

Country Pasture/Forage Resource Profiles

AZERBAIJAN



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CONTENTS

1. INTRODUCTION	5
2. SOILS AND TOPOGRAPHY	7
3. CLIMATE AND AGRO-ECOLOGICAL ZONES	7
Agriculture of natural economic regions	9
Soil and climatic conditions	9
4. RUMINANT LIVESTOCK PRODUCTION SYSTEMS	10
5. THE PASTURE RESOURCE	13
6. OPPORTUNITIES FOR IMPROVEMENT OF FODDER RESOURCES	16
7. RESEARCH AND DEVELOPMENT ORGANIZATIONS AND PERSONNEL	17
8. REFERENCES	17
9. CONTACTS	18

1. INTRODUCTION

Geographic location. Azerbaijan Republic is in the Southern Caucasus, between longitudes 44° and 52° E and latitudes 38° and 42° N. Its territory is 86 400 km². The country has a population of 8 000 000 (7 961 619 was the July 2006 estimate according to the World Factbook with a growth rate of 0.66%) and borders on the Russian Federation in the north (390 km), the Islamic Republic of Iran in the south (765 km), Turkey in the southwest (13 km), Armenia in the west (1 007 km) and the Georgian Republic in the northwest (480 km). Azerbaijan is on the western coast of the Caspian Sea with a coastline of 713 km and has been an important trade and transport point since the beginning of commerce along the Great Silk Road. Mountain Garabakh and the Nakhchivan Autonomous Republic are part of Azerbaijan (see Figure 1). Over half of its territory (59.9%) is mountains (foothills – 17.5%, mountains – 33%, and high mountains – 9.4%) and the rest (40.1%) plains and lowlands. Twenty-seven percent of the territory is above 1 000 m, but 18% is below the mean level of the world oceans.

The Major Caucasus, Minor Caucasus and Talish mountain ranges are rich in natural resources, covered with forests and meadows. The Kur-Araz lowland surrounded by these mountain ranges is the main area that provides the population with agricultural products. In addition there are four more plains: Gusar sloping plain on the northern slope of Major Caucasus, Samur-Davachi lowland, Nakhchivan plain along the Araz river, Absheron peninsula and Lankaran lowland in the foothills of Talish mountains. Details of the land resources of Azerbaijan are given in Table 1.

Crops. Agriculture is the traditional production sector in Azerbaijan, which is among the countries where crops and nomadic cattle husbandry first developed. Archaeological excavations show that cereals were grown in Azerbaijan 6 000–8 000 years BC. Crops are mainly irrigated though people grow rainfed cereals, potato and



Figure 1. Map of Azerbaijan

Table 1. Land resources of Azerbaijan

Indicators	Land resources, ha	Share, %
Total area	8 641 506	100.0
Cultivable lands	4 588 703	53.1
Lands that could be irrigated	3 200 000	37.0
Arable land	1 622 129	18.8
– out of which irrigated lands	1 097 169	12.7
Area under perennial crops	207 257	2.4
– out of which irrigated lands	150 071	1.7
Total irrigated lands*	1 437 694	16.6
Land per head (total)	1.08	-
– including per head arable land	0.20	-
Eroded land of total land resources	3 610 100	41.8
Including: – water erosion	2 972 400	34.4
– wind erosion	367 800	4.2
– Irrigation erosion	269 000	3.1
Irrigated lands subjected to salinization	611 800	7.1
Including: – weak salinization	426 869	4.9
– moderate salinization	129 997	1.5
– severe and very severe salinization	54 934	0.64
Arable land destroyed by contamination	25 000	0.29
Including: By oil and gas production	11 000	0.13
By building industry	5 340	0.06
By construction and waste disposal	1 800	0.02
By erosion and waterlogging	6 000	0.07

* Total irrigated lands also include irrigated meadows, pastures, rested lands and households.

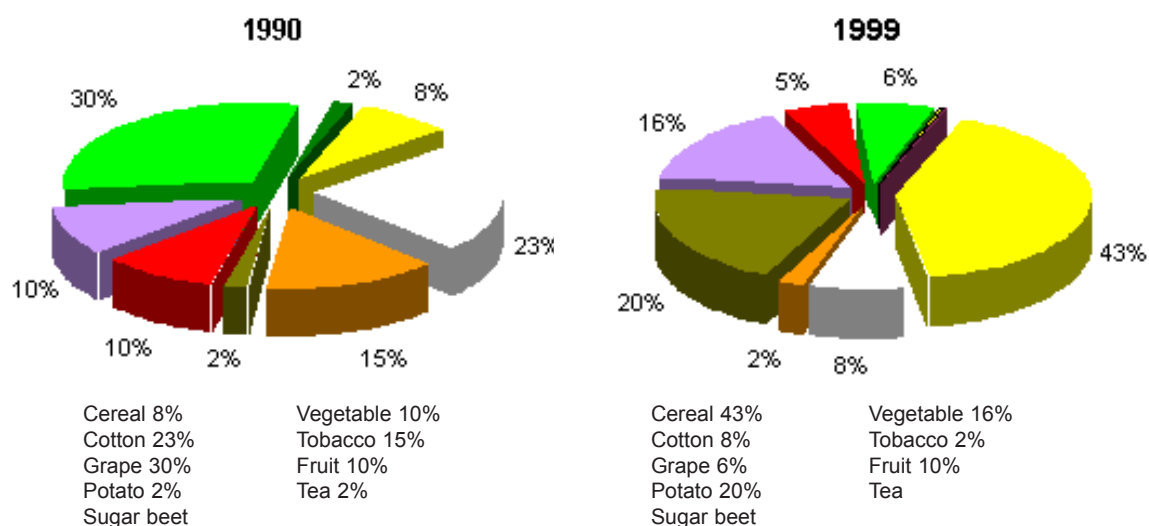


Figure 2. Production structure of crop products

sainfoin in mountains and foothills. More than half the population live in the countryside and agriculture has the largest share of employment. According to 1988 data, nearly 1 139 000 people are engaged in agriculture and forestry: 30.8% of employees in the country. A third of the population is directly engaged in agriculture.

Agriculture plays an important role in terms of gross domestic product (GDP). In 1999 the value of GDP was 16.5 trillion manat (USD93.77 billion) of which agriculture contributed 3.77 trillion manat (USD837 000 000) or 21.6%. The rate of growth of agriculture has been higher than that of other sectors of the economy. By 1998 real growth in the country's agriculture was 6.2%, but in 1999 it was 7.1%.

Azerbaijan has great potential opportunities and comparative advantages in producing traditional agricultural products. Favourable soil-climatic condition, relatively cheap labour and access to rail transport make the agrarian sector a major priority of the non-oil sector. Agriculture has two major parts – crops and livestock. In crop production, cereals, cotton, vegetables, potatoes, fruit, viticulture, tobacco and forage prevail (see Figure 2); in livestock production, cattle, sheep, horse, camel and poultry husbandry dominate.

Structure of total production. In 1999 the share of crops in agriculture was 60.9%, and livestock 39.1% (Figure 3). By comparison with 1990, the share of crops has decreased slightly by 2.6%, and the share of livestock has increased.

A major shift has taken place in the structure of crop products. The share of cereals has increased from 8.0% to 43.0%, that of potato from 2.0% to 20.0%, vegetables from 10.0% to 16.0%. In contrast the share of cotton has decreased nearly thrice, share of grape three times; that of fruit twice and the share of tobacco seven times. For the last ten years crop production has concentrated on cereals, potatoes and vegetables. Per capita wheat consumption is 150–200 kg. In some regions, lentil, chickpea and fodder, mostly lucerne, are important in production systems.

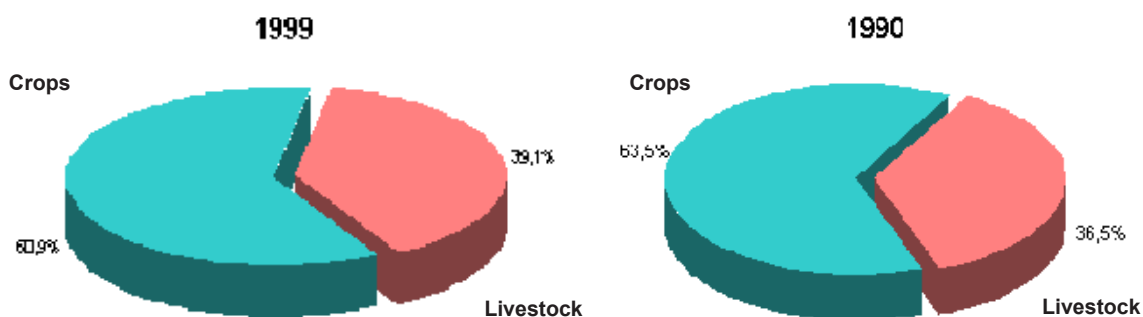


Figure 3. Production structure of agricultural products

2. SOILS AND TOPOGRAPHY

Almost all basic soil types (more than 22), from mountain-meadow soils of the Alpine belt to grey soils of semi-desert and desert areas and yellow soil of Lankaran, are found in Azerbaijan. This range of diversity was favoured by geological structure, relief, hydroclimate and diversity of plant cover.

In the high mountain zone, mountain-meadow and mountain-peaty steppe soils, mountain-meadow grey and mountain-meadow brown soils are widespread. In the medium mountain belt: mountain-meadow, mountain-forest grey, mountain-chernozemic, grey-chestnut, chestnut, brown soils and podzolized yellow soils released from forest and podzolized gley yellow soils are widespread. In the foothills alluvial-meadow, forest, and grey-meadow soils dominate. In plain and plain forest areas, plain-forest, grey, brown, meadow-salinized grey soils, boggy and sandy soils are widespread. Above 3 000 m there are precipices, glaciers, rocks and snow.

Cultivable area is 4 588 703 ha of which 1 437 694 are irrigated. Out of 1 622 129 ha cultivated land (sown), 1 097 169 are irrigated. Land under perennial crops makes up 173 570 ha, household plots 247 948 ha (of which nearly 100 000 ha are irrigated); the rest is fallow, meadow, natural pasture, forest and others.

Erosion damages mountain and foothill lands seriously: 3 610 100 ha (41.8%) of the country has been affected by erosion to a certain extent, including 48.6% of cultivated land and 20% of forests. A factor limiting crop development is salinity. Undeveloped land (salinized, swamp, badly eroded soils, stony river-bed, low and medium mountains, etc.) is 37.4% of the republic. Such a situation may cause shortage in water resources, worsening of climate, desertification of arid zones, and break of ecological balance. In recent years, soil fertility has been falling because of inappropriate cropping systems. Much crop land is on mountain slopes of 2°–12° even 15°. Therefore a wide range of crops are grown in conditions of vertical and horizontal land zonality.

Although the climate permits crop growth all the year round, only a little more than 51% of the land is suitable for agriculture. Crop production is not possible without irrigation as most of these soils belongs to arid and rainfed zones. Current water resources and their unequal distribution make it impossible to provide irrigation economically to many areas. More than 80% of agriculture is irrigated. Improper irrigation management and imperfections cause damage: 426 869 ha of irrigated lands have been exposed to mild salinization, 54 934 ha to serious and very serious salinization, while 2 484 ha of irrigated soils are medium or strongly solonetz-like soils.

Azerbaijan is in an arid zone and has the least home water resources of the Caucasian republics. Its per capita and per unit territory river water resources are accordingly 8.3 and 7.9 times less than those of Georgia. Distribution of streams by regions is unequal. For instance, there are 222–935 million m³ of superfluous water in Shaki-Zagatala, Nakhchivan and Lankaran natural-economic regions, but there are water shortages in Garabakh, Shirvan, along Kur and other regions.

The total stream capacity of Azerbaijan rivers is 32.3 km³ per average year; 22 km³ of it (70%) enters the country from outside its borders (as transit). In dry (provided with 75%) and very dry (provided with 95%) years water capacity of the rivers is reduced 27.8 and 23.2 km³ accordingly, but stream capacity of transit rivers falls to 17.4 and 14.7 km³. Since in dry years water demand in such years is continuous, the water shortage is unavoidable. Water reservoirs are used to produce power to meet the growing demand for energy. The water supply to Kur-Araz lowland is regulated but irrigation water shortage is obvious. As a result of hydro-ecological zonation, 11 underground water resources were revealed in the country. Their operational capacity is 5.2 km³. If the water loss of these rivers is taken into account (in the capacity of 3.0–3.5 km³) then reserves of underground water makes up 8.0–9.0 km³. At present only a little more than 30% of this capacity is used.

3. CLIMATE AND AGRO-ECOLOGICAL ZONES

Climate. The climatic picture is complicated. Mountains occupy more than half of the country (58%); the rest is plains and flat lands (42%). Azerbaijan is surrounded by the Major Caucasus, Minor Caucasus

and Talish mountain ranges. The Kur-Araz lowland is surrounded by these ranges. In different parts of the country, the climate varies from arid to humid “subtropical”.

The lower mountains and foothills have sufficient moisture with the precipitation ranging between 500 and 800 mm. Heavy rains occur in the southwest where weather is under the influence of the Talish mountains and the Caspian Sea. Here, annual precipitation can be as high as 1 500 mm. In the Kur-Araz lowland and plains of Nakhchivan AR, annual precipitation ranges between 200 and 800 mm.

Mountains greatly affect the landscape of the country. The Major Caucasus prevents north winds, but Caucasus summer pasture and the Suram mountain chain in Georgia block the westerly air stream that brings wet weather. There is easy access of air only from the northwest, and from the east along the Urals, Siberia and from Central Asia. The impact of the Caspian Sea on climate is very weak as the weather moves from west to east and wet weather coming from the sea may be stopped by mountains. The climatic peculiarities of both the Caucasus and Central Asia are met in Azerbaijan.

Relief plays an important role in distribution of these peculiarities. Nine out of eleven world climate types occur in Azerbaijan. Absolute height ranges between 4 466 m above sea level and 26 m below sea level. The Caspian Sea and the Black Sea play a significant role in the climate of the region. Azerbaijan has a mild winter, average monthly temperatures only fall below zero in the mountains. In spring, a rise in temperature and length of the day is characteristic. This results in warmth of soil surface in early spring, especially in Kur-Araz lowland. Summers are hot and dry, with strong sunshine. In Absheron temperature ranges are between 23.4 and 25 °C. Summer is cool in the mountains of Lankaran zone, but hot in the plains. The hottest zone is the Kur-Araz lowland where temperatures range between 24.8 and 26.5 °C.

In Kur-Araz lowland and the Lankaran plain, average annual temperature is above 14 °C. In the mountains at 2 500 m the temperature goes down to 4.5–6.6 °C, but at 3 000 m it goes down to 0 °C. In plain areas and foothills the average January temperature rises above 0 °C, but sometimes falls to –10 °C. In the Lankaran plain it even falls to –8 ° to –10 °C; in the Major and Minor Caucasus at 2 000 m average January temperature is –5 °C, but at 3 000 m it is nearly –10 °C. The hottest months are July–August. Average July temperature in Kur-Araz lowland with its foothills, in west Absheron and in the foothills of Nakhchivan is 25–27 °C. At times temperatures reach 40–43 °C in these regions.

The duration of snow cover in the plains is limited, 10–15 days, at 1 400–1 500 m it is rather stable, but in high mountains it reaches to 50–100 days. Some precipitation falls as hail, which seriously damages cotton, orchards, tobacco, vineyards and other valuable crops. In spring, hail destroys cereals. There are often storms in the mountains (35–45 days a year), but seldom on the plains: 5–10 days. The winds are very variable and complicated. In the Absheron peninsula the north and south winds dominate. Wind speeds are not high with the exception of the Absheron peninsula.

Precipitation. The amount of precipitation ranges between 500 and 800 mm in mountains and foothills, which is considered sufficient moisture. Precipitation in the plains of Lankaran in the southeast of the republic reaches 1 500 mm under the influence of the Talish mountains and Caspian sea. Precipitation in Absheron peninsula, in the Kur-Araz lowlands and the plains of Nakhchivan AR ranges between 200–300 mm. In the Minor Caucasus precipitation ranges between 600 and 900 mm, but in the moderate mountain part of Major Caucasus it is between 600 and 1 200 mm. In high parts of Major Caucasus and in the central plain of Lankaran precipitation is 1 200 mm/year. Precipitation usually falls in the cold season. Most precipitation is in winter in Lankaran-Astara regions and is 2–5 times more than that of other regions.

Distribution of spring precipitation varies widely. Most spring rainfall is on the southern slope of the Major Caucasus: 250–370 mm. In other areas spring rainfall varies widely. In Lankaran precipitation in spring is two times less than what falls in winter. Summer rainfall tails off here far from the sea. Distribution of spring rainfall in Kur-Araz lowland is very complicated. In Gazakh-Ganja and Upper Garabakh region the rain in summer is 2–3 times more than in winter. In summer on the southern slope of the Major Caucasus there is twice as much rainfall than in winter. In Nakhchivan AR and on northeast slopes of Major Caucasus there is little difference between summer and winter precipitation. In summer the driest zone is the Absheron peninsula.

High autumn rainfall is observed in Astara and Lankaran regions. Distribution of autumn precipitation in Kur-Araz, Gazakh-Ganja, Upper Garabakh regions, in Nakhchivan AR and on the northeast slopes of

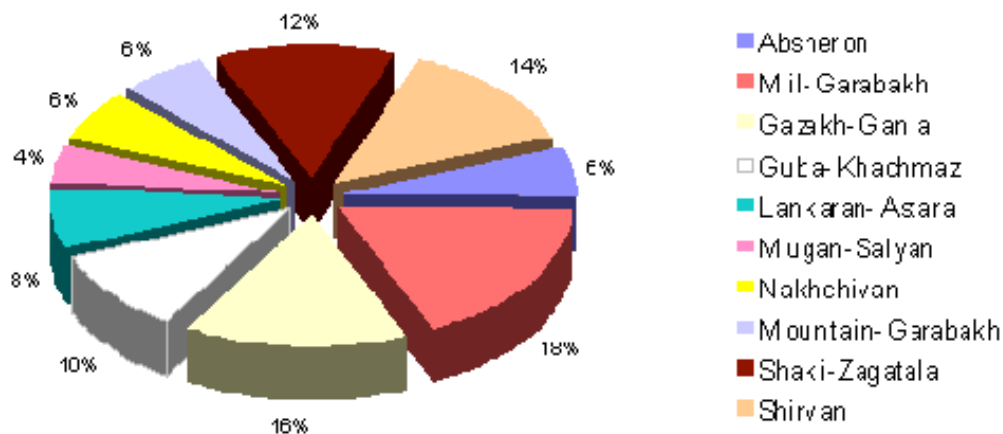


Figure 4. Share of natural economic regions in total land area

Major Caucasus differ slightly from each other. Autumn precipitation is sufficient on the southern slopes of the Major Caucasus.

Agriculture of natural economic regions

Taking into consideration natural-economic and soil-climatic factors, ten natural-economic regions were identified: Absheron, Mil-Garabagh, Ganja-Gazakh, Guba-Khachmaz, Lankaran-Astara, Mugan-Salyan, Nakhchvan, Mountain-Garabakh, Shaki-Zagatala, Shirvan (Figure 4)

Soil and climatic conditions

Absheron region is in the east of Azerbaijan. Total land area makes up 508 000 ha of which 7 800 ha are irrigated. Hot dry summers and mild winters characterize the climate of the Absheron peninsula. Annual temperature ranges between 10 and 14.5 °C. Average January temperature is between -1 °C and +5 °C, but that of July between 21 and 27 °C. The Absheron has a dry climate type. Average annual precipitation is 150–220 mm. As the peninsula is bounded by the Caspian Sea, average annual humidity is 70–80%.

Mil-Garabakh region has in total 1 472 400 ha land of which 214 600 (14.6%) are irrigated. It is in the “subtropical” zone. Average annual precipitation is 200–400 mm, but in mountains it reaches 600 mm. Average annual temperature is 13–14 °C. In general chestnut, grey-meadow and meadow-grey soils occupy a large area here.

Gazakh-Ganja region, in the west of the country, has a dry, warm climate in the plains, temperate-warm and steppe-dry winter climate type in the lowland. In the mountain area the climate is cold and humid. Average annual temperature is 11.8–13.0 °C. Average annual precipitation ranges between 250 and 300 mm. Chestnut, light and dark chestnut soil types prevail in the zone. More than 2 700 ha of land are severely salinized. Total land area is 1 290 000 ha of which 100 000 are irrigated.

Guba-Khachmaz region in the northeast covers 832 000 ha of which 131 400 (15.8%) are irrigated. The region has five districts of which 2 900 (10.3%) ha are severely salinized. Precipitation ranges between 350 and 500 mm during the year. Average annual temperature is 10–12 °C. Steppe brown forest soils, alluvial, grey-brown and chestnut soils are widespread. Alluvial-meadow and meadow-forest soils may be found along the coast.

Lankaran-Astara region covers 639 000 ha. It has dry, hot summers, and wet, temperate winters. Its climate is close to wet “subtropical”. The Talish mountains cause the increase of precipitation and a shortening of the dry period. Average annual precipitation reaches 1 300 mm. Average annual temperature is 14.4 °C; in summer average temperature is nearly 26 °C. Seasonal distribution of precipitation by seasons is not equal. Mainly yellow soils and some meadow-boggy and loamy-boggy soil types are widespread in the zone.

Mugan-Salyan region covers five districts. Its area is 6 124 000 ha of which 182 600 ha (3.0%) are irrigated; 5 500 ha are strongly salinated soils. Basically grey soils, grey-meadow and chestnut soil types and their varieties are found in the region. Average annual temperature is 14–15 °C. Annual precipitation ranges between 180 and 220 mm.

Nakhchivan region covers the territory of Nakhchivan Autonomous Republic; its area is 537 000 ha. Chestnut, grey and grey-brown soils are widespread. A severe continental climate is characteristic here. Average annual temperature is 13 °C–14 °C. Precipitation reaches 300 mm in the lowlands, but 600 mm in the mountains. Crops are generally irrigated.

Shaki-Zagatala region is to the north of the country on the southern slopes of Major Caucasus. The climate is temperate and belongs to the wet “subtropical” climate type. Rainfed agriculture prevails. Average annual precipitation is 600–700 mm. In high mountains it reaches to 900 mm. Average annual temperature ranges between 10.5 and 12.6 °C. Total land area of the region is 1 039 000 ha of which 66 700 (6.4%) are partly irrigated. Forest-meadow, alluvial-meadow and meadow-garden soils are widespread here. Strongly salinized soils make up 300 ha.

Shirvan region is divided into mountain and plain areas; its area is 1 134 000 ha of which 174 600 ha (15.4%) are irrigated. The climate is dry hot – dry-“subtropical” climate. Average annual temperature is 14–14.5 °C. July temperature reaches to 38–40 °C. Precipitation ranges between 220–240 mm per year.

Mountain Garabakh covers 496 000 ha of which 8 500 are irrigated. Average annual temperature is 10 °C; sometimes it falls to –12 °C. Annual precipitation reaches 600 mm in the mountains but 400–450 mm in the plains. Basically grey-brown, chestnut, light-chestnut soil types and their varieties are widespread here. Washed-out and erodible soils are also found.

4. RUMINANT LIVESTOCK PRODUCTION SYSTEMS

Livestock production occupies second place in the country. Its history dates to ancient times. In all regions of Azerbaijan cattle are very important for meat and milk; they are no longer used for draught. All farmers keep at least one or two cows for subsistence dairy products, but richer farmers own more.

As a result of agrarian reforms the livestock husbandry has been fully privatized; only an insignificant part of cattle is maintained in the 21 state breeding farms (Table 2). Transfer to the private sector produced a rapid increase in cattle numbers. In 1999 cattle numbers reached 1 883 300 head (local data, FAOSTAT figure 1 621 100) increasing by 60% and number of sheep and goats to 5 143 300 head (local data, FAOSTAT figure 5 511 900) increasing by 2.1 times compared with 1995 when reforms began. Animal husbandry is now entirely at household level. Some of the origins of the problems the sector faces relate to this.

Keeping a few cattle in small holdings impedes the introduction of complex technological processes. Animal feeding, milking, slaughter, breeding and veterinary services are undertaken individually. In the time of the former USSR, animal husbandry was mainly in industrial livestock complexes created in the composition of kolkhozes and sovkhoses and skilled specialists were engaged in the sector (Table 3).

As Table 3 shows, stock numbers increased and decreased from time to time from 1990 to 2005, but starting from the years when agrarian reforms were initiated the number of horned cattle and small ruminants began to increase because of privatization and transition to market economy. Decrease in pig numbers was because local people do not eat pork. Production and selling of milk and dairy products is common in all regions especially in Absheron where

Table 2. Number of animals in 2001 (thousand)

	Cattle and buffaloes	Cows and buffaloes	Sheep and goats
Combined	2 021.6	1 300.4	6 085.7
State farms	18.1	6.4	262.1
Private farms and peasants	2 003.5	1 294.0	5 823.6

Table 3. Number of livestock by year (,000) for selected years 1990–2005

Years	Cattle	Buffaloes	Total	Of which			Sheep	Goats	Pigs	Poultry
				Cows	Dairy buffaloes	Total				
1990	1 615.4	300.1	1 915.5	603.4	112.9	716.3	5 315.2	198.4	202.1	30 343.2
1995	1 340.9	291.9	1 632.8	742.5	122.9	865.4	4 373.1	184.5	33.4	14 418
1996	1 383.7	298.0	1 681.7	772.5	128.0	900.5	4 434.3	210.1	30.4	13 333
1997	1 477.9	302.0	1 779.9	822.7	134.9	957.6	4 648.3	273.8	23.4	13 231
1998	1 550.2	293.3	1 843.5	895.0	135.5	1 030.5	4 896.1	370.9	21.0	14 741
1999	1 621.1	292.1	1 913.2	925.8	135.0	1 060.8	5 102.8	409.1	26.1	13 874
2000	1 664.4	297.0	1 961.4	958.9	139.2	1 098.1	5 279.7	494.2	19.7	14 711
2001	1 722.9	298.7	2 021.6	1 001.7	n.r.	n.r.	5 553.1	532.6	18.6	14 740
2002	1 794.3	303.6	2 097.9	1 001.7	n.r.	n.r.	6 002.9	556.0	16.9	15 351
2003	1 872.2	306.4	2 178.6	1 042.3	n.r.	n.r.	6 392.5	594.0	19.8	17 138
2004	1 934.4	307.4	2 241.8	1 057.7	n.r.	n.r.	6 676.0	604.1	20.4	17 545
2005	2 007.2	308.6	2 315.8	1 117.0	n.r.	n.r.	6 887.4	601.4	22.9	18 253

n.r. = no record. Source: FAOSTAT 2006.

the city of Baku is located. Most families earn their living by selling live animals, meat, milk and dairy products.

Milk production is a priority for home consumption. Farmers have a strong interest to increase milk production and sell dairy products. All milk-processing factories stopped operating after reforms in agriculture. Marketing of animal and dairy products is a cardinal problem.

There are no great differences in the management of cattle. In mountains and foothill regions all animals including dry cows, milking cows and young stock are usually taken to the mountain slopes and hills to graze in summer. In the plains animals are taken to river banks or crop stubbles and fallows. In winter animals are kept indoors, stall-fed and watered.

In the Absheron peninsula cows are often kept in the yards as there is no natural pasture. In the central plain cattle herds move to high pastures in summer. Unfortunately most pastures were occupied by Armenian invaders as a result of conflict around Mt Garabagh.

Lucerne is an important fodder in irrigated plains. There fresh lucerne is given to the stall-fed cows several times a day. Feeding cows intensively with fresh lucerne may cause bloat so to avoid this lucerne is wilted. In mountains and foothills, hay from natural grass is an important source of winter-feed, with sainfoin or lucerne. Maize stalks have only regional importance; cereal straw is used for feed and bedding. Farmers try to collect enough fodder, especially in mountains where winter is long. Large stacks of hay are stored in barns, in yards or on top of cattle houses and covered with polyethylene. Milking cows usually get concentrated feed, cotton seed cake, maize or barley in winter.

All cattle including milking cows, young stock, bulls and dry cows are herded together and natural mating takes place on the pastures. This method provides the greatest chance for cows to become pregnant but also causes degeneration. In the past artificial insemination was widely used. Finding breeding bulls for mating is not a problem. Bulls available in villages are used for mating; owners do not charge a fee. Housing condition varies depending on farmers' condition. On hot days cattle are kept inside to protect them from heat.

The types of byre varies in different regions according to availability of space and quality of ventilation and lightning. Manure is collected, dried as bricks and used for fuel where people have no access to natural gas. Most farmers use manure as fertilizer.

Small ruminants All small ruminants are owned by villagers. Most of the farmers keep 15–20 or more sheep. Large owners keep 200–500 and employ a shepherd, or family members take the sheep for grazing. Sheep are predominant, goats make up 1–2% of flocks. In some villages, especially in the mountains, small ruminants are herded in joint village flocks.

In early summer flocks used to leave the hot lowlands for the better grazing and cooler highlands. Unfortunately most summer pastures are now under occupation, so sheep owners cannot take their flocks to summer pastures. Flocks taken to summer pastures of Major Caucasus Mountain (northeast of the country) return to lowland in autumn. In summer pastures, better grazing and cool weather contributes

to increased weight gain. Important summer pastures are in the Major and Minor Caucasus Mountains. Large owners keep adult and young stocks in different flocks and farmers separate rams from ewes until the mating season.

In winter small ruminants are housed at night to protect them from cold and wolves. This tradition is especially common for farmers in mountain regions. During this period flocks are taken to graze on southern slopes and are given supplementary feed such as dried hay or coarse fodder. Rams for slaughter are kept separately and intensively fed with barley and concentrates.

Milking sheep is a common practice; it starts two or three weeks after lambing and continues for four–five months. Lambs are allowed to suck twice daily, then once a day. Farmers make various dairy products, like cheese, yoghurt, gurut (dried whey) and butter. Most dairy products are consumed domestically, but large owners sell some. Milk production ranges from 0.4 to 0.5 litre per ewe per day. Sheep are shorn once or twice a year depending on tradition and regions. Average wool production per ewe is 2.5–3.0 kg. Most farmers own 20–25 sheep and keep one or two stud rams. Surplus males are usually castrated. Animals are sold all year round in case of need for cash. During “Gurban bayrami” there is a mass slaughter. Goats have regional importance where farmers have no access to pastures. Goats never make up the majority in the flocks. Farmers shear goats in spring and make “palas” (a type of hand-made carpet).

Average size of flocks consists of 500 or 600 ewes. The main source of feed is grazing natural pastures. Villagers keep various sheep breeds depending on climate. Most widespread local sheep breeds are “Azerbaijan mountain merino” mutton-wool sheep, “Garabagh” sheep, “Balbas” sheep, “Bozakg” sheep and “Gala” fat-tail wool-mutton sheep. “Gala” sheep predominate in Absheron peninsula, but “Balbas” sheep are widespread in Nakhchivan Autonomous Republic.

Equines. Draught oxen and horses were used for field work before crop production was mechanized in the 1950s. Equines are still, however, used as transport by farmers. Horse and donkey carts are used for carrying wood and hay on the plains and for travelling to distant fields. Farmers who take their flocks to summer and winter pastures depend on equines. Currently there are about 60 800 in the country.

Sheep are usually grazed all years round. Only in winter (90 days) 0.5 kg barley per sheep is given as supplementary feed. In regions with severe winter, besides that 2 kg dried hay is given. This is common for villagers in high mountain zones. During this period per sheep fodder requirement makes up 45 kg barley and 100 kg dried hay. In the central plains where farmers grow cotton, cotton seed cake for sheep

Table 4. Production of main livestock products (1 000 tonnes) for selected years 1990–2005

Years	Meat-total (carcass)	Of which				Milk-total	Of which		Eggs, Mln unit	Wool, greasy weight
		Beef and veal	Mutton and goat	Pork	Poultry meat		Cows and buffaloes	Sheep and goats		
1990	175.5	73.9	35.4	12.6	53.6	970.4	953.9	16.5	985.3	11.2
1995	80.6	41.2	23.0	2.1	14.3	826.5	820.7	5.8	455.8	9.0
1996	85.7	43.6	25.6	1.7	14.9	843.3	829.4	13.9	477.3	9.1
1997	90.5	48.4	25.8	1.6	14.7	881.5	867.7	13.8	492.4	9.6
1998	99.9	50.0	32.1	1.3	16.5	946.5	931.4	15.1	509.0	10.3
1999	104.6	52.0	34.8	1.5	16.3	993.4	977.2	16.2	526.3	10.5
2000	108.7	55.5	35.1	1.0	17.2	1 031.1	1 013.8	17.3	542.6	10.9
2001	114.1	57.2	36.8	1.1	19.1	1 073.7	1 054.9	18.8	n.r.	11.6
2002	124.6	62.6	37.5	1.3	23.2	1 119.8	1 099.7	20.1	n.r.	11.8
2003	134.4	66.6	39.2	1.5	27.1	1 167.8	1 147.0	23.4	n.r.	12.1
2004	143.7	69.1	40.7	1.6	32.2	1 213.6	1 188.6	25.1	n.r.	12.3
2005	149.4	71.8	42.3	1.7	33.6	1 252.3	1 226.7	25.6	n.r.	13.0

n.r. = no record. Source: FAOSTAT 2006.

Table 5. Meat and milk imports for selected years 1985–2004

Item	1985	1990	1992	1995	1996	2000	2001	2002	2003	2004
Cattle imports (head)	n.r.	n.r.	0	0	0	0	208	3 010	5 701	2 230
Total meat imports (,000 mt)	n.r.	n.r.	23.5	24.8	42.6	22.8	12.4	7.7	10.5	8.9
Milk equivalent imports (,000 mt)	n.r.	n.r.	86.8	109.2	159.4	49.1	63.3	102.0	113.4	111.9

n.r. = no record. Source: FAOSTAT 2006.

is widely fed in winter. Most cattle and sheep are fed green forage or dried hay, including lucerne, sainfoin or natural grasses. At present a further substantial increase of feed production has to come from the arable land or through increase in the productivity of pastures. In spite of the above-mentioned limiting factors, since 1996 a substantial increase of animal products has been observed (Table 4). Imports of meat and meat products and milk and dairy products have decreased compared to 1996, although the number of live cattle has increased (probably for breeding purposes) and milk equivalent imports have been running at over 100 000 tonnes since 2002 (Table 5).

5. THE PASTURE RESOURCE

Pastures and meadows satisfy two-thirds of total fodder requirement of livestock and are the cheapest fodder base in the republic. Winter and summer pastures cover 2 000 000 ha mainly in Kur-Araz lowland, Gobustan, Jeyranchol, Ajinohur mass, Alpine and Subalpine meadows of Major and Minor Caucasus, in the mountain zone of Nakhchivan Autonomous Republic and partly in Talish mountain. Table 6 provides detailed information on pasture fields available in the republic

Table 6. Pasture areas (1 000 ha)

Pastures and meadows total	Including pastures		Of which			
	Total	Suitable	Winter pastures		Summer pastures	
			Total	Suitable	Total	Suitable
2 500	2 384	1 804	1 780	1 400	604	404

[Note: the 116 000 ha difference between 2 500 000 and 2 384 000 are meadows]

Winter pastures are an indispensable, cheap fodder resource for nomadic cattle and sheep. Winter pastures in the republic are desert, semi-desert and field vegetation. Soils under these types of plants were formed in various regimes of moisture and salinization. Winter pastures below sea level and 100–150 m above it represent mainly brown- grey soils of various salinity, but for foothill pastures (150–200 m) chestnut soils and soil types are typical. Sandy soils spread along the coastal area.

The above mentioned pastures represent characteristic and zonal types of vegetation like fringo (*Artemisia fragrans*) or fringo-thistle formations (*Artemisia fragrans-Salsola nodulosa*). The rest of the species or their conenoses are met locally inside zonal types. Fodder value of vegetation formations of winter pastures is characterized by edible parts of perennial plants grazed by cattle as well as ephemers and ephemeroïds. Grazing period of winter pastures is 180–200 days from October till April–May. In wet spring months productivity of pastures reaches 1–1.2 tonnes/ha for dried hay. In foothills where chestnut and sodic soils with rocky-loamy mechanical composition prevail, one can meet various steppe and dry steppe associations and motley grasses of cereals. Some of them that predominate are: *Bothriochloa ischaemum*, *Agropyron cristatum*, *Tragopogon orientalis*, *Stipa capillata*, *Stipa szowitsiana*, *Festuca sulcata*, *Agropyron desertorum*, *Kochia postrata*, *Poa bulbosa*, *Poa pratense* and many others. Co-dominants are: *Artemisia fragrans*, *Onobrychis transcaucasica*, *Onobrychis cyri*, *Achillea millefolium*, species of *Thymus*, *Salvia*, *Astragalus*, *Hedysarum*, *Medicago*, *Galium* and other steppe species. Although winter pastures are very important, no fundamental measure has been taken to improve and use them rationally.

Summer pastures are found in Major and Minor Caucasus in Nakhchivan AR as well as in the South of the republic in Talish mountains from 1 600–2 800 m up to 3 000–3 500 m above sea level. The total area of summer pastures is 600 000 ha. Every year more than 3 000 000 head of sheep, goats and young cattle are taken to summer pastures to graze for 100–120 days during May-September.

Vegetation of summer pastures is a diversity of associations, mainly (more than 80%) perennial grasses, among which some species can form thick turf. The level of productivity of pastures varies between areas depending on their location within each mountain belt.

Main forages of summer pastures are: *Festuca ovina* – perennial turf forming, xerophytic grass. It flowers starting from mid-spring till late summer and runs to seed.

Festuca varia – perennial tough plant forming loose turf. It usually flowers in June–August and runs to seed and forms steppe-meadow in alpine and subalpine belts. Though it is a poor-quality fodder plant, it is considered an important plant in formation of turf on bare mountain slopes. Average dry matter productivity of this plant is 1.0–1.6 tonnes/ha for alpine meadows but 1.4–2.5 tonnes/ha for sub-alpine meadows. Superficial improvement of these pastures can lead to increase in dry matter production.

Festuca sulcata – perennial xerophyte favouring turf formation. Vegetation period is longer than for other grasses and lasts till frost. It contains a considerable amount of cellulose so is not willingly grazed by animals.

Bromus spp. perennial grass that starts flowering from July till August and runs to seed. It usually grows in mountain-meadow and partly in skeletal meadow-steppe soils. All types of animals willingly graze the fresh plants.

Poa spp. – thick perennial favouring turf formation. It flowers starting from June till October and runs to seed. It is widespread in subalpine and alpine mountain belts and prefers to survive in rocky slopes with fine soil, in ravines of rocks and in sediment soils. It grows rapidly after grazing and is willingly grazed by cattle, horses and sheep in alpine and subalpine meadows.

Nardus stricta is perennial and begins flowering from June till August and runs to seed. Mat grass forms a thick turf and almost completely covers the soil surface. *Festuca varia* – vegetation with *Nardus* in subalpine belt produces 2.4–tonnes/ha dry matter. Mat-grass is willingly grazed when it is young by all types of animals.

Carex coascia – thin bushy rhizomatous perennial that begins flowering from early June till August. All types of animals willingly graze it till it flowers.

Carex tristis – perennial thick turfy plant that begins flowering from May till August and runs to seed. It is an important plant for meadows and pastures. It is met in the subalpine belt in mesophyl meadows.

In addition natural pastures contain *Salsola*, various species of lucerne (*Medicago sativa*, *Medicago coerulea*, *Medicago glutinosa*, *Medicago lupulina*, *Medicago caucasica*, *Medicago falcata*), some clovers (*Trifolium resupinatum*, *Trifolium repens*, *Trifolium pratense*), sainfoin (*Onobrychis*), sweet-clover (*Melilotus*), as well as a number of halophytes (*Salsola dendroides*, *Salsola nodulosa*, *Salsola ericoides*).

Poisonous and injurious plants and weeds present in natural pastures

Hundreds of poisonous and injurious plants and weeds, belonging to various families, are common in natural pasture, meadows and rangelands. Most of them belong to Ranunculaceae, Euphorbiaceae, Umbelliferae, Caryophyllaceae, Geraniaceae, Hypericaceae and Scrophulariaceae. Work has identified that the total amount of poisonous and injurious plants and weeds that are not consumed by animals constitutes 20–25% of dry matter production of natural pastures and meadows. A considerable amount of poisonous and injurious plants and weeds in natural pastures and meadows cause animal losses, miscarriage, barrenness and poor quality of animal products. Pastures trampled down moderately or severely favour the spread of poisonous plants; in such cases, useless plants gradually force valuable fodder plants out (Table 7).

Sown fodder is very important, especially in the plains. It is also valuable for rotation. Fodder crops are usually in irrigated plains, mountain and foothill zones as well as in dry land zones with sufficient moisture. Farmers prefer to grow lucerne, sainfoin and maize depending on soil-climatic condition; sorghum, fodder beet and rape are grown by some farmers.

Lucerne is the «Shah» of fodders and is grown in all irrigated areas, as well as in mountain and foothill regions with high rainfall. Lucerne is partly fed fresh and partly as hay for feeding in winter. If agro-technical measures

are followed in a timely way, lucerne gives 4–5 cuts in a year (with irrigation that yields 80–120 tonnes/ha green forage or 10–15 tonnes/ha dried hay). In dry land agriculture it yields 6–10 tonnes/ha dried hay from 2–3 cuts. Dried lucerne hay contains 18% digestible protein, 2.7% oil, 30.2% cellulose, 39.4% nitrogen-free extractive substances and 9.7% ash. If good care is taken, through its root nodules lucerne accumulates more than 100 kg/ha nitrogen that is equal to 0.4–0.5 tonnes mineral nitrogen fertilizer (in physical weight). In Azerbaijan lucerne may be sown in spring and in autumn: autumn sowing is better. Optimum sowing for this crop is 20 September–10 October. Seed rate is 12–15 kg certified seed/ha (for fodder production) and 8–10 kg for seed production.

Sainfoin (*Onobrychis*) is the most productive fodder for cultivation in high rainfall mountain and foothill regions as well as in plains where irrigation is scarce. In rainfed conditions sainfoin gives two hay cuts that yield 5–6 tonnes/ha dried hay. The first cut yields 3.5–4 tonnes/ha dried hay. Sainfoin is a good crop before cereals, and potatoes. It contains 16.4% protein. In foothill zones sainfoin is sown both in autumn and in spring. Seed rate is 80–100 kg seed/ha. Sowing depth is 4–5 cm.

Maize (*Zea mays*) is an important fodder crop. Seeding rate is 25–30 kg/ha.

Sorghum (*Sorghum* spp.) differs from other fodders by a number of peculiarities. It is tolerant to drought and salinity and has capacity of ratooning; it does not respond to irrigation like maize. Two, rarely three, irrigations is enough. It is especially suitable for weak-saline soils. Sorghum grown in Kur-Araz lowland, Mil-Mugan and Shirvan zones yielded 55–60 tonnes/ha fresh from two cuts, whereas maize yielded 18–20 tonnes/ha. Seed rate is 18–20 kg/ha.

Fodder beet (*Beta vulgaris*) is an important cattle fodder. It suits plain, foothill and mountain regions. It yields on average 60–80 tonnes/ha root in irrigated plain conditions, 40–60 tonnes/ha in mountains and foothills and 20–25 tonnes/ha tops. Irrigated fodder beet is sown in both autumn and in spring. Seed rate is 12–15 kg/ha.

Rape. Spring and winter types available; usually grown as a catch crop for its short vegetation period. Sown in August–September and satisfies cattle requirement for green forage in March–April of the next year. Seed rate is 8–10 kg/ha.

Constraints to fodder production. The following factors lead to a shortage of fodder resources in the republic: poor soil fertility; relatively low quality of pastures; overgrazing or grazing without control; lack of inputs like high quality seed material, mineral fertilizer and plant protection means to improve natural pastures and meadows. Erosion in mountain and foothill zones causes loss of soil fertility. Under the influence of intensive rain and snow the fertile soil surface is eroded and leached. Wind erosion also occurs in mountain and foothill areas. As a result of natural and human impact, 41.7% of the soil surface has been subjected to erosion. About 63.5% of total pastures and rangeland available in the country was

Table 7. Some poisonous and injurious fodder plants widespread in natural pastures

Plant	Area of distribution
Causing disorders of the central nervous system	
<i>Hyoscyamus niger</i> L.	Summer pastures
<i>Cicuta</i> L.	Summer pastures and meadows
<i>Atropa belladonna</i>	Mountain zone of the country
<i>Ephedra</i> L.	Rocky and sandy soils
<i>Chaerophyllum</i> L.	Forest, forest-steppe and mountain regions
<i>Euphorbia</i> L.	Forest- steppe and steppe zones
<i>Veratrum lobelianum</i>	Subalpine and alpine meadows
Causing disorder in function of heart, lung, digestive and respiratory organs	
<i>Anemone</i> L.	Around forests
<i>Ranunculus</i> L.	Pastures provided with sufficient moisture
<i>Tanacetum</i> L.	Forest- steppe and mountain zones
<i>Euphorbia</i> spp.	In all pastures and meadows of the country
<i>Trollius</i> L.	Subalpine and alpine meadows, humid areas
<i>Senecio caucasicus</i> , <i>Senecio latifolius</i>	Humid meadows
<i>Picris</i> L.	Semi desert winter pastures
Causing decrease in quality of meat and milk	
<i>Lepidium</i> L.	In all regions
<i>Thlaspi</i> L.	In all regions
<i>Anthemis</i> L.	Summer pastures
Fouling wool	
<i>Onopordon</i> L.	Natural pastures, road sides
<i>Xanthium vulgaris</i> , <i>Xanthium pungens</i>	Around channels and river banks
<i>Xanthium albinum</i>	In valleys, shrubby places and river sides
<i>Medicago</i> spp.	Semi desert winter pastures

subjected to erosion processes of which 22.7% is weakly eroded soils, 14.9% moderately eroded soils and 25.9% severely eroded soils. Overgrazing and uncontrolled grazing also cause to erosion that leads to a decrease in soil fertility and productivity.

It was found that in pastures subjected to moderate and severe erosion, the quality of plant cover has become worse; especially legumes (lucerne, sainfoin, clover, lupin and sweet clover) disappear. Only those plants that are resistant to trampling and drought remain in the plant cover. Usually weeds (*Senecio* spp. and thistles) replace useful grasses in such pastures. Availability of a lot of stones of various sizes also has a negative impact on pasture productivity.

6. OPPORTUNITIES FOR IMPROVEMENT OF FODDER RESOURCES

It is advisable to undertake the following measures to improve pastures available in the country: superficial improvement of winter and summer pastures; fundamental improvement of winter and summer pastures; protection of natural pastures from erosion; organization of fodder seed production; development of sown pastures; research on improving natural pastures.

Superficial improvement of winter and summer pastures is of particular importance in the increase of fodder production. Superficial improvement of winter pastures includes: fertilizing, harrowing of soil surface, control measures against poisonous and injurious plants, sowing valuable pasture grasses and regular irrigation. In addition fertilizing would increase productivity of winter pastures. It was found that application of ammonium nitrate at a rate of 150–200 kg/ha (physical weight) and superphosphate (150–250 kg/ha) as well as manure (10–15 tonnes/ha) increases productivity of natural pastures by 50–70% and improves fodder quality as well as botanical composition of the plant cover.

Fundamental improvement of winter pastures requires turning the turf layer over and sowing the land to seeds of perennial meadow grasses resistant to drought, salinity and heat. Sown pastures located in the steppe zone may be used as pasture and as meadow. Broadcast seed sowing should be undertaken in autumn in rainfed winter pastures. Sowing of winter barley, rye (120–140 kg/ha), Kochia (*Kochia prostrata*) (8–10 kg/ha) and wheat-grass (*Agropyron* spp.) (15–16 kg/ha) has shown very promising results.

Superficial improvement of summer pastures may include weed cutting during 2–3 years, hoeing etc. It is advisable to cut weeds before flowering in order not to allow them to run to seed. Fertilizing of summer pastures should be undertaken after each 4–5 years with application of active nitrogen and phosphorus (60–90 kg/ha). Manure and phosphorus are applied in the autumn, but nitrogen in spring after each grazing.

Erosion control. Emphasis should be put on erosion protecting measures to improve pasture productivity. Rehabilitation of plant cover of pastures on slopes is of great importance to stop erosion. Uncontrolled grazing also favours erosion. Most of the pastures suffer from overgrazing so controlled grazing is another way that may reduce erosion.

There are three groups of summer pastures: the first group of pastures are in good state where 7 head of animals can be grazed on 1 ha area while 5 head of animals can be grazed in the second group of pastures and 3 in the third group of pastures. Therefore, the grazing rate of each group of pastures should be followed. The grazing rate of moderately eroded pastures should be decreased by 50%, but grazing of animals in severely eroded pastures should be stopped for 2–3 years. The other priority to prevent soil erosion is controlled grazing where animals are allowed to partly graze the pastures. The pasture area is divided into 5–6 parts. Each part is grazed for 5–6 days. So animals are allowed to graze each part of the field after 25–30 days. The interval of grazing enables pastures to restore plant cover and maintain turf layer.

Fodder seed production. Most fodder seed in Azerbaijan was produced by state seed farms; after agrarian reforms were implemented state farms were abolished and only a few farms were maintained

under supervision of research institutes. At the moment most fodder seed probably comes from on-farm production or farmer to farmer exchange. Seed of traditional fodder crops (lucerne, clover, lucerne) is widely available in local markets. The purity of seed produced by farmers is not so high. Certified fodder seed is only produced by the experimental station of the Research Institute of Forage Crops, Meadows and Rangelands. The area of sown fodder crops has decreased compared with 1991. Every year the country needs 1 600 tonnes of lucerne seed, 600–800 tonnes of sainfoin seed, 500 tonnes of horse bean seed, 300 tonnes of vetch seed, 400 tonnes of rape seed, 600 tonnes of soybean seed, 1 500 tonnes of rye seed, 1 500 tonnes of oats and 300 tonnes of sorghum seed to maintain the area of fodder crops. The use of new fodder crop varieties would increase fodder productivity by 20–30%. Seed production of perennial grasses is also of great importance; but nobody is engaged in their seed production.

7. RESEARCH AND DEVELOPMENT ORGANIZATIONS AND PERSONNEL

The Research Institute of Forage Crops, Meadows and Pastures supervised by the Ministry of Agriculture is the only institute that deals with fodder development in the republic. It was founded in 1969 and has five departments and laboratories with 100 employees of whom 12 are researchers including one professor and six candidates of sciences (PhD.). In early 2000 all research institutes (supervised by the Ministry of Agriculture) available in the country (15 research institutes) including the Research Institute of Forage Crops, Meadows and Pastures were put under the Agrarian Science Centre of Azerbaijan.

In the course of recent years the institute released seven new fodder crop cultivars, including two lucerne, three perennial grasses, one sainfoin and one *Kochia* as a result of plant breeding activities. The main direction of research work carried out at the institute includes:

- seed multiplication of new fodder crop varieties and development of new cultivars;
- working out progressive seed production methods of sown (lucerne, sainfoin) fodder crops and pasture – meadow crops suitable for various soil-climatic types of the country as well as the study of their cultivation technology.
- development and application of rational use of natural pasture and meadows; superficial and fundamental improvement of natural pastures.

The Research Institute of Forage Crops, Meadows and Pastures has five experimental stations and sites located in Absheron, Kurdamir, Agstafa, Shaki and Gadabay districts.

The Research Institute of Erosion and Irrigation, Research Institute of Animal Husbandry under supervision of Agrarian Science Centre as well as the Institute of Botany, the Institute of Genetics and Selection supervised by the National Academy of Sciences also carry out some research dealing with fodder crops. In addition the Ministry of Agriculture has also a department of pastures. This department though is not involved in research activities but coordinates the policy of the Ministry of Agriculture related to rational utilization of pastures, rangelands and meadows, as well as to superficial and fundamental improvement of pastures.

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