

AT THE CROSSROADS BETWEEN EAST AND WEST
IN THREE HOSPITABLE COUNTRIES

AGRICULTURE AND BREEDING HAVE BEEN DEVELOPED SINCE THE NEOLITHIC

COPING WITH THE RHYTHMS OF THE SEASON

A TREASURY OF GENETIC RESOURCES IS MAINTAINED IN GARDENS

TO MAKE BREAD, CHEESE AND WINE

PASTORALISTS AND FARMERS MANAGE THE LANDSCAPES

RURAL PEOPLE KNOW AND USE WILD PLANTS AND ANIMALS

COMBINING BIODIVERSITY, HEALTHY ECOSYSTEMS AND SMALLHOLDERS' DEDICATION:
A PATHWAY INTO THE FUTURE

Հողագործությունը և անասնապահությունը զարգացել են նոր
քարեդարյան ժամանակներից ի վեր

Թեկնիկ և սեփականությունը neolit dövründən inkişaf etdirilmişdir

նեոլիտի ժամանակ – միջատաբուծության և
մեթերաբուծության զարգացում

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INTRODUCTION

DURING THE NEOLITHIC, 10 000 TO 5 000 YEARS AGO, HUMAN BEINGS STARTED TO CULTIVATE AND DOMESTICATE PLANTS AND ANIMALS. THE DEVELOPMENT OF AGRICULTURE CHANGED THEIR LIFESTYLES; UP TO THEN THEY HAD BEEN MAINLY HUNTER-GATHERERS. THE AVAILABILITY OF FOOD IN THE SAME AREA FOR LONG PERIODS OF TIME MEANT THAT IT WAS POSSIBLE TO SETTLE DOWN, BUILD PERMANENT DWELLINGS, MANUFACTURE POTS AND TOOLS, EXCHANGE GOODS AND ORGANIZE MORE COMPLEX SOCIAL STRUCTURES.

The early process of agricultural development was not uniform either in place or time. Almost all the plant species cultivated in the world today originate from just four or five areas in Asia, Africa and Central/South America; agriculture began in these places and then spread throughout the rest of the world. The Southern Caucasus, together with the Fertile Crescent,¹ is one of the areas from which many plant species originated.

In particular, it is considered the centre of origin of one of the most widely cultivated crops, soft wheat, and of several fruit species. Legume species were cultivated in rotation with cereals, and diversification of crops and cropping systems provided more complementary food for humans, contributed

to maintaining soil fertility and made the best possible use of the many different microclimates and biodiversity species available in the Southern Caucasus.

A diversified diet, based on cereals, fruits and dry cooked legumes, together with vegetables and roots, occasionally supplemented with meat, improved both the fertility and health of the population which, in turn, determined the increase in numbers and the longevity of individuals. The archaeological evidence of late Bronze Age tools, probably used for digging, as well as the remains of grapes, peaches and other fruits found in Armenia, Azerbaijan and Georgia, strongly suggest that a process of agricultural evolution was already well under way.

¹ The Fertile Crescent is a crescent-shaped region in the Near East, comprising the basins of the Tigris and Euphrates Rivers (Mesopotamia), of the River Jordan, and the lower basin of the Nile in Egypt.



The Stones of Carahunge in Armenia (sixth millennium BC), also known as “the Stones of Zorats”

EARLY AGRICULTURE IN THE SOUTHERN CAUCASUS

In the first part of the last interglacial period, about 10 000 years ago, the climatic conditions of the Fertile Crescent and the Southern Caucasus were particularly favourable for growing many species of wild plants (such as grasses, legumes and trees with edible fruits) with a potential human use. Submountainous areas were partially covered by trees and shrubs and partially by steppe vegetation.

Within relatively short distances, these areas presented varied microclimatic conditions, depending on altitude, slope,

orientation, solar exposure and availability of water. Species included wild cereals (barley in the more arid zones, wheat in intermediate zones and rye in the more humid and cooler zones); legumes such as lentils, vetches, peas, *Lathyrus*, chickpeas and fava beans; and fruit trees and shrubs producing almonds, pistachios, figs and oak acorns, etc. Many of these could be preserved throughout the winter. These environments were well suited to human dwellings, since they guaranteed availability of combustibles for domestic use and that of many edible annual and perennial plant species.



In Armenia, archaeological remains of the Hittite and the Urartu tribes, dating between 4 000 and 3 000 years ago, reveal that agriculture was already well developed. The laws of the Hittites specifically refer to fruit orchards and vineyards and establish punishment for stealing fruit.

Theft from a private apple orchard shall be punished with a fine of between six and ten silver coins. Theft from an apple orchard belonging to the community will be punished with a fine of three silver coins.

These rules suggest that even in those early times there were both private and public fruit orchards, and that laws had been set in place to protect them. In excavations of sites settled by the Urartu tribes in present-day Armenia and Azerbaijan, archaeologists have found the remains of carbonized fruit, as well as apple, grape and pomegranate seeds and plum, peach and apricot stones. Cuneiform writings from that period often refer to fruit orchards.

In Southern Caucasian architecture, grapes and pomegranates are favourite decorative motifs. There is evidence to suggest that the region supplied ancient Greece and Rome with apricots, as well as dwarf varieties of apples or plums, such as the Regina variety. Fruit trees were planted between the rows of vines. Cultivation of wheat and barley dates back five to six thousand years BC, and animals such as cattle, pigs, sheep and goats were domesticated during the Neolithic. In prehistoric settlements (Teghut, Shengavit, Nakhchivan, Kultapa, Aghstev, etc.), remains of cereals, animal and agricultural tools have been identified. Fossils from Bronze Age settlements testify that agriculture was the major occupation of indigenous tribes residing in the Armenian highlands.



In later times, the varieties and breeds of animals and crops were improved (fine- and coarse-wool sheep, draught and saddle horses and a wide range of wheat, barley and grapes). In the upper valley of the River Aratsani, in the catchment area of Lake Vana and in Tsopq and the Ararat Valley, viticulture and fruit farming were advanced. Greeks retreating through Armenia found large quantities of stored wine and beer, as well as raisins and other dried fruits in the villages. Archaeological digs in Azerbaijan from the Aratta, Lulubi and Kutuy periods give incontrovertible evidence of domestication of most agricultural crops from 5000 to 4000 BC. Finds from Kultapa (Nakhchivan) and Mingacevir excavations dating back to the third century BC show that cereals were also cultivated in these areas.

The Southern Caucasus is rich in archaeological findings that testify early development of civilization. Above: excavations at the site of Dmanisi, dating back to prehistoric times (about one million years ago). <<Left: a skeleton found in a burial site in Mingacevir, now preserved in the History Museum of the Azerbaijan Academy of Sciences



Environmental conditions in the Southern Caucasus have favoured the differentiation of many species and the development of agriculture. Grapes were among the first fruits to be domesticated

The Shulaveri-Shomu culture in east Georgia (Kwemo Kartli region), which occupies the middle course of the Mtkvari Valley, is among the best known Neolithic cultures of the Southern Caucasus. The sites are generally located on the most fertile land along rivers, not far from the foothills. The Shulaveri-Shomu culture is characterized by circular mud-brick houses, domestic animals and cereals. Remains of *Triticum polba*, *T. macha*, bread wheat, barley and millet were discovered at Shulaveri.

The material culture includes handmade pottery with incised and relief decoration, an obsidian industry based on the production of regular blades with a high proportion of burins and scrapers, and large numbers of bone and antler implements. The sites of Shulaveri, Imiris and Khramis didi gora (Kwemo Kartli region) were excavated by a team from the National Museum of Georgia.



Petroglyphs in Gobustan confirm the early development of crop cultivation and animal husbandry in the Southern Caucasus

GOBUSTAN CAVES

Gobustan is an archaeological site in Azerbaijan near the Caspian Sea, about 60 km southwest of Baku. It comprises rock caves that were used as shelters as far back as 10 000 years ago.

At the end of the 1930s – when the area was used as a stone quarry – petroglyphs were found in the caves. They had been carved from about 3000 BC to the first centuries AD. Evidence of fire-worship can also be found in pictures carved in stone. The petroglyphs

depict people, animals, plants (especially wheat and barley), agricultural tools, musical instruments and boats and testify that crop production and animal husbandry were common practices dating back to the Neolithic. Pictures of boats carrying the sun allow scientists

to presume that the inhabitants of these places knew how to navigate ships by the sun and the stars and had direct contact with the Sumerians (the former population of Mesopotamia), who belonged to the most ancient cultures on the continent.

THE ORIGIN OF WHEAT CULTIVATION IN THE CAUCASUS

Wheat has been cultivated in the Southern Caucasus for 6 000 years, as evidenced by ethnographic, archaeological and botanical studies. Traces of burnt wheat straw found among bricks, together with the remains of wheat stubble, show that wheat was grown locally rather than being imported from elsewhere. In fact, the region is considered a primary centre of origin of the most widespread wheat species, *Triticum aestivum* (bread wheat).

The history of the domestication of wheat is complex, involving selection of species by farmers, natural evolution and hybridization. The result is a wide range of cultivated and wild varieties, with different specific characteristics, often sharing the same habitats. Many authors also believe that the evolution process is still under way, as natural cross-fertilization still takes place between wild and cultivated *Triticum* species.

THE OBJECTIVES OF WHEAT DOMESTICATION

People have selected wheat to increase its production, facilitate harvesting and storing, and augment pest resistance. The comparison between domestic and wild wheat illustrates the long process of selection in obtaining wheat with more suitable characteristics for cultivation and human consumption:

- ✿ Production of plants with “non-shattering” seeds that do not break off the plant before harvest and are therefore easy to harvest. (In nature, wild grasses disperse their seeds by releasing them once ripe and not synchronizing is a security system to face unpredictable climate variability and other stresses such as grazing by animals and wind storms.)
- ✿ Production of large, plump seeds. (In nature, seeds are smaller so that plants can produce them with less use of energy and nutrients.)

- ✿ Production of more seeds per plant by increasing the number of fertile flowers. (In nature, it is more secure to produce a larger number of plants each with a limited number of seeds.) Traditional crops used by farmers in difficult environments also have a limited number of seeds per plant because the entire plant is used (e.g. leaves are fed to animals, stems are used for housing, roots are used for soil erosion control.)
- ✿ Production of “naked” varieties, where the husk around the seed comes off easily during threshing. (In nature, wild varieties of wheat are hulled to improve the protection of the seed against aggression by animals, wind and heavy rains.)
- ✿ Production of seeds that germinate together. (In nature, wild forms have adapted to delay germination until climatic conditions are suitable and to vary the timing of germination so that seeds do not grow and die altogether during a season of erratic and poor rainfall.)
- ✿ Response to irrigation and resistance to wilt, rust and other pests. (In nature, this resistance is reached through the use of a combination of varieties and species rather than through a higher resistance of plants grown in monocultures.)
- ✿ Good response to fertilizers. (In nature, this response is reached through a combination of species and varieties. Biological processes are enhanced and the combination of species and varieties maximizes the use of soil nutrients).

For these reasons, domesticated varieties are better suited to agricultural production, but they may lose their capacity to survive if the conditions for which they have been selected disappear. For example, “non-shattering” varieties would no longer be able to colonize new areas, and plants that germinate simultaneously would not be able to survive if a sudden drought follows germination. Local farmers are aware of the importance of managing a large number of varieties, and of maintaining old varieties that contain genetic material resulting from thousands of years of human selection. These heirlooms may provide the genes needed to create varieties that will thrive in a changing climate.

ANTIQUITY OF GRAPEVINE CULTIVATION IN THE SOUTHERN CAUCASUS

by Lorenzo Costantini and David Maghradze

Recent archaeobotanical material dating back to the seventh-sixth millennium BC confirms that the Caucasus was an independent heart of a food-production economy. This refers in particular to wheat, barley, rye and grapevine, the remains of which have been found in various Neolithic settlements. Armenia, Azerbaijan and Georgia are three important areas for both the study of varietal (ecotype) diversity of wild grapevine and for knowledge of the process of domestication.

The presence of grape seeds in archaeological sites is sporadic and occasional, since they are not foodstuffs of economic importance that would justify their being accumulated, unlike cereal or legume seeds. The importance of archaeological seeds in the study of cultivated grapevine origin and evolution as well as for ancient wine-making has often been affirmed by botanists, agronomists, archaeobotanists and archaeologists. According to morphological and ampelographic analysis, the seeds from neolithic Shulaveris Gora and Dangruei Gora (Georgia) are considered to

be those of the cultivated vine – *Vitis vinifera* L. spp. *sativa* DC. In Georgia, seeds and other grapevine remains have been found in more than 40 sites, from the early Neolithic onwards. Archaeological seeds have also been found at Shomu Tepe (Azerbaijan). According to Kavtaradze, the mainly sixth millennium chronology of the early farming culture of Shulaveri-Shomu Tepe in the central part of the Southern Caucasus is based on calibrated radiocarbon evidence. These calibrated data partially solve the discrepancy between the Near Eastern archaeological parallels of this culture, dated to the seventh-sixth millennium, and the uncalibrated radiocarbon dates of the Shulaveri-Shomu Tepe culture, which were largely placed in the fifth millennium.

In the framework of the collaborative project “Conservation and sustainable use of grapevine genetic resources in the Caucasus and Northern Black Sea Region”, coordinated by Bioversity International (formerly IPGRI) and supported by the Government of Luxembourg, a special section has been dedicated to the archaeology of grapevines. This research has been undertaken by the Bioarchaeological Research Centre of the Italian Institute for Africa and the East

(IsIAO) in collaboration with several Georgian institutions. It is expected that this collaboration will increase our knowledge of the evolutionary process of one of the most important cultivated plants that has accompanied the development of central Asian societies, and build up a computerized database for grapevine biodiversity.

The collection of information will provide documentation on the use of grapevines through the various stages of cultural, social and economic development of the region. Moreover, the studies will provide additional information connected with ethnological and anthropological topics related to traditional agricultural systems and to models of sustainable agriculture.



Photo by D. Maghradze

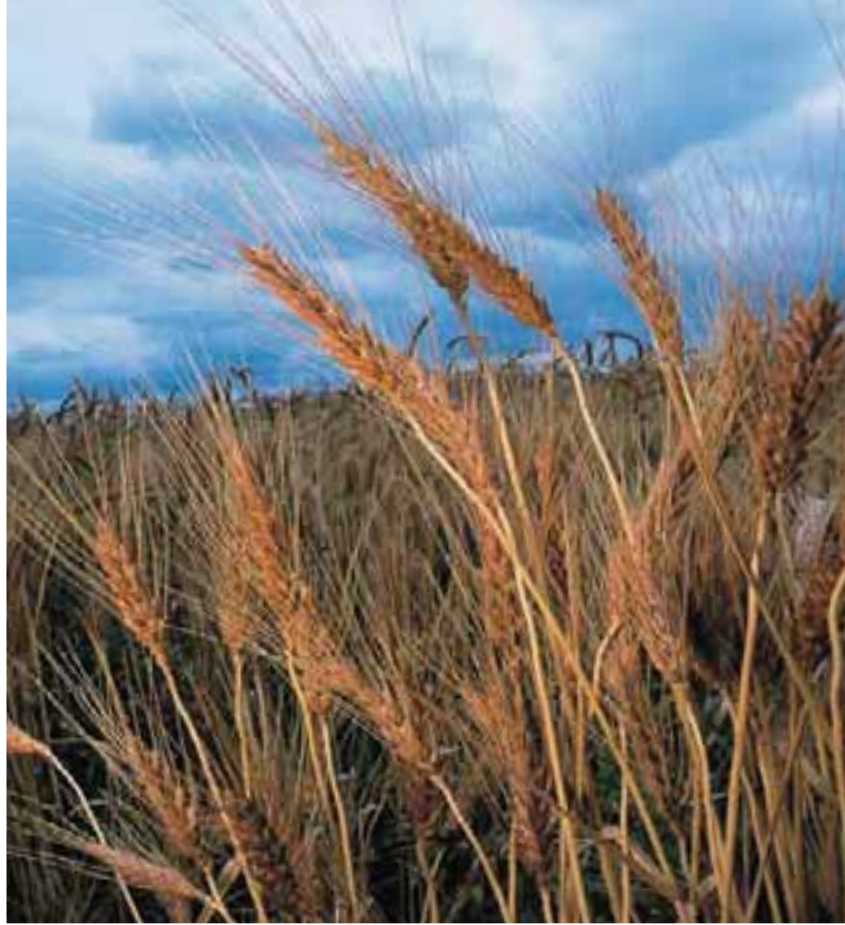


Photo by D. Maghradze

Top: ancient *kvevri* (clay vessel for making wine) from Vani, Georgia. Centre: *pithos* from Tsikiagora, Georgia. Below: carbonized seeds of cultivated grapevines from Tsikiagora



Photos by D. Maghradze



THE ANCESTORS OF WHEAT

The Caucasus is a centre of origin of wheat species, some of which form the base of wheat production throughout the world. For example, *Triticum spelta*, a form of semi-wild wheat with a resistant midrib and hulled grains, is considered one of the earliest ancestors of bread wheat. Remains of *T. spelta* have emerged from excavations led by the Georgian archaeologist, Iv. Javakhishvili, in the Imiris-Gora region (east Georgia), together with bread wheat, *T. cariticum*, wheat with single and double grains, barley, oats, lentils and millet, all catalogued as early as the fourth or fifth century BC. Eight different varieties of wheat, including those considered as the evolutionary link between the ancient species and those cultivated today

(*T. polba*, *T. macha*, *T. aestivum* and *durum* wheat), were found by the botanical archaeologist Chubinishvili at Aruklo, in western Georgia, in a site dating back to the sixth century BC.

In Kultapa, Azerbaijan, not far from Nakhchivan, carbonized wheat dating from the Neolithic has been found. In Chalagantepe (Agdash) and Misharchay (Jhalilabad), wheat remains from seven to eight thousand years ago were discovered. The high mountains and alpine highlands are the main regions of species formation and intraspecific differentiation. A favourite dish cooked in Azerbaijan from bread-baked wheat (*T. aestivum*) is *aghandz*. It is made from roasted wheat grains,



The history of the domestication of wheat is complex, involving selection of species by farmers, natural evolution and hybridization. Such processes are still under way. From left to right: *Triticum monococcum* and three subspecies of *T. aestivum*: red doli, macha and spelt

often mixed with seeds of other plants (for instance, hemp, flax or some leguminous seeds) and it is believed that *aghandz* is the most ancient wheat product in human meals.

In Armenia, in archaeological sites dating back some 8 000 to 5 000 years (Shengavit and others), mainly barley-wheat mixtures have been discovered. Pure wheat crops appeared later, about 3 000 years ago (Karmir-Blur, Argishtikhinivili and others). Carbonized wheat spikelets and grains of *T. aestivum*, *T. compactum*, *T. spelta*, *T. sphaerococcum* and *T. dicoccum* were found in archaeological excavations.

At the Erebuni Nature Reserve in Armenia, *T. urartu* was discovered, together with other wild wheat species such as *T. boeoticum*, *T. araraticum* and *Amblyopyrum muticum*, a species taxonomically intermediate between *Agropyron* and *Aegilops*.

The latter species caused great interest among scientists, because some consider it to be the donor of the first (A) genome, which is widespread in tetraploid and hexaploid wheat. Six varieties have been identified to date; new scientific data will shed light upon their characteristics. For this reason there is an urgent need to protect these varieties.



Many local wheat varieties, such as *Triticum georgicum*, are disappearing because of their limited market value, but they should be maintained because of their importance for selection, especially in view of changes in environmental conditions.

>>Right: Irakli Rekhviashvili, Head of the Selection Achievement Testing Station in Asureti, Georgia, inspects a wheat field

Aegilops, a wild relative of wheat

Aegilops is a cereal similar to wheat, and grows in the Southern Caucasus, sharing the same habitats as other wild wheat species and varieties.

Recent interest in this species arose from the cytological proof of its role in the origin of tetraploid and hexaploid wheat varieties, i.e. of some of the most widespread crops in the world. Further research on *Aegilops* could have various benefits – by bringing improvements to the wheat itself, because it is a rich reservoir of genes for drought resistance and poor-soil tolerance; it could encourage and promote the sustainable development and protection of the ecosystem in which it grows. Its habitat is the same as that of other wild wheat species and varieties, which would also benefit from this situation.

The genus *Aegilops* comprises 11 diploid and 12 polyploid species, including tetraploids and hexaploids, nine of which grow in the Southern Caucasus.

The genus *Triticum*

The Southern Caucasus is famous worldwide for its diversity of endemic species and subspecies of wild and cultivated wheat. At present, over a dozen species and several hundreds of subspecies have been identified in the region. All the three countries maintain rich collections within public institutions. Many local wheat varieties are no longer used, mainly because they do not sufficiently increase production with increasing inputs, and they are not easily sold in international markets. Consequently, many valuable subspecies and forms, which are of great importance for selection, are disappearing. All cultivated wheat species of the genus *Triticum* have a number of chromosomes, a multiple of seven, and they have been classified as diploid (with $2n=14$ chromosomes), tetraploid ($2n=28$) and hexaploid ($2n=42$). Further studies have confirmed that the basic genome of the Triticeae tribe is organized into seven chromosomes, and that a specific chromosome or part of it in a basic genome is genetically related to a specific chromosome or part of it in all other genomes of the Triticeae. This is because gene synteny has been conserved throughout genome evolution and speciation of the genera in the Triticeae tribe and Poaceae family. The table on page 102 lists the species and main subspecies of the *Triticum* genus.





The Erebuni Reserve near Yerevan, established in 1981, is a unique place in which many wild wheat species and wheat ancestors are grown and preserved. >>Right: Syuzanna Hovsepyan collects *Aegilops* specimens, a wild relative of wheat grown at the Erebuni Reserve, for the State Agrarian University of Armenia and a close-up of mature *Aegilops*

CLASSIFICATION OF <i>TRITICUM</i> SPECIES AND MAIN SUBSPECIES				
Ploidy level	Species	Main subspecies	Common name	Notes
Diploid	<i>T. monococcum</i> L.	–	einkorn or small spelt wheat	cultivated
		<i>aegilopoides</i> (Link) Thell.	–	wild
	<i>T. urartu</i> Tumanian ex Ghandilyan	–	–	wild
Tetraploid	<i>T. turgidum</i> L.	–	pollard wheat	cultivated
		<i>durum</i> (Desf.) Husn.	durum wheat	cultivated
		<i>carbolicum</i> (Nevski) A. & D. Löve	Persian wheat	cultivated
		<i>dicoccum</i> (Schrank) Thell.	emmer wheat	cultivated
		<i>palaeocolchicum</i> (Menabde) A. & D. Löve	–	cultivated
		<i>polonicum</i> (L.) Thell.	Polish wheat	cultivated
		<i>turanicum</i> (Jakubz.) A. & D. Löve	Khorassan wheat	cultivated
	<i>diccooides</i> (Körn. ex Asch. & Graebn.) Thell.	wild emmer	wild	
	<i>T. timopheevi</i> (Zhuk.) Zhuk.	–	–	cultivated
		<i>armenicum</i> (Jakubz.) van Slageren	–	wild
Hexaploid	<i>T. aestivum</i> L.	–	common or bread wheat	cultivated
		<i>compactum</i> (Host) Mackey	club wheat	cultivated
		<i>macha</i> (Dekapr. & Menabde) Mackey	–	cultivated
		<i>spelta</i> (L.) Thell.	large spelt or dinkel wheat	cultivated
		<i>sphaerococcum</i> (Percival) Mackey	Indian dwarf bread	cultivated
	<i>T. zhukovskyi</i> Menabde & Ericz.	–	–	cultivated



Examples of selected *durum* wheat varieties

The main characteristics of three varieties of *durum* wheat that have been recently selected in Azerbaijan are described below.

Terter. This variety has been obtained through intraspecific hybridization of the *Giorgio 447* variety of Italian origin with the *Mehsuldar* (productive) variety. The height of the plant is 90–95 cm; vegetation period is 180–218 days; tillering ability is good; its diversity is *provinciale*. The length and thickness of the ear are average. The potential productivity of the plant is 6.5–7 tonnes/ha; grain size is large; 1 000 kernel weight is 53–58 g. The macaroni quality of the grain is satisfactory; gluten quality belongs to the second group. It can be slightly infected with rust and mildew diseases; susceptibility to stem rust is average. It is resistant to smut diseases, but its resistance to frost is weak.

Garagilchig-2. This variety has been obtained by crossing the *Garagilchig* variety with the *Norin-10* variety through multiple individual selection. With semi-winter characteristics, the plant is short (78 cm), resistant to lodging, early ripening and has good tillering ability. Its diversity is *apulicum*. The ears are cylindrical

and large, and density is average. The potential productivity is 7–8 tonnes/ha; in high agrotechnical on-farm conditions 6–7 tonnes/ha yield has been obtained. The light-yellow grain is longish, oval and large; 1 000 kernel weight is 45–50 g. Grain albumin is 15–16 percent; gluten is 28–32 percent, total macaroni quality is extremely high (4.9 points). Although the variety has weak resistance to frost, it is drought tolerant. It is resistant to rust diseases, mildew and stinking/barley smut, but can be slightly infected by loose smut.

Bereketly-95. This variety has been obtained through intraspecific hybridization of the wheat varieties *Qirmizi* and *Garagilchig-2*. It is a quality, semi-winter, intensive plant, short (95–98 cm), high-yielding and tolerant of extreme climatic factors. Its vegetation period is 210–219 days; tillering ability is good. Its diversity is *hordeiforme*. The ears are red and prismatic. The potential productivity of the variety is 7–8 tonnes/ha; the grain is extremely large; 1 000 kernel weight is 56–60 g. Grain albumin is 13.5–14.5 percent; average value/magnitude of gluten is 26–28 percent. The plant is resistant to rust mildew and smut diseases as well as to drought and frost.



FRUIT DOMESTICATION

Thousands of years ago, fruit growers in the Southern Caucasus learned how to transfer fruit trees (which grew wild on the mountains) to the fields and gardens below, close to the settlements where people lived. These fruit growers also mastered the art of grafting. Evidence suggests that the technique was practised in the region as early as 6 000 years ago.

In Azerbaijan, the local population settled in the vicinity of forests and used wild crops as rootstock in hybridization with local fruit varieties; fruit orchards were established along the edges of forests. This is still a tendency of the local population in the Quba-Khachmaz and Sheki-Zagatala regions. The local *Gizil Ahmedi* and *Jir Haji* apple varieties have been developed through improvement of wild apple varieties.

In Armenia, fruit farmers developed late-flowering almond trees to overcome late frost damages.

In Azerbaijan, in order to withstand the strong winds blowing in the southeastern lowlands, varieties of olive trees with a very strong connection of drupes were selected.



Fruit orchards were originally established along the edges of forests, using wild crops as rootstocks in hybridization with local fruit varieties. Apple orchard in Quba, Azerbaijan (left); pear grafted on to spontaneous pome hybrid (centre); olive tree variety selected for its resistance to strong winds (right)



The Southern Caucasus is a centre of origin of important wild almonds such as *A. fenzliana*. Though wild almonds are often bitter and their domestication is complex and poorly known, the domesticated sweet types have been found in archaeological remains from the Bronze Age suggesting that the almond was already cultivated together with cereals and grapes

During Roman times, Armenian growers developed a plum – today’s Reine-Claude (greengage) variety – which was considered preferable to the common wild plums found on the hillsides.

In the Southern Caucasus, fruit growing has always been greatly influenced by climate and geology. Even when these two factors conspired against fruit cultivation, local farmers adapted production to the physical circumstances. In Georgia, an apple variety known as Kekhura was identified and cultivated to take the place of the small wild apples growing in the woods.

Since much of the terrain in the country is mountainous, fruit growers built terraces to grow their vines and fruit trees, and selected varieties that would flourish in mountainous regions. Until the eighteenth century, fruit varieties grown in the Southern Caucasus were isolated from genetic influences from other parts of the world.

In the nineteenth century, in Europe, new cultivation and production techniques had developed and, with advanced research into genetic improvement, European fruit varieties started to replace the local ones.



In universities, students learn about both indigenous germplasm and high-yielding introduced varieties that hold the potential to sustain agricultural production in the future

Some varieties failed to adapt, but others thrived and were widely grown. Thanks to the favourable climate, some varieties did even better in their new habitat, producing higher yields. Among these was the Champagne rennet apple, imported into Georgia from France. As the region's transportation network improved, more fruits were exported from the Southern Caucasus.

Records show that, in 1914, the Armenian railway carried 1 600 tonnes of apricot purée and other conserves, such as fruit syrups, from Yerevan to destinations including Baku, Tbilisi, Saint Petersburg, Moscow and Warsaw. In 1921, a new era in fruit cultivation in the Southern Caucasus began. Large-scale agricultural farms developed, with the principal aim of increasing production. As a result, cultivation of a wide



Professor Aida Stepanyan of the State Agrarian University of Armenia explains local fruit varieties. After a long period in which many varieties were abandoned in favour of a few high-yielding ones, today there is increasing awareness that diversification contributes to resilience to climatic and economic fluctuations and enables small farmers to reach the markets with their products

variety of fruits, which had always been the practice under private ownership in small orchards, was largely abandoned in favour of a relatively narrow selection of high-yielding varieties. Intensifying agricultural production did produce gains in all sectors, including those of livestock, cereals and fruits. Advances were made in studying the particular agronomic, genetic and biochemical aspects of fruit cultivation.

This led to both an increase in the indigenous germplasm available and to the introduction of new varieties. However, this progress came at a high price in terms of loss of local rural traditions and knowledge, since there was no place for these in the new collective agrarian society. Some examples follow of fruits that have been cultivated in the three Southern Caucasus countries since prehistoric age.



The walnut is well adapted to the climatic conditions of the Southern Caucasus and represents a precious source of food and energy

Walnut (*Juglans* spp.)

Armenian	<i>Ynkuiz, Kakal, Popok</i>
Azeri	<i>Goz, Javis</i>
Georgian	<i>Kakali, Nigozi</i>

The walnut exists in the wild in the Southern Caucasus and is perfectly adapted to growing in its different ecosystems. Walnuts represent a highly nutritious and versatile food that has been used and selected for millennia in the region; they are often used in paintings for their beautiful shape, and are a precious source of energy in the diets of the Caucasian people, particularly in winter. They are also used in many traditional dishes. Walnuts are one of the genetic resources of the region that must be maintained and cultivated because they are adapted to local conditions. Furthermore, walnuts are an important income resource for smallholders who cultivate them in their gardens to

sell on local and national markets. Walnuts are consumed fresh or processed as a quality food throughout the year. *Juglans regia* is native to the mountain ranges of Central Asia, extending from Xinjiang province of western China and parts of Kazakhstan, through Afghanistan, Turkmenistan and the Islamic Republic of Iran. In these countries, there is a great genetic variability, particularly ancestral forms with lateral fruitfulness.

The introduction of the walnut into the Southern Caucasus goes back to the period preceding the birth of Christ. Because of favourable conditions in the region, the walnut tree became an endemic species. Until the nineteenth century, the landscape was thickly covered with walnut forests, but unfortunately these have been gradually depleted to provide timber. In the twentieth century, the mass felling of these trees came to a halt and, instead, plantations were established.



Mr Baghdassaryan builds models made of beautiful walnut wood (left); Hikmet Novrusov cuts a slice of sheki halvasi, a delicious cake (right)

In Armenia, *Juglans nigra* L., *J. mandshurica* Maxim. and *J. regia* L. are all present, but for nut production purposes, popular tradition has selected around 100 seedling lines of *J. regia*, which are widespread in several regions.

In Azerbaijan, there are mixed groves of walnut with Caucasian persimmon (*Diospyros lotus* L.) in the Talish Mountains; with oriental plane (*Platanus orientalis*) in the Lesser Caucasus (Zangilan district, Basitchay reserve); with yalangoz (false walnut) (*Pterocarya pterocarpa*) and Caucasian persimmon in the Greater Caucasus (Sheki-Zagatala region); and with chestnut (*Castanea sativa*), birch and relict species. A.I. Guliyev found 396 forms of walnut, 136 of which maintain important farming indicators. The walnut varieties *Kagizi*, *Katan koynek*, *Araz*, *Disar*, *Darvish papag* and *Nazikgabig* developed over time through folk selection methods known in Europe, the United

States of America and other countries. The varieties *Evrica* and *Blekmer*, well known in California, have been developed from the *Kagizi* variety which, in the eighteenth century, was taken to the United States from Azerbaijan.

In Georgia, the walnut is mainly represented by seedling lines belonging to *J. regia* L., which vary greatly from one another. Indeed, many genetic forms are catalogued according to the shape of the nut: *globosa*, *ovalis*, *ovata*, *obovata* and *rostrata*. The size of the fruit also varies greatly, ranging from 25–45 mm in height to 22–41 mm in width. Other forms are catalogued according to the fat levels of the nut, which may vary from a minimum of 55 percent up to more than 75 percent.

The walnut kernel is consumed fresh and is used in the preparation of traditional sweets such as *shakarburra* and *pakhlava*.



Magamued Yekabashov with his production of walnut oil

In the Sheki-Zagatala region of Azerbaijan and in Georgia, people make preserves from immature walnuts, which they also sell at markets. Wood from the walnut tree, which polishes up beautifully, is highly prized in furniture-making, as well as for making gunstocks.

In the Southern Caucasus, the available genetic material is excellent, such as the many accessions that can be found in the collection established at the Zagatala Station of the Research Institute of Horticulture and Subtropical Crops in Azerbaijan. This legacy has never been exploited to its full potential; some seedlings have apical and lateral fruit production, and are resistant

to diseases. Furthermore, in Georgia, a study and collection of various types of walnut have been carried out by the Institute of Horticulture, Viticulture and Oenology in Tbilisi.

With regard to commercial standards set by world markets, varieties for selection should have fruits no smaller than 28 mm, with kernels of a light amber colour. These are rich in fats but have a flavour that is not too sharp. As for fruit-bearing characteristics, preference should be given to genotypes with lateral fruiting, with a good resistance to disease; in the forests of the three countries it is possible to find several genotypes with these features.



The hazelnut has a rich and diversified genetic heritage. Many varieties are studied at the Genetic Resources Institute in Baku and many wild forms are widespread throughout the Southern Caucasus

Hazelnut (*Corylus* spp.)

Armenian	<i>Tkbil, Pnduk</i>
Azeri	<i>Fyndig</i>
Georgian	<i>Tkbili</i>

This deciduous shrub is widespread throughout the Southern Caucasus, in both its cultivated and wild forms. The genus *Corylus* has a varied genetic patrimony, offering wide scope for cultivation. *Corylus* is one of the most ancient sources of nuts known to human beings. Indeed, it is widely held to have been the first species of shrub to emerge after the last Ice Age, helped by its considerable capacity to establish itself in different environmental conditions – so much so that it is often used to anchor soils in areas prone to erosion. Varieties found in the Southern Caucasus include several types that produce few suckers and could therefore be used to produce single-trunk trees, a feature that would be highly attractive for production purposes.

The absence of suckers could lower maintenance costs and make mechanical harvesting easier.

In Georgia, the endemic varieties *Corylus colchica* Abb. and *C. imeretica* Kemular Nat. enabled P.M. Zhukovsky to consider the Southern Caucasus one of the centres of origin of the genus. Hazelnuts have the advantages of being easy to transport and keep for long periods. The hazelnut has one of the highest fat contents of any fruits, they can be either eaten fresh or toasted and, in some cases, as in the preparation of cosmetics, they can be used while still unripe. They have a high nutritional value and are extensively used in cakes and biscuits, and for the preparation of poultry and vegetable dishes. There are also genotypes with unusual traits, such as red fruits or, like the cultivar *Badam*, a nut in the shape of an almond. Both features make them suitable for niche markets.



The almond is one of the world's oldest nut crops and is an essential component of a healthy diet. It has a high content of healthy fats, vitamins E and B2, magnesium and potassium

Almond (*Amygdalus* spp.)

Armenian	<i>Nush, Badam</i>
Azeri	<i>Badam</i>
Georgian	<i>Nushi</i>

The almond is a drupaceous tree and is generally the first to blossom: a genetic characteristic that has aesthetic advantages, but that is a serious drawback from an agronomic point of view since it restricts cultivation to those varieties that flower late and are therefore not at risk from spring frosts. In order to tackle this problem, a number of late-flowering genotypes have been selected locally, although the quality of the almonds cannot compete with that of Californian almonds, which are the benchmark for international marketing. Three almond species are found in Azerbaijan, the common almond (*Amygdalus communis* L.), the mountain almond (*A. fenzliana* Fritch. Lipsky) and the Nair almond (*A. nairica* Fed. et Takht.), which are widespread naturally. The village of Badamli, Nakhchivan, bears evidence of long cultivation of almonds. By using this gene pool, the local population has selected almond accessions with valuable agronomic indicators through folk selection methods and has cultivated these almonds in their households.

The application of traditional selection methods has resulted in the emergence of high-quality almond varieties such as *Saray*, *Apsheron*, *Shabbuz* and *Novrasta*.

The almond has two clear advantages over many other types of fruit – it keeps for long periods and is easily transportable. In the Southern Caucasus, growers have also developed numerous ways of exploiting its suitability for processing, especially in confectionery. Two almond species, *A. fenzliana* Fritch. and *A. georgica* Desf., could have value as dwarfing rootstocks for other drupaceous species.

Fig (*Ficus* spp.)

Armenian	<i>Tuz</i>
Azeri	<i>Enjir</i>
Georgian	<i>Leghvi</i>

The genus *Ficus* includes some 1 000 species, most of which are evergreen. In subtropical climates, a few deciduous species exist, among which the edible *F. carica* L., found throughout the Caucasus as the following types:



Fresh figs contain up to 25 percent sugar, mainly fructose and glucose, which is easily assimilated by humans

- ❁ *Ficus carica silvestris*, or wild fig tree, that can be used as a pollinizer;
- ❁ *F. carica hortensis*, which does not require pollination, since it has partenocarpic fruits;
- ❁ *F. carica smirniaca*, which requires pollination in order to bear fruit;
- ❁ *F. carica intermedia*, whose flowers produce fruit without pollination if they are formed on branches from the previous year. Those formed on branches of the current year need pollination if they are to bear fruit.

The process of producing fruit is extremely complex and involves a small insect, called *Blastophaga psenes* L., measuring 2.5 mm, which lives in the fruit of the wild fig tree. The male insect, which is wingless, fertilizes the female – which is larger, black in colour and has wings – before dying. As the fertilized female insects swarm, and leave the fruit – the first of the two fruitings that occur each year in the wild fig tree – they become covered with pollen.

The females then transfer the pollen to the flowers of the female fig, where they lay their eggs. Here, brushing against the style of the gynaecium, they pollinate the tree.

The flowers that give rise to the first production of figs bloom in May and the fruit ripens in July (the early harvest crop called “Breba”). The flowers that produce the second crop of figs form in July, with the fruit ripening in September. The flowers producing the next set of fruit form in September, with the fruit ripening in May of the following year.

Fresh figs contain up to 25 percent sugar, while the figure may be as high as 75 percent in the case of dried figs. Around 90 percent of the sugars are made up of fructose and glucose, two glucides that are easily assimilated by the human organism. The fruit is rich in P, Fe, Mg and Cu, thiamine (vitamin B1), riboflavin (vitamin B2) and carotene (vitamin A). The fig is a hardy tree that thrives even in conditions of dry heat, although it does not easily tolerate excessively wet conditions and cannot survive at temperatures lower than -17°C . The form of the tree changes according to the conditions – it may grow as a shrub, with several trunks, or as a tree, with a single trunk and several branches. It is an easy species to propagate, either by suckers, by cutting or by grafting. Propagating by seed is also simple, but in this case the genetic characteristics of the mother plant are not passed on.



Pear (*Pyrus* spp.)

Armenian	<i>Tandzeni, Tandz, Panta</i>
Azeri	<i>Armud</i>
Georgian	<i>Mskhali, Panta Mskhali</i> (wild)

Vavilov indicated three centres of diversification of the cultivated pear, divided by geographic area: China, Central Asia (including northern India, Afghanistan, Tajikistan, Uzbekistan and West Kiamscian) and the Southern Caucasus. The most common species of *Pyrus* that can be found here are:

- ✿ *P. communis* L.: the tree grows up to 20 m. Wide pyramid-shape, with or without thorns. Long-living. Small, oval leaves. Flesh is sharp and acid.
- ✿ *P. caucasica* Fed.: the tree grows up to 25 m; long-living. Round to oval leaves and roundish fruit. Flesh is sharp and acid. Prefers sunny zones.
- ✿ *P. salicifolia* Pall.: the tree grows to between 8 and 10 m, is resistant to cold, droughts, saline or rocky soils. Lanceolate, hairy, silvery leaves. Flesh has fibrous glomerules. Used as rootstock.
- ✿ *P. siriaca* Boiss.: large tree (10 m), pyramid-shaped. Fruit is classic pear shape.



Pear wood is highly prized and is used to make tools, instruments and furniture. This has caused the genetic erosion of giant centenary pear trees, making it increasingly difficult to find them.

<<Left: a 150-year-old pear tree



Pears were already widely cultivated by ancient civilizations and today many cultivated and wild pear varieties can still be found in the Southern Caucasus

In Armenia, pear trees are less cold resistant than other species, such as apples, and are cultivated mainly in the Ararat Valley. Soil type plays a decisive role since many parts of the country have calcareous-clay soils, making the pear vulnerable to chlorosis. Varieties of pear found in Armenia have the same origin as those grown in Azerbaijan and Georgia. They are divided into three groups.

- ❁ The first group consists of long-established pear varieties that ripen in summer. They are propagated by suckers and produce a small fruit, similar to that of the wild pear tree, with a very sweet, aromatic flesh that is well suited to drying. This type of pear is called *Panta* or *Amarva tandz*, meaning “summer pear”, or *Katuk tandz*, meaning “pear that falls”. The latter name comes from the Kafan region where trees grow

so tall – up to 20 m – that the fruit cannot be reached and harvesting has to wait until the pears drop to the ground. Another local name is *Megra tandz*, meaning “honey-tasting”, a clear reference to the fruit’s very sweet flavour.

- ❁ The second group covers varieties of pear that ripen in autumn or winter. They have coarse, juicy flesh with a slightly acid taste and a large number of sclereids. The trees are vigorous and have good resistance to disease and aphids, but they are vulnerable to attacks by *Septoria piricola*. This group includes several Armenian varieties, such as *Dzmer nuk*, *Kaghani tandz* and *Isha tandz*, as well as varieties from Azerbaijan, such as *Nar Armudi*, and from Georgia, such as *Khechchuri*. It is believed that the group, which is typical of the Southern Caucasus area, is derived from the Chinese pear and is a hybrid of *P. salicifolia* Pall. x *P. communis* L.

✿ The third group comprises varieties of pear that are recognizable from certain characteristics, including the thickness of the leaves and the shape and flavour of the fruit. They are generally small trees, with thin leaves and fruit that ripens in summer or early autumn. The flesh is soft, aromatic and juicy, with a sweet-sour taste. Among cultivars belonging to this group are *Malacha*, *Adriani*, *Sini*, *Emsba*, *Eghvard tandz*, *Gulab* and *Nanaziri*.

Only two of the 18 species growing in Azerbaijan are cultivated: *P. communis* L. and *P. serotina* Rehd in the Sheki-Zagatala and Quba-Khachmaz regions; 14 wild forms and over 170 local varieties have been found that have not yet been described in the literature. *P. salicifolia* Pall can grow in very arid and stony terrains where no other tree can flourish.

Over centuries, the local population has selected different pear forms from forests for their distinguishable characteristics and cultivated them in their households, which resulted in the emergence of hundreds of local pear varieties. According to the academician Ahmad Rajabli, once there were more than 400 folk selection varieties of pear in Azerbaijan, half of which are under threat of disappearance. But, in spite of this, one can still find undocumented forms in forests and households.

Pears have been cultivated in Georgia for centuries. Even today, ancient pear trees can be found, belonging to the old and popular *Panta mskhali* local variety. Pears were widely used by a variety of ancient civilizations. The ancient Greeks had advanced knowledge of the fruit and of growing techniques. They knew about seed propagation and rootstocks and used various methods to fight parasites. They also understood the importance of cross-pollination for improving production and adopted techniques to bring forward the tree's fruiting period.

One such practice involved driving a stake into the trunk, in order to weaken the tree and force it to bear fruit more quickly.

Among the varieties found in the Southern Caucasus, some are resistant to scabies, one of the most dangerous parasites, and to the dreaded fire blight (*Erwinia amylovora*), and they could be used in programmes of genetic improvement of European pear varieties. Some pear genotypes – among them the variety *Buldurcimbudu* (meaning “quail thigh” in Azeri) – have dwarfing characteristics. Thus far, the challenge of dwarfing pear trees has only been tackled by using quince trees as a rootstock, in order to reduce the pear's vigour. Finally, several pear varieties are valuable for their large fruit and good flavour, such as the *Kban armudu* pear variety observed in the farmholding of Zulfugar.

Quince (*Cydonia oblonga* Mill.)

Armenian	<i>Serkevil</i>
Azeri	<i>Heyva</i>
Georgian	<i>Komsbi, Bia</i>

The quince is a small deciduous tree, many varieties of which can be found in the Southern Caucasus. It is highly resistant to low temperatures and is propagated either by suckers or by grafting. Some varieties bear fruits that can be eaten fresh and others have fruits that can keep for long periods. Other varieties are suitable for processing, while some are valuable for their resistance to diseases. This genetic material, after testing to ensure grafting compatibility, could be useful as rootstock for pear trees.

The quince, in fact, as pear rootstock reduces the plant size and improves the fruit taste. If such tests prove positive, the nursery sector could derive significant benefits. Some quince varieties grow on soils with an active limestone level of over 5 percent, without symptoms of chlorosis, a characteristic rarely found in the current selection of quince rootstocks available in European nurseries. These Caucasian quinces, if positively tested for pear grafting compatibility, could contribute to the development of pear orchards also on limestone soils.



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1: *Amygdalus communis*, 2: *Juglans regia*, 3: *Cucurbita pepo*, 4: *Hippophae rhamnoides*, 5: *Punica granatum*, 6: *Malus orientalis*, 7: *Prunus divaricata*, 8: *Castanea sativa*, 9: *Rubus idaeus* [Source: ТРОССГЕЙМ, А.А. 1952. РАСТИТЕЛЬНЫЕ БОГАТСТВА КАВКАЗА. МОСКОВСКОЕ ОБЩЕСТВО ИСПЫТАТЕЛЕЙ ПРИРОДЫ. МОСКВА.]



THE ORIGIN OF LEGUME-GROWING PRACTICES

Pulses have been discovered in many archaeological sites where cereal remains were found. The association of legumes with the chaff of domesticated cereals assumes the synchronous development of cultivation between legumes and cereals. Legume plants (family Fabaceae) are particularly adapted to withstand seasonal climatic fluctuations and demonstrate a high degree of adaptability. They have hypogeal germination that protects seedlings from frost, wind, insects and grazing damage. Thanks to their tolerance, grain legumes survived major climatic changes at the end of the Pliocene and were available for collection by humans.

Legumes are generally high in protein and carbohydrate content. Some of them are easily assimilated while others are less palatable and need to be cooked before becoming edible. Their importance in the diets of people in the Southern Caucasus is witnessed by the large variety of legume-based dishes in the traditional cuisine and by the many cultivated forms that can be found in gardens.

In addition to their importance for balanced human diets, grain and forage legumes fix atmospheric nitrogen (N) through soil bacteria (*rhizobia*) contained in nodules on their roots. The N is used by the plant to grow and is also transferred to subsequent crops, increasing their yields. Legumes contribute to improving physical and chemical soil properties and are therefore essential elements of sustainable agriculture production systems. A progressive shift from N fertilizers to N-fixing legumes would seem to be highly desirable in the context of the increasing prices of fossil fuels and mineral fertilizers, and to reduce emissions from the agriculture sector.



It has been estimated that, globally, current biological nitrogen fixation (BNF) by crop legumes is 20 to 22 million tonnes of N each year and there is potential to increase this amount if relevant biological processes are promoted within legume-based production systems, either as green manure, planted in intercropping systems or as part of a scheme of crop rotation. This contribution has tremendous potential to sustain agriculture production systems in the future, contributing to more economically viable and environmentally friendly agriculture.

Pulses have been cultivated in the Southern Caucasus since time immemorial. Remains of mixed cereals and pulses have been found in many archaeological sites, confirming their synchronous development in the dawn of agriculture. Beans being sundried (above) <<Left: Gulperi Abdullazade with a dish of beans from her family garden in Yeniyol village



Legumes have the ability to fix atmospheric nitrogen, making the land fertile for the next crop and reducing the need for fertilizers. Vazhe and Vano Loladze of the Elkana NGO in their chickpea field, and a close-up of a chickpea plant. >>Right: immature green peas

Chickpea (*Cicer arietinum* L.)

Armenian	<i>Siser</i>
Azeri	<i>Nokbud</i>
Georgian	<i>Mukbudo</i>

Different geographic groups of cultivated chickpea species (*Cicer arietinum* L.) are found in the countries of the Southern Caucasus. A total of 51 subspecies of cultivated chickpeas are registered. In addition, there are dozens of ecotypes, which are characterized by the shape and colouring of the seeds. The shapes of chickpeas vary. In dry climate conditions, the seeds are usually angular with thick skins. In humid conditions, they are bean-like with thin skins.

The seed skin may be white, yellow, pink, brick-red, grey, brown, red-purple or multicoloured. There is a relationship between the flower colouring, shape and seeds. Local chickpea varieties are extremely diverse; most are endemic in the Southern Caucasus

and represent great value in terms of selection. Unfortunately, local varieties are rarely cultivated at present. Chickpeas have been used in cooking over the generations, for instance in *lablabi* (a well-known dessert) and in *dovga*, *dolma*, *bozbash* and *piti*.

Vetch (*Vicia* spp.)

Armenian	<i>Gjulul</i>
Azeri	<i>Larga, Cholnokbudu, Inek nokbudu</i>
Georgian	<i>Tsertsvela</i>

Vetch is a perennial, rarely annual, or biennial herbaceous plant. Most species are weeds and grow in fields under winter and spring crops. Some varieties, e.g. *Vicia sativa* (common vetch) and *V. villosa* (hairy vetch), may be cultivated as forage herbs in low mountain and foothill zones. Roots are spindly, and stalks are branchy, stagnant or unfolded and villous. Vetch blooms from June to July. The seeds are round. Vetch is a valuable forage crop, rich in proteins.



Green pea (*Pisum sativum* L.)

Armenian	<i>Volor</i>
Azeri	<i>Goy nokhud</i>
Georgian	<i>Mtsvane, Barda</i>

The Southern Caucasus is a centre of origin of the green pea. It grows mainly in subalpine zones. The *Pisum sativum* L. variety is cultivated. It has two subspecies: *sativum*, ordinary green pea, and *arvense*, field green pea. Many interesting old green pea varieties and populations exist in Armenia. For instance, in Salvard village, Sisian region, there are many local varieties with different morphological and biological characteristics. Wild species of these peas are of great interest and sometimes they are named as a separate variety, e.g. *P. arvense* L. (*P. sativum* conv. *speciosum* [Dierb.] Alef.) – green peas, field green peas, *gyulul*. Single green pea plants may be found in sown areas under local varieties of wheat and barley. They are currently cultivated less often, and thus may die out so it is important to protect them. They are characterized by the shape of their seeds and colour of the flowers, similar to the *Zangezour* local varieties of cultivated green peas.

Lentil (*Lens* spp.)

Armenian	<i>Vosp</i>
Azeri	<i>Marjimak, Marji</i>
Georgian	<i>Ospi, Ugrekbeli</i>

Lentils are cultivated almost exclusively in Azerbaijan (according to FAOSTAT, in 2008 Armenia produced 11 tonnes and Azerbaijan 1 900 tonnes), where they are one of the main traditional crops. The main species are *Lens culinaris* (food lentil, cultivated), *L. ervoides*, *L. orientalis* and *L. ervilia* (a French lentil). Numerous populations and local forms are specific to the southern Mugan region. A lentil with small seeds belonging to the *L. culinaris* species is widespread in the country. Some selection varieties are also available (such as *Azer* and *Arzu*). In the Southern Caucasus, lentils are mainly used in the Azeri cuisine. Local people in Azerbaijan make various dishes including soup, desserts, *dolma* and *plov* from lentils. The wild species is widespread in the low and medium mountain belts of the Caucasus range, Nakhchivan and the Talish regions in forests and shrubby lands on stony slopes and on rocks.



The rich diversity of legume species and varieties of the Southern Caucasus contributes to increasing soil fertility, regulating the variability of the climate and maintaining ecosystem functions



TABLE A



TABLE B



TABLE C



TABLE A: 1. *Pisum elatius* M.B. (Лерик в Тальше): 1a. – боб. – 2. *Cicer ervoides* (Sieb.) Fenzl (Каре). – 3. *Cicer anatolicum* Alef. (Ольты): – 4. *Vavilovia formosa* (Stev.) Fed. (хребет между Маднис-хеви и Эльбрусом): 4a –цветущая ветка. **TABLE B:** 1. *Hedysarum caucasicum* M.B. (Солух-даг в Дагестане): 1a – бобы.- 2. *Hedysarum formosum* Fisch. Et Mey. (Шорбулаг близ Еревана): 2a – бобы. **TABLE C:** 1. *Astragalus candolleanus* Boiss. (Ахура в Нахичеванской АССР). – 2. *Astragalus declinatus* Willd. (Пирдаудан): 2a – бобы. 3. *Astragalus cicer* L. (окр. Ставрополя). – 4. *Astragalus aureus* Willd. (Арагац). **TABLE D:** 1. *Ononis arvensis* L. (Гуниб.). – 2. *Cytisus caucasicus* Grossh. (Гагра Х Адлер): 2a – бобы- 3. *Teline monspessulana* (L.) Koch (Сочи). **TABLE E:** 1. *Gleditsia caspica* Dsf. (Ленкорань): 1a–боб. – 2. *Albizia julibrissin* Durazz. (Ленкорань): 2a – боб. **TABLE F:** 1. *Ornithopus compressus* L. (Келасури). – 2. *Glycyrrhiza glabra* L. (Тбилиси). – 3. *Glycyrrhiza echinata* L. (Майкоп). – 4. *Scorpiurus minima* A. Los. (Картмаши Х Х Карамарян). [Source: Grossheim, A.A. 1952. ФЛОРА КАВКАЗА, (Flora of the Caucasus). Vol. V-Rosaceae- Leguminosae. Moscow-Leningrad]

TABLE D



TABLE E



TABLE F





ARCHAEOLOGY OF LIVESTOCK KEEPING

Whether the spread of agropastoralism was a result of an increased number of hunter-gatherer groups or by farmers' colonization is uncertain. However, the integration of grain and livestock production in a system of mixed farming – in which cereals and pulses were grown in flatter, better-watered lowland soils and sheep and goats grazed and browsed on rougher upland terrain (whether locally or by means of seasonal transhumance) – proved to be effective, both ecologically and nutritionally, in sustaining the growing number of sedentary villages.

The bones of domestic cattle dating back to the fifth millennium BC were found during an archaeological dig in Georgia. Cattle domesticated from wild aurochs have served the Georgian people for more than 7 000 years.

Archaeological materials and ethnographic data provide evidence of sheep breeding and its role in the development of the Southern Caucasus. The oldest Kolkheti-Greek epos – the legend of the Argonauts and the Golden Fleece – might refer to the old tradition of using sheep skins to collect golden flecks in rivers.

Cattle breeding provided meat, milk, skins and draught power. According to archaeological data, butter was prepared in clay wares during the Neolithic. In the fourth century BC, Hippocrates described the Scythian practice of butter preparation in wooden wares. Butter was called *buttirons*. This name spread throughout Western Europe. A butter beater made not of wood, but of burnt clay, a better-quality material, was used in the early centuries and can occasionally still be found in some mountainous areas.



Sheep grazing in the Vorotan Valley, Syunik Marz, Armenia. The integration of grain and livestock production proved to be effective in sustaining the growing number of sedentary villages in the early stages of agricultural development. <<Left: Ilhama Abdulhamidova, in Kish, makes butter with a traditional churn. It is a long and tiring job: the churn must be pushed back and forth for about an hour in order to separate the butter from the buttermilk

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DIVERSIFICATION FOR ADAPTATION

SINCE THE NEOLITHIC, AGRICULTURE HAS BEEN BASED ON DIVERSIFICATION IN ORDER TO MAKE THE MOST EFFICIENT USE OF THE TEMPERATURE VARIATIONS, DIFFERENT TYPES OF SOIL, VARIOUS WATER SOURCES, AND VARIOUS SPECIES OF CROPS AND ANIMALS THAT EXIST IN NATURE AND IN ORDER TO PROVIDE BALANCED MIXED NUTRIENT ELEMENTS TO HUMANITY, INCLUDING ENERGY SOURCES, PROTEINS, VITAMINS, MINERAL SALTS AND FIBRES.

Diversification of agriculture and food production through landscape management enhances the resistance to pests and diseases, the maintenance of soil fertility and implies a reduced use of energy, among other features. Today, scientific evidence demonstrates that diversification contributes to increasing resilience to climatic and economic fluctuations that affect agricultural production and the billions of poor and rural populations depending upon it.

Yet diversification of crops and livestock is also important to avoid excessive food waste and to enable small farmers and their production capacity to reach the markets.

A larger, collective effort should go into promoting agricultural production and consumption habits based on diversification. Consumers are already requesting food more adapted to their health and lifestyles. They are increasingly paying attention to food that is produced according to seasonality, territoriality and quality requirements.

Farmers will need to readapt their crops and livestock to their territories, and provide a diversified, integrated and advantageous offer for the consumer. Local and national policy-makers will have to accompany this change and science and breeding activities will need to enlarge their programmes and provide new seed bases relying on the many seed and genetic resources that can sustain diversification of agriculture.

The Southern Caucasus with its genetic resources should be at the centre of this agricultural diversification process.



