output that may be deemed to be adequate, on the one side to the expectations of systems that are not tuned to maximization, and on the other side to the functionality of fundamental ecological processes, such as the stocking up of reduced carbon, and the protection of the soil from desertification and from other imbalances; these processes are not altered by exclusive or massive recourse to external energy sources, as tra-

Fig. 6.16 - Pantelleria's terracings are an example of man's ability for landscape structuring (Photo by T. La Mantia).

Species	N. of species
Cereals	
Wheat (*Triticum*)	5
Oat (*Avena* spp.)	3
Barley (*Hordeum sativum*)	
Canary grass (*Phalaris canariensis*)	
Fodder	
Sulla (*Hedysarum coronarium*)	
Clover (*Trifolium* spp.)	3
Gorse (*Ulex europaeus*)	
Grass pea (*Lathyrus*)	3
Pink serradella (*Ornithopus sativus*)	
Corn spurry (*Spergula arvensis*)	
Oilseeds	
Linseed (*Linum*)	2
Safflower (*Carthamus tintoria*)	
Yellow mustard (*Sinapis alba*)	
Rapeseed, Coleseed (*Brassica*)	3
Seasoning, colouring and tannic agents	
Black Cumin (*Nigella sativa*)	
Cumin (*Ciminum cyminum*)	
Anise (*Pimpinella anisum*)	
Fennel (*Foeniculum vulgare*)	
Thyme (*Thymus vulgaris*)	
Hyssop (*Hyssopus officinalis*)	
English lavender (*Lavandula vera*)	
Peppermint (*Mentha piperita*)	
Rosemary (*Rosmarinus officinalis*)	
Sage (*Salvia officinalis*)	
Sweet Iris (*Iris pallida*)	
Damask Rose (*Rosa damascena*)	
Laurel (*Laurus nobilis*)	
Common Hop (*Humulus lupulus*)	
Common Madder (*Rubia tinctorum*)	
Sumac (*Rhus coriaria*)	
Legumes	
Lentil, Vetch, Fava bean (*Lens, Vicia, Lathyrus*)	
Pea, Chick-pea (*Pisum, Cicer*)	
Lupin (*Lupinus* spp.)	4
Fruit Bearing trees	
Olive tree (*Olea europaea*)	
Carob tree (*Ceratonia siliqua*)	
Almond tree (*Prunus amygdalus*)	
Fig tree (*Ficus carica*)	
Pomegranate tree (*Punica granatum*)	
Vegetables	
Beetroot (*Beta*)	2
Cabbage (*Brassica*)	4
Parsley (*Petroselinum crispum*)	
Artichoke, Cardoon (*Cynara*)	2
Rape (*Brassica*)	2
Pusly (*Portulaca oleracea*)	
Onion, garlic, leek (*Allium*)	4
Black salsify (*Scorzonera*)	2
Asparagus (*Asparagus officinalis*)	
Seakale (*Crambe maritima*)	
Celery (*Apium graveolens*)	
Endive, chicory (*Cichorium*)	2
Garden chervil (*Anthriscus cereifolium*)	
Peppergrass (*Lepidium sativum*)	
Parsnip (*Pastinaca sativa*)	
Oyster plant (*Tragopogon porrifolius*)	
Spanish oyster plant (*Scolymus hispanicus*)	
Horse parsley (*Smyrnium olusatrum*)	
Dill (*Anethum graveolens*)	
Rue (*Ruta graveolus*)	
Sorrel (*Rumex acetosa*)	
Wild amaranth (*Blitum*)	3

Table 6.11 - Main crops native to the Mediterranean area (BLONDEL and ARONSON, 1999, modified).

ditional systems are based on natural processes (fixation of atmospheric nitrogen, biological control, etc.) endorsed by their own high biodiversity level.

The survival of traditional systems is to be greatly appreciated: the decline that could lead to their disappearance and to that of the relative landscapes, in fact, would represent a grave loss not so much to agriculture or to the environment as much as, on more general terms, to Italian culture, since they are the expression of an age-long relationship between nature and history, between environment and culture, that has led to extraordinary results over the Italian territory, both in terms of its productive and environmental quality and of its landscape and aesthetic traits.

These agricultures, within the, at times dramatic, limits of short resource availability or of unfair social and economic conditions, have supported varied and healthy diet habits in the form of products that today are considered to be typical – and thus are much appreciated on the markets – in so far as they are living testimonies of local nature and culture.

Species biodiversity

The Mediterranean Basin is a centre of origin of numerous plant and animal species, that are nowadays being cultivated and raised well over its borders (Table 6.11). The great abundance of species was determined by the *in situ* evolution of native germplasm, by the supply from other regions, and by the age-long anthropogenic activities of domestication and genetic improvement.

Italy, among the Mediterranean regions, represents the centre with the highest genetic richness, due to the environmental heterogeneity of its territory and to the long and intense history of peoples and dominations, sharing great and often far away agriculture civilizations. Nowadays, within the range of plant species, and to the exclusion of ornamental and forest species of no agricultural interest, the 'checklist of cultivars' by Hammer *et al.* (1992, 1999a,b) lists 665 species for Italy. Of these, 551 are cultivated in the Center and in the North, 521 in the South and in Sicilia and 371 (a tentative figure) in Sardegna.

Soon after their domestication – which had taken place between 8,000 and 6,000 BC – other species from the so said Fertile Crescent were added to the indigenous ones. So, already in the first half of the 6th millenium BC in Italy the following were cultivated: two species of awned wheat (big emmer, *Triticum dicoccon* syn. *Triticum turgidum* subsp. *dicoccum*, and small emmer, *T. monococcum*), barley (*Hordeum vulgare*), pea (*Pisum sativum*), lentil (*Lens culinaria*), bitter vetch (*Vicia ervilia*), chick pea (*Cicer arietinum*), broad bean (*Vicia faba*), and linseed (*Linum usitatissimum*).

As for the fruit trees, there are some indications dating the origin of olive, grapevine and fig cultivation in the Mediterranean as far back as the 4th millennium BC (the seeds collected from spontaneous wild plants of grapevine, fig and olive, out of excavations in Sicilia, are dated from this period) (COSTANTINI and COSTANTINI BIASINI, 1997). Species such as the apple, the pear, the damson and the cherry – which were collected in the wild between 2,000 and 3,000 BC in the regions of the North (PALS and VOORIPS, 1979, mentioned in ZOHARY and HOPF, 1993) – in order to spread out in cultivation have had to wait for the success on a wide scale of the grafting techniques that had come around in the first millennium BC (Table 6.12).

Among the animal species, current bovine breeds descend from *Bos taurus primigenius*, also known as the European Aurochs, whose range was established in Germany and Great Britain during the Neolithic and which disappeared in the 17th century; from *Bos taurus brachyceros* or *Bos longifrons*, from which the Reggiana breed derives, as well as the cosmopolite Friesian breed; finally, from *Bos taurus frontosus*, which is considered to be the ancestor of pied Béarnais cattle. As far as goats and sheep are concerned, the somatic analogies and at times some surprisingly associable characteristics among the diverse breeds lead to the assumption of a common ancestor origin, even though from different insular, peninsular and continental areas and districts. The Comisana breed, for example, places the origins of one of its progenitors in Oriental Asia, while its birth is reckoned to come from the crossbreed of sheep from the large islands of the East and Central Mediterranean; in the same way, the Sardinian breed owes its origins to the sheep of the East Mediterranean, and the settlement in its current habitat is probably an outcome of trade exchanges.

The great variety of natural species originating from the intersection of components of different biogeographical origin has progressively become richer in the course of time. To the indigenous species, to the ones from the regions of the Near-East, from Africa and from Europe, other species were added, coming from the regions touched by the Roman Empire in its expansion, and others, in the following centuries, were introduced during the Arab domination, coming from the arid and semi-arid regions of the Mediterranean, the Middle-East, the Arab peninsula, the tropical and sub-tropical regions of sub-saharian Africa, as well as from the monsoon areas of India and China, or from the regions with a continental climate of the Asian highlands (Table 6.13).

Apricot (*Prunus armeniaca*)
Sour cherry (P*runus cerasus*)
Carob (*Ceratonia siliqua*)
Chestnut (*Castanea sativa*)
Citron (*Citrus medica*)
Cherry (*Prunus avium*)
Quince (*Cydonia vulgaris*)
Fig (*Ficus carica*)
Almond (*Prunus amygdalus*)
Apple (*Malus domestica*)
Pomegranate (*Punica granatum*)
Hazelnut (*Corylus avellana*)
Walnut (*Juglans regia*)
Olive (*Olea europaea*)
Pear (*Pyrus communis*)
Peach (*Prunus persica*)
Pistachio (*Pistacia vera*)
Plum (*Prunus domestica*)
Grape (*Vitis vinifera*)

Table 6.12 - Fruit-trees distributed in Italy throughout the Roman period.

Vulgar and scientific name	Century of introduction in Europe	First dated report in Italy
Millet (*Sorghum bicolor*)	XI	
Rice (*Oryza sativa*)	X	
Durum (*Triticum durum*)	X	
Sugar cane (*Saccharum officinarum*)	X	973
Tree cotton (*Gossypium arboreum*)	XIII	
Levant cotton (*Gossypim herbaceum*)	X	973
Bitter orange (*Citrus aurantium*)	XI	1094
Lemon (*Citrus limon*)	X	1095
Lime (*Citrus aurantifolia*)	XIV	
Pomelo (C*itrus grandis*)	XI	
Watermelon (*Citrullus lanatus*)	X-XI	
Spinach (*Spinacia oleracea*)	XI	1352
Artichoke (*Cynara cardunculus*)	XV	1439
Aubergine (*Solanum melongena*)	X	1330

Table 6.13 - Species distributed in Italy following the Arab domination (WATSON, 1983).

At the half of the second millennium, after the conquest of the American continent and the contact with its extraordinary genetic richness had taken place - which is held to be superior to that of the Old world as far as species richness goes – numerous new species were introduced, which were to change Italian agriculture and feeding habits (potato, tomato, corn, etc.), turn into pests in the agrosystems, and spread in the gardens and in the cultivation landscape (Table 6.14). This flux, in fact, has been going on ever since, and again in recent times the diffusion of new cultivations over vast areas has been witnessed: the best known example is perhaps that of the Kiwi (*Actinidia chinensis*), which came to Italy at the beginning of the 1900s, but began to truly propagate in plantations at the beginning of the '70s.

Vulgar and scientific name	Date of introduction in Italy
Potato (*Solanum tuberosum*)	1564-5
Corn (*Zea mays*)	1495-1500
Tobacco (*Nicotiana tabacum*)	1560
Tomato (*Licopersicum esculentum*)	1544
Runner bean (*Phaseolus coccineus*)	1642
Bean (*Phaseolum vulgaris*)	1550
Chile pepper (*Capsicum annuum*)	1551
Butternut squash (*Cucurbita maxima*)	1558
Sunflower (*Helianthus annuus*)	1568
Chilean strawberry (*Fragaria chiloensis*)	1780
Indian Fig Opuntia (*Opuntia ficus indica*)	XVI sec.
Peanut (*Arachis hypogaea*)	1772
Sweet potato (*Ipomoea batatas*)	1630
Avocado (*Persea gratissima*)	XVI sec.
Jerusalem artichoke (*Helianthus tuberosus*)	1606
American agave (*Agave americana*)	1561
Rock grape (*Vitis rupestris*)	1907

Table 6.14 - Species introduced in Italy following the discovery of the American continent (Maniero, 2000).

If the flux of new species has never stopped, but rather continues to this day – often stimulated by merchant interests lured by illusory cultivation alternatives (it is the case of jojoba, babacu palms, kenaf) – it would seem, on the contrary, that even by examining only the species level, Italy is revealing a loss of biodiversity. For example, the absence from cultivation – at least over wide areas and excluding spontaneous colonization phenomena or the presence within germplasm banks - of species such as the sugar cane, sumac, cotton, mulberry – used for silkworm rearing – can be ascribed to various factors, though up until rather recent times they were still spread over wide areas. Statistical informations stress the 'disappearance' of a few cultivations, too, even within the limits imposed by the changing methodologies of the surveys. There surely are many reasons for this: market changes, agriculture policies, changes intervening at the agrosystem level – the most conspicuous of which is the downturn of rotations of corn/leguminous plants. By examining, for example,

SPECIES	Surface area (ha)		
	1950	1970	1996
CEREALS			
Soft wheat	39.01	22.38	15.35
Durum	16.10	13.92	32.24
Rye	1.16	0.31	
Barley	2.95	1.57	6.96
Oat	5.57	42.61	2.76
Rice	1.69	1.52	4.60
Grain sorghum		0.04	0.69
Corn	14.61	9.00	19.80
INDUSTRIAL PLANTS			
Tobacco	0.69	0.37	0.93
Sugar beet	2.05	2.46	4.83
Hemp	0.66	0.01	
Flax	0.22	0.01	
Cotton	0.27	0.04	
MINOR CEREALS			
Emmer	0.04		
Buckwheat	0.07		
Millet	0.03		
Foxtail millet	0.01		
Broom-corn (seeds)	0.10		
Canary-grass	0.01		
Minor cereals	0.00	0.04	0.22
GRAIN LEGUMES			
Broad bean (for consumption as dried beans)	6.37	3.12	0.96
Bean (for consumption as dried beans)	5.59	1.71	0.25
Chickpea	1.30	0.36	0.06
Grass pea	0.11	0.02	
Lentil	0.30	0.06	0.02
Lupin	0.55	0.13	
Pea (for consumption as dried beans)	0.24	0.08	0.07
Vetch	0.25	0.19	
Other legumes	0.01		
OILSEEDS			
Colza	0.08	0.02	1.26
Rape	0.08	0.01	
Peanut	0.04	0.01	
Soy	0.01	0.00	4.32
Sunflower	0.04	0.04	4.90
Ricinus	0.01		
Sesame	0.01	0.02	

Table 6.15 - Surface percentage changes in Cereals, Grain Legumes, Industrial plants, Oilseeds, and Minor Cereals cultivations. The percentage values are referred to the sum of the considered species' cultivated surface area, not to the entire surface of all the crops (ISTAT data).

the recent agriculture census (2001), it can be noticed that numerous minor cereals (rye, buckwheat, millet, panic, broomcorn, canary grass), leguminous plants (asparagus bean, mung bean, black-eyed pea, cowpea, hyacinth bean, pigeon pea), industrial plants (hemp, linseed), oilseeds (castor-oil, sesame, cole, peanut), are no longer in culture, despite being present in the previous census (table 6.15). Quite a few among the 179 horticultural species that were described in a treatise of 1926 (VIANI, 1926) are not cultivated any more.

Intraspecific biodiversity

The interaction between anthropogenic and environmental factors shows up also at the level of intraspecific biodiversity. On the ground of the selective pressure exercised by man over the centuries, numerous plant varieties or animal breeds have been selected that are locally suitable to the environmental characters, to the cultural needs and to the urgencies of market or sustenance economies. These are selections often distributed over very limited territory - even of single companies – but which, in some cases, have expanded their range of cultivation outside their original borders, owing to worthy features and characteristics of full adaptability.

The properties of the old varieties – also known as ‘primitive varieties’ or ‘obsolete cultivars’, and, to the non-specialized in the case of fruit culture, ‘ancient fruits’ – were in line with the needs of agrosystems that were based on natural processes, which ensured the reproductive functions through energy and matter flows and cycles, based on internal system resources. Intraspecific variability allowed for the availability of genotypes that were adequate to the horticultural environment, resistant to environmental stresses and to pathologies, and endowed with nutritional characteristics and qualitative features that were suited to the needs of the farmers and of the markets.

Processes of intraspecific biodiversity loss have been going on since quite a few years: these are ‘genetic erosion’ phenomena, brought about by the diffusion of simplified – also from the genetic point of view - monoculture systems; also, by market calls – since many years the market has been attracted, or somehow directed, toward uniformity by marketing strategies; by the offers of the nursery sector – often determined by organization needs concerning the adequacy of genetic material propagation; and by legislative measures straining to influence the choice of varieties. Changes in land use that have steered toward the abandonment or urbanization of territories featuring ancient agriculture practices, rich in biodiversity piled up – so to speak - over the centuries, have always held great relevance, in terms of genetic erosion processes, due to features unique to traditional Italian agriculture (BARBERA, 2000).

It is the - generally well known - case of mountain agriculture, but however it has taken shape also in very fertile territories, subjected in recent times to the ‘pathologies’ of peri-urban agriculture: the plains of Campania and the one surrounding Palermo (the Conca d’Oro) – a territory defined by historians as ‘one of ancient and mythical tree predominance’ (BEVILACQUA, 1996) – are the best known examples of what has happened, or is yet to happen, to the irrigated landscape full of vegetable and fruit gardens, which SERENI (1972) defined as the ‘Mediterranean garden’.

The processes of genetic erosion have concerned the fruit market, as well as the vegetable, herbaceous and livestock markets, though through diverse timings, intensity and procedures. In-depth analyses on agriculture biodiversity loss are lacking, and it is difficult to disentangle oneself in the mass of synonymies and dialectical names awaiting a precise varietal definition. Considering the history of Italian agriculture and territory over the last century, the internal genetic erosion rate is probably not too far removed from the 75 percent figure, allotted by FAO on a planetary scale to the loss of agriculture vegetal resources from the start of the century till 1993.

Fruit trees

Italy represents, ever since a long time, the most important European fruit-producing country. It has always lived up to this pre-eminence, by adjusting its productive systems to the needs of the producers and of the market. A great wealth, displayed by the cultivation of the numerous species coming from temperate and sub-tropical climates, together with a great interspecific genetic variability, have always accompanied all major adjustments in the field, ranging from the family-run fruit orchards, to the mixed ones, up to the intensive ones. The diffusion of the latter on an ample scale has led to heavy intraspecific biodiversity loss, starting from the end of World War II. Different are the reasons that have come into play. A pre-eminent role has most certainly been played by the disappearance of mixed agriculture typical of the areas of historical sharecropping, by the diminished role of Mediterranean fruit and vegetable cultivation in peri-urban territories, by the decline of fruit farming in the mountains and of dry tree farming in the South (BEVILACQUA, in print). On top of the mentioned reasons those driven by the market have come around, heralded by the needs of the great distribution, asking for reduced variability also on qualitative stands. Genetic erosion has especially been related to areas in the plains, beginning from the regions in the North, where processes of cultural intensification have brought about with greater swiftness and ease the diffusion of monoculture plantations, the disappearance of family-run mixed fruit orchards, and the rarefaction of tree rows, hedges, and belts that often had been hosting so-said minor fruit yielding species – mulberry, mountain ash, azarole – usually absent in specialized cultures (AA.VV., 1999).

The ample literature on Italian fruit breeding provides numerous accounts stressing the great loss of intraspecific biodiversity; which however still persists to a high degree, considering that a recent census of Italian genetic fruit cultivation resources lists and briefly describes 3,065 different varieties, conserved at assorted institutions (Mi.P.A.F., 2002).

Genetic erosion is related especially to short cycle species, such as the peach, and, for obvious reasons, to the duration of the life-cycle; it is less related to species such as the olive, whose trees have a life-span of a few centuries. As for the latter, 538 autochthonous varieties turned out to be present and conserved in Italy in 1998 (FAO, 1998).

Contemporary to the genetic erosion to which autochthonous germplasm has been subjected, a wide distribution of exotic varieties from foreign countries has taken place. It has to be taken into account, however, that the new varieties have a restricted genetic basis, and that the balance between gains and losses is certainly tilted in favour of a lower genetic richness.

The processes of genetic erosion, in the case of fruit cultivation, have not been particularly influenced by rules or legislations, insofar as no 'prescriptive' list exists today, like

Fig. 6.17 - Chestnut varieties (Photo by G. Bounous).

Fig. 6.18 - Nowadays the 'Annurca' apple is still brought under the shade to ripen: it is an old variety from Campania (Photo by T. Caruso).

the one that is enforced on vegetable cultivation instead. Rather, a list of 'recommended' varieties exists, based on the 1994 'list of fruit trees varieties' proposed by the Ministry of Agriculture through the Research Institute for Fruit Cultivation (Istituto Sperimentale per la Frutticoltura - ISF) of Rome. Moreover, the relentless activities of genetic improvement, as well as the need to have in stock certified material, have de facto significantly lowered the offer of nursery material, which is by now composed almost exclusively of recently established varieties (BARBA and FAEDI, 2002; DELLA STRADA and FIDEGHELLI, 2002). One commendable exception is the development of a fruit culture habit addressing the cultivation of ancient varieties; together with it, the rise of a specific nursery activity, also bent on the recreative and cultural side, as highlighted by the trail of pomological exhibitions following one another during non-exclusively local acts.

Grapevine is another exception; since 1971 rules are in force which consent the planting, re-planting or overgrafting only of the varieties that are entered in a special National Catalogue; this includes both the varieties used in wine-making and the raw edible ones, as well as the rootstocks.

Cereals, fodder plants, industrial crops

Different species of cereals and legumes turned out to be cultivated in Italy already in the 6th millenium BC. This, together with the relentless selection activities and the environmental diversity of national territory that has already been stressed upon, has led to the achievement of great specific and varietal abundance. In the case of cereals, initiatives by famous breeders (DE CILLIS, STRAMPELLI) have added on these decisive initial conditions; in fact, at the beginning of the 20th century they imported materials coming from other Mediterranean countries (BOZZINI *et al.*, 1998).

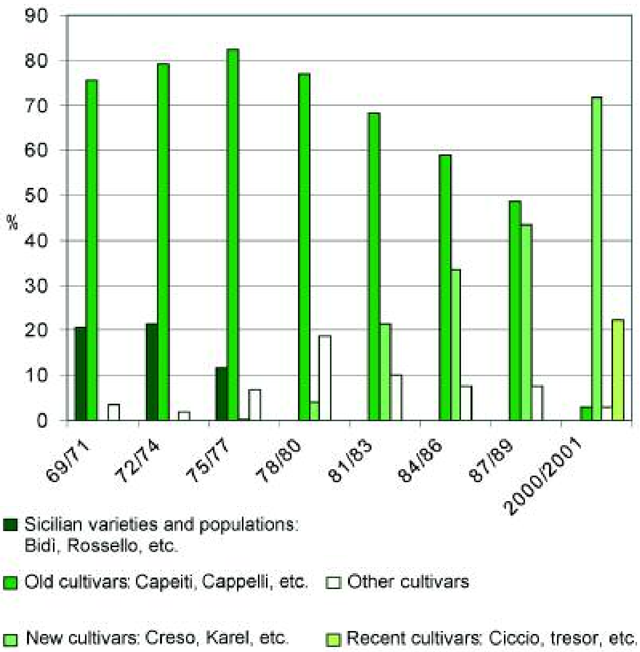

Fig. 6.19 - Percentage incidence of durum wheat varieties cultivated in Sicilia, separated on the basis of their genetic origin (LA MANTIA and BARBERA, in print).

The loss of biodiversity in the case of this group of crops is strictly connected to the changes that have intervened in the agrosystems and thereafter in the agronomic techniques (fertilization and weed control). It is enough to think about the relationships tying rotation systems to legumes, and the employment of straw to the adoption of tall wheats.

Since 1966 the modifications imposed by the EU directives and by national legislation (Law 1,096 of 1971 and following modifications) have added on this situation, by providing that the varieties of cereals - for fodder, oil-seeds and fibers – as well as the likes of beetroot and potato, are to be registered in official catalogues, with production and marketing being limited to the thereby entered seeds.

The reasons behind biodiversity loss are in any case dependent on the species characteristics and on the social and economic context.

It is obvious that the most significant genetic erosion has been affecting those species with restricted ranges, such as the minor cereals – eg. emmer – and corn legumes such as the lentil. In the case of soft wheat, the selection of new varieties has taken place further back in time, and has been decisive in the better employment of the favourable environmental conditions distinguishing this crop's range. Whereas in the case of durum wheat, the connection between production funding and the employment of certified seeds has de facto increased the wide scale disappearance of unregistered varieties. At the half of the last century more than 400 wheat strains were known to be cultivated in Italy. Nowadays it is estimated that more than 90 percent of these have been lost (HAMMER *et al.*, 1999a), even though they might be present under different names in other collections on a wider world scale (Figure 6.19).

Different is the case of the fodder crops, whose prevalent cross-fertilization has in fact led to the establishment and endurance of many ecotypes, and therefore, exceptionally, to their registration up until 2002 (FALCINELLI, 1999). However, the erasure of the ecotypes and their subsequent registration as varieties by 2003 will probably cause a restriction of their number.

If, as is the case with the varieties mentioned before, various reasons – to mention but one example, the qualitative characteristics of the products obtained from particular varieties of durum wheat – have contributed to an at least partial preservation of the original biodiversity, in the case of industrial and fiber crops instead, the selection of new varieties solely in view of their reproductive response has been pursued. This has in fact led to a continuous renewal of the cultivated genotypes.

Fig. 6.20 - Reduced size distinguishes new from old varieties of wheat (Photo by I. Poma).

Vegetables

The phenomenon of genetic erosion nowadays is severe than the one affecting cereals and legumes. Opposite trend phenomena have in fact counteracted this tendency, such as the permanence of family-run or amateur horticulture, based on native varieties, whose seeds are self-produced or tracked down on the local market. Vegetables have nonetheless come across diversity loss out of simplification of cultivation techniques and diffusion of a reduced number of varieties with restricted genetic basis, promoted by the seed industries and imported by significant quotas.

Biodiversity loss has come about as a result of the EU legislation system (70/458, acknowledged by National Law of April 20, 1976 and subsequent modifications) which has led to the registration of about 40 vegetable species.

During the '70s the Vegetable Varietal Register was established in Italy, in which (list b) 726 local varieties came to be registered as 'before 70s': populations and ecotypes selected by the growers over time. In the following years, as a consequence of the repeatingly negative data checking, relative to the identity of the specimen varieties that were preserved at the seed industries in charge of their conservation, a renewed edition of list b was issued, to the effect that 326 varieties were removed since nobody proposed for their purity maintenance. Another 46 varieties have later on been removed owing to the lack of varietal identity and homogeneity requirements. Nowadays, the new list includes both freely pollinating varieties – 506 from the old list and 350 established after 1977 – and 74 F1 hybrids off the old list, together with 490 new hybrids registered after 1977. Varietal innovation, in many cases characterized by the distribution of hybrids, particularly refers to the following species: asparagus, chickpea, cucumber, onion, dwarf and climbing bean, broad bean, fennel, lattuce, aubergine, paprika, pea, tomato, spinach and courgettes, for which at least half of the currently cultivated varieties is of recent constitution (FALAVIGNA, 2002; BRAVI *et al.*, 2002).

The removed varieties, just as the never registered ones, are today those subjected to the risk of disappearing. The genetic richness peculiar to the sector also stems from varieties which belong to minor non-registered species, ranging from species or wild varieties known as being ancestors or similar to currently cultivated major species (genus *Allium*, *Beta*, *Brassica*, *Cichorium*, *Lactuca*, *Cynara*, *Foeniculum*, *Sinapis*, *Eruca*), to around 400 spontaneous species of alimentary or seasoning interest, such as origanum, thyme, etc. (LA MALFA, 1995).

Zootechny

The intensive model has imposed as a selection objective the quantitative and qualitative increase of zootechnical productions, by resorting to breeds with highly productive potential. In time, this objective has substantially diminished the role played by frugal though little productive local breeds, up to endangering their very existence. Rising consciousness over the risk of erosion of animal genetic resources in Europe dates to the beginning of the '60s, and quite soon it focused on the problem of the conservation of the breeds in danger of extinction (OLLIVIER *et al.*, 1988; BODÒ 1990).

Fig. 6.21 - Modicana breed cattle raised in the Sicilian hinterland (Photo by B. Portolano).

Fig. 6.22 - Nice specimen of Siriana caprine breed (Photo by B. Portolano).

In Italy, FAO registered 116 breeds between equids, bovines, ovines, caprines and swines in 1992 (AA.VV., 1983; ROGNONI and PAGNACCO 1983; GANDINI and ROGNONI, 1996). Out of these, 26 were considered to be in critical conditions, 27 to be in danger of extinction and 2 to be already extinct.

Surveys run in Italy show in fact an even greater diversity: for example, 54 breeds or minor populations were ascribed in 1983 to the ovine species alone, by the CNR (Consiglio Nazionale delle Ricerche). Fifty-one of them have since been supplied with an ethnographic record, and only 29 of them were known or bibliographically referenced at the time. Among the latter, 15 are the ones registered in the National Genealogical Register managed by the National Livestock-raising Association. The remaining 25, in fact, may be considered as residual ecotypes, present in dimensionally very reduced and little accessible areas that have not supported the exchange of breed animals, thereby inducing the fixation of well evident characters. As for the caprine species, the registered breeds-populations are instead 22, only 7 of which are entered in the National Genealogical Register of the species (Girgentana, Maltese, Jonica, Garganica, Camosciata delle Alpi, Saanen, Sarda).

For the bovine species, as a result of a national demographic survey conducted within the premises of the CNR project 'Defense of the genetic resources of animal populations', five groups of populations have been identified on the basis of their numbers and of the evolutive tendency of their density. The figures are illustrated in Table 6.16. The widely spread or cosmopolite breeds are represented by the Italian Friesian, Italian Brown and Italian Red Pied.

In the field of the safeguard of equine and asinine breeds and populations, interest has mainly been addressed to the genetic originality of the breeds and populations themselves. Under this framework a classification has been devised, as reported in Table 6.17.

With respect to the monogastrics, the most relevant species are the domestic pigs, the avicultural breeds and the rabbit breeds. As for the former, five different breeds are present on the Italian national territory: Calabrese, Casertana, Cinta Senese, Mora Romagnola and Sicilian Black. Among the autochthonous avicultural breeds are numbered the Padovana White, Silver and Black, the Robust Pied and Lioned and the Rovigo Ermellinata. Among the rabbit breeds the most important ones for recovery and valorization purposes are the Grey breed and the Giogo di Carmagnola.

Group and consistency	Breed
Breeds – relict populations (less than 1,000 individuals)	Agerolese Burlina Cabannina Calvana Garfagnina Montana Pisana Pontremolese Pustertaler
Breeds – semi-relict populations (comprising between 1,000 and 5,000 individuals)	Cinisara Bianca Val Padana Reggiana Valdostana P.N.
Breeds – populations with low numeric consistency (comprising between 5,000 and 25,000 individuals)	Pezzata Rossa d'Oropa Pinzgau Rendena Sardo-Modicana Valdostana Castana Valdostana P.R.
Breeds – populations with sufficient numeric consistency (comprising between 25,000 and 100,000 individuals)	Grigia Alpina Maremmana Podolica Romagnola Sarda
Breeds – populations with good numeric consistency (higher than 100,000 individuals)	Chianina Marchigiana Modicana Piemontese
Widespread breeds (cosmopolitan)	Bruna P.R. Italiana Frisona Italiana

Table 6.16 - Autochthonous or cosmopolitan bovine breeds and populations present in Italy.

Equines
Autochtonous breeds
1. Agricolo Italiano da Tiro pesante Rapido;
2. Avelignese;
3. Bardigiano;
4. Cavallino di Esperia;
5. Cavallino della Giara;
6. Cavallino di Monterufoli;
7. Cavallo delle Murge;
8. Lipizzano;
9. Maremmano;
10. Norico;
11. Purosangue Orientale;
12. Sanfratellano;
13. Tolfetano;
Autochtonous populations
1. Cavallo del catria;
2. Cavallo del Ventasso;
Saddle-competition populations
1. Anglo Arabo Sardo;
2. Sella Italiano;
Asinines
Autochtonous breeds
1. Asino dell'Amiata;
2. Asino dell'Asinara;
3. Asino di Martina Franca;
4. Asino Ragusano;
5. Asino Sardo;

Table 6.17 - Classification and equine and asinine breeds present in Italy.

Reasons for conservation

The consciousness of the negative consequences, both current and potential, springing from genetic erosion has grown throughout the years, and has been matched by steady legislative and ruling actions and by the implementation of solid conservation practices, though marred at times by an inconsistent and ineffective agenda.

According to Cannata and Marino (2001) different components take a share at defining the 'complex value of biodiversity', thereby providing the reasons sustaining conservationist policies, and precisely:

1) Components deriving from the ecological functions: the sustainability of the agrosystem – the possibility for it to produce by resorting to natural processes and resources, thus reducing or avoiding the resort to external resources, and the ability (resiliency) to maintain or recover its ecological stability in the case of negative occurrences – depends on the preservation of high levels of biodiversity.
2) Components deriving from the economic dimension, through direct usage values, connected to resource consumption (see *Atlas of Typical Products*), or indirect values (landscape and environment improvement for touristic purposes), as well as through the future potential resource exploitation whose value is at present underestimated. To this purpose it is useful to keep in mind that within the traditional genetic resources of wild relatives are sometimes found characters of resistance and hardiness that may come in handy, as it has already happened, in programmes of genetic improvement, not only in the case of agrosystems (biodynamic and biological agriculture, etc.) that resort to null or minimal employment of chemical agents, but also in view of changing environmental conditions (climate changes) and of the related distribution of new pathogens.
3) Component that springs from the cultural and ethical dimension that is connected to biodiversity. In this sense it is to be considered that the biodiversity of agriculture systems is strictly associated to the cultural diversity of the agricultural communities, and that the safeguard of multiculturalism cannot be set apart from the part played by material cultures and by their relationship with biological diversity. Again, the existing value of biological diversity has to be acknowledged in a non-anthropocentric outlook, whereas the importance of the transmission of current genetic richness to future generations, for whatever use they will have in mind for it, takes man back to the centre of the stage.

Initiatives under way

Mature and widespread consciousness of the value of biodiversity and of the subsequent need to place policies of protection and development at the top of the political agenda is not fully adhered to as yet, but many progressive steps have been taken allowing Italy to currently hold a position of eminence, at least among the Mediterranean countries (SCARASCIA MUGNOZZA, 1998).

Let it be mentioned that within the project 'Plant Genetic Resources', funded by the Ministry of Agriculture and Forest Policies (MiPAF), and run in cooperation with numerous scientific institutions of the fruit cultivation department, ISF has recently published the results of a three-year research for the census of the genetic resources conserved by 15 IRSA – Institutes for Agriculture Research and Experimentation – (table 6.18), which total 21,843 accessions.

In particular, for that which pertains to the genetic resources of fruit cultivation, a survey conducted by MiPAF has ascertained that in our country there are numerous operative structures (Table 6.19) and that 3,065 Italian varieties are conserved altogether (Table 6.20).

Experimental Institute	Genera	Species	Total Accessions	Italian Accessions	Italian cultivars, landraces and wildtypes
Agronomic	1	1	202	159	159
For citrus fruit cultivation	12	66	310	157	25
For forest settlement and the Alps	4	4	30	28	17
For cereals cultivation	5	43	8,759	2,366	1,413
For fodder cultivation	2	3	1,770	1,770	1,770
For industrial cultivations	4	5	826	206	51
For olive oil and olive	1	1	109	82	80
For flower cultivation	13	60	379	165	22
For fruit cultivation	15	80	4,546	1,883	1,775
For olive cultivation	1	1	296	256	256
For vegetables cultivation	3	8	45	34	2
For silviculture	6	12	705	568	257
For tobacco	1	68	1,711	329	329
For viticulture	1	8	2,106	1,681	1,029
For zootechny	1	6	49	19	19
Total	**70**	**366**	**21,843**	**9,703**	**7,204**

Table 6.18 - Genera, species, total and Italian accessions conserved at the MiPAF institutes and partecipating to the project "Plant Genetic Resources" (Source MiPAF, 2002).

Institution	Species
Azienda Agricola Sperimentale Dimostrativa Pantanello (Metaponto, Mt)	Apricot; Quince; Fig; Strawberry; Almond; Medlar; Peach; Plum; Grape
Istituto Propagazione delle Legnose - CNR (Scandicci, Fi)	Cherry; Quince; Persimmon; Apple; Hazelnut; Pear; Peach; Plum
Istituto Fisiologia, Maturazione e Conservazione del Frutto delle Arboree Mediterranee - CNR (Sassari)	Cherry; Fig; Apple; Pear; Plum
Centro Ricerche Produzione Vegetale (Diegaro, Fo)	Apple; Pear
Istituto Sperimentale per la Frutticoltura - SOP Caserta	Apricot; Chestnut; Cherry; Quince; Fig; Persimmon; Almond; Apple; Medlar; Hazelnut; Nut; Pear; Peach; Plum
Istituto Sperimentale per la Frutticoltura - SOP Forlì	Strawberry; Apple; Pear; Peach; Plum
Istituto Sperimentale per la Frutticoltura - Roma	Kiwi; Apricot; Cherry; Strawberry; Apple; Hazelnut; Pear; Peach; Plum
Istituto Sperimentale per la Frutticoltura - SOP Trento	Cherry; Raspberry; Apple
Centro Sperimentazione Agraria Regionale Laimburg (Ora, Bz)	Apple
Ente reg. per la promozione e lo sviluppo dell'agricoltura Regione Friuli Venezia Giulia	Cherry; Apple; Pear; Peach
Agenzia Servizi Settore Agroalimentare Marche	Apple
Associazione Archeologia Arborea (Città di Castello, Pg)	Cherry; Fig; Apple; Pear; Peach; Plum
Veneto Agricoltura	Apple; Pear
Servizi sperimentazione, informazione e consulenza in agricoltura Regione Campania (Napoli)	Apricot; Cherry; Apple; Plum
Dipartimento Biotecnologie Agrarie e Ambientali - Università degli Studi di Ancona	Apricot; Cherry; Strawberry; Raspberry; Apple; Pear; Peach; Plum
Istituto Coltivazioni Arboree - Università degli Studi di Bari	Cherry; Fig; Almond
Dipartimento Colture Arboree - Università degli Studi di Bologna	Apricot; Cherry; Quince; Apple; Pear; Peach; Plum
Dipartimento Ortoflorofrutticoltura - Università degli Studi di Firenze	Persimmon; Peach
Dipartimento Produzione Vegetale - sezione Coltivazioni Arboree - Università degli Studi di Milano	Apple
Dipartimento Arboricoltura, Botanica e Patologia vegetale - Università degli Studi di Napoli	Apricot; Persimmon; Apple; Walnut; Pear; Peach; Plum
Istituto Coltivazioni Arboree - Università degli Studi di Palermo	Apricot; Cherry; Apple; Pear; Peach; Plum
Istituto Frutti-Viticoltura - Università Cattolica di Piacenza	Cherry; Quince; Apple; Pear
Dipartimento Agronomia Ambientale e Produzioni Vegetali - Università degli Studi di Padova	Apple; Pear; Peach
Dipartimento Coltivazione e Difesa Legnose - Università degli Studi di Pisa	Apricot; Almond; Apple
Dipartimento Colture Arboree - Università degli Studi di Torino	Apricot; Chestnut; Cherry; Raspberry; Apple; Hazelnut; Walnut; Pear; Peach; Plum
Dipartimento Produzione Vegetale e Tecnologie Agrarie - Università degli Studi di Udine	Kiwi; Apple
Dipartimento Produzione Vegetale - Università degli Studi della Tuscia, Viterbo	Azarole; Quince; Apple; Medlar; Pear; Grape

Table 6.19 - Institutions conserving fruit species in Italy according to investigations conducted by MiPAF (2002).

The action of conservation of genetic resources, carried out through the above mentioned initiatives, is chiefly managed through the *ex situ* pattern, with the creation of the so said 'germplasm banks'.

In this respect, seed conservation practice is commonly taking place for herbaceous species, owing to the advantages that stem from such an easily wrought technique, reproducible and fit for long-time conservation issues, and which, through ease of reproduction, also allows for comfortable characterization and evaluation of all conserved material. The advantages, among which others stand out – for example, the absence of cross-over risks between cultivars and their wild relatives – vastly exceed the limits this technique has been known to display – the species with recalcitrant seeds are unsuitable; also all coevolution processes are interrupted, but this limit is common to all *ex situ* techniques – so that it is widely adopted throughout Italy. In fact at least 15 in-

Common name	N. of Italian varieties in collection
Kiwi	21
Apricot	197
Azarole	5
Chestnut	41
Cherry	442
Quince	7
Fig	73
Strawberry	34
Persimmon	14
Raspberry	1
Almond	72
Applce	834
Medlar	35
Hazelnut	39
Walnut	33
Pear	444
Peach	601
Plum	153
Grape	19
Total	**3,065**

Table 6.20 - Fruit species and Italian varieties conserved by the institutions mentioned in Table 6.19 (MiPAF, 2002).

stitutions are active in the field, with a total of 69,000 conserved accessions. By all means the most important one is the Germplasm Institute of Bari, which preserves around 55,000 accessions of cultivars and of their wild relatives, mainly focusing on cereals and legumes, partly the outcome of numerous international exchanges (HAMMER *et al.*, 1999a).

In the case of fruit species the leading technique by far is their conservation in 'collection fields', a method whose suitability is quite well-established, in particular with regard to asexually propagated perennial species. This technique is widely practiced, especially as a result of the ease of characterization and evaluation of the collectioned material right through the conservation event, in spite of the many limits – the need for ample areas, the high conservation costs for the management of the fields and for the susceptibility of the collections to illnesses, fires, vandalistic acts, all of which may undermine their integrity or even their very existence. The didactic and cultural possibilities are not to be underrated, too, as the presence of the fields inside protected areas suggests; in this case they should possibly be included into practices of valorization of ecomuseums (BARBERA, 1999).

The other techniques of *ex situ* conservation are less commonly practiced, as they are considered to be little reliable, or too costly in financial terms. The main reference is to *in vitro* conservation techniques, through the culture of tissues which can undergo cryoconservation. A few satisfactory results have been obtained, also through employment of slowed-down growth conditions, for a number of fruit trees, such as the olive, the chestnut and the grapevine, but this cannot hide the risk of somaclonal mutations during conservation. The techniques of DNA or of pollen conservation also present some limits, that are possibly going to be overcome only through further in-depth studies.

Ex situ conservation techniques applied to animals of zootechnic interest are mainly referrable to the cryoconservation of haploid (seed) and diploid (embryos, somatic cells) genetic material. The aims that such cryoconservation techniques pursue in the realm of *ex situ* conservation substantially boil down to repopulating areas with local breeds, to creating new breeds, to implementing gene introgression, and finally to studying the *loci* of quantitative characters (QTL; section *Genetic diversity of plant species of agricultural interest*) with the aim of maintaining sound examples of genetic variability spread over the territory (BREM *et al.*, 1984).

The great advantage of *in situ* conservation, which in Italy, in the case of agriculturally pertinent cultivations, has to be substantially interpreted as 'in-farm conservation', lies in the possibility of avoiding to hinder coevolutive processes, that is the dynamic integration between genetic resources and the anthropic and the natural environment. It is conducive to that strategy implementation, even though its advisability has to be evaluated time and again with regard to the fulfilment of a few parameters – economic soundness, necessity of supervision – and to the overcoming of a few obstacles of methodological nature, mostly related to the difficulty of determining the 'genetic size' of the population to be conserved.

As for livestock raising, *in situ* conservation allows for better management of *inbreeding* levels and of casual genetic drift of small populations, through an accurate selection of the parents of future generations and through adequate scheduling of the matings, keeping in mind that future *inbreeding* is a function of present-day kinship between the breed animals. Nevertheless *in situ* conservation is generally held to be possible only in the case of species whose productions have a sound economic value, thus allowing for zooeconomic self-sustainability. Methods of *in situ* conservation take to the exploitation of biotechnologies, such as semen deep freezing and artificial insemination, under the priority aim of increasing the generation interval and the ease of management of the mating plans.

In Italy *in situ* conservation is feasible in the areas thriving on traditional agriculture especially if they are placed inside protected areas, not only as the resulting constraints are helpful in warranting continuity of land use and an agrosystem management that keeps coevolving with the biodiversity it hosts, but also because such placement is conducive to an easier access to all actions to be taken in view of production support.

Even though the role of biodiversity in view of the sustainability of Italian agrosystems, and of such agrosystems with regard to the 'natural' environment, is widely acknowledged, in order to achieve an effective protection and valorization policy a few limits have to be taken into account. They depend on an incomplete knowledge of biological diversity as it is conserved in Italian agriculture, on uncertain developments of present conservation initiatives, and on risks – or opportunities – deriving from the current or predictable state of the evolution of agrosystems, in line with the tendencies in developed countries.

The need of a census of all structures operating in the field and of the genetic material thereby conserved is to be taken into consideration, be they public or private, so as to achieve effective coordination in view of the exchange of materials and experiences and of the common management of data and informations. One has to become aware of the limitations and difficulties of the synonymies – to name but an example – a problem that can be solved only through an accurate characterization of the genotypes.

While on this line of reasoning about biodiversity, evaluation of the possible influences by Genetically Modified Organisms (GMO) cannot be avoided, if, after thoughtful consideration of the range of criticism on the international stage, their distribution comes to be interpreted as more of a risk than an opportunity, the latter being a rather simplicistic approach based on the belief that the future diffusion of new transgenic cultures may constitute a genetic enrichment (International Centre for Genetic Engineering and Biotechnology (a cura di), 2002; Ministero dell'Ambiente e della Tutela del Territorio – Commissione tecnico-scientifica per la biosicurezza, 2001). Even though Italian agriculture may be considered to be relatively immune from the risks, deliberately feared by the developing countries, of intraspecific variability disappearance – local varieties and breeds – through transgenic culture diffusion, the consequences of the impact of GMO pollen transmission and of the employment of genetically modified herbicide-tolerant cultivations are to be explored under a different light. In the first case a study (Eastham *et al.*, 2002) by EEA (European Environmental Agency) points out how genetically modified cultivars of basic species – rape, beetroot, potato, corn, wheat, barley, fruit plants – in many cases undergo a high risk of genetic pollution from non-modified cultivars and wild relatives exposure to pollen (Table 6.21). As for the distribution of herbicide-tolerant GMOs a recent survey (Dale *et al.*, 2002) strengthens all current worries about the reduction 'of diversity of infesting weeds in GM fields and in nearby environments'. To assess it concisely, the current state of knowledge seems to be confirming the concern already expressed by the Italian Ministry of Environment in 2001 (Ministero dell'Ambiente e della Tutela del Territorio – Commissione tecnico-scientifica per la biosicurezza, above mentioned).

The diffusion of systems of biological or biodynamic agriculture most certainly elicits a basically different outlook, since their productive processes are based on agrosystem biodiversity and at the same time they guarantee a heavy decrease of the existing risks for all related natural or semi-natural environments. The process – already under way – of valorization of typical products is to be reviewed in the same favourable way, since their organoleptic characteristics and their image to the public are based on the fact that they are the very outcome – direct or, in the case of processed products, indirect – of a locally based biodiversity.

Cultivation	**Cross-fertilization induced genetic flow frequency**	
	Between cultures	**Between cultures and wild parents**
Colza	High	High
Beetroot	Medium–high	Medium–high
Corn	Medium–high	Unknown for wild parents
Potato	Low	Low
Wheat	Low	Low
Barley	Low	Low
Strawberry, Apple, Grape, Plum	Medium–high	Medium–high
Raspberry, Blackberry, Ribes	Medium–high	Medium–high

Table 6.21 - Possible genetic flow through pollen transfer for a few important agricultural cultivations (Eastham *et al.*, 2002).

And the favourable outlook should be extended to all initiatives aimed at the safeguard and valorization of traditional agriculture landscapes, whose particular biodiversity comes through as a constituent element, and comes to be preserved through their protection. Finally, as far as conservation strategies are concerned, the traditional difference between *in situ* and *ex situ* conservation techniques, which used to refer back to two different conservation approaches – *in situ* in the areas out of the farmer's reach; *ex situ* in 'static' germplasm banks – is today replaced by a method entailing so-said integrated or complementary conservation, which spins out different procedures at the same time, in relation to the different resources that are to be protected, to the range of the extinction risk, to the dimension of the ranges (Perrino and Desiderio, 1999).

Biodiversity protection through the promotion of top quality products[5]

The protection of agriculture and livestock biodiversity is often 'coupled' to the valorization of typical alimentary products (Protected Designation of Origin – PDO, Protected Geographical Indication – PGI, Specificity Attestation – SA or Traditional Speciality Guaranteed - TSG), both 'traditional' and biological[6], as well as to private initiatives, such as the Aids for Products under Extinction promoted by the *Slow Food Arc* (Table 6.22); and public, too, such as the *Atlas of typical products of the Italian Parks* (http://www.atlanteparchi.com) promoted by the Ministry of the Environment and of the Protection of the Territory – Service for the Conservation of Nature, and implemented by *Slow Food* together with Legambiente and Federparchi.

The policies regulating the quality of agriculture products may have positive impacts on biodiversity. Conservation and promotion of domestic rare or endangered species and of the genetic heritage can be supported by labelling and certification mechanisms.

Even though the quality labels of the typical products – PDO, etc. – were born in order to protect and promote top quality agroalimentary products, through them biodiversity comes to be protected as well, on the basis of the bond it has with the plant cultivars or with specific animal breeds.

Italy turns out to be particularly fertile, with typical productions appearing in quite a few different agroalimentary divisions. There are numerous products that were already protected in previous times by similar, though national, systems. Some of them, especially vegetables and fruits, are bonded to local ecotypes – for example, the bean of Sarconi, a PGI product from Basilicata, an outcome of cross-overs of local varieties of Cannellini and Borlotti beans.

	Category				
Region	**PDO**	**PGI**	**Traditional product**	**Slow Food Presidium**	**Total**
Abruzzo	2	1	73	1	77
Basilicata		2	41	1	**44**
Calabria	7	1	104	1	**113**
Campania	6	2	111	7	**126**
Emilia R.	11	10	73	7	**101**
Friuli V. G.	2		76	2	**80**
Lazio	6	2	103	1	**112**
Liguria	1		101	9	**110**
Lombardia	13	3	201	3	**220**
Marche	2	2	93	6	**103**
Molise	1	1	86		**88**
Piemonte	9	2	162	15	**188**
Puglia	7		84	4	**95**
Sardegna	3		43	2	**48**
Sicilia	5	3	64	9	**81**
Toscana	3	6	302	12	**323**
Trentino A.A.	4	2	186	4	**196**
Umbria	2	3	62	2	**69**
Valle d'Aosta	4		17	1	**22**
Veneto	8	5	206	4	**223**
Inter-regional				1	**1**

Table 6.22 - Different protection resources listed by separate categories and regions.

The task of the mentioned labels, though, is not by itself assuredly protective. The specification, which is necessary to qualify for the label designation, could lead, as a direct consequence, to the standardization of the methods of preparation, with the ensuing risk of genetic variety reduction. On top of that comes the fact that commercial promotion of a particular label may drive the producers from the relative areas to homologate themselves to the production, so as to try and benefit from the complex array of advantages deriving from the label's reputation on the national and foreign markets.

Another domain of protection is that of 'traditional' products. With the Legislative Decree no. 155 of 1997

[5] This chapter portion is by D. Marino and G. Cannata.

[6] For these cultures the older varieties often end up being more adaptable

[7] Ministry Decree of September 8, 1999, no. 350 'Regulation with rules for the identification of traditional products as mentioned by article 8, § 1, of legislative decree of April 30, 1998, no. 173'.

[8] The list was published with Ministry Decree MiPAF of July 18, 2000.

Italy has agreed upon the Directive 93/43/CEE on the hygiene of alimentary products (HACCP). The application of this legislation would risk to erase the greater part of Italian traditional products, for which it would be difficult to comply to rules that have been wrought to take effect on large alimentary industry. A derogation has therefore been devised, in order to identify long-time settled[7] processing, conservation and seasoning methods. On this basis the Regions have arranged for the identification of their own traditional products, to which measures included in LD 155/97[8] are not going to apply, and for the ensuring of hygiene and healthiness through a different set of rules. The objective is to protect the gastronomic heritage typical of Italian regions; in fact, it keeps up with the drafting of an Atlas of the gastronomic heritage, integrated with references to the cultural, craft and artistic local heritage. The effect on biodiversity is similar to that played by typical products, as many of them come from – or are themselves – local plant varieties or typical animal breeds, even in danger of genetic erosion.

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