Subregional Report on Animal Genetic Resources: **Central America**

Acknowledgements
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Introduction

This document is one of a set of subregional or regional reports prepared as part of the Annex to *The State of the World's Animal Genetic Resources for Food and Agriculture*. It consists of two sections:

- a factsheet; and
- a synthesis of priorities.

The factsheet is a compilation of background material on the significance of livestock to the subregion's economy and food security; the characteristics, distribution, and relative significance of the various livestock production systems; and the characteristics of animal genetic resources.

The priorities presented in this report are based on the outcome of consultations held at the subregional level to review a draft report on strategic priorities for action, which had been prepared by FAO as a global-level synthesis of priorities identified in the Country Reports submitted as part of State of the World process. The consultations, which were held during the final quarter of 2005, took the form of e-mail conferences and/or physical meetings, and provided an opportunity for country representatives, from both technical and policy backgrounds, to identify priorities and to further strategies for cooperation.

Subregional factsheet: **Central America**

1 Importance of livestock to subregion's economy and food security

The countries of the Central America subregion, as defined for the purposes of this report, include Costa Rica, Cuba, the Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua and Panama. In spite of the historical and cultural links between the countries of Central America, there is much diversity in social, political, and economic terms, as wfell as a large variety of natural environments. In pre-Columbian times, most of modern Central America was part of the Mesoamerican civilization. The Mesoamerican region extended from central Mexico south to the northwestern border of Costa Rica and gave rise to a group of stratified, culturally related agrarian civilizations spanning a period of approximately 3 000 years, prior to the European discovery of the New World by Columbus in the fifteenth century. Mesoamerica is one of our planet's six cradles of early civilization

Present-day Central America is home to 170 million people, about 3 percent of the world population, who speak about 200 different languages. The average population growth rate is 1.5 percent, which is higher than the world average of 1.2 percent (UNFPA, 2005). Most of the subregion's people live in and around cities. Population projections for all of Central America indicate the continuation of a historical trend toward greater urbanization. According to 2004 United Nations Population Division (UNPD) estimates, by the year 2015 every Central American country's urban population will exceed its rural population.

Central America constitutes roughly 2 percent of the total world land area; almost 260 million hectares, of which 14 percent is arable land, 38 percent permanent pasture and 28 percent forests and woodland. Most of Central America rests on the Caribbean Plate, and the subregion is geologically active, with volcanic eruptions and earthquakes occurring from time to time. Although a large part of the subregion is tropical, different climatic zones exist, varying with altitude from tropical to cool. The eastern side of the subregion has high rainfall. The verdant landscape includes large central areas of plateau and low-lying rainforests which support a wide range of tropical flora and fauna. Fertile soils from weathered volcanic lavas have made it possible to sustain dense populations in the agriculturally productive highland areas (ibid.). Large geographical features include the Sierra Madre mountain range, Lake Nicaragua and the Panama Canal.

The economies of the countries in the subregion are becoming more diversified. While agriculture is still the largest employer, the tourism, industrial and service sectors have become increasingly important. An important feature for the economy of Central America is the Inter-American Highway that enables trade flows to the United States of America. Panama is an important trade hub for the subregion, servicing trade between North and South America. A summary of general information for the subregion is shown in Tables 1, 2 and 3.

CENTRAL AMERICA

TABLE 1
Land area and population

	Land area (× 1 000 km²)	Population 2003 (million)	Population density (km²)	Population growth rate (% *per annum*)	
				1975–2003	2003–2015
Costa Rica	51	4.2	82	2.5	1.5
Cuba	110	11.2	102	0.7	0.2
Dominican Republic	48	8.6	178	1.9	1.3
El Salvador	21	6.6	319	1.7	1.6
Guatemala	108	12.0	111	2.4	2.3
Haiti	28	8.3	301	1.9	1.4
Honduras	112	6.9	62	3	2
Mexico	1 909	104.3	55	2	1.1
Nicaragua	121	5.3	44	2.5	1.9
Panama	74	3.1	42	2.1	1.6

Data from UN and FAO statistics.

TABLE 2
GDP and the economic contribution of agriculture

	GDP[1] 2003 (US$ billions)	Value added in agriculture[2] 2003 (% of GDP)	Agricultural population[1] 2003 (% of total)
Costa Rica	17.5	9	19
Cuba	.	.	15
Dominican Republic	16.5	11	16
El Salvador	14.9	9	31
Guatemala	24.7	23	49
Haiti	3.0	28	61
Honduras	6.9	14	32
Mexico	639.1	4	22
Nicaragua	4.1	19	19
Panama	12.9	8	22

[1] Data from UN and FAO statistics.

[2] Data from World Bank statistics.

TABLE 3
Land use

	Arable (%)		Permanent pasture (%)		Forest / woodland (%)	
	1993	2003	1993	2003	1993	2003
Costa Rica	5	4	46	46	31	-
Cuba	30	28	24	26	24	-
Dominican Republic	22	23	43	43	12	-
El Salvador	28	32	33	38	5	-
Guatemala	12	13	24	24	48	-
Haiti	28	28	18	18	5	-
Honduras	15	10	14	13	54	-
Mexico	13	13	41	42	26	-
Nicaragua	11	16	40	40	26	-
Panama	7	7	20	21	44	-
Average	14	14	38	38	28	

Data from UN and FAO statistics.

1.1 Agriculture

Central America is predominantly an agricultural subregion; agriculture makes up a large proportion of the economy and a critically important source of livelihoods. Between 15 and 30 percent of GDP in Guatemala, Honduras, Haiti and Nicaragua is derived from agriculture, and approximately a quarter of employment in the subregion is based on agriculture. Even Costa Rica, an upper-middle income country, derives about 20 percent of its employment, and nearly 10 percent of its GDP, from agriculture.

Between the 1960s and 2003, the total agricultural area in Central America has increased by almost 16 percent, to reach more than 140 million hectares – more than half of the total land area of the subregion (FAOSTAT). Seventy percent of the agricultural area is permanent pasture and 25 percent is arable land. The area with permanent crops is small. Pastureland in Guatemala increased by an astonishing 134 percent (albeit from a small base) to 2.6 million ha between the early 1960s and 2003. The deforestation rate is high and the forest and woodland area in Central America as a whole decreased by almost 19 percent during the same period (ibid.).

Within Central American agriculture a distinction can be drawn between small producers and commercial farms, with medium-sized producers occupying an intermediate position (Pomareda and Murillo, 2003). Small producers, with limited access to land, and low quality resources, are in the majority. Most of these small-scale producers belong to the maize–beans (Mesoamerican) farming system, the most important farming system in Central America. Stretching from Central Mexico to the Panama Canal, and with an estimated agricultural population of about 11 million including a substantial indigenous population, this system covers 65 million ha and is historically and culturally based on the production of maize and beans for subsistence (FAO, 2001). It occupies mostly upland areas, the holdings are of small size and there is a high degree of home consumption of farm output. Coffee, and intensive small-scale irrigated vegetable production (in areas close to roads and urban centres), are important income sources (ibid.). Significant portions of the population keep cattle, but are not specialist livestock keepers (Pomareda and Murillo, 2003).

Large-scale estates, frequently in excess of 100 ha, are interspersed throughout the maize–beans (Mesoamerican) farming system. Often internationally owned, these estates have traditionally been dedicated to the commercial production of coffee and beef, although more recently rubber, cut flowers and foliage production have increased in importance. In addition, commercially operated family farms created by European settlers are clustered in the more fertile valley areas, and often produce vegetables and dairy products as well as coffee (FAO, 2001). There are also transnational firms, specialized in the production of bananas and pineapples. For many years these firms have controlled large areas of land and employ the poorest and least-trained agricultural labourers (Pomareda and Murillo, 2003).

The medium sized operators produce coffee, milk, poultry and eggs, fruit and ornamental plants. They are involved in exportation. The agro-industrial firms include those which are involved in basic transformation (rice mills, sugar refineries, coffee processing plants, cattle and poultry abattoirs), and more advanced agro-industries in the dairy sector, fruit processing, oil preparation and other sectors (ibid.).

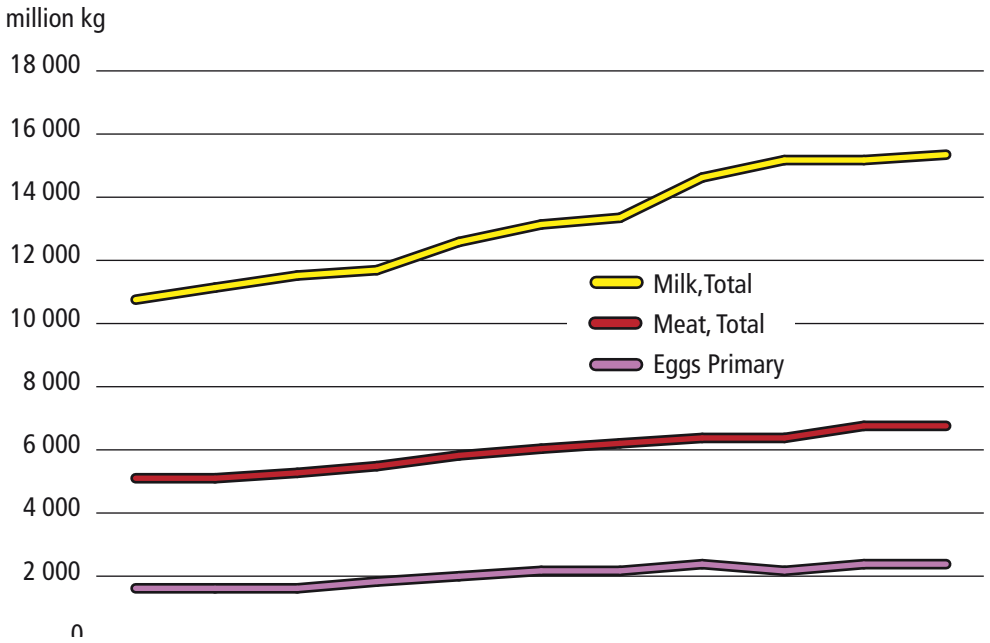
The subregion accounts for a significant portion of world trade in a number of agricultural commodities including coffee, bananas, sugar cane, vegetables, pineapple and shrimps. Coffee, sugar cane and banana are predominantly cultivated on the hillsides and are crops that have been grown for a very long time. Products that are cultivated on a lesser scale include vegetables and mini-vegetables for export, cantaloupes, strawberries (and other berries), ornamental plants and flowers; poultry can also be included in this category (ibid.).

Central America has, however, for the past 20 years been suffering the effects of the coffee, banana and sugarcane crisis. Real domestic prices for commodities such as maize and beans have also been stagnant or declining in recent decades as a result of greater external access to domestic markets, and lower levels of domestic market protection (FAO, 2001).

1.2 Production and consumption

Across the subregion, the use of livestock varies with the environment and the culture. Production and consumption figures reflect subregion-specific livestock species and products (FAO/UNEP, 2000). Figure 1 shows the total production of meat, milk and eggs in Central America.

FIGURE 1
Total production of meat, milk and eggs in Central America, 1995–2005



Source: FAOSTAT.

Among livestock products, milk has the highest production in the Central America subregion, accounting for 2.5 percent of total world milk production. Milk production increased by 43 percent in the ten years between 1995 and 2005 – an annual growth rate of 3.3 percent. Mexico is one of the major milk producing countries in the world, contributing 1.5 percent of world milk production. Modernization and improved herd management among larger producers are important elements in Mexico's growing milk output (FAO, 2004a). Honduras increased its milk production by almost 300 percent from 1995 to 2005, an annual growth rate of 13.3 percent (FAOSTAT).

Egg production in Central America is 4 percent of total world egg production. It increased by 44 percent in the ten years between 1995 and 2005 – an annual growth rate of 3.4 percent. Mexico is the sixth largest producer of eggs in the world, and the third largest consumer. Per capita supply of eggs increased from 12 to almost 16 kg per year between 1993 and 2003.

Meat production in Central America contributes almost 3 percent to total world meat production. It increased by 32 percent in the ten years between 1995 and 2005 – an annual growth rate of 2.5 percent. The strongest trend in livestock production in Central America has been the growth in poultry meat production (FAO, 2003a). In 1995 beef and veal made up the bulk of meat production – almost 38 percent of the total. However, in 2005 poultry meat production made up more than 45 percent of total meat production, while beef and veal production had decreased to 31 percent. Mutton and lamb meat production also increased significantly (almost 42 percent) from 1995 to 2005, albeit from a small basis.

In the period 1993 to 2003 meat supply per capita per year increased at an annual growth rate of 2.7 percent in Central America. Chicken is the meat with the highest consumption in the subregion because of its quality and low cost. Average poultry supply per capita in 2003 in Central America was 21.3 kg, with Panama having the highest supply, at 30 kg per capita per year and Haiti the lowest, at 4.5 kg per capita per year. The annual growth rate of poultry supply during the 1993 to 2003 period was 5.2 percent, compared to global production growth of 3 percent (FAOSTAT).

Although recent significant increases in beef consumption have been rare on world level, such increases occurred in half of the Central American countries. Honduras increased its bovine meat supply per capita by almost 80 percent between 1993 and 2003.

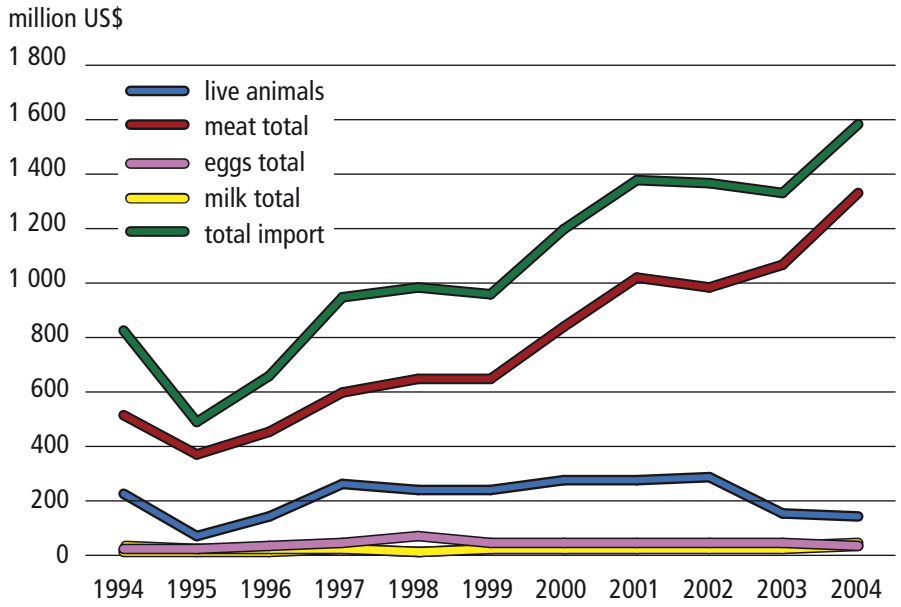
1.3 Imports and exports

The countries of Central America are emerging economies with generally good economic growth. From the mid-1980s onwards, the countries of the subregion have implemented several trade liberalization reforms. Greater integration into world markets resulted in the 1990s from their adherence to the Uruguay Round (1986–1994), membership in the World Trade Organization (WTO), and subscription to several Free Trade Agreements. Mexico also joined NAFTA (North American Free Trade Agreement). With liberalization, trade flows have increased and actual and potential comparative advantages have been revealed (Monge-Gonzáles *et al.,* undated).

Central American economies show varying degrees of openness. A number of key agricultural commodities for domestic consumption (e.g. dairy products, beef, pork and poultry) enjoy some form of protection in the countries of the subregion. Effective rates of protection are highly dispersed across products and across countries (ibid.). However, under the Dominican Republic–Central American Free Trade Agreement (DR-CAFTA), signed into law in mid-2005, the United States of America and six Central American countries (Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, and Nicaragua) will, in stages over 20 years, completely phase out tariffs and quotas on all but four agricultural commodities traded between them. Once it takes effect, the agricultural sector of the United States of America will over time gain free access to the six highly protected markets on a reciprocal basis, matching these countries' current duty-free entry for nearly all their agricultural exports to the United States of America. The United States of America is the major market for livestock and livestock products of Central America (ibid.).

During the last decade, the value of total imports of live animals and primary animal products in Central America showed an upward trend (Figure 2). There were decreases in 1995 – caused by the severe economic crisis in Mexico in 1994–1995, and 2002, a result of the stalling of economic growth in Mexico in 2001. Mexico is the main importer in the subregion for practically all live animals and primary animal products, and therefore has a strong influence on all trends. Central America's most important import product is meat. Imports of meat increased more than 150 percent from 1994 to 2004, at an annual growth rate of 9 percent. Pig and poultry meat make up roughly equal shares of meat imports – both about 40 percent. Mexico has become a major importer of poultry meat and is a fast growing net importer of pig meat (FAO, 2003a). Imports of beef and buffalo meat made up, on average, 20 percent of total meat imports during the last decade, but decreased after 2002. Mexico was among the top three importers worldwide of beef from the United States of America by volume in 2002, importing 28 percent of its total exports. The increase in beef imports up to 2002 was related to significant increases in beef consumption occurring in Mexico (FAO, 2003a).

FIGURE 2
Imports of live animals and primary livestock products in Central America



Source: FAOSTAT.

Imports of live animals are the second most important element of total imports. After a decrease in 1995, imports were quite stable from end 1990s to 2002, but decreased after. This was mainly a result of reduced cattle imports in Mexico.

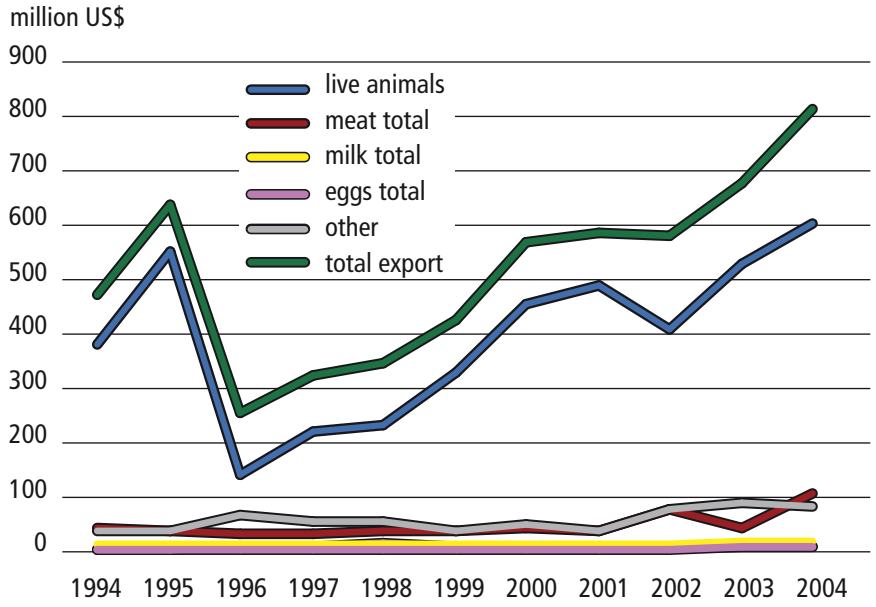
Imports of milk (cow milk, whole, fresh) decreased after 1994, but grew again from 2000 onwards. Mexico is responsible for the bulk of the imports and has a big influence on the subregional figures. Milk imports in Mexico decreased up to 1999 and grow again from 2000 onwards. All other countries of the subregion, except the Dominican Republic, increased their milk imports significantly. Panama had a growth rate of almost 160 percent annually from 1998 to 2004. Costa Rica, Cuba and Panama used not to import any milk, but started doing so in recent years. It has to be noted that the import of milk in the form of primary livestock product (whole, fresh) is only 5 percent of total milk products imported in Central America (FAOSTAT). Mexico imports significant amounts of nonfat dry milk and whole milk powder to meet growing demand. Mexico is expected to continue as a significant importer of dairy products to augment domestic production. While imports are likely to consist primarily of bulk products such as nonfat dry milk, higher value products such as specialty cheeses and ice creams are also likely to find a home in Mexico's growing consumer markets as tastes, preferences, and shopping habits increasingly mirror those of the United States of America and Europe (Cattlenetwork.com, 2006).

Import of eggs in Central America is low, as Mexico, responsible for the bulk of the eggs consumed in Central America, has a very low dependency on imported eggs. More than 99 percent of the eggs consumed in the Mexican market are supplied by the domestic industry (Ruis, 2003). Also, considering that eggs are considered a staple food in the Mexican market, imports of these products are subject to a special treatment. Until 1994, imports of eggs were made under a special programme negotiated between the poultry sector and the government. Most of the egg imports were used for the industrial development of the border areas and sometimes were used by the State Trading Enterprise, Conasupo, to regulate the domestic market in case of shortage. During the negotiations of NAFTA, Mexico established a special treatment for the imports of eggs (ibid.).

The import of fibres, hides and skins is not of great importance in the subregion and decreased by almost 15 percent annually from 1994 to 2004. The import of other products such as honey, beeswax, and fat, increased by almost 14 percent annually during this period, with the biggest contribution came from animal oils and fats, particularly the fat of pigs imported by Mexico (FAOSTAT).

During the last decade the value of total exports of live animals and primary animal products in Central America showed an increasing trend (Figure 3). The economic crises of 1995 and 2002 led to decreases in total exports in 1996 and 2002.

FIGURE 3
Export of live animals and primary livestock products in Central America



Source: FAOSTAT.

All Central American countries, except El Salvador, are net exporters of agricultural and agro-industrial products to the world as a whole and to the United States of America. The United States of America is the major market for livestock and livestock products from Central America (Monge-Gonzáles *et al.*, undated). In terms of value, live animals are the most important export product. In 2004 live animal exports from Central America were worth US$607 million of which the United States of America imported almost US$550 million (90 percent) (FAOSTAT). Cattle make the greatest contribution to live animal exports.

Export of meat was fairly stable during the last decade, except for increases in 2002 and 2004, during which years the value of exports more than doubled that of the preceding years. These increases were mainly the result of the start of buffalo meat exports from Costa Rica. In recent years more than 70 percent of meat exports were beef and buffalo meat (FAOSTAT). Costa Rica is the only country in Central America exporting buffalo meat, but buffalo meat made up 35 percent of beef and buffalo meat exports in 2004 (FAOSTAT). Nicaragua is an important beef and veal exporter. Almost 45 million kg of meat worth US$144 million were imported into the United States of America from Central America in 2004 (FAOSTAT). Pig and poultry meat showed significant increases in exports after 1994. In particular, export of poultry meat surpassed exports of beef and buffalo meat in some years during the last decade.

Exports of milk, eggs, fibres, hides and skins is not of great importance, although exports of milk increased by almost 300 percent from 1994 to 2004. The export of fibres, hides and skins decreased during the last decade.

1.4 Projected demand for livestock products

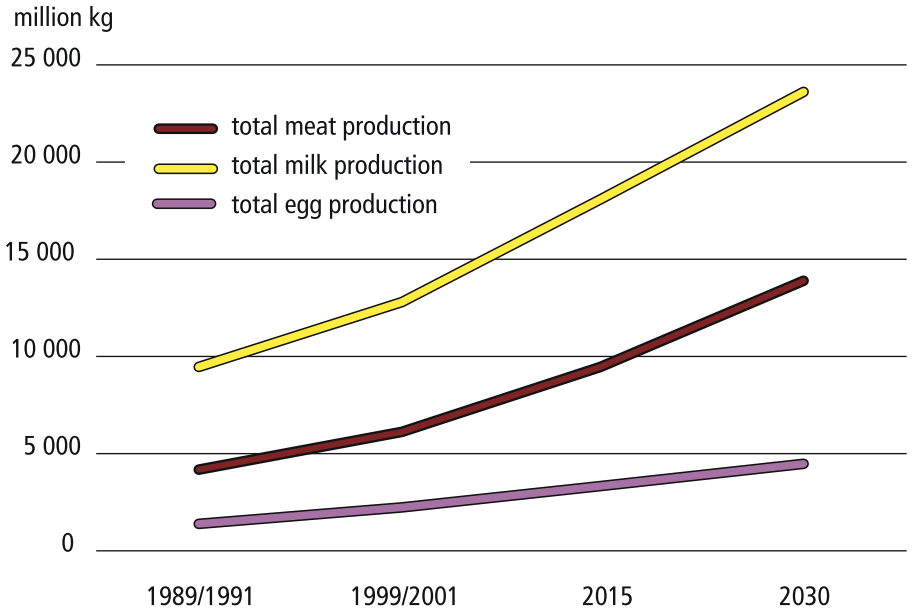
Annual growth rates for total livestock numbers and total meat, milk and egg production are given in Table 4. Growth rates will be slower over the period 2000 to 2015, compared to 1990 to 2000. However, annual growth rates, particularly in meat production, are expected to stay high. Total livestock numbers in Central America are predicted to more than double from 1989-1991 to 2015, from 462 million to more than 1 billion. Figure 4 shows that total milk, meat and egg production for Central America are predicted to increase to 2030.

TABLE 4
Growth rates for livestock numbers and production in Central America

	Annual growth rate (%)	
	1990–2000	2000–2015
Total livestock numbers	4.72	2.21
Total meat production (kg)	4.05	3.07
Total milk production (kg)	3.07	2.34
Total egg production (kg)	4.27	2.55

Source: FAO (2003b).

FIGURE 4
Past and projected total meat milk and egg production in Central America



Source: FAO (2003b).

The predicted annual growth rate for meat is about 3.1 percent and for milk about 2.3 percent for the period 2000 to 2015. Meat production will increase to 55 kg per capita and milk production to 106 kg per capita in 2015. For comparison, the figures for the developed world are projected to be 87 kg of meat and 267 kg of milk in 2020. The expectations for Central America compare very favourably with those of other developing countries. The growth rates over the period 1989-1991 to 1999-2001 are especially impressive for poultry meat where the output increased by 8 percent per year. Poultry meat output is predicted to stay high with an annual growth rate of 4.1 percent to 2015; the highest annual growth rate is predicted to occur in Guatemala (FAO, 2003b).

In Latin America overall, consumption of animal products (meat) has historically been higher than in other developing country regions and is predicted to increase further (FAO, 2003a). The per capita demand for meat products is projected to rise to 64.3 kg in 2020. Demand is very close to supply and this is also true for milk. In the next 20 years the intake of calories per capita is predicted to grow (van der Zijpp, 2003).

1.5 Poverty

Poverty rates can be quantified on the basis of a poverty line, which provides a threshold in income or consumption below which a household can be classified as poor. Some poverty lines aim to be internationally comparable and, thus, are useful for producing continental and global totals. Widely cited examples are US$1 day^{-1} and US$2 day^{-1} lines published by the World Bank. Data based on an international poverty line show the number of people who cannot purchase a roughly similar basket of commodities (World Bank, 2001). National poverty lines reflect intercountry differences in economic and social status and are used to assess progress on a national scale. The figures presented in Table 5, utilize three different poverty lines: US$1 day^{-1}, and US$2 day^{-1} and national poverty lines based on Technical Advisory Committee (TAC) of the Consultative Group on International Agricultural Research (CGIAR) data. In Latin America as a whole, economic growth rose only slightly through the 1990s and poverty fell only slightly. Apart from in the Dominican Republic, at least one quarter of the population of all the countries in the subregion live in poverty (defined as living on less than US$2 a day), roughly the same as in the late 1980s. In Guatemala and Honduras, 40 percent of the population is extremely poor (living on less than US$1a day) (Table 5).

TABLE 5
Poverty rates by country

Country	TAC Definition	Less than 1US$/day	Less than 2US$/day
Costa Rica	29.0	9.6	26.3
Cuba	*	*	*
Dominican Republic	55.0	3.2	16.0
El Salvador	51.0	25.3	51.9
Guatemala	71.0	39.8	64.3
Haiti	76.0	*	*
Honduras	37.0	40.5	68.8
Mexico	30.0	17.9	42.5
Nicaragua	20.0	*	*
Panama	42.0	10.3	25.1

Sources: FAO (1997) and World Bank (2001) as presented by Thornton *et al.*, (2002).

* Data unavailable.

In Latin America and the Caribbean overall, the per capita income level is projected to increase from US$3 590 in 1995 to US$6 266 in 2020. The outlook for income increases is good compared to the rest of the developing world, but the level is still only about 20 percent of per capita income in the developed world. In the next 20 years, the intake of calories per capita is projected grow and the percentage of malnourished children to decrease. The continent, however, is very diverse in agro-ecological and socio-economic conditions. The encouraging average growth rates do not reveal extreme differences in standards of living and access to essential resources that exist within the subregion (van der Zijpp, 2003).

2 Livestock production systems

2.1 Overview

In this report, livestock systems will be described according to the classification developed by FAO (1996a) using updated data from 2004. FAO (1996a) distinguish grassland-based systems, mixed rainfed systems, mixed irrigated systems and landless systems. The land-based systems are further distinguished by agro-ecological zone (arid/semi-arid, humid/subhumid and temperate/tropical highland). A description of the classification system can be found in the Annex to this factsheet. Except for grassland-based systems of the humid and subhumid zones, all livestock production systems are present in this subregion. However, mixed systems are the most important systems, in terms of total population, and generally have the highest production figures. In Central America, permanent pasture covers a high percentage of the area in all systems.

Grassland-based systems

Grazing systems are important in Central America, which has low population density and a relatively high degree of urbanization. Cattle are the most important livestock species. Thirty-nine percent of the global production of meat coming from grassland-based systems of the zones originates from Latin America, and this percentage would probably be significantly higher if calculated for beef and veal alone (FAO, 2006).

The grassland-based system of the arid and semi-arid zones is the most important grassland-based system in Central America. Total milk production in this system is high, and milk yield per cow in this system is higher than in all other systems in Central America. Grassland-based systems in temperate /tropical highland zones are less important in Central America, and productivity levels tend to be low (e.g. milk yields of only 856 kg/cow/year, which is more than 400 kg less than the average in Central America). Temperate breeds perform well in tropical highland situations, except at very high altitudes. Local breeds play an important role where subsistence objectives are still important, cash income is limited and few purchased inputs are used. In the tropical highlands, the grassland-based system is affected by seasonality of fodder supply which, in turn, largely depends on rainfall patterns (FAO, 1996a). Where milk markets generate the appropriate incentives, dairy cows are either fed cut-and-carry forages or pastures are irrigated. Central American farmers in this system mainly produce for the domestic market (ibid.).

Mixed systems

Mixed systems that include crops and livestock are widespread in Latin America on small and medium-sized farms (Wilson *et al.,* 1995). Mixed rainfed systems are the most important production systems, in terms of human population sustained, and animal production figures.

Mixed rainfed systems

The mixed rainfed systems of the temperate zones and tropical highlands is the most important mixed rainfed system in Central America in terms of human population sustained. It has the highest outputs of many livestock products, such as sheep and goat meat, pig meat, poultry meat, eggs, and total milk production. Highest total milk production is a result of the high number of dairy cows in this system, although milk yield per cow is low compared to the other mixed rainfed systems. The maize–beans system covers 65 million ha stretching from Central Mexico to the Panama Canal. The system is historically and culturally based upon the production of maize and beans for subsistence. Livestock in this system usually consists of some chickens, and sometimes some cattle (FAO 2001).

The mixed rainfed system in the humid and subhumid zones has the largest share of cattle in Central America – almost 16 million head. Criollo cattle (*Bos taurus* types, introduced by the Spaniards 400 years ago) constituted the main animal resource in tropical Latin America. However, over the last 50 years, Zebu cattle (*Bos indicus*) have largely replaced the Criollo cattle. In the subhumid and humid areas, cattle are by far the dominant species. These systems tend to produce mainly beef. Milk is more important in subtropical areas and drier parts of the tropics, particularly where farms are smaller and access to markets is good (FAO, 1996a).

The mixed rainfed system of the humid and subhumid zones in Central America is very heterogeneous, having a diverse range of socio-economic conditions, soils and climates. The system covers regions with especially difficult climatic conditions for livestock (high temperatures and high humidity). Adaptation

of highly productive temperate breeds to these challenges has been poor. *Bos taurus* cattle, sheep and goats were introduced some four centuries ago. *Bos indicus* cattle were introduced a few decades ago and have now replaced the earlier-introduced cattle breeds in tropical areas. The system is far less densely populated in Central America compared to Asia, having five times more agricultural land per inhabitant (FAO, 1996a). This system caters to large domestic markets and it is also linked to export markets. Under smallholder conditions milk tends to be a more important output than meat (ibid.). Milk yield per cow is highest in this system compared to all other mixed systems in Central America. The mixed rainfed systems of the humid and subhumid zones are replacing grazing systems in Central America, mainly driven by economic development and technological innovations. Farmers in Central America are clearing rainforests to expand this system (ibid.).

The mixed rainfed system of the arid and semi-arid zones is less important than the other mixed rainfed systems in Central America, although outputs are high compared to grassland-based and mixed irrigated systems. Given the low intensity of the system and the multiple purposes of livestock, the introduction of improved breeds has been limited (Steinfeld and Maki-Hokkonen, 1995).

Mixed irrigated systems

Mixed irrigated systems are less important than rainfed systems in Central America. Human population and total output of animal products are mostly lower than in other systems, although productivity figures tend to be higher. Dairy milk production and total milk production is higher in the temperate zones and tropical highlands of the mixed irrigated system than in all other systems in Central America. The temperate zones of Mexico account to a large extent for these high figures for dairy production. Breeds used in this system are of relatively high genetic merit (mainly Holstein-Friesians) and productivity is relatively high (FAO, 2005). With respect to productivity, beef production per head, is highest in the arid and semi-arid zones at 53 kg/head; the same is true for and sheep and goat meat at 7 kg per head on average. A typical example of this system in Central America is the lucerne/maize-based intensive dairy system of Mexico (FAO, 1996a)

Landless systems

In Central America, output of pig and poultry meat and eggs is highest in the monogastric landless system. This system is defined by the use of monogastric species, mainly chickens and pigs in a production system where high energy concentrate feed such as cereals, oilseeds and their by-products, is introduced from outside the farm. This system is an open system in terms of nutrient flow (ibid.). The landless monogastric system is almost exclusively based on hybrid and high-producing exotic breeds, and the expansion of this system is clearly a threat to traditional breeds. The system is frequently stratified, meaning that different enterprises specialize in the production of parent material, the production of young animals or the fattening process. The short production cycle of these species allows a high turnover and, therefore, a capacity to rapidly adjust to changes in demand for products and in the prices of inputs. The system is very knowledge and capital intensive. It is easily transferred across agro-ecological conditions, because of its minimal links to the land base.

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TABLE 6
Resource base, production and productivity figures of the different production systems found in Central America

	Grassland-based			Mixed rainfed			Mixed irrigated			Landless	TOTAL
	Temperate/ Highlands	Humid/ Sub-humid	Arid/ Semi-arid	Temperate/ Highlands	Humid/ Sub-humid	Arid/ Semi-arid	Temperate/ Highlands	Humid/ Sub-humid	Arid/ Semi-arid		
Parameters:											
Human population (millions)	1.9		9.4	48.2	30.7	22.8	26.5	13.1	12.8		165.2
a) Resource base											
a1. Permanent pasture (1 million ha)	6.4		22.6	14.8	12.9	9.1	9.2	3.2	18.2		96.5
a2. Arable land (1 million ha)	1.0		2.5	6.8	9.5	5.2	4.4	2.4	3.7		35.5
a3. Irrigated land (1 million ha)	0.2		0.9	1.1	0.7	0.6	1.4	0.9	2.2		8.0
a4. Livestock numbers (million head)											
cattle	0.9		3.8	8.6	15.7	7.9	4.9	4.1	4.3		50.1
dairy cows	0.4		1.4	2.7	1.2	0.9	2.1	0.7	1.1		10.4
buffalo											
sheep and goats	0.6		1.5	4.7	3.0	5.1	3.8	1.8	1.4		21.9
b) Major outputs (1 million kg)											
beef and veal meat	38		221	308	583	236	261	111	272		2 030
buffalo meat											
sheep and goat meat	3		8	20	13	17	14	5	10		90
pig meat	12		62	209	146	108	174	67	84	475	1 337
poultry meat	8		39	189	158	38	123	76	53	2 170	2 854
eggs	7		35	153	103	40	104	37	48	1 809	2 336
dairy milk	302		2 084	2 820	1 794	1 029	3 016	878	1 334		13 257
other milk					46	25	39		60		170
milk production total	302		2 084	2 820	1 840	1 054	3 055	878	1 394		13 427
c) Productivity and density indicators											
beef and buffalo meat kg/head	43		58	36	37	30	53	27	63		40
sheep and goat meat kg/head	5		5	4	4	3	4	3	7		4
milk yield kg/cow	856		1541	1039	1529	1183	1429	1278	1203		1279
d) Self-sufficiency of systems											
ruminant meat kg/inhabitant	22		24	7	19	11	10	9	22		13
monogastric meat kg/inhabitant	11		11	8	10	6	11	11	11		25
eggs kg/inhabitant	4		4	3	3	2	4	3	4		14
milk kg/inhabitant	161		222	59	60	46	115	67	109		81

Sources: FAO (1996a); FAO (2004b).

2.2 Roles and functions of livestock in Central America

In the grassland-based systems in Central America cattle are the most important livestock species. In the arid/semi-arid zones only 37 percent of total cattle population is made up of dairy cattle, and beef and veal meat is an important output, although milk production is also significant. In the grassland systems of the arid/semi-arid zones goats are kept for meat and milk (FAO, 1996a).

In mixed systems, livestock perform a series of functions: providing a continuous flow of cash income; a means to concentrate nutrients through manure; fuel; draught power; a cash reserve for emergencies; and as a buffer to risk in crop production (ibid.). In the African and Asian mixed rainfed system, the multiple roles of livestock are the dominant roles, particularly animal traction and manure. However, in Central America, the system provides food products to large domestic markets and is also linked to export markets. Table 7 gives some general roles and functions of livestock in mixed systems.

TABLE 7

Roles and functions of livestock in mixed crop–livestock systems

• Large ruminants provide power for operations such as land preparation and for soil conservation practices
• Both ruminants and non-ruminants provide manure for the maintenance and improvement of soil fertility.
• The sale of animal products and hiring out of draught animals provides cash for the purchase of fertilizers and pesticides used in crop production.
• Animals grazing vegetation under the tree crops control weeds and reduce the use of herbicides in farming systems.
• Animals provide entry-points for the introduction of improved forages into cropping systems. Herbaceous forages can be undersown in annual and perennial crops, and shrubs or trees established as hedgerows in agroforestry-based cropping systems.

Source: Devendra *et al.* (2005).

The role and function of livestock in landless systems in Central America comprises the output of food products such as meat and eggs.

2.3 Projected changes in production systems over time

Future developments in Latin America will be influenced by environmental, farming and nature conservation policies (Van der Zijpp, 2003). Key factors affecting farming systems in Central America are population numbers, natural resources and climate. It is expected that in coming years there will be an absolute increase in rural populations in the countries of Central America. The average per capita daily nutrient intake is expected to increase by 10 percent 2000 and 2030. This increase in calorie intake is expected to derive principally from meat, vegetable oils and dairy products. There may be moves to promote organic farming. Much will depend on the development of markets for more expensive organic products and the rigidity of enforcing environmental policies in Latin America itself and in the potential export markets. It is predicted that the Latin American continent should, during the next 20 years, achieve an improved nutritional status, less poverty, and more intensive agriculture (ibid.).

Grazing systems

Over the ten year period 1982-1984 – 1992-1994, the area under pasture and grazing land in Central America increased by a total of 6.2 percent. This increase was mainly a result of deforestation, which made considerable parts of the subregion more vulnerable to climatic variation. Climatic changes are likely to exacerbate these risks and have the potential to reduce yields (FAO, 2001).

The tropical highland grazing system in Central America faces a problem of rangeland degradation arising from inappropriate range management practices. These rangelands are frequently part of watersheds, and range degradation causes problems such as flooding and salutation of rivers (FAO, 1996a). The inability of grassland-based systems in Latin America to provide continuous and sufficient yields because of declining soil fertility, has contributed to the expansion of the agricultural frontier at the cost of natural forests (FAO, 2006). The establishment of silvopastoral systems offers a valuable chance to restore the productivity of the land, which has become degraded because of the inability of farmers to properly manage the land cleared for crop production. This is also a means to reduce the pressure for further deforestation. In marginal areas, the positive potential of silvopastoral systems is particularly significant, as environmental degradation is usually at its worst in areas, such as hillsides, foothills and highlands (ibid.).

Mixed farming systems

In Central America, extensive ranching systems are increasingly evolving into mixed systems as urban demand for crop staples and livestock products as well as road infrastructure expands (FAO, 1996a). Pastures have traditionally been established jointly with an annual crop, mainly maize or rice. Lack of sustainability of continuous annual cropping on acid infertile soils, has increased incentives for developing nutrient-efficient crop–pasture rotations (ibid.).

The major concern related to the mixed rainfed system in the arid/semi-arid zones is the degradation of land resources because of their limited production potential under growing population pressure. In livestock terms, this relates particularly to overgrazing and range degradation. Livestock in this system produce relatively high amounts of methane per animal kept, and more so per kilogramme of meat or milk produced. The resource base puts a ceiling to agricultural intensification. Alternative development strategies and the reduction of population pressure on the resource base are key elements for the sustainable development of these regions (ibid.).

In the highlands of Latin America, production increases must come from further intensification of crop–livestock land-use systems. Conditions in the highlands should favour small-scale mechanization because of the high population density, continuous cultivation and relatively heavy soils (Steinfeld and Mäki-Hokkonen, 1995).

Landless systems

Landless poultry and pig production systems account for the majority of the output in developed countries and their share is rapidly increasing in developing countries given their high supply elasticity in the short term (ibid.). The human population in Central America will increase from today's 170 million to almost 200 million by the year 2015 – an increase of 16 percent. With increasing incomes, urbanization and ageing populations, the demand for livestock products is increasing. Neither the grazing system nor the mixed farming system, as we know it, will be able to satisfy this increase in demand. The greatest part of the additional demand will have to be supplied by the industrial type of production (FAO, 1996b).

2.4 Impact of production system trends on animal genetic resources

The cattle genetic resources of cattle present in Latin America have three origins: the original Criollo types, which are *Bos taurus* cattle with 500 years of adaptation to tropical conditions; *Bos indicus* breeds derived from imports from South Asia during the last century; and European and North American breeds, imported in recent times. Although grazing systems have serious environmental problems such as pasture degradation and deforestation, the demand for breeds that are well adapted to the local grasslands is unlikely to decline.

The future of livestock populations in mixed farming systems is closely linked to crop integration. As human pressures increase, livestock's roles in the provision of draught power, utilization of crop wastes and the provision of dung for fuel and manure will be affected. Landless systems will become increasingly significant in Central America. The external inputs used in these systems allow the production environment to be highly controlled so that an animal's full genetic potential can be expressed. Therefore is a reduction in the range of genotypes used. Nonetheless, prudent management of genetic resources for current and potential future use within these systems remains important.

3 Animal genetic resources

3.1 Status

Table 8 illustrates the number of animals of each major species in the Central America subregion and also gives an estimate of the number of breeds. Tables 9 and 10 show the transboundary mammalian and avian breeds in Central America.

TABLE 8

Total population size and number of breeds of the major livestock species in the Central America subregion and their share of the world total

	Population size (1 000)	Number of national breed populations	Share of world total	
			Population (%)	Number of breed populations (%)
Buffalo	-	5	-	3
Cattle	51 693	214	4	8
Goat	12 297	61	2	5
Sheep	9 983	58	1	3
Pig	19 690	81	2	6
Ass	3 671	7	9	4
Horse	8 487	88	15	7
Chicken	614 409	91	4	4
Duck[1]	8 515	3	1	1
Turkey	5 036	3	2	2
Goose (domestic)	40	3	0	1

[1]Domestic duck and Muscovy duck.

Source for population figures: FAOSTAT data for 2004.

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TABLE 9
Transboundary mammalian breeds in Central America

Cattle (1)	Cattle (2)	Sheep	Horse
Aberdeen-Angus	Mashona	Barbados Black Belly	American Saddle Horse
Brown Swiss	Creole	Charollais	Anglo-Arab
Argentine Criollo	Murray Grey	Columbia	Appaloosa
Asturian Valley	Nelore	Corriedale	Arab
Australian Friesian Sahiwal	Ongole	Criollo	Belgian Draft
Ayrshire	Piedmont	Dorper	Costeño
Beefmaster	Pinzgau	Dorset Horn	Lusitanian
Belgian Blue	Puerto Rican	East Friesian	Morgan
Belmont Red	Red Angus	Hampshire Down	Palomino
Boran	Red Poll	Ile-De-France	Paso Fino
Braford	Red Sindhi	Karakul	Percheron
Brahman	Romagnola	Katahdin	Quarter Horse
Brangus	Sahiwal	Merino	Shetland Pony
Charbray	Salers	Pelibuey	Thoroughbred
Charolais	Santa Gertrudis	Polypay	Welsh Pony
Chianina	Senepol	Rambouillet	Purebred Spanish
Chusco	Shorthorn	Romanov	Costarricense de Paso
Dexter	Siboney	St. Croix	Creole
Droughtmaster	Simmental	Suffolk	Hackney
Gelbvieh	Tabapua	Texel	Hispano-Arabe
Gir	Tropical Dairy Criollo	Wiltshire Horn	American Paint
Guernsey	Tuli	Canaria	Azteca
Guzerat	Indo-Brasilian	Castilian	Iberoamericano
Hereford	Simbrah	Spanish Churro	
Holstein (black and white)	AFS	Lacha	
Jersey	Sarda		
Limousin	Dairy Gir		
Marchigiana			

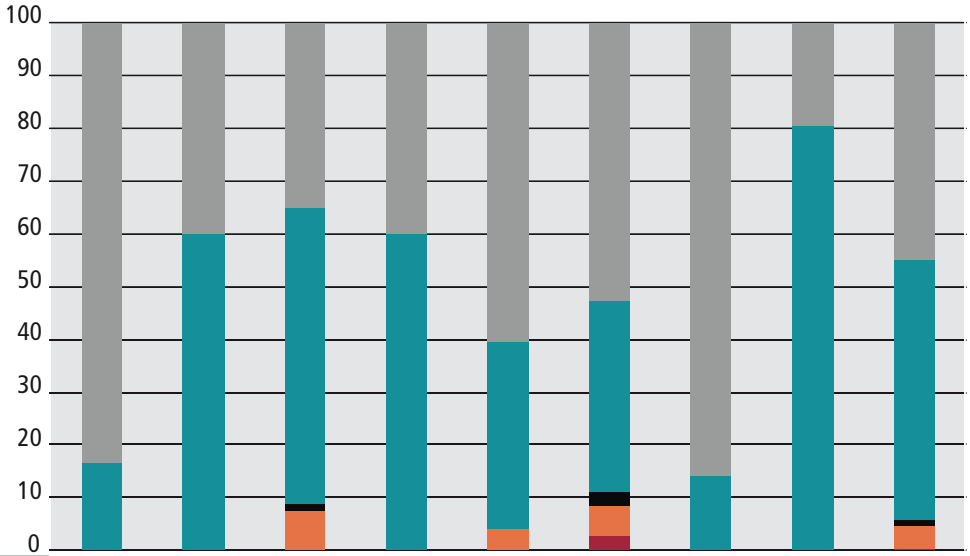
Goat	Pig	Rabbit	Buffalo	Ass
Alpine	Duroc	Angora	Jafarabadi	Burro Kentucky
Anglo-Nubian	Hampshire	Blauer Wiener	Mediterranean	
Boer	Jersey Red	California	Murrah	
Creole	Lacombe	Chinchilla		
Criollo	Large White	New Zealand		
Guadalupe Island	New Haitian	New Zealand White		
Saanen	Pelon	New Zealand Red		
Toggenburg	Pietrain	Mariposa		
French Alpine	Poland China	Géant des Flandres		
Granada	Landrace			
La Mancha	Dalland			
Murciana	PIC HY			
	Seghers			
	Geneticporc			

TABLE 10
Transboundary avian breeds in Central America

Chicken (1)			Chicken (2)	
Commercial strain, broiler, Arbor Acres AA broiler breeders			Commercial strain, layer, Shaver	
Aseel			Commercial strain, layer, Shaver Starcross 579	
Plymouth Rock Barred			Araucana	
Catalana Del Prat			Commercial strain, layer, Hendrix Bovan Brown	
Commercial strain, layer, Cobb 500			Commercial strain, layer, Hy-Line	
Cornish			Commercial strain, layer, Hy-Line White	
Commercial strain, layer, Dekalb			Commercial strain, broiler, Kabir Chicks Ltd.	
Commercial strain, Hubbard			Commercial strain, layer, Lohmann	
Commercial strain, layer, Hy-Line Brown			Commercial strain, Peterson	
Commercial strain, layer, ISA Brown			Plymouth Rock	
Commercial strain, layer, Leghorn			Commercial strain, layer, Shaver Starcross	
Light Sussex			Sumatra	
New Hampshire			Warren	
New Hampshire Red			Commercial strain, broiler, Euribrid Hybro	
Rhode Island Red			Orpington Buff	
Commercial strain, broiler, Ross				
Duck	**Goose**	**Guinea fowl**	**Muscovy duck**	**Turkey**
Pekin	White Hungarian	Purple Guineafowl	Muscovy	White
		White Guineafowl		
		Grey Guineafowl		

Figures 5 and 6 illustrate the structure of the data recorded in the Global Databank for Farm Animal Genetic Resources, showing the risk status of the mammalian and avian breeds recorded for each species in the Central America subregion up to 2005. Only 5 percent (17 of 320) of extant mammalian and avian breeds in Central America are categorized as at risk. However, this is probably an underestimate of the actual situation, primarily because of a lack of information. Population data is available for only 16 percent of mammalian and avian breeds, and those that are most at risk of extinction are usually those for which it is most difficult to obtain accurate census information (FAO/UNEP, 2000).

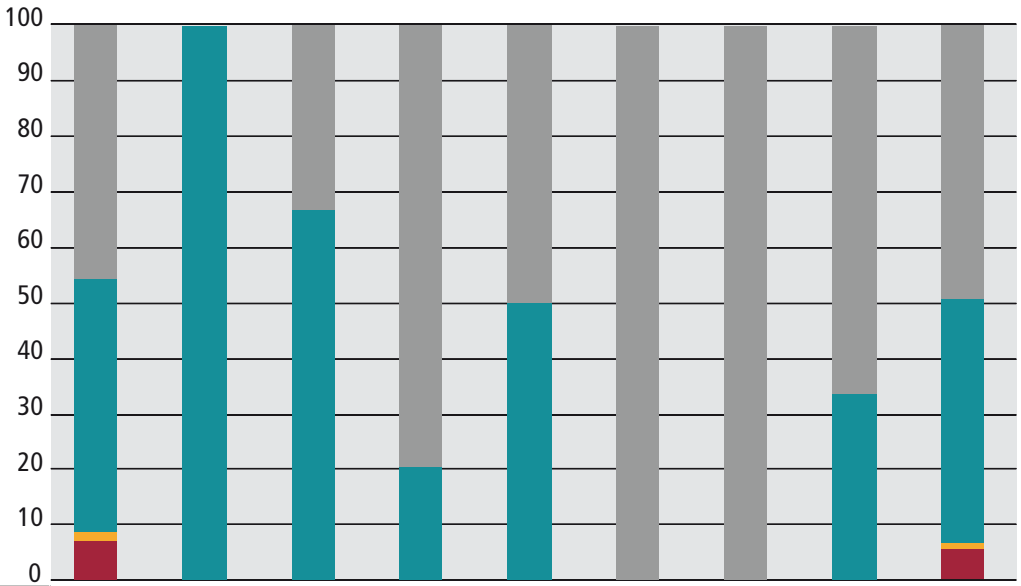
FIGURE 5
Risk status of Mammalian breeds recorded in the Central America subregion* up to December 2005: absolute (table) and percentage (chart) figures



RISK STATUS	Ass	Buffalo	Cattle	Goat	Horse	Pig	Rabbit	Sheep	Total
critical	0	0	0	0	0	1	0	0	**1**
endangered	0	0	7	0	2	2	0	0	**11**
extinct	0	0	1	0	0	1	0	0	**2**
not at risk	1	3	52	9	17	13	2	25	**122**
unknown	5	2	32	6	29	19	12	6	**111**
Total	**6**	**5**	**92**	**15**	**48**	**36**	**14**	**31**	**247**

*Breeds that are also recorded in countries outside Latin America and the Caribbean are excluded from the analysis.

FIGURE 6
Risk status of avian breeds recorded in the Central America subregion* up to December 2005: absolute (table) and percentage (chart) figures

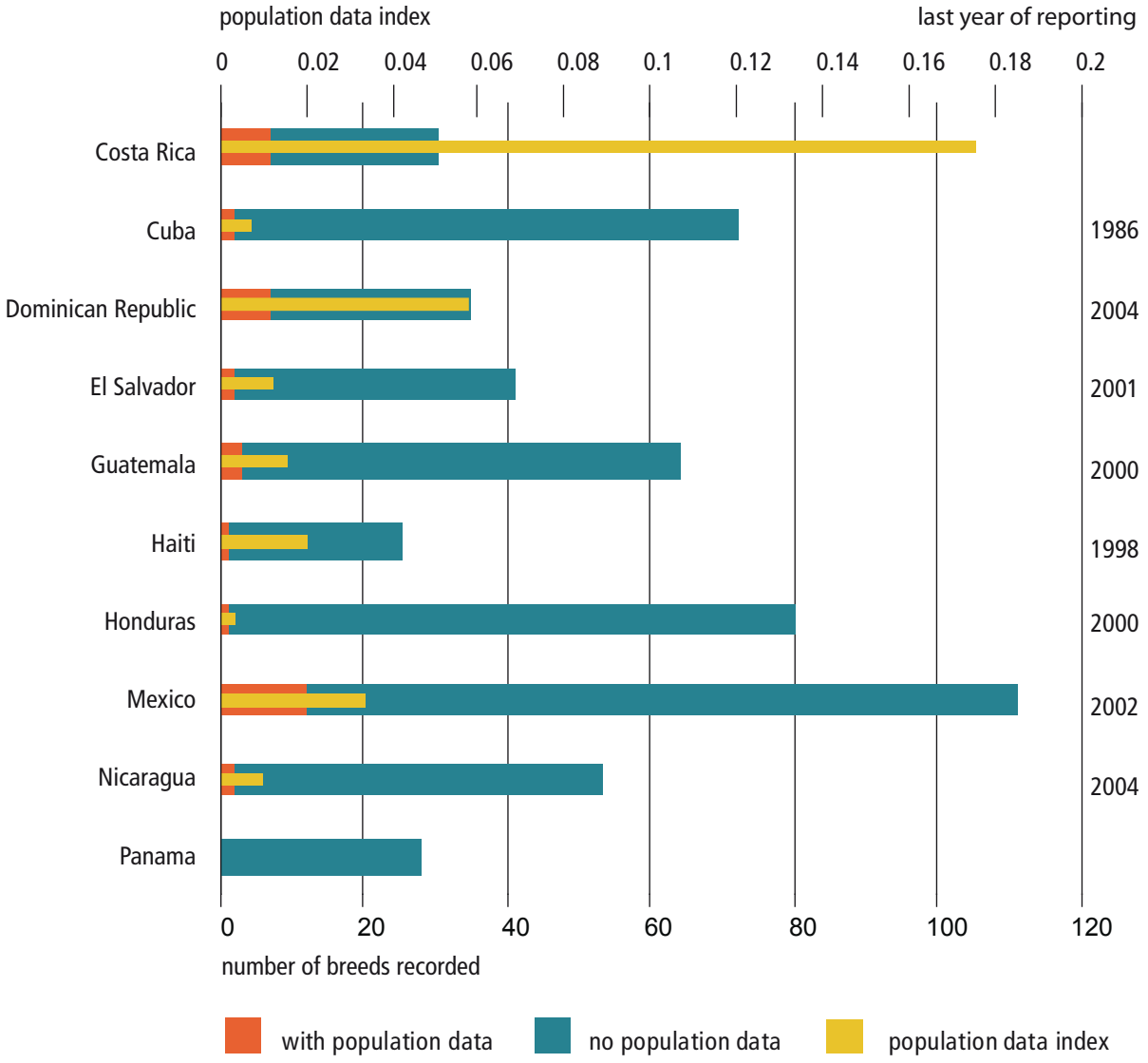


RISK STATUS	Chicken	Duck	Goose	Guinea fowl	Muscovy duck	Pheasant	Quail	Turkey	Total
endangered	4	0	0	0	0	0	0	0	**4**
endangered-maintained	1	0	0	0	0	0	0	0	**1**
not at risk	27	1	2	1	1	0	0	1	**33**
unknown	27	0	1	4	1	1	1	2	**37**
Total	**59**	**1**	**3**	**5**	**2**	**1**	**1**	**3**	**75**

*Breeds that are also recorded in countries outside Latin America and the Caribbean are excluded from the analysis.

Figures 7 and 8 provide general overviews of the quantity and quality of the population data provided by each country for their AnGR. The total number of breeds recorded by each country is shown. No information is displayed for those countries for which no breeds are recorded in the Global Databank for Farm Animal Genetic Resources. For all other countries, breeds are split into those with population data and those with no population data (risk status unknown). When one or more fields in the Global Databank for Farm Animal Genetic Resources are completed then the breed is identified as having population data. For those breeds recorded as having population data, a population data index (PDI) is calculated, which provides an indication of the completeness of the data provided by the country. Selected basic population data fields, regarded as being the most important and used in the calculation of risk status, are considered – population size (absolute or range), number of breeding females, number of breeding males and the percentage of females bred to males of the same breed (FAO/UNEP, 2000).

FIGURE 7
Population data status and index for mammalian breeds recorded by country of the Central America subregion up to December 2005

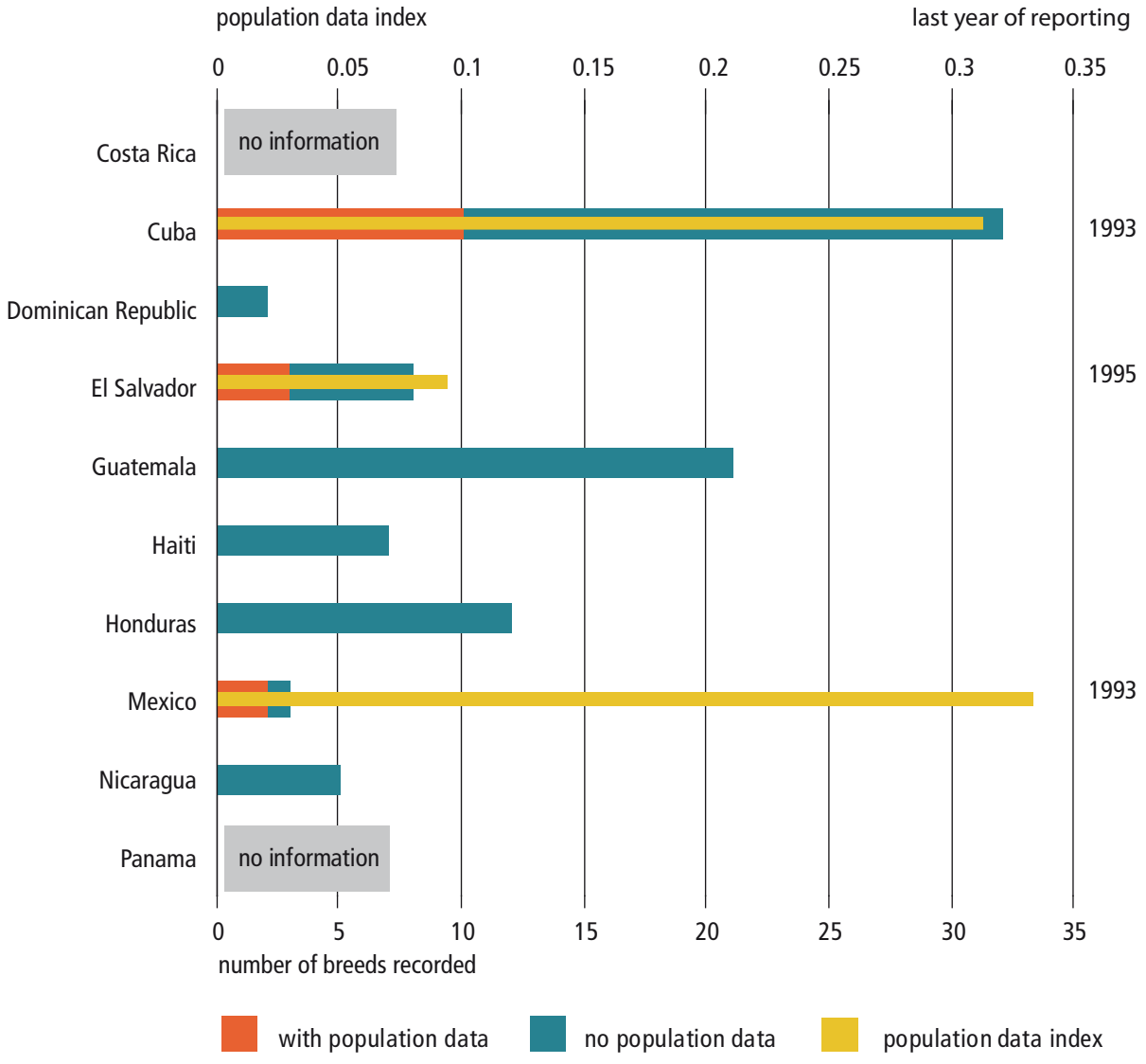


With population data: Those breeds with information recorded in one or more of the 16 population data fields.

No population data: Those breeds with no information recorded in any of the 16 population data fields.

Population Data Index (PDI): For each country the PDI was calculated only for those breeds recorded with population data. The PDI is the fraction of selected population data fields (population size, number of breeding females, number of breeding males and the percentage of females bred to males of the same breed) that contain information, averaged across breeds.

FIGURE 8
Population data status and index for avian breeds recorded by countries of the Central America subregion up to December 2005



With population data: Those breeds with information recorded in one or more of the 16 population data fields.

No population data: Those breeds with no information recorded in any of the 16 population data fields.

Population Data Index (PDI): For each country the PDI was calculated only for those breeds recorded with population data. The PDI is the fraction of selected population data fields (population size, number of breeding females, number of breeding males and the percentage of females bred to males of the same breed) that contain information, averaged across breeds.

3.2 Threats to animal genetic resources in Central America

Important threats to AnGR in Central America include natural disasters, climate change, animal diseases, environmental degradation and lack of appropriate livestock policies.

Natural disasters are a threat to AnGR in Central America. In El Salvador, for example, the livestock sector has been severely and frequently affected by several types of disaster, including hurricanes, earthquakes, volcanic eruptions, and droughts (CR El Salvador, 2003). Honduras has been affected by climatic phenomena such as "El Niño" and strong hurricanes, which have devastated land and livestock populations. CR Honduras (undated) notes that mechanisms to prevent loss of animal genetic resources in case of disasters are needed. Climate change is likely to exacerbate these risks. Scientific estimations indicate that changes in the global temperature may have an effect on the intensity and frequency of tropical cyclones affecting Central America. According to the scientific assessment of the Intergovernmental Panel on Climate Change (IPCC), a change in the climatic conditions may have an effect on important economic activities, such as forestry and agriculture, as well as affecting biodiversity, water resources, human health, and coastal and marine ecosystems. Central American economies are highly dependent on agricultural products. The relationship between agriculture and the climate, increase the vulnerability of the sector to potential climate changes (Central America Country Studies Project Team, 1995).

Deforestation, overgrazing, and other inappropriate agricultural activities, have left millions of hectares of land in Latin America moderately or severely degraded. This situation poses a threat to livestock production systems and the associated animal genetic resources. Since 1960, almost 50 percent of Central American forests have been destroyed (IFPRI, 1995). "Slash and burn" agriculture, practised widely in Central America, has destroyed much of the subregion's rich biodiversity. There is a high rate of soil erosion from the often steep, tropical hillsides. Irrigated areas throughout the subregion are affected by waterlogging and the accumulation of harmful salts.

Animals are also challenged by many diseases, especially in the warm humid areas. Tick-borne infections such as babesiosis and anaplasmosis are becoming more widespread in the subregion and pose particular problems for newly imported breeds. A number of bacterial and viral diseases can cause mortality, reproductive disorders or chronic loss of productivity in cattle and sheep – for example, anthrax, brucellosis, blackleg, mastitis, tuberculosis and rabies. Classical swine fever is a serious problem in the subregion. Most notably, epidemics in Cuba in 2001/2002 and the Dominican Republic in 1998 led to the deaths or slaughter of large numbers of pigs (OIE, 2006). Venezuelan equine encephalomyelitis is also prevalent in the subregion resulting in considerable losses among horses and donkeys (FAO/UNEP, 2000).

3.3 Unique resources highlighted

Most domesticated livestock species in Latin America and the Caribbean were introduced to the subregion by successive waves of European exploration and colonization. Few domesticated animals existed in pre-colonial times, although indigenous peoples did domesticate a number of species. These include guinea pigs, dogs, llamas, alpacas, Muscovy ducks, turkeys and black chickens (ibid.).

The West African Dwarf goat, brought from West Africa together with slaves, is thought to have contributed considerably to some local goat breeds. Introduced species soon adapted to local environments and now represent well-adapted breeds (ibid.). Turkeys are thought to have been first domesticated in the subregion about 2 000 years ago (ibid.).

Apart from the major domesticated species, Latin America is home to a large number of microlivestock species which include a variety of ungulates as well as rodents and reptiles. The paca is a prolific rodent species which is able to provide a valuable source of meat without destroying forest ecosystems (ibid.). The capybara, also a prolific species, is noted for its meat and leather. This large rodent can be used to graze swampy grasslands, which are generally rejected by cattle. Other rodents such as the coypu, guinea pig, agouti and hutia also represent valuable sources of food. Among the ungulates, the collared and the white-lipped peccaries are prolific animals appreciated for their meat and leather (ibid.). These species, as well as the capybara, are already being raised commercially. The iguana, an indigenous reptile, is also a popular source of meat in parts of Central America (ibid.). Green and brown iguanas are hunted for their meat and eggs, or for their commercially valuable hides. Newly hatched iguanas are sometimes captured for the export pet trade. Iguana eggs are a highly prized local food. In some Central American countries, iguana meat is not only daily subsistence food, it is also in demand for the typical dishes of the Lenten period. Large quantities of live green and brown iguana are sold in the local markets where the consumption of this reptile is a long-established tradition (FAO, 1996c).

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Annex

Classification of livestock production systems

FAO (1996)[1] used the agro-ecological zones (AEZ) described by the Technical Advisory Committee (TAC, 1994)[2] and provided a comprehensive description of global livestock production systems using quantitative statistical methods. In this system the distinction is based upon grassland-based systems (LG), mixed-rainfed systems (MR), mixed irrigated systems (MI) and landless systems (LL). The landless livestock production systems are not linked to agro-ecological zones.

- Grassland-based systems (LG) are livestock systems in which more than 90 percent of dry matter fed to animals comes from rangelands, pastures, annual forages and purchased feeds and less than 10 percent of the total value of production comes from non-livestock farming activities. Annual stocking rates are less than 10 livestock units per hectare of agricultural land. A further distinction is made between Temperate Zones and Tropical Highlands (LGT), Humid and Subhumid Tropics and Subtropics (LGH) and Arid and Semi-arid Tropics and Subtropics (LGA).

- Mixed-rainfed systems (MR) are defined as rainfed systems in which more than 10 percent of the dry matter fed to livestock comes from crop by-products and/or stubble or more than 10 percent of the value of production comes from non-livestock farming activities. A further distinction is made between Temperate Zones and Tropical Highlands (MRT), Humid and Subhumid Tropics and Subtropics (MRH) and Arid and Semi-arid Tropics and Subtropics (MRA).

- Mixed-irrigated systems (MI) are defined as irrigated systems in which more than 10 percent of the dry matter fed to livestock comes from crop by-products and/or stubble or more than 10 percent of the value of production comes from non-livestock farming activities. A further distinction is made between Temperate Zones and Tropical Highlands (MIT), Humid and Subhumid Tropics and Subtropics (MIH) and Arid and Semi-arid Tropics and Sub-tropics (MIA).

- Landless systems are defined as those where less than 10 percent of the dry matter consumed is produced on the farm where the livestock are located, and where annual average stocking rates are above 10 livestock units (1 LU = 1 cattle or buffalo or 8 sheep or goats) per hectare of agricultural land. Furthermore, landless monogastric (LLM) and landless ruminant systems (LLR) are distinguished. The former are mainly industrial, intensive and vertically-integrated pig and poultry enterprises whose economic outputs are higher than those of ruminant enterprises. In landless ruminant systems, the value of production of the ruminant enterprises is lower than that of the pig and poultry enterprises.

[1] FAO. 1996. *World livestock production systems. Current status, issues and trends*, by C. Seré, H. Steinfeld & J. Groenewold. FAO Animal Production and Health Paper No. 127. Rome.

[2] TAC. 1994. *Animal agriculture in developing countries: technology dimensions*. Development Studies Paper Series. Morrilton, Arkansas. Winrock International.

Subregional priorities: **Central America**

Representatives of Costa Rica (4), Cuba (6), Dominican Republic (5), El Salvador (4), Guatemala (5), Honduras (9), Mexico (15), Nicaragua (3), and Panama (3), and the Ibero-American Network for Biodiversity Conservation of Local Domestic Animals in Sustainable Rural Development (CYTED XII-H) participated in the electronic consultation held during November 2005, and agreed on priority actions to be undertaken in the subregion.

1 Inventory and characterization

Actions to be implemented:

- develop strong national organizations for the management of animal genetic resources (AnGR) to prepare strategic plans based on the Country Reports and to advise governments on the implementation of national policies (there are examples of commissions/councils for AnGR in Cuba, Costa Rica and Mexico);
- define a minimum profile for the National Coordinator for AnGR;
- build a Central American network, involving national and subregional institutions (animal health programmes), and breeder organizations;
- establish national scientific organizations for animal production in several countries;
- develop national databases for AnGR and update DAD-IS;
- develop subregional and regional projects on characterization of regional transboundary AnGR;
- implement workshops for training on methodologies to estimate animal inventories and to characterize AnGR;
- use the structure of CYTED XII-H to accomplish some of these activities.

FAO should: coordinate national initiatives for inventory and characterization, providing protocols and seed money for specific international projects; and support human capacity building and public awareness activities.

Other institutions identified for the region: CYTED XII-H, IICA (Inter-American Institute for Cooperation on Agriculture), OIRSA (Organismo Internacional Regional de Sanidad Agropecuaria).

2 Utilization

Measures to ensure sustainable utilization:

- look for niche markets and promote local trade in animal products derived from locally adapted AnGR;
- integrate the production-process-trade-consumption chain for animal products, especially of those derived from locally adapted AnGR, to promote fair benefit sharing;
- seek ways to enable a premium to be obtained for animal products raised under environmentally friendly production conditions;
- governments should invest in research, development, innovation, technology transfer, product processing, and marketing of animal products, specially of locally adapted AnGR;
- avoid the indiscriminate importation of exotic AnGR;
- develop breeding programmes for locally adapted AnGR in traditional production systems;
- utilize the media to disseminate knowledge, experiences, roles and values of AnGR, underlining historic and cultural values;

- promote knowledge of the importance of AnGR in formal education;
- evaluate traditional knowledge of AnGR management though scientific methodologies and promote their use, especially where women are involved.

Subregional and regional actions to be implemented:

- build breeders' organizations for locally adapted AnGR and promote regional interaction among them (particularly for Creole dairy cattle national breeders' associations);
- promote participation in local, national or regional agricultural fairs, in order to show locally adapted AnGR and their products;
- develop sound breeding structures for the sustainable use of locally adapted AnGR, involving breeding companies;
- develop a regional network for AnGR;
- continue the implementation of subregional and regional workshops organized by FAO to build capacities for the management of AnGR;
- develop regional and subregional projects involving several institutions and disciplines;
- prepare video conferences on successful international trading of traditional animal products.

3 Conservation

Measures to insure sustainable conservation:

- build strong consultative committees involving people with various backgrounds (production, administration, training, research, business, etc.) to organize and prioritize public awareness, research and training activities, the structure and functionality of which will vary among countries;
- organize academic events to promote awareness of the importance of AnGR, insuring the participation of students;
- promote the inclusion of specific topics regarding the importance of AnGR in food security at various levels of educational programmes;
- identify practical criteria to define distinct animal populations to be conserved and improved, so that financial support is prioritized;
- promote the organization of small producers in cooperatives to promote fair trade;
- CYTED XII-H propose a model they use which involves participation at different levels: natural resources (biodiversity), production systems, human resources (breeders), processing, marketing and consumers;
- develop genetic reserve units (production units involving various locally adapted species) to be used for research, training, and sustainable production (an example being the "cotos de reserva genética" in Cuba).

Subregional and regional actions to be implemented:

- FAO should utilize the media to promote the importance of AnGR, identifying "marketing"experts to convince the public and decision-makers about the role and values of these resources;
- FAO should coordinate with Ministries of Education the preparation of materials with illustrations of AnGR to be used in schools;
- FAO should promote the establishment of an "international day of AnGR";
- organization of workshops for training a large number of people from the subregion, using the structure and experience of CYTED XII-H and the local capacities;
- increase the participation of locally adapted AnGR in subregional or regional fairs;
- promote the exchange of transboundary AnGR among countries;
- develop subregional/regional germplasm banks identifying fair mechanisms to ensure benefit sharing (although this may be a complex task).

4 Policy, institutions and capacity building

Main limitations:

- several countries do not have functional National Focal Points for AnGR (NFP);
- where NFP are in place, there is not enough communication and coordination among primary stakeholders, and there is a lack of support from governments;
- in most countries there is a lack of awareness of the importance of AnGR;
- in several countries, human, physical and financial resources for the management of AnGR are limited.

Measures to ensure strong focal points:

- identify minimum standards for the people and institutions involved in the coordination of AnGR activities at national level;
- look for ways to ensure continuity of the activities of NFP activities, after changes in government administration;
- develop strong NFP/Consultative Committees involving the main stakeholders, and build national networks.

Regional actions to be implemented:

- FAO should initiate regional coordination through the support of a regional network based on a Web page, using the experience and organization of CYTED XII-H;
- the regional network should coordinate the efficient use of infrastructure, laboratories, technologies and human resources, for specific regional activities;
- once this regional network is operating, NFP may look for a regional organization with the potential to foster an RFP, for example, IICA (with governmental representation) or CYTED XII-H (there were suggestions that FAO should finance the RFP).
- FAO should invite financial organizations to participate in regional and subregional workshops on AnGR;
- FAO should identify and publicize a list of potential donors, indicating support priorities, project application forms and schedules for application;
- FAO should support regional an subregional projects such as the Creole Cattle Project, prepared by members of CYTED XII-H.