

ACADEMIE ROYALE DES SCIENCES D'OUTRE-MER

**Role of Urban and Peri-urban
Livestock Production in
Poverty Alleviation and Food Security
in Africa**

by

Eric THYS

KONINKLIJKE ACADEMIE VOOR OVERZEESTE WETENSCHAPPEN

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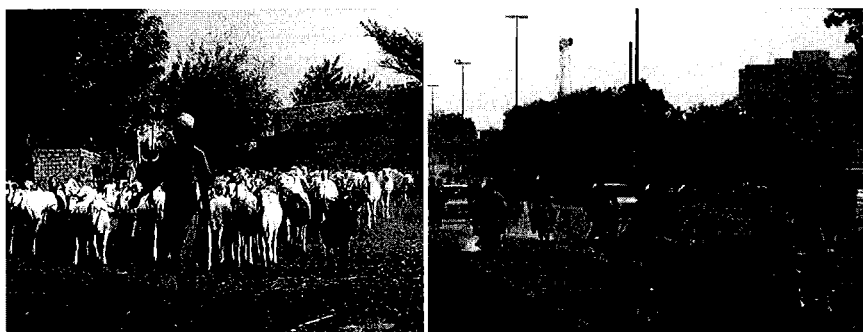
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Institute of Tropical Medicine, Antwerp



A flock of small ruminants entering the city of Maradi (Niger) contrasting with the fully urbanized centre of Ouagadougou (Burkina Faso).

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FOREWORD

Urban livestock is of great importance for developing countries with regard to food safety in cities, and the provision of quality protein food in the context of a dramatic increase in the human population. This aspect will be developed later in this paper, but it is already important to highlight the fact that demographers predict that in 2025, 65 % of the world's population and approximately 50 % of the African population will be concentrated in towns.

Since the early nineties, a lot of publications have focused on the fact that the number of animals kept in towns in developing countries is considerable. Apart from the growth of the industrial livestock sector, animals are also present in the city at household level for social security and economic purposes.

Over time, the side effects of this phenomenon on the environment, on human and animal health and also the technical aspects of animal husbandry and economic profitability in the urban context began to concern professionals and urban planners.

At the same time, as a consequence of Structural Adjustment Programmes (SAPs) and other cyclical factors, poverty has not diminished over the last decade, so that security-related urban livestock rearing seems to have a specific importance.

Considering that a significant amount of information was available, it appeared of great interest to approach this complex subject and provide some recommendations. It was also recognized as important in light of the fact that food safety and poverty reduction are currently major preoccupations for donors.

The study was limited to Africa for the reason that the field of urban livestock production is very heterogeneous and that Africa still remains an important target for aid agencies.

LIST OF ABBREVIATIONS AND ACRONYMS

DGDC	Directorate General for Development Cooperation
EU	European Union
ETC	ETC International Group
FAO	Food and Agriculture Organization
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
ITM	Institute of Tropical Medicine
MSc	Master degree
NGO	Non-governmental Organization
PUI	Peri-urban Interface
RIPROSAT	Réseau International des Diplômés en Production et Santé Animales Tropicales (alumni network)
RUAF	Resource Centre on Urban Agriculture and Forestry
SAP	Structural Adjustment Programme
UN	United Nations
UNDP	United Nations Development Programme
UNCHS	United Nations Centre for Human Settlements
WHO	World Health Organization

DEDICATION

This work is dedicated to the late Professor Jozef Mortelmans, former Head of the Veterinary Department of the ITM, who will permanently remain a model for us.

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We are very grateful to the Directorate General for Development Cooperation (DGDC) of the Belgian Federal Public Service of Foreign Affairs, Foreign Trade and Development Cooperation, both for their financial support, which made this study possible, and for their great interest in this particular aspect of urban development, food security and poverty alleviation.

We are also thankful to the alumni of the Tropical Animal Health and Production courses of the Institute of Tropical Medicine (ITM), especially André Mfoukou-Ntsakala who carried out the survey in Brazzaville and Mamadou Oueadraogo who was responsible for a similar exercise in Ouagadougou. We are also grateful to all the other participants in these surveys, especially the authorities of the various towns where studies were carried out, the staff of the public services involved, as well as research units and the many individuals and households who cooperated with us in Africa.

Thanks also to Stanny Geerts, promoter of the research, and to our other colleagues at the Animal Health Department of the ITM who made very fruitful comments and suggestions for improvements.

SUMMARY

Urbanization is a world trend and demographers predict that in 2025, 65% of the world population and approximately 50% of the African population will be concentrated in towns. Predominantly rural in the past, Africa currently has the highest annual urban growth rate in the world. African urbanization is not the consequence of an industrial revolution, as in other parts of the world, but rather results from rising levels of health among urban dwellers. The economy is characterized by trade and crafts more than by industry, and there is a very large and growing informal economy. However, over the last decade, as a result of economic crises and the subsequent implementation of Structural Adjustment Programmes, this emerging sector has been ravaged. This has resulted in urban poverty severe enough to jeopardize livelihoods as well as food and nutrition security in most of the towns. Alternative food supply sources, such as home production and participation in public and household-to-household transfers, are therefore playing an increasingly important role among the survival strategies of poor urban inhabitants.

As well as agriculture, livestock is of great importance for developing countries in the context of food safety, and the provision of quality protein food to the populations. Since the early nineties, numerous publications have highlighted the fact that the number of animals kept in towns in these countries is considerable. Apart from the emergence of the industrial livestock sector, animals are also present in the city at household level for social security and economic purposes. Eventually, the side effects of this phenomenon on the environment and on human and animal health have come to concern professionals and urban planners. They have also focused on the technical aspects of animal husbandry and the issue of economic viability in the urban context. The aim of our research was to study this phenomenon and its secondary effects in Africa through the available literature, and the implementation of our own surveys, principally in Ouagadougou (Burkina Faso) and Brazzaville (Congo).

Livestock production inside city boundaries is, like urban agriculture, a very old phenomenon. Cities have always needed to secure their source of proteins and other animal products and by-products. The presence of backyard animals was a common phenomenon, even in western countries until quite recently.

The study shows the complexity of the situation regarding urban and peri-urban livestock production, which comprises a wide variety of species, breeds and forms of production, ranging from the simple ownership of animals to industrial systems. Milk production, using dairy cattle, is the most widespread practice, as the product is highly perishable and the proximity of the production plots is a guarantee of freshness for the customer. This is the same situation for camels. Two cases of cow's milk production are described in West Africa (boxes 1 and 2).

Urban sheep and goat production is traditionally linked to the custom of sacrificing animals for religious feasts, including the well-known Moslem Sheep Festival, and to savings. The cases of Maroua, Cameroon (box 3) and Maradi (box 4) give more details about the importance of small ruminants in mid-sized towns. Back-yard poultry is very common, but also large-scale units producing eggs and meat. Box 5 illustrates small-scale commercial production of broilers in Yaoundé, Cameroon. Pig production remains marginal in most parts of the African continent, due to the important constraint of African Swine Fever, except in a few countries such as Nigeria, Madagascar or South Africa. Finally, in addition to those already mentioned, most other domestic animal species are to be found in towns: birds (ducks, guinea fowls), guinea-pigs, and rodents including rabbits and the great cane rat.

The sector is facing a wide range of difficulties arising from the urban context in which it has been evolving, including feed problems, lack of space, lack of services, etc. However, in spite of producing various negative effects, such as pollution, roaming in the streets and so on, urban livestock production presents significant social, environmental and economic opportunities and benefits.

The importance of livestock production as a survival strategy for poor urban dwellers has been highlighted in our surveys in Ouagadougou (26.2% of the households are practitioners) and Brazzaville (8.9%). It is mostly people with previous experience in the field who are involved. The average profile of the current urban livestock owner in Ouagadougou is a person, usually a man, with previous experience in livestock, generally declaring himself to be a breeder and/or a cultivator, and having a household with more than three to five persons. The average profile of the current urban livestock owner in Brazzaville is a person who was involved with livestock before the 1997 war, and who occupies a compound larger than 388 m².

Agriculture is more commonly practised than livestock keeping, but the latter is more important in cash generation. Another important point is that livestock is not necessarily combined with agriculture (mixed farming). Depending on the location, livestock is not combined with agriculture in 56.9% of the households with livestock in Ouagadougou and in 37% of those in Brazzaville. Livestock also has an important cultural and socio-religious role to play. The survey in Brazzaville also shows that urban livestock production is negatively influenced by conflicts and that it leads to a shift to smaller species, such as poultry and rodents.

The study focuses on the difference in perception between the authorities and those involved in livestock production, as well as between experts and producers. Public authorities are more sensitive to the negative aspects of the activity, such as lack of hygiene, road accidents, neighbourhood conflicts and damage to property. They seem to be particularly influenced by socio-economic factors, such as, for instance, the scale of the professional sector. Experts involved in research seem to be the persons most aware of the positive effects of urban livestock keeping. Aside from a concern with technical factors, the producers

themselves seem to be especially worried about theft, which explains why, despite attempts to keep animals outside city boundaries, people seek to keep them inside their compounds.

The differences in viewpoint are clearly linked to conflicts between the perceived interests of the various stakeholders, in what is a complex context overall, and thus to a difference in opinion about the advantages of urban livestock production itself, as well as about the nuisance it entails. The study of manure management in Ouagadougou and Brazzaville provides an example of these divergent positions.

Urban livestock production has many interfaces and has to be considered in a broader urban-rural continuum, as illustrated in the framework drawn up on the basis of the study (fig. 14).

The future of this evolving phenomenon seems to be dependent on the reconciliation of the various points of view involved, and on real and pragmatic consideration of the limitations of urban and peri-urban livestock production, and the nuisance it causes in terms of human health and urban hygiene. How this nuisance can best be controlled requires a common approach on the part of the various actors concerned, based on an accurate analysis of the objective facts. This should be taken into account when setting up city survival strategies so as to avoid a situation where urban livestock production remains stuck in the informal economic sector and in illegality. Figures are currently sufficiently strong to prove that urban livestock production is still a dynamic sector. No one knows when it may go into decline, but the important socio-cultural value attributed to animals in many African cultures will probably ensure that animals will be kept longer for that purpose than for food and income.

The aspect of the activity which seems least well documented, is that of the transmission of diseases to man. Indeed, although the theoretical model suggests that a high population concentration near animals and animal-based industries constitutes a potential danger to public health, experts who have been consulted on the matter seem to have little information suggesting that cities are at a higher risk than rural areas. Nevertheless, this aspect is too important, ethically speaking, to be neglected.

1. The General Context of Urban Livestock Production

1.1. URBANIZATION IN THE WORLD AND IN AFRICA

1.1.1. Urbanization: A World Trend

Urbanization can be defined as a process involving an increase in the proportion of the population that is urban or simply the “proportion urban”. Urbanization appears as an irreversible world trend affecting both the developing and the developed countries (fig. 1). In the last three decades the urban population of the developing world has risen threefold (RABINOVITCH & SCHMETZER 1997). For the first time in the history of humanity, more people will live in cities than in rural areas. DEELSTRA & GIRARDET (2000) state that “we are turning ourselves into an urban species”.

Continents can be classified in three groups (DGCID 2000):

- Continents, like Europe and North America, where the urbanization process started earlier and is very deeply rooted (75 % of the population is urban) and where the annual urban growth is slowing down and is currently 1%;

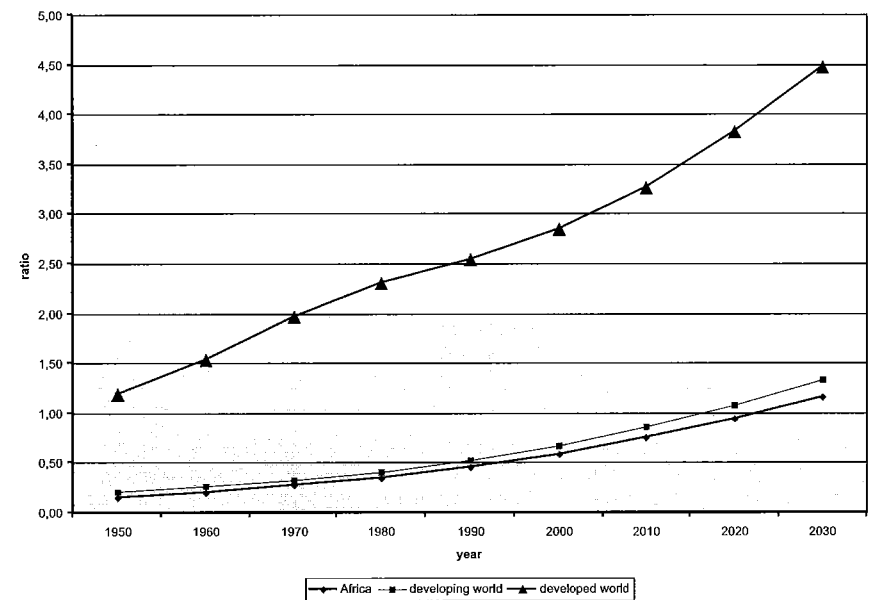


Fig. 1. — Evolution of the ratio urban/rural population in developing and developed countries (1950-2030).

- Latin America, where urbanization is also an old process, but where the growth rate is still significant (approximately 2%);
- New urbanization areas like the Middle East, Asia (excluding Japan) and Africa with a growth rate ranging from 2.5 to 5% at country level.

1.1.2. Particularities of Africa

In the past, Africa was a predominantly rural continent (DRESCHER *et al.* 2000). However, it currently has the highest growth rate in the world, with an average yearly estimate for the period 2000-2020 of 4%. Extrapolation of data shows that in 2025, 50% of the Africans will be living in towns (DGCID 2000).

Even in historical times, West Africa was already characterized by large cities. MAQUET (1966) spoke about the civilization of the cities. The best-known places are those in the kingdoms of Ghana, Mali and Songhay, but several other cities rose up in the area demarcated by the Atlantic Ocean, the Nile and the Gulf of Benin. Urbanization in Africa was also influenced in the late 19th and the early 20th centuries, by the colonial tendency to found towns to facilitate the exploitation of the colonies. ATKINSON (2001) pointed out that about half the cities of over one million in population, in the countries of the South, were founded by Europeans in that context.

The current pattern of urbanization in West Africa differs somewhat from that of East Africa (UNCHS 2001). In many West African countries there are few secondary cities, so the population is concentrated in one or a few larger cities. Population growth in East Africa is more evenly distributed over secondary and tertiary cities. Large cities in that part of the continent are also going through a period of rapid growth. By 2015, it is expected that Lagos (Nigeria) will have a population of more than ten million inhabitants, and seventy cities will have populations of more than one million. More precise data show that there is a strong contrast between the degree of urbanization among the different countries: 50% for Congo (Brazzaville) versus 5% for Burundi, for example. Cities in countries bordering the sea are developing faster than cities in inland countries (DGCID 2000).

Until recently, the most important contributor to urbanization in both West and East Africa was migration from rural areas. Now, natural population growth is responsible for a good part of that increase. In southern Africa, for instance, this is already the most important factor (fig. 2).

1.1.3. African Cities: General Economic Development Context

There is no doubt that urbanization influences the development pattern in general.

Sub-Saharan Africa, in particular, is experiencing accelerated urbanization, which is not the consequence of an “industrial revolution” as in most parts of the world (DGCID 2000). The strong demographic growth there is the consequence of improved levels of health, rather than the effect of the development of an

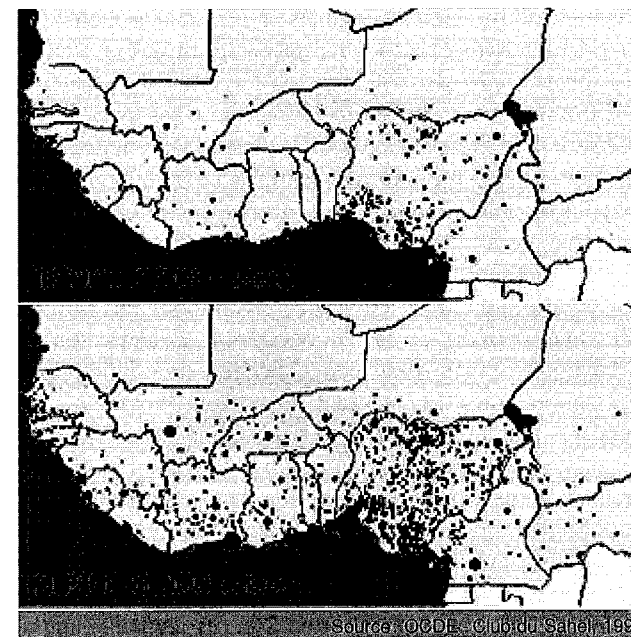


Fig. 2. — Expected evolution of the number of cities in western and central Africa between 1990 and 2020 (downloaded from <http://www.fao.org/NEWS/FACTFILE/IMG/FF9720-e.pdf>).

economy which remains more characterized by trade and craft than by industry. Before independence, the colonial powers generally favoured exporting raw materials rather than developing local manufacturing, to the benefit of metropolitan industries. Subsequently, industrialization failed to build up a sustainable industrial network and the export of raw materials still remains very important. Sub-Saharan African urbanization has been sustained by the development of a huge sector of small businesses and activities, which can be defined as an informal economy. In all of Africa, barely 10% of those entering the labour market today can find formal employment (ATKINSON 2001).

However, it is important to keep in mind that in the beginning, this informal economy was not only a response to the need for employment on the part of an increasing urban population, in the context of a weak and inadequate formal economy, but also an integral part of the ongoing urbanization process in sub-Saharan Africa itself. In the past thirty years, the number of people involved in that informal economy has increased sevenfold (DGCID 2000). Such is the case that small enterprises have been developed from these “small street jobs” (FODOUOP 1991, MENGHO 1998). According to the “Club du Sahel” (1999) the

effects of Structural Adjustment Programmes on urban areas include: higher food prices, higher prices for imported goods, growing joblessness among middle-class residents, lower wages and reductions in basic health, education and other social services. In this context, the informal economy has helped, and continues to help, poorer people to absorb such a major macro-economic shock. The link between urban poverty and the informal sector is overwhelming (SETHURAMAN 1997). A very considerable growth in the informal sector can be expected over the next twenty-five years in West Africa (Club du Sahel 1999).

This crisis situation and the evolving urbanization process have resulted in urban poverty severe enough to jeopardize livelihoods, as well as food and nutrition security in most of the towns (MAXWELL *et al.* 2000, HADDAD *et al.* 1998). Urban issues have not always been recognized as being as important as those involving rural communities. In “World Urbanization Prospects”, the UN even stated that there was still a real anti-urban bias among several aid agencies (UN 1999) and that urban poverty alleviation was not integrated in their aid policies. Recent research has shown that the assumption that poverty, food insecurity and malnutrition are largely rural problems is not accurate anymore (MAXWELL *et al.* 2000). There is a clear-cut shift, and this issue more and more concerns poor populations whether urban or peri-urban.

Therefore, Urban Poverty and Urban Food Security are becoming unavoidable concepts in the new list of development priorities, alongside Rural Poverty and Food Security.

1.1.4. Urban Food Security

Food security in general is a concept that has been on the international agenda since as far back as 1948 (ARMAR-KLEMESU 2000) but which has evolved considerably over time and become more complex. Currently there are approximately two hundred definitions and four hundred and fifty indicators of food security (HODDINOTT 1999). Right to food has come to be seen as a “fundamental right”. It has also been realized that the problem of hunger tends to be the consequence of inequalities in distribution and that increased food production is only part of the solution. As a consequence, the concept of food security has shifted from referring simply to the amount of food available at national and/or local level, to a more complex idea regarding access to food at the household or individual level (ARMAR-KLEMESU 2000). In much of the literature concerning food security, a distinction is drawn between chronic and transitory food insecurity, the latter being cyclical or temporary. Therefore, the concept of adequate food at the household or individual level has to be considered in terms of quality as well as quantity and adequate access has to be obtained at all times, both throughout the year and from one year to the next. The inequalities in food access urged Tim LANG (1999) to use the expression “food democracy” to refer to the demand for greater access to, and collective benefit from, the food system.

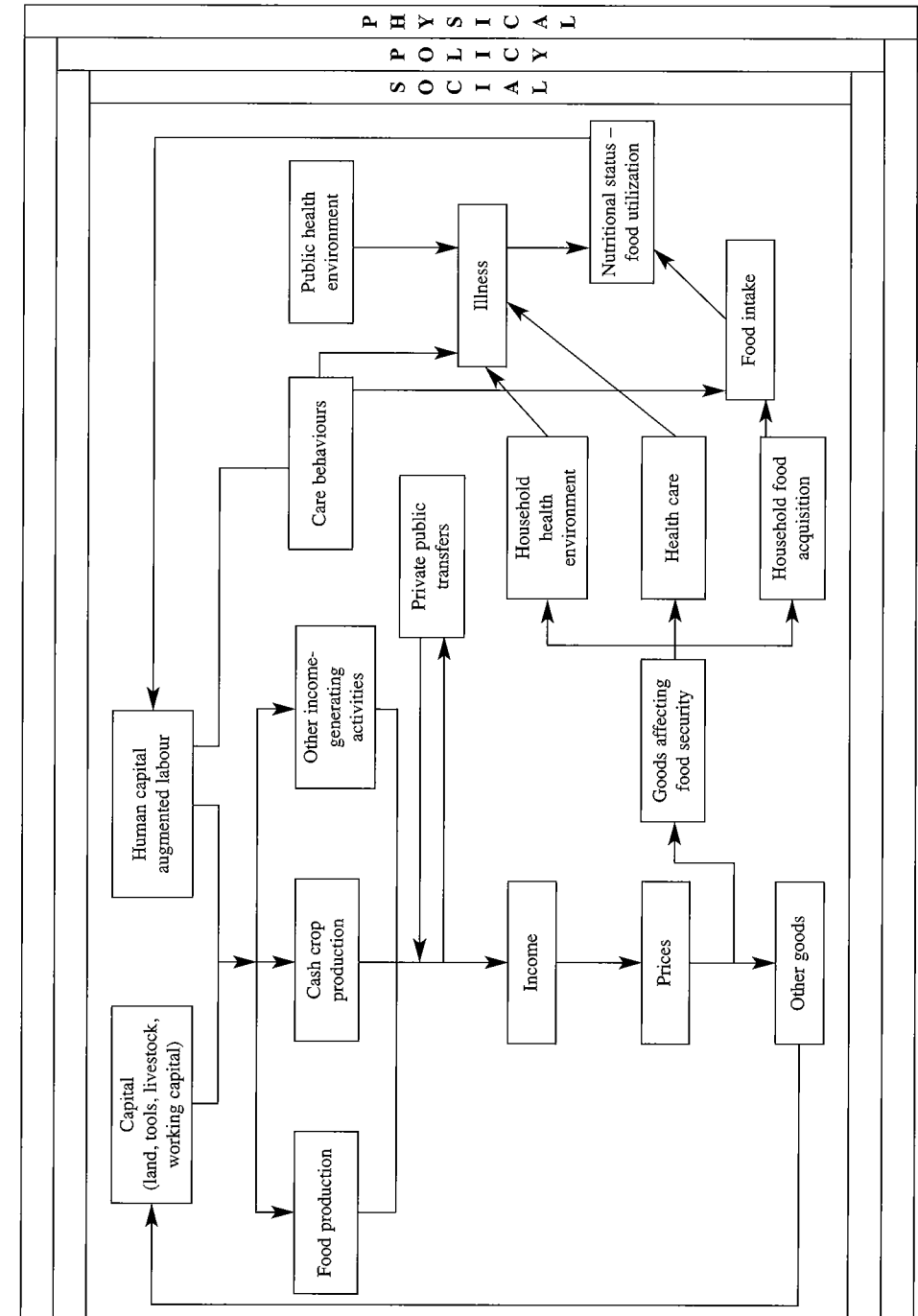


Fig. 3. — The determinants of household food security (HODDINOTT 1999).

Summarizing the concept, the Declaration of Rome on World Food Security (Rome, November 13-17th, 1996) included the following definition: “food security exists when all the human beings have, at any time, a physical and economic access to a sufficient, healthy and nourishing food allowing them to satisfy their energy needs and their food (dietary) preferences to lead a healthy and active life”.

Figure 3 illustrates the complexity of, and the interrelationships between, the different factors affecting food security at household level in general.

The general definition of food security is applicable to urban conditions, with the understanding that there are some specificities which are detailed below. In the same way as above, the concept urban poverty can be defined as “having income below a so-called poverty threshold, with revenues too low to allow access to basic services, benefit from adequate shelter or have sufficient access to food” (adapted from SETHURAMAN 1997).

Urban food insecurity has important health implications. A review conducted by HADDAD *et al.* (1998) found that in most of the cities studied, urbanization coupled with economic crisis lead to an increase in the number of underweight preschoolers. At the same time, urban living generally implies greater female participation in the labour force and this, along with other characteristics of urban employment, makes the provision of adequate childcare difficult. This can have negative effects on the nutrition status of children, even keeping in mind that increased household revenues improve the possibilities of purchasing food. To achieve a better understanding of the impact of under-nutrition and malnutrition on children, urban-rural and intra-urban comparisons have been made. The results show that, even if average childhood mortality and percentages of children underweight are generally lower in urban than in rural areas, the intra-urban differences between social classes are of a much larger magnitude than urban-rural differences (RUEL *et al.* 1998). This confirms the relationship between urban poverty and food security and the need to improve food availability.

Lifestyle changes and shifts in dietary patterns (food style) are also identified as consequences of urbanization and rapid economic development. When populations move from rural to urban areas their diet becomes generally more varied and includes higher proportions of fat, refined sugars and meat products. The reasons for that diversity compared with diets in the rural world are: higher income, changing values and norms, and cultural diversity (HADDAD *et al.* 1998). DELGADO *et al.* (1999) showed that there is a positive relationship between increase in meat consumption and increase in revenues. Currently, a significant proportion of individual food consumption occurs outside the home, mainly of food sold by street vendors. One of the reasons is that home to work distances in town are time-consuming, so that employees prefer to stay at their work place during the day. However, the consumption of street-vendor food cannot be dissociated from in-home consumption in the study of food patterns, which, as a result, become more complex and more difficult to carry out (BENDECH *et al.* 1996).

Another important question related to human nutrition is where urban dwellers are getting their food from, and at what cost. According to ELLIS & SUMBERG (1998), people get foodstuffs, like grains, vegetables, fruit, meat, milk and fish from three sources: the market, their own production and transfers from public assistance and other households. Cities require vast areas of land for their food supply and depend on large amounts of food being brought in from outside the land area they actually occupy (DEELSTRA & GIRARDET 2000). The way cities deal with the micro- and macrocommercial networks involved depends on their particular development and evolution (VAN DE VEN 1985).

The question of how income is spent is also important. Several studies have shown that 60 to 80 % of revenues are spent on the purchase of food (RUEL *et al.* 1998). A recent study on food security in Accra (MAXWELL *et al.* 2000) even shows that households spend 90 % on the purchase of food. The greater dependence on the market system and on commercially processed food creates a situation in which wage employment and monetary income are the main prerequisites for achieving food security. However, the majority of urban dwellers in developing countries are disadvantaged, and have limited purchasing power as most are engaged in very low-paid employment, in both the formal and the informal sectors (ARMAR-KLEMESU 2000).

To ensure a certain level of food security, one of the most important points relating to urban markets is the mechanism whereby food prices are determined. These are dependent on a number of factors, including the efficiency of the food marketing system. Inefficient food marketing systems linking urban and rural areas can increase the cost of food. Bad roads and inadequate storage facilities can lead to high losses that increase the cost of transportation from the countryside. The organization of the intra-urban network of wholesale traders, distributors, processors and retailers is also a factor in determining food prices, as are macro-economic policies, albeit indirectly (RUEL *et al.* 1998).

Alternative food supply sources, like home production and participation in public and household-to-household transfers, are therefore increasingly becoming part of the survival strategies of poor urban inhabitants.

1.1.5. Urban and Rural Areas and the Peri-urban Interface

The enumeration of possible bottlenecks related to food provision shows the complexity of the situation, and strongly indicates that the way to deal with the problem of poverty and food security should certainly not involve taking distinct approaches in urban and rural areas.

Indeed, the perception that the city and the countryside are linked is rapidly gaining ground, shifting away from the notion that there is a clear-cut distinction between the rural and the urban world. A sharp distinction between rural and urban settlements, assuming that the inhabitants can be reduced to two main categories, in particular agriculture-based in the country and manufacturing- and

service-based in the urban areas, seems to be inappropriate in most cases (ADELL 1999). In fact there is a continuing and varied exchange of resources between urban and rural areas. To various extents, depending on the location, the sector interaction consists of rural activities taking place in town (*e.g.* urban agriculture) and non-farm activities taking place in the rural area. Households can have activities and settlement in both parts, so that one can speak about “multispatial households” (TACOLI 1998).

In between the clear-cut urban and rural areas, there is a complex interface area called the peri-urban zone or peri-urban interface (PUI). Although even the most remote rural villages are often linked to urban areas through flows of people (rural emigration), goods, money and information, the peri-urban interface is where these dynamic processes have a more marked impact on residents’ livelihoods (TACOLI 2001).

In Africa, as in South Asia, peri-urban development is almost entirely the result of the restructuring of peasant activity and the informal economy (ATKINSON 2001). The French literature on African cities speaks about “le phénomène péri-urbain” (ADELL 1999). The fringes of cities are the products of the interaction between state intervention and policies, and the action and the practices of the inhabitants in terms of the everyday use and appropriation of space, as well as strategies around land, housing and informal building practices.

Considered from a spatial perspective, the process of city growth is permanently evolving. Depending on the type of evolution of what can be called the “real urban tissue nucleus” (often, in Africa, the modern colonial city), rural land can be trapped in the interstices creating a complex peri-urban interface. The “rural” fringes are first transformed into a “hybrid” peri-urban interface. That interface becomes more and more “urban” and the process goes on in that direction. Wakernagel & Rees (1996) cited by DEELSTRA & GIRARDET (2000) quoted the concept of “urban ecological footprint” to illustrate how the surrounding rural and natural areas are being affected by cities.

Therefore would it not be more appropriate to disclaim the old term of urban-rural dichotomy and to rather consider a rural-urban continuum?

1.1.6. General Urban Environmental Issues

It is important to highlight general environmental issues in cities in developing countries before analysing the effects of urban livestock production, so as to be able to put its effects in a global perspective.

Urban environmental problems vary from town to town and region to region, and are influenced by such variables as a particular city’s size and growth rate, income levels, and local geographic, climatic and institutional specificities. Especially where local authorities are weak or under-financed, rapid economic or population growth can exacerbate these problems. Environmental management tends to be more difficult in very large cities, as a consequence of the considerable

financial resources needed to provide adequate services and the administrative patchwork of responsibilities resulting from the overlapping of different jurisdictions (Linares *et al.* 1993 cited by WRI 1996). Although most of the world’s population will soon be living in the cities of the developing countries, those problems have often been absent from the global environmental agenda. Aware of the discrepancy between that global agenda and the problems confronting cities, a number of researchers, donor agencies and NGOs have advocated over the past years a renewed focus on the so-called “brown agenda” including the pollution, poverty and environmental hazards in cities.

The most important issues are related to water and sanitation, waste water disposal, solid wastes, indoor air pollution and urban pollution more generally. The lack of adequate water and sanitation services is certainly one of the greatest threats to human health in developing countries. In 1994, at least 220 million urban inhabitants still lacked a source of potable water near their homes. Only 18 % of low-income residents have a house-connected water supply. The proportion of the urban population covered by sanitation services is even smaller, and more than 420 million urban dwellers do not have access to even the simplest latrine. Many resort instead to open defecation on land or in waterways. Low-income families are more affected and they often share latrines with a hundred or more other community members. Waste water disposal is a related problem. In developing countries, it is estimated that more than 90 % of sewage is discharged directly into rivers, lakes and coastal waters without any treatment at all.

Moreover, cities generate large amounts of solid waste and these amounts increase with income. In developing countries, an estimated 20 to 50 % of generated solid waste remains uncollected. Unremoved waste increases the risk of development of vectors and the spread of diseases, especially when the refuse is mixed with human excrement (WRI 1997). The lack of access to basic water, sanitation, drainage and solid waste disposal services in most of the cities in developing countries makes it almost impossible for poor urban dwellers to prevent the contamination of drinking water and food (HADDAD *et al.* 1998).

While it is difficult to assess the composition of urban solid waste in developing-world urban areas accurately, RUSHBROOK & FINNECY (1988) have identified a basic distinction with the developed world: the organic portion of urban waste is much larger in developing countries than in developed ones (57.3 % vs. 23.5 %). Greater proportions of paper (32.5 %), metal (10.5 %), glass (9.5 %) and plastic (8.5 %) are contained in the urban waste of developed countries. Urban waste in developing-world cities contains approximately twice as much dust and ash (23.1 %) as in the developed world. It is crucial to take account of waste composition when planning waste management in developing countries. One example of its significance is that where you have organic waste with a high moisture content, options such as incineration or organized recycling become highly questionable (RICHARDSON & WHITNEY 1995).

Indoor air pollution from burning low-quality fuels, such as charcoal or animal dung, has been largely considered a rural problem. Yet many urban inhabitants in developing countries rely on biomass fuels for cooking and heating. This danger is certainly higher for poor people and for women and children who tend to be more exposed in smoky kitchens (McGranahan 1993, cited by WRI 1996).

Last but not least, urban (outdoor) air pollution is another threat, also encountered in developing countries. The main sources of air pollutants are industries, general energy consumption, and vehicular sources. In many cities of the developing world, motor vehicle use per capita is relatively low, but a tremendous increase in the use of two-, three- or four-wheel vehicles has been observed. Lead is particularly hazardous for human beings and cars that still rely on leaded petrol account for up to 95% of airborne lead pollution in those countries. Urban air pollution, of course, increases the risk of respiratory illnesses. But, it also causes damage to crops, vegetation and infrastructures.

1.2. URBAN AGRICULTURE AS A RESPONSE TO URBAN FOOD SECURITY

1.2.1. Historical Facts and Evolution

As explained in point 1.1.4., urban dwellers are often urged to implement alternative food supply strategies in order to survive. Home food production, or urban agriculture, is one of those solutions.

Food production in and around urban areas is certainly not new (MOUGEOT 1994, ELLIS & SUMBERG 1998, FLEURY 1999) but the magnitude of the phenomenon was for many years underestimated and neglected by most donors and planners. One of the reasons is a “memory gap” by western development planners till one decade ago.

However, the disappearance of agriculture from western cities and the removal of food production from urban economies, are very recent events in the history of humanity (MOUGEOT 1994). As a result of the evolution of cities in developed western countries, mainly since the industrial revolution, we began to forget that urban agriculture (including urban animal production) is not a recent phenomenon and that the intensification of agriculture comes about in response to the needs of urban populations, for whom food supply has always been a critical problem. It was thus imperative for them to invent systems to make this supply sustainable. This evolution was often connected with the development of systems of transport of water and of irrigation. Archaeological digs have found traces of urban agriculture on all the continents (MOUGEOT 1994).

In Western Europe, including Belgium, orchards existed previously inside cities, in plots of land surrounded with walls. In 1982, 19.6% of registered farms were considered as peri-urban or urban units in France (THIEBAUT 1996). Since

the early 19th century, urban gardens have been rented by urban dwellers of rural extraction, attracted by the new industries concentrated in the cities. At this moment, there are 1.05 million of these “Arbeitergarten” in Germany (THEOBALD 1997) and market gardens can also be observed in other developed countries, mainly in the suburbs. Indeed, certain western cities positively promote urban agriculture. In the United States of America and in Canada, in addition to the classic deprived market gardens, gardens can be found on ground lent by the municipality to needy inhabitants, sometimes with, sometimes without the additional granting of credit for the purchase of seeds and other essentials. The city of Sheffield in England proceeds in the same way (Care & Lane 1993 cited by MOUGEOT 1994).

At present, it is certainly Asia which is ahead in the field of urban agriculture, including livestock rearing. Figures dating from 1992 show that a third of the Chinese population is fed by urban agriculture. The organic recycling of waste has been developed in a remarkable way in this country, integrating plant and animal production. Animals (mainly poultry and pigs) and plants are linked in various integrated systems. All appropriate surfaces — gardens, roofs, balconies, tops of walls — are used. In Manilla (Philippines), the owners of undeveloped plots of land are obliged by decree to use them for agricultural purposes. In Latin America, the official authorities more and more support urban agriculture. In Costa Rica, for example, the Ministry of Food is convinced that it is better to encourage city-dwellers to produce their own food than depending on distributions of food to feed their children (MOUGEOT 1994).

In Africa, finally, urban agriculture (or “urbaculture” as SMIT *et al.* 1996 put it) seems to have largely developed at the same time as colonial cities (GOLHOR 1995). KIRONDE (1992) estimates that in 1950, 40% of the manual workers in Dar es Salaam (Tanzania) possessed a field in town. More recently, the proportion of African urban dwellers practising urban agriculture has varied from place to place, but it can be very high. Vennetier (1991) cited by GOLHOR (1995) estimates that in Libreville (Gabon) 80% of the women are practising agriculture. In Accra (Ghana), 15% of the households are engaged in some kind of agricultural production (MAXWELL *et al.* 2000). Overall in Africa, it is estimated that around 6% of the 200 million urban dwellers are engaged in urban agriculture. These figures can be compared with the estimated total of 800 million urban dwellers in the world, who are involved in urban livestock, crop, or fish production (RABINOVITCH & SCHMETZER 1997).

MOUSTIER (1999) presented three major factors which have boosted the development of proximity urban agricultural practices in Africa in recent years. First, the degradation of the road network, principally in Central Africa, is isolating more and more cities from inland production zones. Cities in Africa are also less densely occupied than in developed countries, which allows “interstitial” agriculture between developed plots. Finally, these cities generate large quantities of organic waste, which can be recycled through agriculture.

Interest in urban agriculture on the part of academics and the development community grew slowly from the end of the 1970s, but became more pronounced in the early 1990s (see the “founding” editorial, *Spore Bulletin*, June 1991). Over the last few years the number of workshops, papers, electronic conferences, etc. organized on urban agriculture in developing countries has increased dramatically. We can cite the published works, e.g. MOUSTIER *et al.* (1999), KOC *et al.* (1999), OLANREWAJU (1999), BAKKER *et al.* (2000) and DRESCHER *et al.* (2001). The last electronic conferences were those organized by the Resource Centre on Urban Agriculture and Forestry (RUAF) on “Appropriate Methods for Research, Policy Development, Planning, Implementation and Evaluation In Urban Agriculture” (4-16 February 2002) and on the “Agricultural Use of Untreated Urban Wastewater In Low Income Countries” (24 June - 5 July 2002).

1.2.2. Current Concepts

According to MOUGEOT (2000a) urban agriculture can be defined through types of economic activities, product types (food/non-food), location (intra-urban or peri-urban), types of areas where it is practised (on-plot, off-plot, ...), types of production systems (crop, livestock, ...) and, finally, product destination (home consumption and/or market) and production scale.

Some scholars have expressed some doubt about the validity of identifying farming in cities as a special activity in some way different from plant and animal production taking place elsewhere (ELLIS & SUMBERG 1998). Equally, participants in the e-conference “Urban and Peri-urban Agriculture on the Policy Agenda” (DRESCHER *et al.* 2001) expressed the view that in many cities, peri-urban farmers represent a very different group from those farming in the cities. There is also an increasing perception that there is in fact an urban-rural continuum and that the rural and urban environments operate as a system, interacting in many ways (DRESCHER *et al.* 2000, TACOLI 2001). This is of course important for the analysis of the situation and for conceiving ways of improving things. Therefore, there is certainly a need to consider agricultural practices in another way, to integrate the different possible interactions and to define the specificity of urban agriculture, such as it may be.

Thus, MOUGEOT (2000b) has put forward the concept of urban ecosystem and argued that the “lead feature of urban agriculture which distinguishes it from rural agriculture is its integration into the urban economic and ecological system”. Clearly, urban agriculture has relationships with urban land management or use, urban survival strategies, (sustainable) urban food security, urban planning, urban food supply systems and rural agriculture. We can certainly add urban public health to this list.

To attempt to incorporate the different aspects of urban agriculture, the same author has also offered the following revised and quite exhaustive definition: “Urban agriculture is an industry located within (intra-urban) or on the fringe

(peri-urban) of a town, a city or a metropolis, which grows or raises, processes and distributes a diversity of food and non-food products, (re-)using largely human and material resources, products and services found in and around the urban area, and in turn supplying human and material resources, products and services largely to that urban area”.

1.2.3. Who is Involved in Urban Agriculture and Why?

Urban agriculture in developing countries involves many stakeholders, including producers, suppliers of resources, input and services, transporters and processors, retailers and consumers, promoters and managers (NGOs, development agencies, ...), urban planners and municipal authorities (MOUGEOT 2000a). However, the principal actor is the producer. While some producers are from the middle and the rich classes (MOUGEOT 1994, JACOBI & AMEND 1997), most urban farmers are men and women with low incomes who grow food largely for home-consumption, on private or rented plots, along roadsides or on fallow ground. Other groups are low-income public servants or employees facing delayed wage payments due to ongoing economic crises, and the so-called “open space producers” producing on a larger scale. They are the most important suppliers for the market (JACOBI & AMEND 1997). According to a survey implemented in Dar es Salaam (SAWIO 1993), urban farmers are evenly distributed across educational levels, and interviewees agreed that high-income earners are doing most of the urban farming in that town.

There is no doubt that urban agriculture connects well with women’s traditional childcare and general household management roles. Gender ratios vary greatly from city to city, but, in general, Africa has the largest proportion of women involved in urban agriculture, except in Dakar and Accra (NUGENT 2000). They are growing crops and perishable vegetables, as well as herbs and spices for family consumption. The fact that women tend to dominate urban agriculture is also a consequence of the fact that they are marginalized in other forms of employment in the formal sector compared to men (DRESCHER *et al.* 2000).

Because of the resources needed to engage in urban agriculture, even for small-scale production units, this activity is not carried out by recent migrants, but rather by city dwellers resident there for several years, sometimes five or twenty years (MOUGEOT 1994). Potential producers have to gain access to land. Access to urban land happens through diverse modalities of tenure and usufruct. Arrangements are very often informal and sometimes based on customary laws (MOUGEOT 2000b). Access to land also has a social dimension where newcomers first have to build good contacts with their neighbours before gaining the usufruct of a plot (DENNERY 1997). With regard to the variety of locations and the size of the plots, production systems are very diverse.

Even if urban agriculture is often characterized as a means of obtaining some amount of food for household consumption through non-market and subsistence

means in Africa (RUEL *et al.* 1998), there are also other motivations. Based on the response of city residents involved in a set of seventeen city case studies, NUGENT (2000) gave the following ranked reasons for engaging in urban agriculture: production for home consumption, income enhancement, as a strategy against economic crisis, high prices on the food market, income or asset diversification, supplementary employment, strategy in case of conflict, poor weather conditions. It is noteworthy that the first six factors are economic. Food insecurity, or the perceived risk of food insecurity, seems to be a common concern among almost all urban farmers and the enhancement of household food supplies seems to be more important than the wish to increase cash income or obtain employment. However, this distinction should not be taken too far, as farming yields direct income through sales and employment, or indirect income through reduction of expenditures on food. Depending on the location, urban agriculture covers 15 to 50 % of those expenditures (NUGENT 2000, MOUGEOT 1994). The real impact on diet depends on the quality of the produce (RUEL *et al.* 1998).

Among the indirect positive effects of urban agriculture, one must count the impact on community welfare. Urban farmers contribute to community relief groups or to funeral groups. Also, side activities such as trade in inputs and transport are created, and these generate some wage labour, though insofar as crop cultivation is concerned, this is relatively insignificant in scale (NUGENT 2000).

1.2.4. Most Important Current Constraints and Issues

The major constraints faced by urban farmers are access to and/or availability of land and water (DRESCHER *et al.* 2000). Good soil quality is important (TACOLI 2001), as well as appropriate seeds (GOHLOR 1995). Depending on the location, town by-laws can seriously constrain urban farmers and regulations can prohibit the production of certain types of food. This applies more often to livestock (see below) but crops can also be concerned, *e.g.* cereal crops in the streets of Ouagadougou (Burkina Faso). To ensure his production, the ideal situation for the farmer is to obtain formal ownership of his plot. In urban centres statutory systems (formalized land titling and registration) tend to prevail (TACOLI 2001). The location of the field in public areas, or farming at a long distance from the residence can create insecurity and favour theft (DRESCHER *et al.* 2000).

As time goes by, intra-urban farming is squeezed by the spread of built-up areas. At the same time, urban expansion on the fringes has a significant impact on farming systems in the surrounding peri-urban and rural areas. Increasing demand for foodstuffs by urban consumers stimulate agricultural and horticultural production, especially of high-value, perishable products, but the downside of this influence is often increased competition for natural resources like water and land (TACOLI 2001).

Another important issue related to urban agriculture is that of human health hazards. ARMAR-KLEMESU (2000) reviewed these as: 1° inappropriate handling of agrochemical products by producers; 2° crop selection or location without due regard to existing environmental pollution in the air, soil or water; 3° livestock production (see below); 4° application of unseparated/unsorted or insufficiently treated solid and liquid organic wastes to vulnerable crops; 5° poor handling during marketing and distribution. Fertilizers, insecticides, pesticides and herbicides frequently used to improve the yield may be dangerous for the producer himself, but toxic residues can also have a negative impact on human health and the environment. Bio-accumulation of heavy metals and the presence of toxins in crops are also general environmental issues resulting from the uncontrolled use of certain products (DRESCHER *et al.* 2001).

Organic urban wastes, including manure and sewage, are popularly used as compost for market gardening, but can be a potential hazard where there is microbiological contamination. The use of water polluted with human excreta, for example, can facilitate the spread of disease. GOLHOR (1995) reviewed this as a potential hazard in several African cities. The risk of contamination by microbes or toxic products increases when the vegetables are eaten raw. Irrigation channels located in urban and peri-urban areas can favour the proliferation of mosquitoes and the extension of vector-borne diseases, like malaria, transmitted by *Anopheles gambiae* (McMICHAEL 2000). Even the types of crop grown and farming methods used can determine to a large extent whether or not the risk of malaria is increased. The conditions for growing wet crops and forms of ridge cultivation (*e.g.* rice, sweet potato and yams) are favourable for the breeding of *Anopheles* sp. Maize and banana crops, as well as tall grasses, seem to present no particular malaria risk (DRESCHER *et al.* 2001). However, according to DE ZEEUW & LOCK (2001) detailed information on the actual health impact of urban agriculture is scant.

Another important issue is the attitude of the urban planners towards urban agriculture. Urban planners tend to exclude agricultural practices from their vision of the future. It is a current paradigm that agriculture, by definition, does not fit within the city and that urban agricultural practices are likely to disappear in the near future (DRESCHER *et al.* 2001).

1.3. PRELIMINARY OBSERVATIONS AND CONSIDERATIONS

Urbanization is a real issue in developing countries and is a complex phenomenon. Figures show that urban agriculture certainly contributes to the food security of urban dwellers. Low-income households are involved, but also other socio-professional groups are attracted, practising urban agricultural activities for their own consumption or for commercial purposes. Gender also plays an important role.

With regard to the history of urban agriculture and the evolution of African cities facing huge economic crises, urban farming appears to be more than a transitional activity for the poor. Nevertheless, urban planners are reluctant to consider this activity as a valuable component of urban development.

Urban livestock is often considered as a part of urban agriculture. But we must examine whether urban livestock exists apart from, or is embedded in a global farming system. This topic is addressed in the following chapters.

2. Urban Livestock Production

2.1. HISTORICAL FACTS AND EVOLUTION

It is a well-established fact that urban per capita demand for dairy and meat products is higher than in rural areas due to higher global per capita income (DELGADO *et al.* 1999). Supply of livestock products to rapidly expanding urban populations is therefore an important issue for the future insofar as food security is concerned. That supply can come from outside the city but also from inside.

Livestock production inside the city boundaries is, like urban crop cultivation, a very old phenomenon. Cities have always needed to secure their source of proteins and other animal products and by-products. The perishable nature of dairy products meant that the presence of backyard cows was a common phenomenon, even in western countries until relatively recently. In southern countries, camel or buffalo cows are also kept in backyards.

By the turn of the 19th century, it was not uncommon in New York or other important American cities for individual families to own a cow, or two or three pigs. In Manhattan, the proximity of the city market and the possibility of recycling urban wastes and distillery mash by-products, gave dairymen and pig raisers a comparative advantage over the more distant rural producers (TREMANTE 2000). In several countries, pigs have played an important role in recycling organic urban wastes. From the Middle Ages, roaming pigs were observed in cities. In France they took the name of *porcs éboueurs* ("garbage collector pigs"). From time to time these animals provoked road accidents and were frequently banned from the streets for a while (THIEBAUT 1996). In Belgium, urban dairy cows were also common. In the 19th century, in the city of Hasselt, where traditionally a white alcohol is made, beef was fattened with the mash by-products from the liquor factory. According to certain sources, the beginning of the end for urban livestock in that country was the promulgation of laws on hygiene in and around the 1850s (Mammerickx, personal communication 2000). Nevertheless, more than a hundred years later, in the 1960s, dairy cows could still be observed in the centre of Antwerp, a large town in the north. In fact, even at that time, dairy vendors still brought their products to the cities on horse-drawn carts (Mortelmans, personal communication 2000). Both world wars (1914-18 and 1939-45) saw urban populations again practising a certain type of urban agriculture, by, as a minimum, exploiting undeveloped land and by raising animals, in order to survive. Currently, Heifer Project International (HPI), which has been leading livestock projects in predominantly rural areas for more than fifty years, is implementing urban livestock programmes in the States. In 1996, it launched its first North-American urban animal-agricultural initiative in Chicago, to alleviate poverty in that city.

In developing countries urban livestock is still important. Regarding Africa, CENTRES, in 1991, counted 20,000 households possessing cattle in Bamako, capital of Mali (CENTRES 1996). More than half (51 %) of the households in six major Kenyan cities keep livestock (Lee-Smith & Memon 1994 cited by WATERS-BAYERS 1995). In Maroua (Cameroon) there was, in 1985, a sheep or a goat for every six inhabitants (THYS & EKEMBE 1992). Even in densely populated Cairo, 5 % of households keep animals, especially chickens and pigeons, sometimes on roofs or balconies (Khouri-Dagher 1987 cited by MOUGEOT 1994). In Peru, more than 50 % of households raise guinea-pigs at home, for food (CHARBONNEAU 1988).

Looking back at the history of urban livestock farming systems worldwide, and taking the current situation in Africa into account, helps us to qualify the categorical view that moving livestock out of the city to the peri-urban area is the only possible solution (FAYE 1999). Indeed, the situation is very much in flux, but, even if the trend in developing countries follows that in western countries, and urban livestock numbers decrease in time, nothing certain can be said about the timing of that process. In this regard we agree with the non-linear approach of some authors, *e.g.* SCHIERE (2001), in the search for solutions. Another question is whether urban animal production is only one part of urban agriculture or has specific characteristics of its own and, if so, what their importance for the guidance of urban livestock production is.

We now propose to describe urban livestock systems, based on the available literature and on our own experiences. Later on in this chapter, we shall examine the constraints and the opportunities facing this phenomenon with a view to improving our understanding of it.

2.2. URBAN LIVESTOCK FARMING SYSTEMS IN AFRICA

2.2.1. General Typology

According to WATERS-BAYER (1995), urban livestock systems can be classified in various ways: location (urban or peri-urban or on/off-plot), main production goal (commercial versus subsistence), scale of production, intensity of production, husbandry methods (roaming, herding, tethering, stall-feeding), land tenure (private, usufruct, rent or lease, informal agreement). Classification based on animal size and species can also be added to this list.

The urban/peri-urban classification is the most often used. Inside the town boundaries small enterprises predominate while most of the medium or large-scale farms are located in the peri-urban area where more land is available. These peri-urban enterprises are more commercial and specialized: in poultry, pig, beef or dairy production. Government services are generally more attentive to these larger farms. The reasons are probably that these enterprises need more technical advice,

are owned by more educated and/or important persons and that, at the same time, small-scale production falls outside the formal economy.

WATERS-BAYER (1995) developed the on- and off-plot classification. This is quite important as one of the major complaints against livestock keeping in town is the roaming of animals in the streets (see constraints).

On-plot. The livestock is kept inside the owner's compound and has to be fed and watered there. Some of these backyard animals are allowed to roam for part of the day, mostly in the evening when the traffic has slowed down. This practice is particularly worthwhile in the rainy season as the animals have access to grass. The on-plot system includes the indoor fattening of sheep for Moslem festivals, which is found in West and North African cities. Even large animals like cattle or camels can be found on-plot in the centre of towns.

Off-plot. Besides the occasionally roaming animals from the on-plot system, some animals are permanently herded, tethered or allowed to stray on free land, or on land belonging to city dwellers who may or may not have given their agreement.

GHIROTTI (1999) used the scale classification and described three types: small-scale livestock production, semi-intensive producers and large-scale units.

Small-scale livestock production is more focused on subsistence and includes all kinds of species (large animals, like dairy cows, and small stock, like small ruminants, pigs, poultry, pigeons, rabbits, guinea-pigs and wild rodents). SMITH & OLALOKU (1998) defined this as a subsistent production system. The accent lies more on home consumption than on revenues from marketing. Semi-intensive producers are not only focused on home consumption, but also on the commercial aspects of livestock production. They keep small flocks of small ruminants, or a few milk cows under an intensive, zero grazing feed system. Large-scale units are mostly peri-urban. Exotic breeds and strains are frequently used. As an example of these large-scale plants, 90 % of modern poultry production in Ivory Coast is concentrated around the capital Abidjan (GHIROTTI 1999). Integrated crop-livestock systems can also be found in peri-urban areas, for example in Senegal and Gambia (Akinbamijo, personal communication 2000).

2.2.2. Specificities of Different Types of Production

2.2.2.1. Dairy Cattle and Camels

Dairy cattle production in town is widespread, as the product is highly perishable and the proximity of the production plots is a guarantee of freshness for the customer. This practice is well documented for a large number of African cities:

- North and West Africa: Sfax, Tunisia (SALEM *et al.* 1998), Dakar, Senegal (BA DIAO 1999), Addis Ababa (BONNET & DUTEURTRE 1999), Ouagadougou and Bobo Dioulasso, Burkina Faso (CENTRES 1996, GOOSSENS *et al.* 1998, SIDIBE 1999), Bamako, Mali (DEBRAH *et al.* 1995, CENTRES 1996), Niamey, Niger (SALLA 2000), Ogun District, Nigeria (ADU *et al.* 1998);

— Central, East and Southern Africa: Bujumbura, Burundi (NDUHIRUBUSA 1995), Dar es Salaam, Tanzania (SUMBERG 1997, 1999), Mwanza and Shinyanga, Tanzania (NYAMRUNDA & SUMBERG 1998), Tanga, Tanzania (MULANGILA *et al.* 1995).

Dairy cows can be located in peri-urban areas as well as in the city itself. However, intra-urban location has become rare as a result of the introduction of by-laws banning large animals from the city, as, for example, in 1982 in Bamako (CENTRES 1996). Most intra-city herds are in-plot and relatively small. In some medium-sized cities in the hinterland, animals graze in communal herds outside the boundaries and return in the evening to the owners' compounds. Implicitly, in-plot production requires a readily available supply of feed and water. Manure can be a problem but in some cities collection of animal wastes is organized by market gardeners (*e.g.* Bamako).

Peri-urban production units are often owned by the richer, more important urban dwellers — high-ranking officials, traders or members of the military. These people remain resident in the city, commissioning relatives or waged herds-men to run the unit. Imported breeds and crossbreeds are mainly observed in these herds, *e.g.* crosses with Holstein, Montbeliard, Tarentaise and Brown Swiss. Crossbred cows perform better. In Ouagadougou (Burkina Faso), Boly (personal communication 2000) reported that the milk production of crossbred Azawak was approximately three times the production of the pure Azawak cows (11.8 vs. 3.5 l). However, in some countries some problems arising from uncontrolled cross-breeding and the use of artificial insemination can be observed. Smaller breeders sometimes form cooperatives. Studies in Kenya and Ethiopia illustrate the role of dairy cooperatives in reducing transactional costs (STAAL *et al.* 1997). Dairy plants can be involved in the collection of milk from small-scale production units (*e.g.* Nadel in Bujumbura or Saprolait and Salec in Dakar) or in the organization of joint production (*e.g.* the cooperative of Kirkissoye in the peri-urban area of Niamey, and the involvement of the former OLANI — Office du Lait du Niger). In some countries, milk is processed on the farm (*e.g.* soft cheese in Nigeria) or in dairy plants.

Urban cattle fattening has to be considered as a by-product of dairy production. Calving induces milk production and the male offspring is used for meat, exploiting the available agro-industrial by-products, which are relatively cheap in the cities where agro-industry is present.

Dairy production is illustrated by two case studies. The first example (Bamako and Bobo Dioulasso) illustrates a classic city production system in West Africa. The second, Nouakchott, highlights the link between rural and urban areas in a very well balanced system (boxes 1 and 2).

Camel cows are also involved in dairy production in the most northern parts of Africa. MARTINEZ (1989) described the case of Nouakchott (Mauritania), where a dairy camel system developed aiming to supply the Mauritanian capital. Several

Box 1

Dairy production in Bamako (Bobo Dioulasso)
(DEBRAH *et al.* 1995, CENTRES 1996, SIDIBE 1999)

In Bamako, the capital of Mali, in the arid and semi-arid part of Africa, 800,000 inhabitants were living in 1991, on 19,000 ha on both sides of the Niger River. The working population was about 150,000 people, of whom only 7 % were involved in agricultural activities. Bobo Dioulasso (second town of Burkina Faso) is located in the West African subhumid area. 340,000 urban dwellers were living there in 1991, on 4,655 ha. The working population was about 61,000 people, of whom 20 % were employed in agriculture.

Three types of production systems were present in these two cities: 1° high-input, "intensive" market-oriented systems; 2° more traditional, lower-input, but still market-oriented systems; 3° low-input systems mainly aimed at meeting the needs of the family.

Within the "intensive" production systems of Bamako, keepers of dairy cattle are present on private farms with or without official title of ownership. These can get external incomes, mainly on private farms with a title of ownership, where producers can invest more funds in dairy cattle. In addition to Zebus or Mérés (local crossbred N'dama x Zebu), they keep crossbreeds with exotic cattle (Montbeliard) or even pure Montbeliard. Grazing is supplemented year-round with oilcakes and/or bran. Average production remains rather low (one litre of milk per day per cow for human consumption) reaching 2.5 or 3 l with pure Montbeliard or Montbeliard cross-breed cows. On average, producers keep 30 cattle in the peri-urban area. Some of them or their family members have larger herds which remain in the bush, far from town. Furthermore, producers in traditional, lower-input, but still market-oriented systems have smaller herds of local breeds and the family is more involved in husbandry or crop cultivation activities. There is less external input, as there is less available cash. Finally, producers in low-input systems have herds of fewer than 10 animals, use communal parks for grazing and rarely complement their animals' feed with supplementary by-products. Most members of the two latter groups and a few of the first one described, are members of dairy cooperatives. Marketing, which until 1994 was organized through the "Union laitière de Bamako", has since then been sometimes organized by the producers themselves, whether individually or in groups.

An economic study carried out in 1989-1990 on 30 herds showed that production was profitable in the three systems. However, there is an optimal herd size for each system.

In Bobo Dioulasso, the "intensive" production system hardly exists. Trials were made using the local breed to produce "elite" cows.

herds ranging from 10 up to 20 heads are kept in peri-urban encampments. The females are bought in the hinterland together with the newborn. Although daytime is spent outside the compounds, the absence of real pasture in the surrounding area forces the owners to feed their animals with imported concentrated

Box 2

Dairy production in Nouakchott (Mauritania): the rural-urban link
(THYS *et al.* 1993)

Nouakchott is the capital of the Islamic Republic of Mauritania and lies on the seashore in the Sahel climatic zone. The town's population was estimated to be 393,325 inhabitants in 1988. The city of Nouakchott experienced an explosive population increase of 13.5 % during the period 1965-1988 due to prolonged periods of drought.

More to the south, on the bank of the Senegal River, which marks the border with Senegal, there is extensive cattle production, partially based on the exploitation of the "bourgoutière" (fields of *Echinochloa stagnina*, a grass species growing in flooded zones). In this zone vast programmes of rice culture are organized using irrigation in the dry season. Significant quantities of by-products (*e.g.* rice straw) are available as feed for animals.

Following delivery, cows are transferred by truck to Nouakchott (\pm 200 km) where they are kept in permanent stalling. Water and concentrated feed are bought on the spot. The associated tasks are performed, in part, by paid labour. The cows' fodder consists of bran, rice straw and other residues coming from the farm, which is brought to Nouakchott by lorry, with the replacement cows.

The trucks are loaded with the dry cows — for transfer to the bank of the Senegal River — and the manure, which will be spread on the fields in the production zone. The calves born in Nouakchott are fattened and sold locally.

feed. The cows are milked twice a day, producing 3 to 4 l, not including that consumed by the calves. THYS *et al.* (1993) reported that the operation was highly profitable (even with expenses for 4 or 5 kg concentrate daily, and for water). In addition to the revenues coming from the daily sale of milk, the calf and the cow are sold at the end of lactation.

2.2.2.2. Small Ruminants

Sheep fattening operations have developed so as to meet the demand of the urban market at the peak moment of the sheep festival. The technical and economic aspects of these operations have been studied in several cities, *e.g.* Ouagadougou and Kongoussi (MEDENOU 1992), and Bobo Dioulasso (THIOMBIANO 1995) in Burkina Faso and Garoua in Cameroon (CHEVASSUS 1992). Similar to what happens in rural populations, the role of saving also remains important for urban migrants.

A very important study was performed on the socio-economic aspects of urban sheep production in the framework of the EU SECOVILLE project (FAYE 1999). Several studies were implemented in Guinea (Conakry, Kindia, Labé, Kankan,

N'Zérékoré), Ivory Coast (Bouaké), Burkina Faso (Bobo Dioulasso), Togo (Lomé, Sokodé) and Cameroon (Maroua). Owner profiles and marketing aspects are described in the corresponding points (see below).

Based on the system typologies used by BEDNARZ *et al.* (1999) for Maroua (Cameroon) and by CENTRES (1991) for Bamako, the following classification can be established:

- Traditional urban system: a non-commercial system where sheep and goats are raised for home use and for saving. The animals are kept on-plot or browse in the streets. This is a low-input, low-output system.
- Improved traditional urban system: differs from the previous system because it involves the input of fodder and drugs.
- Small-scale mixed systems: mostly found in the peri-urban area; characterized by a higher selling rate and a more technical approach, with separated, better quality housing, use of by-products, drugs, etc. Manure is used for market gardens and other crop cultivation plots.
- Commercial units: larger flocks with significant selling rate.

To illustrate, two case studies are described below, one in Cameroon (Maroua), one in Niger (Maradi). They concern mid-sized towns in dry climatic zones, where sheep and goats are common (boxes 3 and 4).

Small ruminants remain important more than fifteen years after the first surveys. The social aspect seems to be decisive and many social groups are attracted by the possibility of increasing their incomes, mostly by profiting from the Tabasky festival.

2.2.2.3. Poultry-chickens

The above-mentioned classification can also be used for poultry units. NGOU NGROUPAYOU *et al.* (1995) indicated that in Cameroon the sector is generally dominated by traditional poultry production and, in the peri-urban zones, by semi-intensive breeding. The same situation occurs in Kenya (GITAO 1995).

Small-scale production with backyard and scavenger chickens can also be found in cities. Chickens are sometimes kept on rooftops (GERTEL 1997) or on the floor (ENDOM 2002) (box 5). CENTRES (1996) reported that 40 % of households in Bobo Dioulasso and 30 % of those in Bamako are breeding chickens for their own use. Few animals are fed with kitchen residues. The eggs are mostly kept for reproduction. The animals are rarely sold and mostly slaughtered for festivals or to honour a guest.

As eggs and chicken meat are widely appreciated, and are relatively cheap with regard to other animal products, the industrial poultry sector has developed in several countries. However, in cities like Ouagadougou (OUEADRAOGO & ZOUNDI 1999), where the local "bicycle chicken" is highly appreciated for grilling, large-scale production is not very developed, hampered partly by high input costs, and

Box 3

Small ruminants in Maroua, Cameroon

(THYS & EKEMBE 1992, JAHN *et al.* 1995, BEDNARZ *et al.* 1999, JAHN *et al.* 1999)

Maroua is the capital of the far-north province of Cameroon and is predominantly Islamic. The climate is semi-arid with a rainfall of *ca.* 800 mm. The city's main occupations are commercial services, small-scale transformation, and local services. Maroua is also an important cross point for trade, as it is located between Chad and Nigeria. The current population can be estimated at approximately 200,000 inhabitants.

A survey was carried out in 1985 to determine the importance of small ruminant breeding within this urban situation, where 120,000 inhabitants were living at that time. Of the 542 compounds involved in the survey, 90.8% engaged in the rearing and/or domestic slaughtering of sheep and goats. One out of two bred small ruminants (one animal per six urban dwellers). The sheep population was 8.71 times greater than the goat population. Sheep breeds are Poulfouli (Djallonké) or Oudah. Three types of herds were observed: ovine, caprine and mixed ovine/caprine, with, respectively, a flock size of 4.6 ± 0.52 , 3.9 ± 1.12 and 8.9 ± 2.00 . The animals were more frequently kept in-plot in the central parts of the city rather than in the outskirts. Manure was only used in 4% of cases.

Most of the owners (66.2%) kept animals for personal consumption. Total annual slaughter was six times higher than official figures recorded in the municipal slaughterhouses. Fifty percent of the slaughters were performed at home for religious purposes, mainly Moslem festivals. Slaughter frequency presented two peaks in the year. The main one was associated with the Tabasky, "Sheep Festival" (87.5%), the second with Christmas (3.6%). Professional butchers slaughtered the other 50% animals at the municipal slaughterhouses, or at home. Also noted was a substantial parallel market for roast meat.

In the dry season of 1994-95, a double purpose survey was carried out on a sample of 38 flocks of Poulfouli sheep with the aim of analysing productivity, and on a total of 58 flocks to study service delivery. The samples were distributed all over the different districts of Maroua.

In the first sample, marketing of their animals was the main objective of 25.5% of the breeders. The longer the breeder had been active in production, the larger was the flock. People born in Maroua had larger flocks than immigrants. Productivity (expressed in g/kg) varied from flock to flock. Housing determined performance: flocks kept in the owner's house or outside performed better than stabled ones. Productivity was directly related to good hygiene (*e.g.* washing of the animals) and the use of adequate drugs.

The complementary study on service delivery involved seven types of services used by the breeders: purchasing of fodder, feed by-products, minerals, drugs, informal contact with a veterinarian, traditional treatment and information-sharing with neighbours. Only informal contact with veterinarians significantly improved production, suggesting that the advice dispensed in this way was adequate in quality.

Box 4

Small ruminants in Maradi, Niger (ALI LAOUALI 2002)

The city of Maradi is located in the central southern part of Niger. Currently there are approximately 300,000 inhabitants. The annual population growth rate is 6.6%. Eighty-three percent of the urban dwellers are Haoussa and the majority are Moslem.

In 2001-2002, a cross-sectional survey was conducted. Four hundred fifty-three households in urban areas, and within a range of 5 km of the urban areas, were included in the study. A total of 60.9% of the urban households and 81.1% of the peri-urban households keep small ruminants. Ninety-one percent of the livestock keepers were men. The majority of them were farmers, without formal schooling and 51 ± 14 , and 56 ± 15.7 years old, respectively, in urban and peri-urban areas. Small ruminants were kept mainly as a security saving (48.9%) and for social and religious needs (40.7%). Three types of herds were present (ovine, caprine and mixed ovine/caprine). Few ovine herds were found in peri-urban compared to urban areas (10% vs. 31.8%). In both zones, the average size of the mixed herds (10.6 ± 6.6 heads) was almost twice that of the monospecific herds (6.1 ± 3.4 for sheep and 6.2 ± 4 for goats). The calculated birth rates (70% for sheep and 82% for goats) were low. In urban areas, animals were usually stabled throughout the year (50.4%). In the peri-urban areas, stabling during the rainy season was combined with herding during the dry season (38.3%).

Free ranging of goats during the dry season was also observed (15.5% in urban vs. 8.4% in peri-urban). Because of the price of fodder and the difficulty in obtaining it, feeding was a serious constraint, particularly in the period between harvests. The annual herd offtake rates were 44.5% in urban and 53.2% in peri-urban areas. The offtake was due mainly to the sale of live animals (61.5%) and to home consumption (25.1%).

The survey revealed that the production of small ruminants was constrained by lack of fodder, theft of animals, household's food insecurity and the various constraints related to livestock production in urban areas.

partly by consumer taste. Large-scale farms use imported or locally hybrid sires, depending on the goal-eggs or meat (NGOU NGROUPAYOU *et al.* 1995).

Small-scale commercial production exists also in several cities. In Bamako, small units (100-400 chickens or broilers) are located in-plot in rudimentary housing, using improved breeds. Some of the egg-producing units are run by unemployed livestock technicians (CENTRES 1996).

2.2.2.4. Pigs

Pig production remains marginal in most parts of the African continent, except in a few countries, such as Nigeria, Madagascar or South Africa (FAYE 1999). In zones where pork is eaten, a similar evolution as for poultry is observed, with the difference that one of the worst constraints is African Swine Fever, against which no vaccine currently exists.

Box 5

Broiler production in and around Yaoundé, Cameroon (ENDOM 2002)

In Yaoundé, capital of Cameroon, ca. 1,500,000 inhabitants are living on 26,100 ha. The annual population growth is 6.8%. The city is located on a hilly zone, with heights of 1,200 m and plains at 700 m. The climate is subhumid (1,600 mm rain per year).

Facing a drop in income due to the economic crisis of the 1980s, leading to the devaluation of the F CFA (local currency) in 1994, the populations of Cameroon have been developing secondary activities as a source of supplementary income, including the partly industrialized breeding of broilers. Interest in this activity declined after the devaluation of the F CFA in 1994, but subsequently revived.

A survey was conducted in 2001-2002 including 88 producers and allowing the collection of data on 319 flocks of broiler chickens. A complementary qualitative survey sought to gain a better insight into poultry production in Yaoundé. Globally, the percentage of men involved (50.6%) was almost equal to that of women (49.4%). But in urban zones, women were in the majority (64%). It was a secondary activity for 85% of households. Funds from personal savings, or from the participation of their relatives, were used by 94.1% of them to finance the poultry production. 82.4% of the units were located in the owner's compound, which facilitated the use of the domestic workforce (63.6% of the breeders). The size of the broiler flocks varied from 50 to 4,600 chickens. The one-day chicks were produced locally (92.6%) or imported from Europe (7.4%).

The breeders studied had weak professional skills in all areas of production (chicken-run design, heating, nutrition and health management). This situation led to significant losses. The average mortality rate was $8.5 \pm 10.5\%$. The average rate of profitability by flock was $27 \pm 21\%$, where the producer was selling the broilers on the market himself. That rate declined sharply ($3.2 \pm 16\%$) when retailers were incorporated in the chain. The high production cost per broiler ($1,796 \pm 335$ F CFA) and the ruthless competition on the market decreased the competitiveness of the broiler produced in Yaoundé and its neighbourhood, compared to the poultry coming from other regions of the country and that imported from Europe. The breeders in the rural zone, better supervised and producing small flocks (50-500 subjects), were more effective than those in the urban and peri-urban zone.

Pigs play the same role as small ruminants in several cities, like Bobo Dioulasso, for example (CENTRES 1996). In general, backyard pigs are fed with kitchen residues or agro-industrial by-products, like brewers' grain. They also scavenge in the streets of the cities.

Industrial units exist also. Large-scale units once flourished in the peri-urban area of Abidjan, but were wiped out by African Swine Fever.

2.2.2.5. Other Species

In addition to those already mentioned, many other domestic animal species are observed in towns: birds (ducks, guinea fowl), guinea-pigs, rabbits, wild rodents (e.g. the great cane rat).

Keeping rabbits in urban areas is common in some cities but not in others. In Europe, urban rabbit production was, in the past, a typical emergency activity, e.g. during World War II (SCHIERE & VAN DER HOEK 2001).

ODUBOTE *et al.* (1995) studied rabbit keeping around the city of Ile-Ife in south-western Nigeria. The animals are kept in cages made of local material. They are mainly fed on local forage, which is often supplemented with agricultural and industrial by-products. The main problems can be summarized as: reduced reproductive and growth performance and high pre-weaning mortality. The authors conclude that rabbit production can be considered as a cheap way of producing animal proteins when cheap local forage is used.

Guinea-pigs are also typical backyard animals, with quite the same feed habits as rabbits. Originating from Latin America, they were introduced to Africa by the colonials. Guinea-pigs are widespread, but no figures are available on the scale and significance of this production. These animals can be kept on limited space and are ideal animals for indoor production in town. About eight to ten animals can be produced per doe, per year (SCHIERE & VAN DER HOEK 2001), so that one can say that guinea-pig production is, like rabbit production, a cheap and flexible way of producing animal proteins in an urban context.

The great cane rat (*Thryonomys swinderianus*) has been promoted in several places in Africa, as a source of animal protein, notably in Benin. The promotion of this animal, whose production is well suited to conditions in urban and peri-urban areas, started in 1983 in South Benin (YEWADAN 1995). Horses and donkeys are used for transport, as in Senegal for example, generating income for the owners and contributing to the employment of young people (Babacar Camara, personal communication 2000).

2.3. SOCIO-ECONOMIC ASPECTS**2.3.1. Who is Involved?**

The range of urban livestock owners is quite varied. They can be classified using different criteria: age, sex, socio-professional background, rich or poor. The species plays a role too: ownership of urban cattle is mostly limited to upper-income urban agriculture practitioners, but the smaller the animal the more affordable it is to a wider range of people (MOUGEOT 1994). Most urban livestock keepers are active in different fields and urban livestock is often a secondary activity (FAYE 1999).

CENTRES (1991) used a classification for small ruminant owners based on the aim of the practice: 1° "cultural" owners who are continuing rural practices, including superstition or sacrifice; 2° owners using their animals as a form of saving; 3° commercial keepers. SIEGMUND-SCHULTZE *et al.* (1999b) showed that in Bobo Dioulasso, migrants are starting later with livestock keeping than urban natives (43 vs. 28 years) and wait a long time after arrival before starting.

Concerning gender distribution, NIAMIR-FULLER (1994) indicate that many women are running poultry farms of 1,000-5,000 birds in and around cities like Abidjan and Lomé. According to one evaluation, women's peri-urban farms are generally much better run than those of men (FAO 1983 cited by NIAMIR-FULLER 1994). In Bobo Dioulasso, women run 11 % of the small ruminant flocks and tend to keep more sheep than goats (THIOMBANO & MATTONI 1995).

Stakeholders other than owners include: livestock product traders, operators of feed mills, grass cutters, providers of animal health services, ... (SCHIERE & VAN DER HOEK 2001). If the various owner profiles and gender distribution are combined with the parameter "number of animals per owner", we can see that there is certainly a wide range of types of ownership.

The household characteristics of urban dwellers can be related to urban livestock keeping. SIEGMUND-SCHULTZE & RISCHKOWSKY (2001) showed such relations for sheep keepers in Bobo Dioulasso by using three techniques of multivariate analysis: the probability of owning sheep increases with the size of the household and the rate of illiteracy. Households are also more likely to keep sheep if urban cattle husbandry is practised, if there is only one household in the compound and if the parents have been livestock farmers.

2.3.2. Food and Non-food Uses

The reasons why animals are kept are various: family consumption, selling, tradition, prestige, occupational, ...

Animal by-products are a source of edible proteins, but slaughtering animals for home consumption is not so frequent, and depends on the scale of production. Livestock keeping can help in reducing food insecurity in households (MOUGEOT 2000b), whether directly, or indirectly through the sale of animals on the market, thus generating money with which to buy other food products.

Traditional, social and religious motivations seem to be of greater importance for animal keeping than for crop cultivation. Animals are living beings and particular man-animal relations have emerged over time. Currently, meat-centred production is of secondary importance to production for cultural purposes (LECKIE 1999).

The Islamic Sheep Festival (Ayd al-kabîr or Tabasky) occupies an important social place and is a good example of evolution in time and space of a major socio-religious practice. In Maroua, for example, half of the animals slaughtered in 1987 were slaughtered for that sacrifice (THYS & EKEMBE 1992). BRISEBARRE (1999) made an interesting comparison concerning the representation of this sacrifice among Islamic groups in urban zones in France and in Morocco. It seems that in Morocco, more and more urban dwellers entrust the slaughter to a butcher, keeping on the tradition without having to carry out the concrete acts linked to this sacrifice. The constraints of slaughtering an animal at home in a city is one of the reasons for this development, as well as the general conception that a

city must be clean, hygienic and free from odours that are generally considered unpleasant.

2.3.3. Commercialization

The food supply of cities is quite a complex matter. The supply comes from surrounding rural areas or from urban and peri-urban production (industrialized or traditional). So, commercialization circuits can be short (home consumption, selling to neighbours, or in the city markets in case of urban or peri-urban production) or long (coming from the hinterland).

GOOSSENS (1998) distinguished three types based on the type of economy: 1° the informal circuit (peasants, street-traders, ...) with a short variant (direct selling of local milk, poultry, eggs, small ruminants, game meat, ...) or a longer variant (including traditional processing and fast-food, with or without short-term credit); 2° the formal circuit (including wholesalers, shops, ... and industrial processing of the product); 3° the mixed circuit. All of these are influenced by four exogenous or endogenous factors: 1° customer profile and habits; 2° the structure of the production unit; 3° the macro-economic environment (including transport infrastructures, administrative system,...); 4° the characteristics of the product concerned.

As far as commercial flows are concerned, the link between rural and urban is clear. METZGER *et al.* (1995) argued that growing cities create an opportunity for rural dairy production. BA DIAO (2001) compared urban crop cultivation and livestock production in and around Dakar (Senegal). She came to the conclusion that, if in Senegal 70 % of the vegetables and 35 % of the fruits are grown on urban and peri-urban lands, Dakar's livestock production is far from being self-sufficient for all animal products. Urban poultry is an exception, providing 89 % of one-day national chicken needs. However, in other cities, the situation can be different. OUEADRAOGO & ZOUNDI (1999) studied the supply of broilers to Ouagadougou (Burkina Faso). The study showed that the contribution of modern urban producers was low and that traditional rural producers were the main suppliers for urban consumption. The products came from the rural areas over distances ranging from 10 to 200 km. It was estimated that about 20,000 chickens and guinea fowls are brought into Ouagadougou daily. Thirty-one percent went to bar-restaurants-hotels and grill-shops combined, which highlights the importance of fast food in the urban context.

Urban animal products also have to compete with imported products. This is certainly the case of poultry meat and milk products. In most of the countries of sub-Saharan Africa, concentrated milk and powdered milk represent more than 90 % of imported milk-equivalents (GOOSSENS *et al.* 1998).

Marketing of milk and milk products has been studied in several cities. In Ouagadougou, GAMBOULE (2000) observed that the majority of urban households (58.2 %) consumed sweet concentrated milk; 21.1 % were buying powdered

milk and 17.9% local raw milk. Pasteurized milk was only taken by 0.9% of the households. In Ouagadougou, local products were on average cheaper than imported ones. For the same city and Bobo Dioulasso, GOOSSENS *et al.* (1998) observed, in 1995, that, due to the 50% devaluation of the F CFA currency, there was a decrease in imports in milk equivalents of about 50%. This can explain the greater competitiveness of the local products. These authors observed also that the buying behaviour of households is determined by income and the number and age of household members (especially the number of adults and of children under eight years of age).

BONNET & DUTEURTRE (1999) distinguished for Addis Ababa, four dairy market subsystems based on the type of product. First, there is the traditional subsystem, supplying butter used in Ethiopian cooking, coming from both close and remote rural areas (even from as far away as 650 km). The second subsystem involves the supply of cosmetic butter and curdled products, for example "ayib", a kind of cheese. The distance involved is shorter (maximum 80 km). The third subsystem is that of the modern sector which uses milk from state farms, peri-urban and urban private producers, and provides pasteurized milk and standardized western-type dairy products through both private and public networks of operators. Finally, the fourth subsystem is the traditional urban and peri-urban sector of small producers delivering raw milk to households in their neighbourhood. The authors concluded that in the context of urban dairy supply, innovation as well as tradition is important. The milk system can serve as a contemporary monitoring system indicating changes in patterns of urbanization and consumption, spatial organization, opportunities for increased productivity, and the institutionalization of the sector, promoting greater harmonization between legislation and cultural conditions.

In the live animal marketing system, sheep fattening is very important in the context of the Tabasky festival. On being made redundant, many civil/public servants have taken up sheep fattening as a coping strategy. However, the benefit can sometimes be disappointing when too many animals are imported from the rural areas (OUATTARA 1997).

2.4. CONSTRAINTS, EFFECTS AND ISSUES

2.4.1. Animal Production and Commercialization Constraints

A large amount of information is available on the zootechnical performance of animals in towns, but the question is rather whether the production potential of animals in cities is fundamentally different from that in rural areas. FAYE (1999) stated that this was not the case since there is no genetic difference between the two groups of animals. The main factor influencing performance is the human one: it is people who determine how available resources are used, and which management techniques are employed.

Based on a survey of keepers of small ruminants from 1993, MFOUKOUNTSAKALA *et al.* (2001) observed that the major constraints faced by the owners were: feed related constraints (delivery, costs, ...) (47.5% of the owners), theft (13.6%), lack of manpower in the family (12.2%), lack of technical assistance and credit (6.8%), problems with the neighbours (4.1%) and lack of technical knowledge (2.3%), 13.6% responded that they faced no difficulties at all.

Access to a permanent and sufficient source of feed seems to be the major issue. WATER-BAYERS (1995) indicated that there is little room for animal grazing. DRESCHER *et al.* (2001) observed also that access to land (for ruminants) and to water (for all species) represents a major constraint. After all, land can also be used for growing crops. Regarding grazing possibilities, MULANGILA *et al.* (1995) indicated that land holding is a real issue for dairy cows in the peri-urban areas in Tanzania.

However, the proximity of agro-industries in town, where these are present, gives a competitive advantage to urban production, due to better, and sometimes cheaper, access to agro-industrial by-products (SERE & NEIHARDT 1995). In the city, concentrates are often cheaper than roughage (THYS & EKEMBE 1992). Live-stock keepers are inclined to add more (cheap) concentrate to their animals' diet, inducing excess of nitrogen and uraemia accidents.

Within the city boundaries, the lack of space to keep animals is also important and housing is often rudimentary or non-existent. This situation leads the owners to let their animals browse in the streets, which increases the risk of theft and of problems with neighbours (see effects of urban livestock on environment, point 2.4.3.). WATER-BAYERS (1995) stated that resolving housing and feeding problems would also improve animal welfare and reduce losses.

Reproduction performance depends on the type of husbandry. Consanguinity can occur where herds are small and kept permanently stalled, in isolation. Equally, when the owner lets his animals roam, contacts with other animals lead to servicing, but such reproduction is uncontrolled (CENTRES 1991, ALI LAOUALI 2001).

One of the aims of urban livestock production is to obtain revenues. Therefore market access is essential. From the moment he brings his animal or animal products to the market place, the urban livestock keeper is in competition with retailers selling products from the hinterland. The relative cost of production becomes a significant factor at this point. In the dairy sector, case studies in Kenya and Ethiopia illustrate the role of cooperatives in reducing transactional costs (STAAL *et al.* 1997). Semi-intensive dairy producers can reduce their costs by reducing herd size, and increasing proportionally the number of lactating cows (BA DIAO 1999). Concerning poultry marketing in Cameroon, NGOU NGROUPAYOU *et al.* (1995) and ENDOM (2002) highlighted the problems encountered by the producers in and around Yaoundé when the retailers who buy poultry products in the hinterland dump them on the market at low prices. The disappointing prices paid for locally fattened sheep for the Tabasky Feast, when too many animals are imported from the rural areas, has already been highlighted above.

2.4.2. Animal Health Constraints

Based on the results of the studies implemented in the framework of Secoville, FAYE (1999) also wondered if there were animal health specificities linked to animal production in towns. Pathology in that specific environment is more influenced by the owner's behaviour than by the natural environment (see also nutrition problems above).

The pathological status depends on the kind of management employed and the type of unit. EHUI *et al.* (1995) stated that when dairy and small ruminant production systems are intensified, both infectious and non-infectious diseases cause serious economic losses through reduced productivity, when no accurate prevention and treatment are applied. PATZELT *et al.* (1995) described the study of the impact of trypanosomiasis in peri-urban dairy production systems in Uganda. Dairy production around cities in humid and subhumid climates is indeed faced with specific disease challenges. Vector-borne diseases are an example of this pattern. In the case of infectious diseases, isolation by permanent stalling can be a positive means of drastically reducing dissemination (CENTRES 1991).

High mortality rates are sometimes observed in towns. Lee-Smith & Memon (1994), cited by WATERS-BAYER (1995) reported that, in Nairobi, the value of animals that died annually was found to be higher than the value of animals consumed or sold by urban cattle keepers.

Health problems in small ruminants raised in towns are quite well documented. Dietary diarrhoeas are common when excessive quantities of concentrates are used. Lung and gastro-intestinal diseases are the most common diseases in towns, but this is the same picture as in rural areas (DINEUR *et al.* 1985). Nutritional problems in ewes provoke agalactia and lamb mortality (FERMET-QUINET 1991). Gastro-intestinal parasites of small ruminants were also recognized as important in small ruminant flocks in peri-urban Maroua (KILLANGA *et al.* 1999, NGAMBIA FUNKEU 1999).

Ali LAOUALI (2002) studied the animal disease constraints in Maradi (Niger). Animal health problems were due mainly to gastro-intestinal (47% of the cases in urban and 40% in peri-urban areas) and respiratory diseases (21.7% of the cases in urban and 53% in peri-urban areas). In most cases classical veterinary treatment was applied (80.7% of urban cases, and 79.8% of peri-urban). Traditional treatment accounted for 19.2% of the treatments in urban and 20.2% in the peri-urban zone. The use of veterinary drugs of poor quality, usually coming from Nigeria, and cases of last-minute interventions were frequent, and may explain the substantial incidence of ineffective treatment.

The major disease problem in small ruminants remains the ingestion of plastic bags. FERMET-QUINET (1991) observed that 60% of the cases of mortality in Bamako were due to plastic ingestion. This is a consequence of roaming by urban animals in periods of feed scarcity during which animals tend to feed more in dustbins. "Plasticosis" is regularly quoted in the literature and has been the object of detailed studies (SEIBOU 1996, KILLANGA *et al.* 1997).

DREYER *et al.* (1999) studied the health constraints on cattle production in a peri-urban, resource-poor environment in the Botshabelo and Taba Nchu town in the Free State Province of South Africa. They observed that 88% of the cattle owners considered that external parasites presented a problem. Other diseases were dry gallsickness and eye diseases. More than half (58.5%) of the farmers did not treat diseased cattle and 9.5% of them used traditional remedies. The remainder (32%) sought advice and purchased vaccines and drugs.

GITAO (1995) studied the main health problems of poultry in the peri-urban areas within a 30 km radius of central Nairobi (Kenya). He found coccidiosis as the most common problem (35% of the farms).

Nutritional accidents have already been cited among production constraints, but poisoning also occurs in mixed animal/plant systems where agrochemical products are misused.

2.4.3. Effects of Urban Livestock on Environment

Urban environmental issues in general were discussed in chapter 1 (point 1.1.6.). A more specific question is: what is the impact of keeping livestock in towns?

Waste produced in livestock production units includes, in general, waste water used for flushing animal houses, straw from animal bedding, feed residues and animal excreta (faeces and urine). Slaughter offal can be produced in slaughterhouses or in the compound (SCIALABBA 1995). Slaughterhouses, tanneries and milk-processing plants in developing countries are mostly located in towns. The majority of these industries lack functioning waste treatment facilities, thus causing pollution of water, soil and air (SCHIERE & VAN DER HOEK 2001). Odour and noise are often considered as polluting factors in towns. Dust coming from animal movements or from drying wastes is also recognized as an air-polluting agent.

Livestock waste is *in se* a very valuable resource in agriculture and one can even say that manure is even an environmental good because it can be used to improve the physical and chemical properties of nearly all soils (SCIALABBA 1995). However, the intensification of production is changing a beneficial by-product into a polluting agent (STEINFELD 1998). Intensive and semi-intensive livestock farms are mostly located in the peri-urban zone, but can be also found in more central districts. On the other side, all intra-urban small production units together also produce a significant quantity of waste. Industrial livestock keeping, including urban piggeries and large-scale poultry production present the most severe environmental challenge in the livestock sector, specifically where regulations either do not exist or are not enforced (DELGADO *et al.* 1999).

Roaming animals are often considered an important cause of road pollution and accidents, but no clear-cut information on this subject is available in the literature. BENTINCK (2000) described the stray-cattle controversy in Delhi (India) as a good example of a situation which can be observed from different angles. Cattle are certainly a real traffic concern to the extent that cows are frequently observed lying on the roads. But, traffic misbehaviour by humans undoubtedly contributes

more to obstructions and accidents than animals do. Dung on the road is certainly a pollution factor. But, in the specific context of Delhi, the dung does not remain on the streets for long and is used as fuel. In Africa, roaming animals have been banned from city streets following isolated incidents in which they were deemed to have impeded the progress of official motorcades.

Health hazards related to animal pollution are discussed below (point 2.4.4.).

2.4.4. *Effects of Urban Livestock on Human Health*

Human health is inextricably linked to animal health and production. This link is particularly close in developing countries where animals play an important cultural and socio-economic role (WHO 1999). There is scientific evidence that some human diseases can be transmitted from livestock to people during the production, processing or consumption of animal products.

The potential health hazards linked to livestock in towns can be summarized as follows. First of all, zoonotic diseases can be the consequence of physical closeness between animals and humans (SERE & NEIDHARDT 1995, LOCK & VAN VEENHUIZEN 2001). Major infections are brucellosis and tuberculosis. Both are potentially linked to the increasing number of intensive dairy production units in urban and peri-urban locations, the lack of adequate milk-processing systems and the use of unofficial marketing channels (MUCHAAL 2001). BONGERS (1996) stated that 95% of all tuberculosis cases are diagnosed in developing countries and that it is a major AIDS-associated opportunistic disease. However, less information is available on the real number of human cases of tuberculosis caused by *Mycobacterium bovis*. Leptospirosis is also very important in Latin America (GIL & SAMARTINO 2000). Other zoonotic diseases of importance are tapeworm-related, as is hydatidosis in areas where sheep are raised, and human cysticercosis, which is linked to pig husbandry (VAN 'T HOOFT 2000).

Food-borne diseases are also significant. An increased demand for meat coming from a dramatically growing urban population is leading to the increased use of slaughterhouses in urban areas. Poor slaughter hygiene can lead to contamination of the carcasses. Contamination of drinking water or vegetables when using slaughterhouse waste water can lead to the transmission of pathogenic agents such as *Salmonella* sp. and toxins from *Escherichia coli* (e.g. the Shiga toxin, PAL *et al.* 1999).

Upstream, in the production sector, contamination of feed with infected faeces (e.g. *Salmonella*) can lead to infection in animals. Animal products can contain residues of antibiotics or pesticides when there is a lack of control or norms in the intensive production sector. Industrial plants, for instance tanneries, can also contaminate drinking water by discharging chemicals into rivers (e.g. tannin or chromium) (DE ZEEUW & LOCK 2001).

The locating of animal production units in the city causes such nuisance as noise and unpleasant odours. Allergens from livestock waste or dust (particularly from pigs or poultry) can cause occupational diseases in farm workers and proximity

diseases in neighbours, mostly acute and chronic respiratory symptoms similar to those observed in zones in developed countries where pig confinement facilities first appeared (MCBRIDE 1998). Finally, roaming animals can provoke traffic accidents and injury.

The question, however, of what the real impact of those hazards in an urban context is, remains. Up to now, little research has been done on the specific risks of urban livestock keeping, as compared to rural livestock rearing. The e-mail conference organized by ETC and FAO involved two hundred and ten participants in the health and environment workgroup, but little information became available on this issue (DE ZEEUW & LOCK 2001, DRESCHER *et al.* 2001). In a detailed paper on the health hazards of urbanization in developing countries, McMICHAE (2000) stressed the potentiation of vector-borne infectious disease, like malaria, as well as exposure to pesticides and contamination from the use of human excrement as fertilizer, as side effects of urban agriculture.

The conclusion is that the relative importance of livestock rearing for human health can only be estimated. Nevertheless, the role of urban veterinary public health will certainly increase in coming years. Indeed, the upward trend of various diseases in developing countries and the fact that health is multidimensional (WHO 1999) make the protection of growing urban populations a matter of urgency. The intensification of animal production in and around cities and the change in food habits make food safety a priority for public health.

The upward trend in health problems is partly related to the inadequacy and deterioration of the public health and veterinary infrastructures in developing countries, the subsequent lack of control, and the absence of recent survey data (WHO 1999). Currently, veterinary services in towns are more concerned with rabies and the eradication of stray dogs (MESLIN 1996). Similarly, the cost of consulting state or private veterinarians, and the fact that small-scale producers are more often than not in the informal and clandestine sector, make smallholders reluctant to look for advice and intervention.

2.4.5. *Effects of Urban Livestock on Human Nutrition*

Greater dietary diversity may have a positive impact on micronutrient status and malnutrition. Animal products are an important source of essential aminoacids for man.

However, for some urban dwellers, a more sedentary lifestyle combined with the higher fat content of the diet, which comes partially from animal products, increase the risk of obesity, cardiovascular diseases and certain forms of cancer (HADDAD *et al.* 1998).

Another issue is the competition between man and animal for proteins and cereals. Aminoacids are necessary in the diet of monogastric species, like poultry and pigs, which are unable to produce these micronutrients as ruminants do. Cereals are also the main energy source in the diet of these animals.

However, the greater availability of agro-industrial by-products and the availability of large amounts of organic wastes (see point 2.4.1. above) reduce this competition (SERE & NEIDHARDT 1995).

2.4.6. Policy and Urban Planning

Several issues regarding urban development concern local urban authorities. A key question in this context is the provision of sufficient food for the urban population throughout the year. Generally, however, urban and peri-urban livestock production seldom receives full support from the authorities. The main contra-arguments are (SCHIERE 2001):

- Urban livestock is a potential public health hazard;
- Pollution through manure effluent and abattoir waste is part and parcel of urban livestock keeping in cities;
- Urban livestock production is unproductive, inefficient and “backward”;
- Only a small part of the total food requirements comes from urban livestock production;
- It is difficult to control this type of production, which is often informal;
- Urban livestock production is a transient form of farming.

BA DIAO (1999) for Dakar and NYAMRUNDA & SUMBERG (1998) for Tanzania argued that this position resulted in a lack of support from authorities for the milk sector. SMITH & OLALOKU (1998) stated also that a weak institutional and infra-structural base and poor support services had been repeatedly shown to have an adverse effect on the output and economic return from urban dairy units. SUMBERG (1997, 1999) studied the peri-urban production of milk products in Dar es Salaam over several decades and concluded that, notwithstanding variable support from the authorities, this activity failed in large part to supply the city. He argued that there are areas in Tanzania where milk can be produced more easily and efficiently than the hot humid coastal plain around the city. However, due to the perishability of milk this entails organizing an adequate cold chain.

In Africa, by-laws are frequently produced to prohibit livestock husbandry in town, but with varying results. In Bamako, for example, the 1982 ban on flocks numbering more than five animals, was lifted following a violent popular reaction (CENTRES 1991). In other countries by-laws controlling the roaming of animals in towns date from many years ago. In Cameroon, for example, the by-law was promulgated in 1937 and has not been changed since.

2.5. OPPORTUNITIES AND ASSETS

In spite of the numerous constraints already outlined, and of the manifest difficulties it entails, urban livestock continues to be practised. According to the literature, the following assets can be listed:

- Improvement of the supply of perishable but nutritive products, like meat, milk and eggs without the necessity of a long and expensive cold chain due to the proximity of markets. This proximity also reduces transport and energy costs (WATERS-BAYER 1995, GHIROTTI 1999). This is certainly important where access to towns is reduced by the deterioration of the road system and/or where the demand increases as a result of rising incomes (DELGADO *et al.* 1999).
- Pro-poor activity as it can provide poor urban dwellers with easy access to lower-cost food (WATERS-BAYER 1995) though, it should be pointed out that milk is also important for richer consumers (GHIROTTI 1999).
- Livestock keeping is particularly amenable to farming in small urban spaces and where soils are less fertile (MOUGEOT 1994). In some cases it can represent efficiency, bringing a return from land that is unsuitable for construction or is undeveloped (WATERS-BAYER 1995). However, with time, the pressure of urban population growth can create an increase in demand for accommodation, and a shift to construction (Hardouin, personal communication 1998).
- Providing employment, upstream and downstream (WATERS-BAYER 1995).
- The use of animals for transport in town can reduce air pollution (SCHIERE 2001).
- Animals can also play a role in recycling organic wastes. Urban garbage can be an important source of “free feed” for domestic animals. In Khartoum, for example, 70% of the goats’ feed consists of kitchen and street waste (RICHARDSON & WITHNEY 1995). This reduces the cost of waste management to the public at large (WATERS-BAYER 1995).
- Similarly, manure can be collected and used in urban and peri-urban market gardens (DRESCHER *et al.* 2000) with a resulting reduction in the cost of waste management.

As opposed to crop cultivation, the socio-cultural and religious roles of animals in African cultures certainly represent a very specific motivation for animal keeping and are among the main reasons for which urban dwellers persist in keeping animals. This is classically the case in the slaughter of rams for the Sheep Festival. Urban dwellers of rural origin may keep animals out of tradition or, sometimes, have animals in their native village, which they visit from time to time. Others follow the traditional practice of keeping animals as a form of saving, even when they have access to bank accounts.

Finally, the mobility of animals does not only have negative aspects but may also be an asset in case of conflict. Indeed, urban inhabitants could theoretically use certain animals to help them escape from an urban conflict zone.

3. Urban Livestock Case Studies

3.1. CONCEPTUAL FRAMEWORK

The literature review highlights the main issues related to urban livestock production. It shows also that there are strong reasons to see a link between urban livestock keeping practices and the survival strategies of the poor. Notwithstanding the negative effects involved, a relatively large portion of the African urban population is still keeping animals for other purposes than as pet animals. As the fight against poverty in the developing world is a very important current topic, we decided to focus particularly on these effects at household level in our own case studies, and to highlight some remaining question marks.

It is clear that each stakeholder has particular objectives and consequently has a personal point of view regarding the raising of animals within the city boundaries. For their part, administrative authorities and other urban planners mainly seem to stress the negative aspects of urban livestock keeping. However, it appears that the situation is complex and that the anti-livestock keeping attitude in towns is sometimes more a matter of perception than of a logical analysis based on objective facts. Many of the arguments against the practice also have counter-arguments. Relationships between them appear to be crucial for the future of urban livestock production. Figure 4 presents the main interactions and motivations of the stakeholders.

Based on the data of three surveys — Brazzaville (humid zone of Central Africa), Ouagadougou (semi-arid zone of West Africa), and that among the alumni of the ITM veterinary course (27 cities distributed in 14 countries, mostly from West and Central Africa) —, an attempt was made to give an answer to the following questions:

- Is livestock a better survival strategy for poor urban dwellers than other strategies, such as crop cultivation for instance? The different groups were compared in Brazzaville and Ouagadougou and a comparison was made between the two cities.
- What are the most important factors that lead urban households to become involved in urban livestock production?
- Do conflict situations influence livestock production and how does urban livestock develop when the crisis is over? Two hundred forty-nine owners of small ruminants identified in 1993 in Brazzaville, were interviewed in 2002.
- How do the opinions of experts, local authorities and producers of different countries and cities on the constraints of urban livestock production and on animal related health hazards, differ?
- What is the opinion of the experts on man-animal competition for grains and proteins?

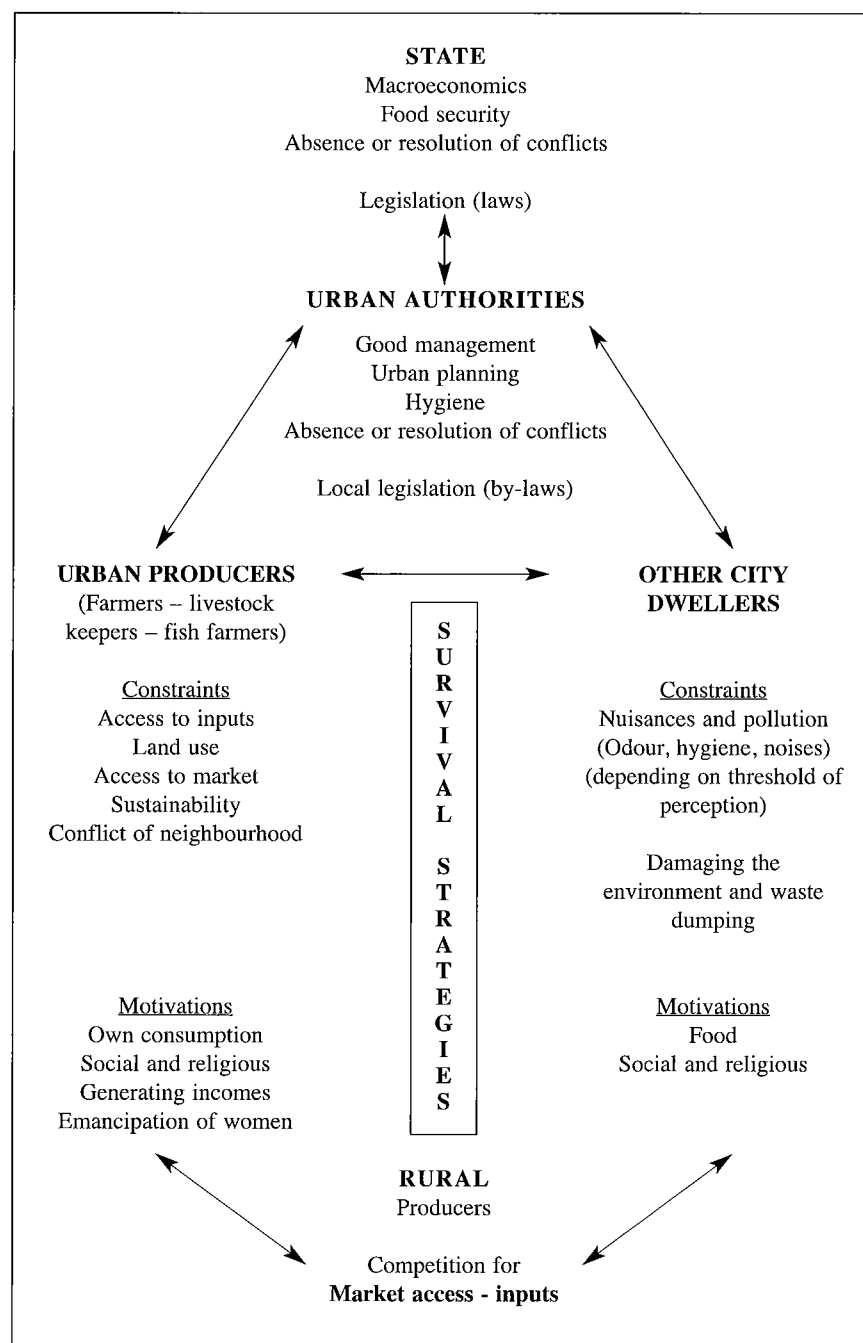


Fig. 4. — Relations between the different stakeholders involved in urban livestock production.

- Manure management is part of the resolution of the negative environmental effects of livestock keeping in town. But what are the numbers and the profiles of the producers recycling or selling it? An attempt to highlight this point is made through the analysis of data from the surveys carried out in Ouagadougou and Brazzaville.
- An urgent question is whether urban livestock production is a passing phenomenon or not. We collected some answers from our experts and from producers and other urban dwellers.

3.2. SURVEY DESIGN

3.2.1. Brazzaville

A two-step survey was organized from January 2001 to June 2002. The statistical unit was the household.

The first step was a single visit, multiple object, randomized survey implemented in the seven urban districts of Brazzaville (see fig. 5). During the period from August to October 2001, 2,757 households were surveyed. The main objective was to determine the proportion of families involved in livestock production and their socio-economic characteristics. The survey also gives a good picture of these characteristics for other groups of urban dwellers.

Based on this first interview, in a second stage an in-depth interview was conducted with 84 randomly selected families keeping livestock only, 246 families engaged in urban crop cultivation only, 135 families involved in livestock and urban crop cultivation, and 245 families doing none of the above. The objective was to determine the underlying reasons for engaging in urban livestock keeping or another activity, including crop cultivation.

The fifth group, of 249 households who kept small ruminants in 1993, was added to the second part of the survey.

The questionnaires used in the face-to-face interviews included the following main groups of questions:

- Location of the household: district, enumeration zone, and sector;
- Identification of the family leader: length of residency in city, origin, gender, age, academic standard, marital status, and number of dependent children;
- Indicators of living standard: type of house, existence of running water, electricity, telephone, main mode of preparation of meals, main means of transport, the total surface of the inhabited plot of land;
- Professional activities: main current activity, sources of incomes, main source of incomes, global income;
- Crop cultivation: practice of crop cultivation or not, main vegetables, constraints, importance of crop cultivation as survival strategy;
- Livestock: practice or not, duration of practice, main reason if not, ownership of the animals in the family, constraints, species and figures, importance of livestock as survival strategy, manure management.

The 245 families who are not involved in crop cultivation and/or livestock were interviewed on their own survival strategies.

3.2.2. Ouagadougou

A single visit, multiple object, one-step survey was implemented from January to April 2002. Two thousand eight households were randomly selected from a database including 13,927 households of 57 enumeration zones distributed in the 5 districts of the city (see fig. 6).

The questionnaire included the same questions as in Brazzaville adapted to the context and the local idiomatic forms.

3.2.3. Mail Survey among ITM Alumni ("RIPROSAT Survey")

A qualitative survey with auto-steered answering to the questions was organized from March to November 2001. The questionnaire was sent by airmail in the beginning of March to alumni located in French- and Portuguese-speaking North, West and Central Africa. Forty-one alumni out of sixty-six contacted answered the questionnaire. Twenty-seven cities were covered. The description of the sample can be found in the appendix.

The sampling was empirical and based on the accuracy of the address of former students recorded in the RIPROSAT database, and the relevance of his/her duty station. To enhance the chance of return of the questionnaire, a few additional measures were implemented, including a two-step consciousness-raising campaign and the inclusion of a "free of charge return" envelope.

The questionnaire was tested during a RIPROSAT Symposium in Ouagadougou in November 2000. The main groups of questions were as follows:

- Identification of the target group: basic and complementary training, current employer, function and activity, resident in the city or not.
- Determination of the city: size (small, average, big and very big), region (central, western and east Africa) and climatic zone (dry to semi-arid, Sudanese, Guinean). A city is considered as small if it has less than 100,000 inhabitants; average if between 100,000 and 500,000 inhabitants; big between 500,000 and 1,000,000; and very big with more than 1,000,000 inhabitants.
- Questions concerning the interest (little, moderate or strongly concerned) in urban or peri-urban livestock production by different population categories, classified according to four types of categories (wealth, sex, age and profession), as well as their main motivation (prestige, security, ...).
- Questions concerning the animal species present in the city and its suburbs, the presence or not of a professional sector, the technical constraints affecting livestock production, the presence of specific animal diseases, the problems of services and competition between private and state services.
- Questions concerning the transmission of diseases from animal to man. The interviewee had to get in touch with the medical authorities of his city.

- Questions concerning the evolution, the constraints and the positive and negative effects of the urban and peri-urban livestock production. The problem of waste and competition for grains and sources of proteins is also approached. The position of the interviewee with regard to livestock production is asked. At the end of the questionnaire the participants are also asked if they have animals and why.
- Questions put directly to the authorities concerning their opinion and the measures taken by them.

3.2.4. Statistical Analysis

The data were stored using the software program Microsoft Excel or Access and treated by means of STATA (Stata Corp 2001) and CART software.

CART is an acronym for Classification and Regression Trees. This approach to classifying data is a non-parametric technique that can select those variables and interactions that are the most important in determining an outcome or dependent variable. For classification and regression trees we assume the existence of a single response variable and one or more predictor variables as with all regression techniques. If the response variable is categorical, then classification trees are created (equivalent to discriminant analysis or logistic regression) and if the response variable is continuous, then regression trees (equivalent to multiple regression) are produced. The predictor variables can be a mixture of continuous and categorical variables. A classification tree is built by first partitioning the response variable into two groups (nodes) corresponding to all possible splits of every explanatory variable. In choosing the best splitter, the program seeks to maximize the average "purity" of the two child nodes. This process is repeated for the nodes within each node. The resulting binary tree is pruned by cross-validation to increase the validity of the final tree. The final output is a decision tree where we decide which branch to follow after applying some tests to one or more variables. More detailed information on classification trees can be found in BREIMAN *et al.* (1984) and STEINBERG & COLLA (1995). The default "Gini method" was used as a splitting criterion, because it usually performs best.

3.3. RESULTS

3.3.1. Role of Urban Livestock as Survival Strategy: The Tale of Two African Cities

3.3.1.1. Brief description of Brazzaville and Ouagadougou

3.3.1.1.1. Brazzaville

Brazzaville is the political and administrative capital of the Republic of Congo. Thirty percent of the total population is concentrated in Brazzaville. This means that it has approximately 1,000,000 inhabitants and 110,000 households. Brazzaville is located on the right bank of the Congo River directly across from the megalopolis

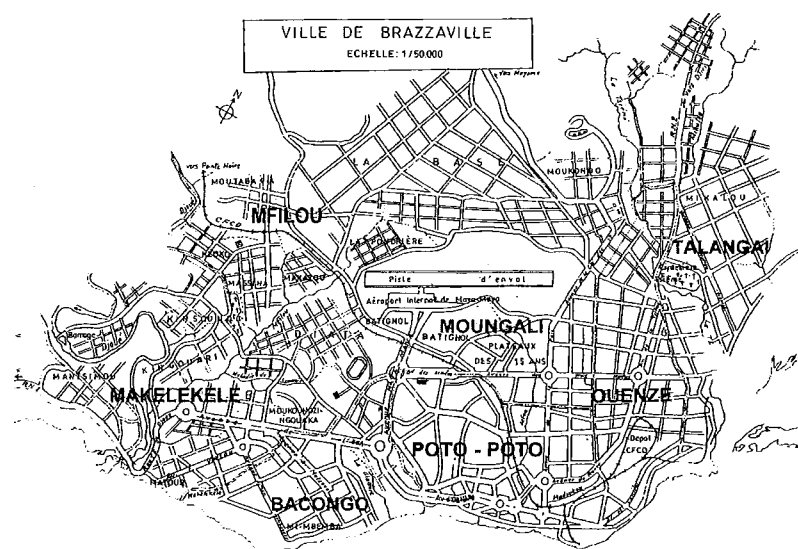


Fig. 5. — Map of Brazzaville indicating the seven districts.

Kinshasa, capital of the Democratic Republic of Congo. The altitude varies between 275 m and 313 m and the total surface is approximately 120 km². The city is divided into seven districts. The climate is equatorial humid with a rainfall ranging between 1,400 mm and 1,600 mm a year. The average temperature is about 24 °C in the dry season and 28 °C in the rainy season.

Like most countries in sub-Saharan Africa, Congo has been, and continues to be confronted with strong growth in its urban population. The wage-earning employment sector has been in crisis for the past decade or so, with continual delays in the payment of civil servants' salaries, pensions and scholarships. Attempts to tackle the economic situation by means of Structural Adjustment Programmes (SAPs) or Reinforced Structural Adjustment Programmes (RSAPs), have not succeeded. Poverty has gradually increased in the city, particularly in Brazzaville where four out of ten people are poor (Doulou *et al.* 2000, cited by MFOUKOU-NTSAKALA *et al.* 2001). This last study also shows that the most important poverty factors are age, the total number of family members and the socio-professional condition. The armed conflicts of the last decade have also had a negative impact on economic and social development. The most serious episode of civil war was in 1997.

3.3.1.1.2. Ouagadougou

Secular capital of the Mossi Empire and political capital of the Republic of Burkina Faso since 1947, Ouagadougou is also capital of Kadiogo province. Situated

in the heart of the country, the municipality of Ouagadougou is divided into five districts and thirty sectors. It has a surface area of 21,930 ha. Seventeen villages are linked to the city and form the peri-urban area. The population of Ouagadougou is currently more than 1,000,000 inhabitants. The annual population growth rate is currently estimated at 9.8%. Ouagadougou belongs to the semi-arid soudano-sahelian climate zone, marked by an average rainfall of 750 mm a year. The rainy season lasts about six months, from May to October. The average temperature is about 30 °C.

3.3.1.2. Urban Crop Cultivation and Livestock Keeping

Table 1 gives the distribution of households in both cities in four categories of activities related to urban crop cultivation and livestock production, as shown by the data from the single survey of Ouagadougou and the first step of the survey of Brazzaville. Inhabitants of Brazzaville are globally less involved in crop cultivation and/or livestock (32.8 % of the surveyed households) than in Ouagadougou (44.1%). Ouagadougou has more households in the livestock sector

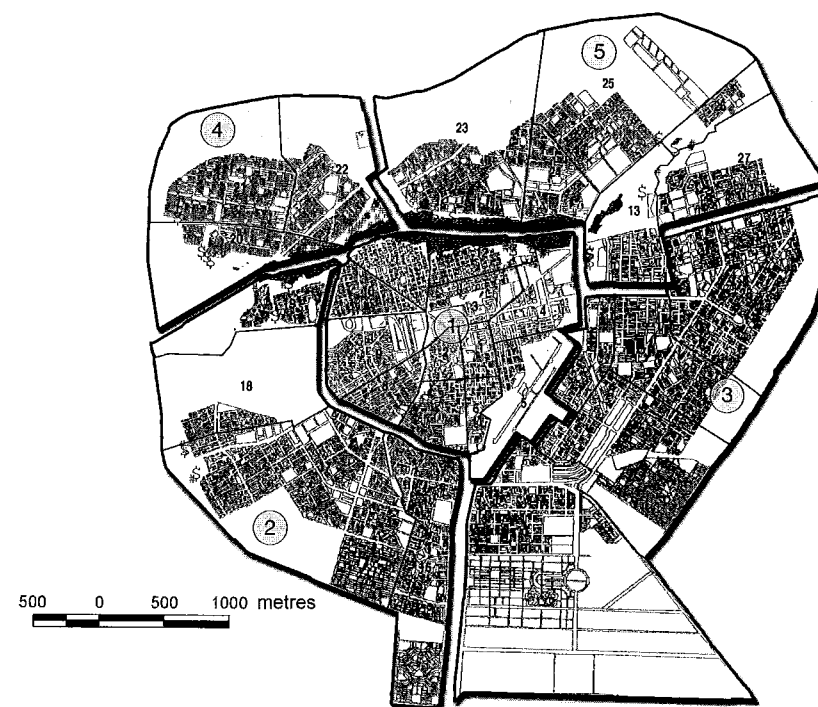


Fig. 6. — Map of Ouagadougou indicating the five districts: 1: Baskuy district; 2: Boulmiougou; 3: Bogodogo; 4: Signoghin; 5: Nongremasoum.

Table 1

Distribution of households interviewed in Brazzaville (first step survey 2001) and Ouagadougou, in four categories (survey 2002)

City		Group 1*	Group 2*	Group 3*	Group 4*	Total
Brazzaville	n	1,852	660	92	153	2,757
	%	67.2	23.9	3.3	5.6	100
Ouagadougou	n	1,107	353	296	223	1,979
	%	55.9	17.8	15.0	11.3	100

* Group 1: neither crop cultivation nor livestock; Group 2: crop cultivation only; Group 3: livestock only; Group 4: crop cultivation and livestock.

(26.2 % versus 8.9 %) and Brazzaville has slightly more cultivators (29.6 % versus 29.1 %). In Ouagadougou only 43.1 % of livestock keepers combine crop production with livestock, against 63 % in Brazzaville.

Livestock is currently more significant in Ouagadougou than in Brazzaville. Factors which might be responsible for this difference include the fact that the conflicts in Brazzaville have caused a decrease in livestock keeping (see point 3.3.1.3. below) and also, the fact that the population of Ouagadougou has, historically speaking, been more involved in livestock rearing. From the visits to both cities it appears also that feed is more readily available in Ouagadougou than in Brazzaville (see point 3.3.3.1. below for the feed constraints). Another important finding is that livestock is not necessarily combined with crop cultivation (mixed farming). Depending on the location, livestock is not combined with crop cultivation in 56.9 % of the households with livestock in Ouagadougou and in 37 % of those of Brazzaville.

3.3.1.3. Sociological Factors Influencing Livestock Keeping

3.3.1.3.1. Motivations

Motivations for keeping livestock vary. The alumni survey allows us to classify those motivations in seven categories: 1° increase in prestige for the owner; 2° as a hobby; 3° tradition (perpetuating customs); 4° learning animal husbandry practices (for the young people); 5° subsistence; 6° security (savings); 7° economic, profit-oriented aims. The first four categories are motivations linked to the quality of life. The last three categories have more to do with the economic domain, involving profitability, income, and home consumption. The well-to-do or rich class is more motivated by the prestige factor and keeping animals as a hobby, though some of them are also involved in economic production. The class with modest incomes is more concerned with subsistence and, even more important,

with security. The poor class is a little less involved than that with modest incomes, and is more motivated by aspects of survival. The perpetuation of customs is more prevalent among the less rich classes than among the well-to-do (tab. 2).

3.3.1.3.2. Owner Profiles in Brazzaville and Ouagadougou

Classification tree analysis was performed to define the most important sociological and wealth factors influencing the presence or absence of livestock keeping in both cities.

The dependent variable was “livestock keeping” and the independent variables were: “district”, “sex head household”, “age head household”, “total persons in

Table 2

Degree of involvement in urban livestock production of the various socioprofessional classes (in %) (RIPROSAT survey 2001)

Category	Little involved	Moderately involved	Strongly involved
CLASSIFICATION 1			
Well-to-do or rich class	42.4	21.2	36.4
Class with modest incomes	3.1	43.8	53.1
Poor class	39.3	10.7	50.0
CLASSIFICATION 2			
Women	18.2	48.5	33.3
Men	3.0	17.6	79.4
Children	82.1	10.7	7.1
CLASSIFICATION 3			
Young people	55.2	37.9	6.9
Persons aged 40+	0.0	9.7	90.3
CLASSIFICATION 4			
Public servants	21.8	59.4	18.8
Employed in the private sector	12.9	58.1	29.0
Self-employed	27.6	41.4	31.0
Storekeepers	21.9	25.0	53.1
Professional farmers / breeders	6.1	6.1	87.8
Retired	20.7	48.3	31.0
Unemployed	50.0	34.6	15.4

household”, “level of education”, “property size”, “transport means”, “availability of water in the compound”, “availability of electricity in the compound”, “habitat status”, “grandparents already in town”, “professional activity”, and “agriculture or not”. The variables “livestock before war 1997” and “income level” were added for the analysis of the data of Brazzaville and “livestock before arriving in the city” for those of Ouagadougou.

Brazzaville

In the context of Brazzaville the most important variables were: “livestock before war 1997” (scoring 100 %), and “property size” (scoring 83.6 %) (fig. 7).

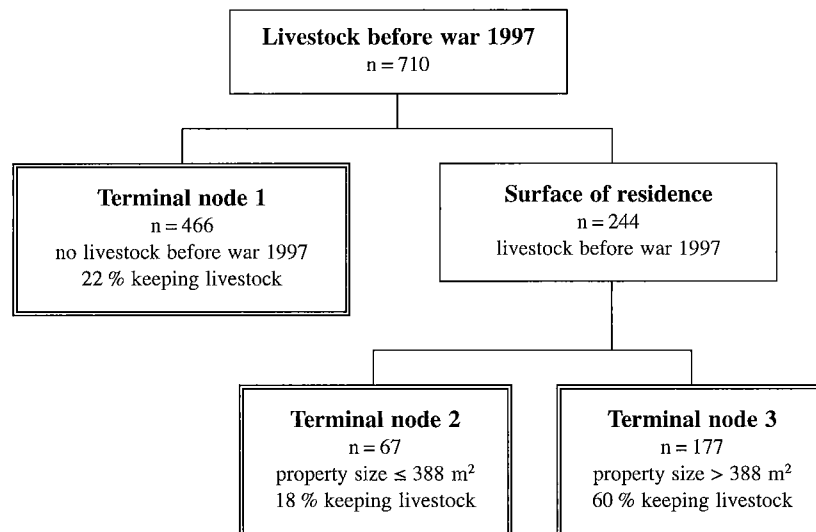


Fig. 7. — Graph of the tree analysis with “livestock keeping in Brazzaville” as dependent variable.

Having experience in the livestock sector before the last conflict appears to be an important factor as far as continuation is concerned. Only 22 % of the people with no experience before 1997 were keeping livestock at the moment of the survey. The conflict did not inspire these urban dwellers to go into livestock. Particular skills are also necessary in order to be able to pursue this activity. The size of the compound also plays a role, most probably because small compounds cannot contain enough animals.

The average profile of the current urban livestock owner in Brazzaville is a person who was involved in livestock before the war of 1997 and who occupies a compound larger than 388 m².

Ouagadougou

In Ouagadougou, important variables were: “livestock before arriving in the city” (scoring 56 %) and “total persons in the household” (scoring 100 %). “Principal activity” (26 %) and “sex” (11 %) belong also to the splitting criteria (fig. 8).

The interaction between the different variables seems to be more complex in the context of Ouagadougou than in Brazzaville. Very small households (≤ 3 persons) are not much engaged in livestock keeping. In Ouagadougou people describing themselves as professional cultivators or livestock breeders (see terminal node 2) are involved in livestock to a significant extent. Having practised in the past is also crucial in this context. Finally, male-led households are more involved than those headed by women.

The results of Ouagadougou confirm the importance of previous practice in determining whether the practice is taken up or continued. The fact that a larger family size determines a higher degree of involvement in urban animal husbandry can be related to the fact that a certain number of people are needed to perform the different tasks and/or to the necessity of generating supplementary income. Regarding gender, male household heads are usually more involved in livestock than female ones. Almost 80 % of the heads of households indicated that they have property of the animals. In only 31.9 % of the cases women were involved in the care of animals. This ownership pattern is confirmed for the whole country by the National Survey for Agricultural Statistics in 1993 (Ouedraogo, personal communication).

The average profile of the current urban livestock owner in Ouagadougou is a person, most often a man, having been previously involved in livestock, generally declaring himself to be a breeder and/or a cultivator, and having a household of more than three to five persons.

3.3.1.4. Is Urban Livestock Production a Survival Strategy for the Poorest City Dwellers?

3.3.1.4.1. Situation in Brazzaville

When asked whether urban livestock production is essential for the survival of a household, 55.5 % of the households interviewed in the second step of the survey in Brazzaville answered “yes”. Eighty-nine percent said the same about crop cultivation. During a focus-group session, people were asked to rank the principal established coping or survival strategies adopted in Brazzaville. The highest score was allocated to livestock production (25 points), the second to crop cultivation (23 points). Ninety-six percent of the households involved in livestock consider it essential for their survival. The most important motivation is income generation (54.3 %), followed by supply of food for the household (34.7 %). Other reasons are savings for retirement (6.9 %) or keeping up tradition (12.1 %).

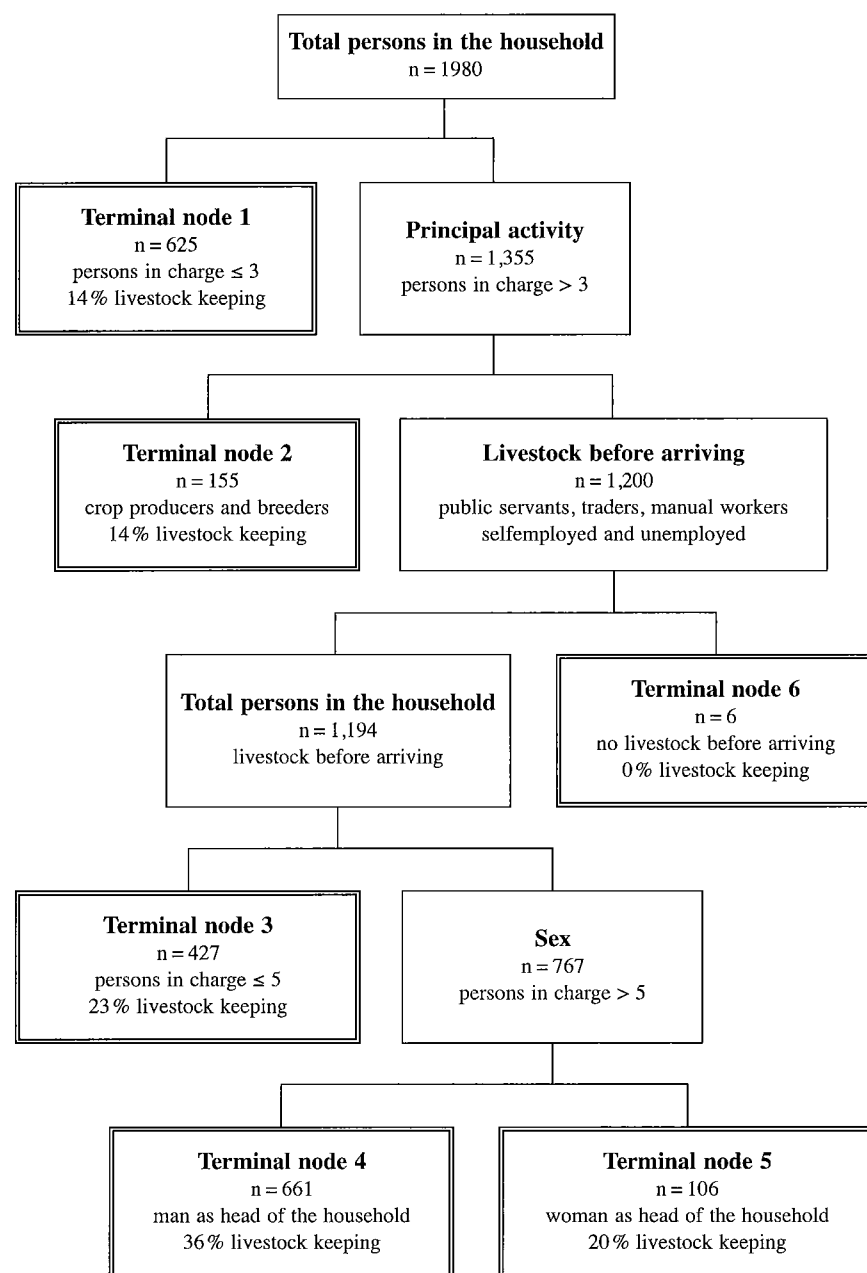


Fig. 8. — Graph of the tree analysis with “livestock keeping in Ouagadougou” as dependent variable.

There are more cultivators in Brazzaville than livestock keepers (see point 3.2.1.) and few persons declare themselves professionals in the latter sector (tab. 3). All professional groups are involved, including the jobless (retired or unemployed persons).

Table 3
Distribution of livestock keepers and cultivators in Brazzaville per profession (survey 2002)

Profession	Livestock keepers		Cultivators	
	Number	%	Number	%
Public servants	55	24.9	90	23.6
Traders, self-employed, private sector	43	19.5	59	5.5
Manual workers	43	19.5	50	13.1
Farmers	22	10.0	78	20.5
Livestock breeders	6	2.7	3	0.8
Unemployed and retired persons	52	23.4	101	26.5
Total	221	100	381	100

Type of housing, as well as water and electricity supply in the compound can be considered as wealth parameters to measure the living standard. Poor people are mostly concentrated in suburban slums or in the less improved central areas of the city, where houses are built with earth and neither water nor electricity are provided in the compound. Table 4 shows the percentage of city dwellers involved in plant or livestock production benefiting from high living standards compared with the group of city dwellers who do not practise crop cultivation or livestock keeping.

Producers have, in general, lower living standards. There is no significant difference between cultivators and livestock owners, except for electricity. Evidently,

Table 4
Percentage of livestock keepers, cultivators and city dwellers practising neither crop cultivation nor livestock for living standard parameters in Brazzaville (second step survey 2002)

Group	Durable house (%)	Water available (%)	Electricity available (%)
Livestock keepers	80.6	57.9	39.0
Cultivators	81.5	59.8	33.7
Non-producers	91.0	77.8	54.0

crop cultivation and livestock keeping are activities the poorest urban dwellers in Brazzaville are engaged in. This is confirmed by the average monthly household income for the three groups: 131,626 F CFA (201 €) for non-producers, 108,955 F CFA (166 €) for livestock keepers and 94,756 F CFA (144 €) for cultivators.

3.3.1.4.2. Situation in Ouagadougou

In Ouagadougou, 84.1 % of the households surveyed answered “yes” when asked whether urban livestock production is essential for the survival of a household. The proportion was higher (88 %) for people keeping livestock than for those who did not (83 %). The majority said that the most important motivation for keeping animals was income generation (63.5 %). Only 7.6 % said that it was for home food supply only, and 21.4 % that both objectives were important; 7.5 % had no precise idea.

To the question whether urban crop cultivation is also essential, approximately the same number of households answered in the affirmative (83.5 %). But, the main motivation was, in that case, food for home consumption (76 %). Only 16.5 % spoke about food and revenues and 5.6 % aimed solely at income generation. On the evidence, it appears that livestock keeping is more commercially orientated than crop cultivation and is considered by the urban dwellers as a better means of increasing household revenues.

Keeping livestock in Ouagadougou is statistically important (see point 3.1.2.). The professions most involved are traders, self-employed persons and persons with no steady incomes — unemployed (tab. 5). The same situation is observed as regards crop cultivation. This is similar to Brazzaville with the difference that there, both forms of production are considered more as main activities rather than either one being seen as secondary.

Table 5

Distribution of livestock keepers and cultivators in Ouagadougou per profession (survey 2002)

Profession	Livestock keepers		Cultivators	
	Number	%	Number	%
Public servants	85	16.5	46	8.0
Traders, self-employed	174	33.7	203	35.5
Manual workers	9	1.7	8	1.4
Farmers	70	13.6	146	25.5
Livestock breeders	23	4.5	13	2.3
Unemployed	155	30.0	156	27.3
Total	516	100	572	100

Table 6 gives the percentage of city dwellers involved in crop or livestock production benefiting from high living standards compared with the group of city dwellers who practise neither.

Table 6

Percentage of livestock keepers, cultivators and city dwellers practising neither crop cultivation nor livestock for living standard parameters in Ouagadougou (survey 2002)

Group	Durable house (%)	Water available (%)	Electricity available (%)
Livestock keepers	35.6	26.1	37.8
Cultivators	25.0	9.7	19.8
Non-producers	50.0	38.4	55.2

More clearly than in Brazzaville, producers in Ouagadougou have lower living standards than non-producing inhabitants, while cultivators have lower standards than livestock keepers. Both activities are practised by the poorest urban dwellers in Ouagadougou. If livestock keepers are relatively more wealthy, it is probably due to the fact that this activity generates higher revenues. Indeed, the livestock keepers declared that they are specifically focused on selling what they produce. The case studies described in the Ouagadougou report prove also that the annual financial return can be high: 40 % to 47 % for the selected pig keepers, 90 % for a dairy and meat cattle producer and 36 % for a mixed rabbit/poultry producer. That seems to prove that livestock keeping is about more than food and can substantially increase the family income.

3.3.2. Effects of Conflicts on Urban Animal Production: The Case of Breeders of Small Ruminants in Brazzaville

Few figures are available for comparing data from the period before and the period after a conflict. Those available from a survey conducted among owners of small ruminants in Brazzaville in 1993, can be compared with those from a new survey in that city, carried out in 2002.

3.3.2.1. Main Observations of the 1993 Survey

The 1993 single visit multiple object survey took place in the seven urban districts of the city. During the period from August to October 1993, 249 owners of small ruminants with a combined total flock of 2,188 sheep and goats were identified and interviewed (MFOUKOU-NTSAKALA *et al.* 2001).

Those breeding sheep only accounted for the largest single group of owners (47.4 %). On the contrary, 17.3 % kept mixed flocks, the average size of which

being the largest found in the survey (16.6). All parts of the city were engaged, to varying degrees, in the production of small ruminants, but the average flock size was higher in the central districts than on the periphery. Small ruminant production in the city was essentially meat oriented. Other than small ruminants, poultry (33% of cases), notably chicken of local breed, pigeons, ducks, and to a smaller extent pigs, provided some room for an alternative choice. Most of the owners were retired (30.1%), followed by public servants (23.7%), traders (18.5%), unemployed people (17.3%) and manual workers (10.4%). Eighty-three percent were men. The average age of the owners was 50.4 years.

From the available data, it was concluded that such production as a survival strategy for urban households was an established reality for those involved, in Brazzaville in the period before war. However, in the meantime the situation had certainly changed as a result of socio-economic upheavals resulting from the armed conflicts of the last decade.

3.3.2.2. Main Observations of the 2002 Survey

Of the former 249 owners, only 90 (36.1%) could be identified again, 40 had died, 67 moved and 52 were missing. Out of the 90 identified residents, 61 (67.8%) no longer possessed animals and were not involved any more in crop cultivation. Only one (1.1%) was involved in crop cultivation only, 25 (27.8%) in livestock keeping only and 3 (3.3%) were involved in mixed farming. In total, 28 (31.1%) were engaged in urban livestock production.

When forced to flee their holdings, owners abandoned their flocks. This seems to prove that keeping animals provides no better guarantee than crop cultivation as far as holding on to property in times of conflict is concerned.

Table 7 gives the distribution of the breeds raised by the 28 livestock keepers. Only 57.1% were still keeping small ruminants. In all, 44.7% of the former owners had switched to poultry. One of the reasons for that shift is that those who lost their animals in the conflict lacked the financial means to reconstruct their flocks.

Two case studies illustrate the situation. One shows Kissari, a retired man, who survives by selling the products of a flock of 32 sheep. A second case is that of a female trader heading a 5-person household who decided to shift to poultry production, principally to provide for her own household but also selling some of the produce from time to time.

These figures show that the conflict had a very negative impact on keepers of small ruminants in Brazzaville. Financial means are very important and it was not possible for everybody to rebuild their flock in the aftermath of the war.

In addition to poultry, which is ubiquitously popular, other species can also play a role. If the figures for the animal breeds kept in Ouagadougou and in Brazzaville in 2002 are compared, small species appear to be proportionally higher in Brazzaville (tab. 8). That this distribution reflects conditions influenced by the conflict, is a plausible hypothesis. Not only poultry but also other small species

Table 7

Distribution of the animal breeds owned by the former owners of small ruminants in Brazzaville (survey 1993)

Breed	Number	Percentage
Sheep	14	50.0
Goats	2	7.1
Chickens	6	21.4
Chickens + ducks	3	10.7
Ducks	1	3.6
Pigeons	1	3.6
Pigs	1	3.6
Total	28	100.0

Table 8

Cumulative percentage of livestock breeders' households keeping a specific species or group of species in Ouagadougou and Brazzaville (survey 2002)

Species	Ouagadougou (%)	Brazzaville (%)
Birds (chickens, pigeons, ducks, guinea fowls, ...)	59.4	77.9
Rabbits	4.3	8.6
Guinea-pigs	0.0	3.7
Pigs	8.1	8.6
Small ruminants	20.1	1.2
Large species (cattle, horses, donkeys, ...)	8.3	0.0

seem to play an important role in the reconstruction of animal stocks for food and/or saving in Brazzaville.

3.3.3. Opinion of the Different Stakeholders on Urban Livestock Production Issues

3.3.3.1. Constraints of Livestock Production in Urban Zones Identified by Experts and Producers

Among the 41 West and Central African experts interviewed in the RIPROSAT survey, 91.2% think that urban livestock production is subject to significant constraints. Table 9 gives a summary of their ranking. Constraints were also identified by the producers in Brazzaville and Ouagadougou (see tables 10 and 11).

Table 9

Ranking of the main constraints on urban livestock production by 41 African experts (in %) (RIPROSAT survey 2001)

Constraints	%
Technical constraints	
Feed (cost, availability of fodder, ...)	61.8
Land-use problems (lack of space, disputes)	35.3
Service delivery (advice, care)	29.4
Veterinary products (cost of drugs)	20.6
Animal diseases	17.7
Training opportunities for the breeders	11.8
Economic constraints	
Marketing (access and organization of the markets, price, competition)	17.7
Financial aspects (access to credit)	14.7
Environmental and social constraints	
Problems with neighbours	14.7
Theft	11.8
Pollution and nuisance (noise, smell, ...)	11.8
Road accidents causing loss of animals	5.9
Establishment of a policy for urban livestock production	3.0

Table 10

Ranking of the main constraints on urban livestock production by 157 livestock owners in Brazzaville (in %) (survey 2002)

Main constraints	%
Feed (cost, availability of fodder, ...)	42.7
Theft	18.5
Lack of financial resources	14.6
Animal diseases and mortality	7.0
Supply of veterinary drugs	5.7
Lack of space	5.1
Housing (problems with fences, ...)	3.6
Problems with neighbours	0.6
Lack of time	0.6
Lack of training	0.6

Table 11

Ranking of the main constraints on urban livestock production by 429 livestock owners in Ouagadougou (in %) (survey 2002)

Main constraints	%
Animal health problems (disease and treatment)	39.0
Feed	22.5
Theft	24.8
Lack of space	9.6
Problems with neighbours	2.3
Lack of manpower	0.9

Feed is the main bottleneck identified both by experts and producers. The observation that in Ouagadougou animal health problems are exceeding the feed problem can be explained by the fact that feed supply is better organized in that city, where 25.8% of the population keep animals. The recent series of conflicts affecting Brazzaville has left the feed supply there in a disorganized state. Feed for poultry now has to come from Kinshasa (DR Congo) or even from Cameroon.

At the same time, animal health, delivery of veterinary services and supply of veterinary drugs certainly remain major concerns for the different stakeholders.

Experts interviewed for the survey identify poisoning and ingestion of foreign bodies, mainly plastic, as the main veterinary problems affecting ruminants in the city. Contagious diseases are less often cited. Only experts in Luanda and Cotonou mention African Swine Fever. In fact, two different situations can be distinguished in relation to the transmission of contagious agents. If animals are free-roaming, they are more exposed than animals which are confined. Nevertheless, in the latter case, transmission can occur via human beings. This is probably the case in Douala, where butchers go from one farm to another to slaughter poultry. The confinement of animals can also cause diseases such as footrot, where there is poor hygiene on the premises. The problem of possible resistance to antibiotics is mentioned in Dakar.

The inadequacy of government services, resulting from a lack of human or other resources, gives rise to a significant proportion of breeders' complaints. The lack of specific knowledge on livestock production in the urban context, is also classified as an important constraint by the experts. This shortcoming results from the fact that the accent has always been put on rural problems. The lack of a means of diagnosis (an operational laboratory) is also noted. The private sector is mentioned as an alternative solution, but the higher cost of privately provided services is considered as a handicap (Dakar and Thiès). Competition between private and government services exists in some cases and mainly concerns unfair

competition from the part of the Government services, which provide treatment free of charge, or whose agents charge fees although they are not supposed to.

On the other hand, 17.6 % of the experts mention the breeders' lack of professionalism, the absence of cooperatives and their reluctance to consult government services. This latter point may be explained by the fact that many people raising animals in the city disappear into the informal economy.

Land-use problems are also important, as a consequence of high population density in fast-growing cities.

Though frequently mentioned by producers, conflict with non-producing neighbours appears to be a less important social constraint than theft, which both producers and experts count among the most serious difficulties facing those who keep animals. As far as pollution is concerned, the evidence suggests that non-producers are less concerned by this than experts are.

The experts are aware of the problems related to marketing and the availability of financial means for the producers. In Brazzaville also, where the sector suffered from the war, animal keepers are more sensitive to the lack of financial resources needed to restart their activities than their colleagues in Ouagadougou.

3.3.3.2. General Opinion of Experts and Municipal Authorities on the Positive and Negative Effects of Urban Livestock

3.3.3.2.1. Opinion of the African Experts

Positive and Negative Effects

The RIPROSAT alumni were asked to enumerate the positive and negative effects of urban livestock production. As positive effects they found important:

- At the household level:
 - Improvement of food supply: animal products more readily available and at a lower cost;
 - Increase in domestic income and household security (sale of products);
 - Creation of employment, at the level of production and distribution;
 - Use of manure as fertilizer for horticulture.
- At community level:
 - Poverty alleviation;
 - Decrease in the import of products of animal origin, mainly eggs, ...

In the peri-urban area, the advantages mentioned are quite similar to those enumerated in the city. At the same time, the role of recycling urban organic waste and the use of manure as fertilizer for regeneration of the soil seem to be considered as a surplus value by some of the participants there.

Pollution and other nuisances — noise, smell and dust produced when cattle cross dirty streets — are cited by about 75 % of the participants as the main negative effects of livestock production. The risks of zoonoses are also mentioned.

It is also interesting to mention that 61.5 % of the participating experts state that they themselves possess animals, ranging from cattle to smaller species. Their motivations vary, but concur with those of the population at large (food, revenues,...). Among them, one is doing a study on the sacrificial sheep during the Sheep Festival (Tabasky), whilst another is carrying out scientific trials using his own animals.

To the last question, whether they were globally pro or contra urban livestock production, 87.2 % of the participants claimed to be in favour of livestock production in the city, provided it is well supervised. Three participants were neutral and two were against. The majority are aware of the importance of livestock keeping for poverty alleviation.

Factors Influencing their Opinion

It seemed worthwhile investigating whether the experts' opinions had been influenced by their position. Analysis by means of the software CART gives the following indications when we use the variable "opinion interviewee" as a dependent variable and the variables "training", "current employer", "function" and "activity" as predictive variables.

A first node split is based on the function (fig. 9). The terminal node 3 includes exclusively the researchers who are 100 % in favour of this type of livestock production. The intermediate node, consisting of administrative and independent staff, is itself divided into two terminal nodes based on the employer. The terminal

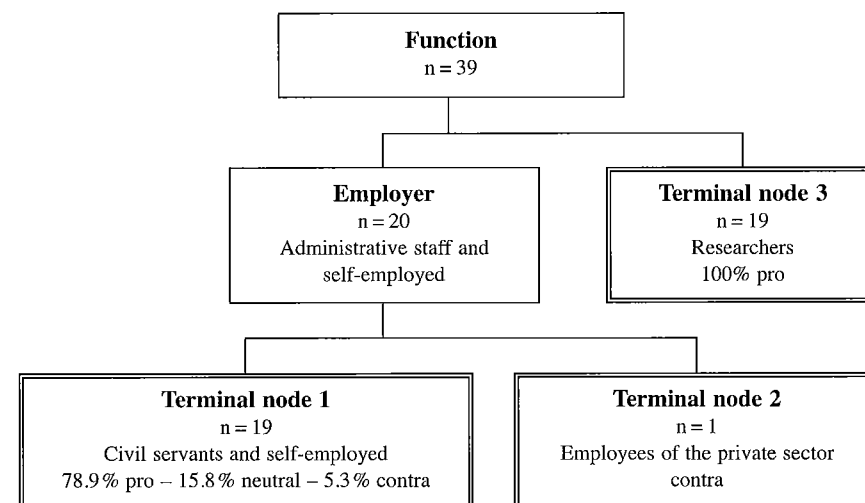


Fig. 9. — Graph of the tree analysis with "opinion interviewee" as dependent variable (RIPROSAT survey).

node 1 starts on the left and consists of executives in the public sector, or self-employed, 78.9% of whom are for urban livestock production. The terminal node 2 consists of a single executive employed by the private sector, who is against.

This analysis of the executives' opinions seems to indicate that the strongest variable explaining the participants' opinions is "function". Researchers seem to be the most aware of the positive effects of urban livestock keeping.

3.3.3.2.2. Opinion of the Municipal Authorities

According to 31 of the experts of the RIPROSAT survey, 32.3% of the authorities interviewed are pro urban and peri-urban livestock production, 22.6% are neutral and 45.2% are against.

Positive and Negative Effects

The majority think that livestock production in the city has certain serious negative effects (see below).

The positive effects mentioned by some focus on the social dimension (cash generation, supply of protein to the population), the collection of taxes and the benefit of avoiding the importation of contaminated meat-based products (dioxin, foot-and-mouth disease and mad cow) from Europe. One participant took the fatalistic view that no one can escape from the influence of tradition.

Although urban authorities are aware of the socially beneficial role of livestock keeping in their towns, they seem to be more concerned by the negative effects (tab. 12).

Road accidents caused by roaming animals are an important concern for municipal authorities, but only a minority of experts (5.9%) cited road accidents as a constraint (see chapter 3, point 3.3.3.1.). In Brazzaville, urban dwellers consider this negative effect of roaming animals as really minor. This illustrates very well the subjectivity of the stakeholders' appraisal, and the need to acquire hard data in order to achieve an integrated approach.

Table 12

Negative effects of urban livestock production according to the authorities (in %)
(RIPROSAT survey 2001)

Negative effects	%
Insalubrity (hygiene, smell, noise)	77.8
Negative effects on urban organization (damage to street furniture/ornaments fouling of the public highway, spatial disorganization)	38.9
Road accidents	38.9
Neighbourhood conflicts (regulation of disputes)	11.1

Factors Influencing their Opinion

As with the experts, it was also interesting to link the pro and contra opinions of the authorities to other factors.

The CART analysis gives the following indications by using the variable "opinion of authorities" as a dependent variable and the following variables as predictive variables: "region", "climatic zone", "size of the city", "scale of production", "involvement of rich and well-to-do classes", "classes with modest income" and "poor class", "professional sector", "transmission of diseases to man", "waste", "competition for grain" and "competition for protein".

A first node split is based on the climatic zone (fig. 10). The terminal node 5 includes the authorities of dry and semi-arid Africa. The intermediate node, consisting of authorities in the other zones, is divided into two nodes based on the scale of the professional livestock production sector. The terminal node 1 starts on the left and includes the city authorities from cities where the professional sector is large and who are in favour of urban livestock production. The intermediate right node splits according to the degree of involvement of the middle class. The terminal node 4 includes authorities from cities where this class is little or only moderately involved and who are for the greater part against urban livestock production. The intermediate left node splits are based on the involvement of the poor class. The terminal node 2 and the terminal node 3 include two groups of administration staff who share, more or less equally, three opinions.

This analysis seems to indicate a difference depending on climatic zone. This could be due to the relative importance of livestock production according to the zone. The fact that the importance of the professional sector and the involvement of the various social classes play a role may indicate that socio-economic factors considerably influence the authorities' opinions.

Measures taken by the Authorities to Control Urban Livestock Production

According to 38.2% of the urban experts, the authorities give measures of support to the sector. Specifically these are support measures for city breeders (e.g. the creation of GIE: economic interest groups, in Senegal), support for positive discrimination for initiatives by operational agencies (NGOs, FAO, ...) or financing of mini-farms and tax-free inputs. In Kigali, training is also encouraged. In the authorities' broader opinion, these measures are often more focused on peri-urban than on urban livestock production. Special zones are reserved for this type of livestock production (Bobo Dioulasso, Bujumbura).

Negative measures to discourage people from livestock keeping are mentioned by 38.2%. The municipal services mainly organize hunts to remove free-roaming animals from the streets. They are then put in animal shelters, auctioned or killed. Some refuse to grant plots of land intended for livestock production. The authorities of the city of Sikasso are particularly attentive to the neatness of their

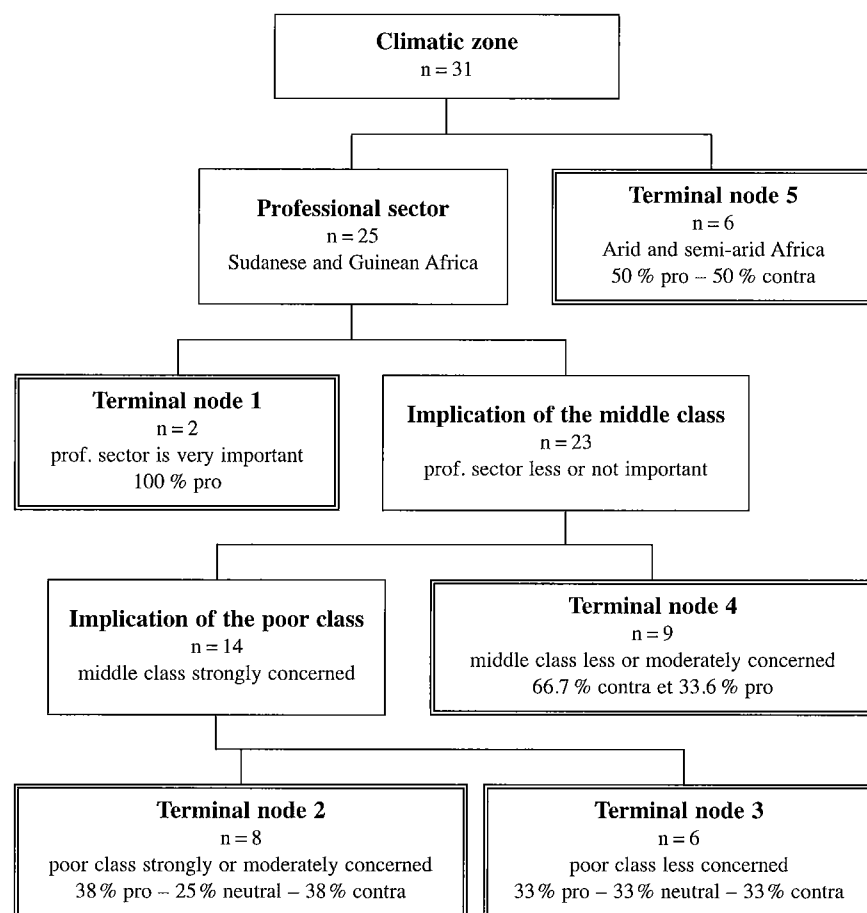


Fig. 10. — Graph of the tree analysis with “opinion of the authorities” as dependent variable (RIPROSAT survey).

city in anticipation of the Africa Nations Cup football tournament. Indeed, the sports authorities decided to organize games in clean cities only.

Legislation is another instrument available to the authorities in their efforts to control animals in the city. However, while 52.9% of the participants in the survey say that they are aware of legislation concerning livestock production in the city, only 44.4% say that it is really applied. The relevant laws are sometimes more general laws applied to this context, such as laws governing animal traffic on public highways (Angola, Cameroon), sanitary laws (Angola), laws on common grazing land (Benin) and laws on agrarian and land reforms (RAF) in Burkina

Faso. Apparently, specific laws are rare and/or little known by the professionals in the sector, so it is scarcely surprising that they are seldom enforced.

3.3.4. Opinion of Experts, Local Authorities and Urban Dwellers on Health Hazards for Humans

3.3.4.1. Opinion of Experts and Urban Authorities

It has already been stated that local authorities are particularly aware of bad hygiene resulting from the presence of animals in towns. Most of them argue also that close contact with animals facilitates the transmission of disease and consider this as a main argument for prohibiting animals within city boundaries.

Although 44.1% of all the experts consulted are aware of cases of transmission of diseases from domestic animals to man in their city, cases are seldom confirmed by the health service. The main diseases are brucellosis, tuberculosis, tapeworm and anthrax. The latter disease is mentioned in various places, but is reported by all three participants in Guinea-Conakry. Porcine cysticercosis, ectoparasites, swine influenza and a case of ecthyma contagiosa are also mentioned, but these are unconfirmed. The most frequently mentioned disease is rabies, mostly transmitted by companion animals, such as dogs, and not by other domestic species.

Contamination of water by excrement can cause infection in humans by bacteria such as salmonella, which causes typhoid fever.

This confirms the fact that little is known about zoonosis in the urban context and its relative importance compared with rural areas (see chapter 2, point 2.4.4.).

3.3.4.2. Opinion of Urban Dwellers

Seventy-two percent of those interviewed in Ouagadougou answered that the presence of animals in the compound did not cause diseases among the inhabitants of the plot, against 6.1% who considered that it was possible, while 21.9% of the interviewees did not know whether the presence of animals in the plot can cause diseases among the inhabitants or not. Rabies is put in the first place as a transmissible disease by 62.5% of them. The remaining 37.5% thought that it could be another disease.

In Brazzaville, a larger number of residents (49% of the interviewees) considered that animals can be a source of contamination for humans.

In conclusion, it seems that, globally, there is a problem of awareness which is linked to people's level of education and understanding of hygiene issues.

3.3.5. Opinion of Experts on Man-Animal Competition for Food/Feed

In developing countries, competition between man and animal is particularly serious in the industrial production of monogastric animals such as pigs and poultry.

Globally, 41.2% of the participants of the RIPROSAT survey think that their city has a problem with the supply of grains. Only 14.7% are of the opinion that this competition also applies to protein. In Bujumbura (Burundi), the competition concerns fishing for small fish (locally called *menu fretin*) in Lake Tanganyika. In Kigali (Rwanda), there is less competition for cereals, as the population gets its energy from food consisting of legumes (beans) and tubers. In Dakar, the problem is also less severe as people prefer to eat rice and fonio, while animals feed on corn and sorghum.

The participants' solutions for overcoming this competition are:

- Support for the farming sector to intensify cereal production in the peri-urban zone (corn, etc.);
- Combating the export of cereal to neighbouring countries (opinion of a Cameroonian expert);
- To carry out priority research on the use of by-products;
- Creation of a "hay bank" to resolve the problem of fodder.

3.3.6. Environmental Problems and Manure Management

3.3.6.1. Livestock Waste Management

A little less than half of the experts in the RIPROSAT survey (45.5%) mention problems of waste. This can involve direct waste (excrement, food residue) or animal carcasses that are dumped illegally. In Douala, excrement from pigs seems to present the biggest nuisance, as well as waste from poultry slaughtered in the compounds. Poultry manure, on the other hand, is useful in crop cultivation, but in big cities, collection becomes a problem. The problem of the lack of personnel in the waste collection service is mentioned in Yaoundé and Conakry. Industry (slaughterhouses and tanneries) mainly located in the city, is an indirect source of waste because of dumped slaughter offal and drainage of polluted water.

3.3.6.2. Manure Management in Brazzaville and Ouagadougou

The use of manure as fertilizer in Brazzaville seems important as 41.4% of producers are using it for that purpose. A little less than half of the livestock breeders in Ouagadougou (43.6%) use the manure themselves, 15.8% sell it, and 0.8% use it within the framework of a cooperative. The remaining 39.7% dump the manure or give it free of charge to neighbours, to apply as fertilizer for the decorative plants in the compound.

It is also important to determine whether factors present in specific contexts can influence the way in which manure is used. The classification tree analysis was applied to a sample of 385 livestock breeders in Ouagadougou and 217 breeders in Brazzaville (survey 2002). "Manure use" includes home use as fertilizer or selling.

The dependent variable was "manure use or not" and the independent variables were: "district", "sex head household", "age head household", "total persons in household", "level of education", "property size", "habitat status", "grandparents already in town", "professional activity" and "crop cultivation or not". The variable "livestock before war 1997" was added for the analysis of the Brazzaville data and "livestock before arriving in the city" for those relating to Ouagadougou.

For Brazzaville, the first node split is based on the variable "livestock before war 1997" (fig. 11). The terminal node 1 includes 21 livestock keepers who had animals before 1997 and who are all of them using the manure. The intermediate node consisting of livestock keepers with no experience before 1997 is divided into two terminal nodes based on the location ("district"). The terminal node 2 includes the breeders from the districts of Makelele, Baongo and Poto-Poto, 83.5% of whom are using the manure. The terminal node 3 includes breeders who are located in Moungali, Ouenze, Talangaï and Mfilou; only 50.7% of them make use of it.

In Brazzaville, previous experience with animals seems to be the most decisive factor determining whether manure is used. Depending on the location, the new breeders put relatively more or less emphasis on its use. So, in Makelele, Baongo and Poto-Poto the number of breeders selling or using the manure as fertilizer is higher than in Moungali, Ouenze, Talangaï and Mfilou. There is a significant level of crop cultivation in the Eastern districts of Makelele and Baongo (respectively 45% and 39% of the surveyed sample). Except for Mfilou (50% of planters), the other districts are less involved in crop cultivation.

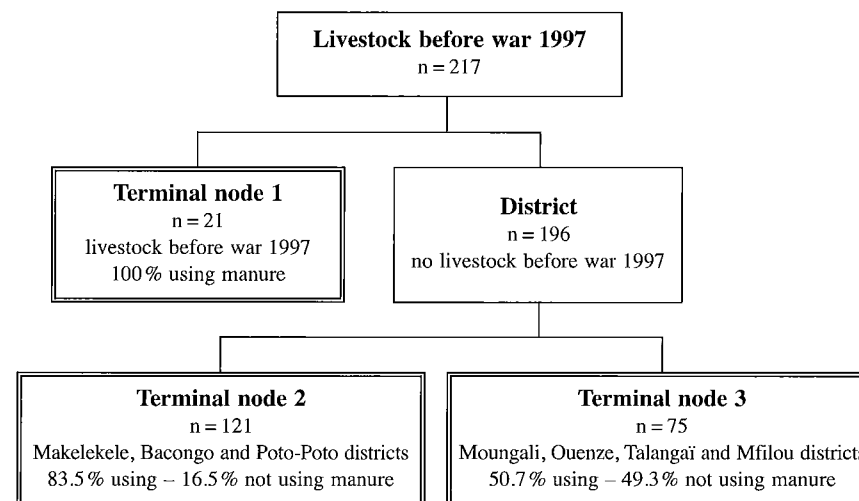


Fig. 11. — Graph of the tree analysis with "manure use in Brazzaville" as dependent variable.

Regarding the Ouagadougou graph, the first node split is based on the variable “crop cultivation” (fig. 12). The intermediate node to the left includes 184 livestock keepers combining livestock keeping and crop cultivation. This node is split into two terminal nodes. Terminal node 1 includes 5 breeders with a property size of less than 25 m², who do not use the manure. Terminal node 2 consists of 179 livestock keepers out of whom the majority (84.4%) use the manure. The second intermediate node (right) is split according to professional activity. Terminal node 5 includes public servants and unemployed persons, the majority of whom are not using manure. The third intermediate node includes traders, self-employed people, manual workers, cultivators and breeders. This node is divided into two terminal nodes based on educational level. Terminal node 3 includes 26 illiterate breeders or breeders from Coranic schools and higher education. The majority (92.3%) are using the manure. Finally, terminal node 4 includes breeders from primary and secondary schools, only 50% of whom are using the manure.

Owners combining livestock with crop cultivation and having a plot larger than 25 m² make extensive use of home generated manure. Public servants and unemployed livestock breeders not engaged in crop cultivation use it less.

In conclusion, it seems that in both cities there is no management of manure in about 50% of cases.

3.3.7. Perception of the Future of Urban Livestock Production

3.3.7.1. Opinion of the African Experts

Regarding the question as to whether urban livestock production is increasing or decreasing, 91.2% of the participants responded that they have the impression that it is increasing. Except for “classical” factors such as tradition, this increase is mainly due to the deterioration of the economic climate, and urban population growth. This can be even more severe when the country is under economic embargo from the European Union (for example Togo at the time of the survey).

In a lot of cities, the administration has opted for an uninterrupted workday in order to lower the transport costs borne by its employees and agents. As a consequence, the latter eat in the city at noon and the street-vending or fast-food sector (grills, etc.) is developing rapidly. The demand for meat by the fast-food sector has increased and part of the informal sector has become involved. The popularity of chicken as meat, and as a source of income, is also a very important factor.

Those who note a decrease in urban livestock production (two researchers in Gabon and one in Guinea-Conakry) attribute it to the negative effects of, and the difficulties that go with, the activity.

Only 3 out of 34 technicians working in cities think that the phenomenon is temporary. Their reasoning is based on prediction rather than on any hard evidence currently available.

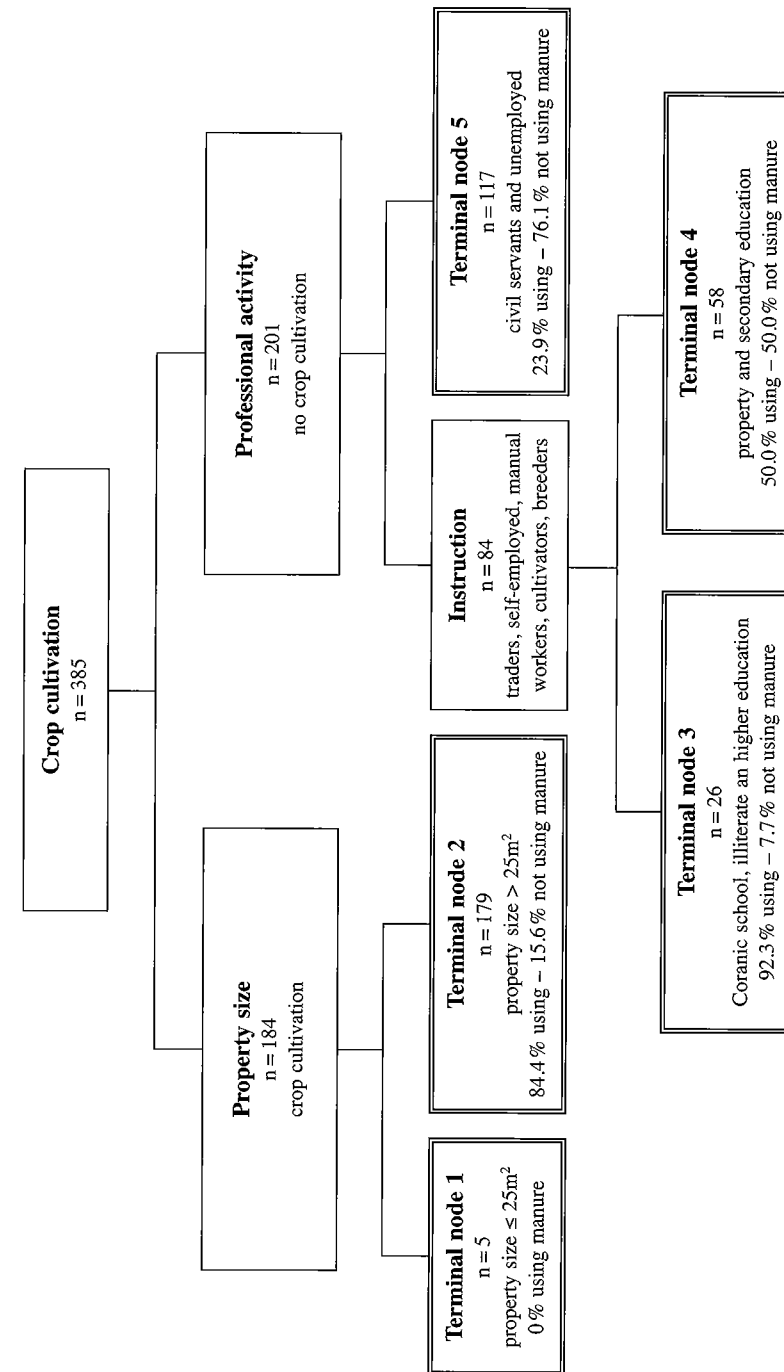


Fig. 12. — Graph of the tree analysis with “manure use in Ouagadougou” as dependent variable.

Those who expect its disappearance speak of the strong constraining effect of repressive legislation (Dakar and Libreville). Relocating the activity in the suburbs is seen as inevitable.

Those who expect it to go on being practised indefinitely, base their prediction, for the most part on population growth, the demand for products of animal origin in the city and economic crisis. An interesting argument presented by one participant is the aspect of “continuum”: growing cities absorb the surrounding villages whose inhabitants practise traditional livestock production.

The different points of view expressed by participants reflect the size of the town or city in which they live. Smaller towns are more traditional and undergo less pressure. Because of poor road systems, they are sometimes quite isolated but have to be self-sufficient, and at the same time meet the increasing needs of urban dwellers (Moanda in Gabon).

Some concrete indicators that urban livestock production may be becoming a permanent practice are: the increasing number of incoming suppliers (Douala) and the increasing number of listed animals (Koudougou, Franceville and Yaoundé). In Sikasso (Mali), big investments have been made and farmland bought back for peri-urban livestock production. In Niamey, the number of peri-urban farms is also increasing. In Mutsamudu (Comoro Islands), the number of animals being raised on roofs is increasing! In Conakry (Guinea), free zones in the city remain occupied and the number of peri-urban farms is increasing.

3.3.7.2. Opinion of the Producers

The majority of the livestock keepers in Ouagadougou (76.9%) think they can continue to practise this activity for a long time, whereas 7.4% say the opposite; 15.7% had no answer to this question. Among those who said this activity will be maintained, 53.7% based their opinion on the likelihood that tradition and custom will endure. 39.9% argue that earned incomes constitute a strong incentive for practitioners to continue. Only 6.4% cited the specific benefit of production for home consumption as a factor favouring continuance. Factors which can affect livestock keeping in Ouagadougou negatively include: 1° lack of space resulting from demographic pressure (36.6% of the interviewees); 2° action by the administration and coercive by-laws (12.2%); 3° neighbourhood problems linked to the nuisance attendant on livestock keeping (noise, odours,...) (7.3%). The other 43.9% attribute the possible decline of the activity to a mishmash of other causes, including theft, fodder availability, etc.

In Brazzaville, a large proportion (45.5% of the interviewees) think that livestock production is incompatible with an urban environment. This is echoed by the fact that only 8.9% of its urban population practise livestock production, compared with 25.8% in Ouagadougou. However, 52.9% consider that the urban authorities should not forbid urban livestock keeping. In fact, 64% think that urban planning should designate special areas for that purpose.

4. General Discussion

4.1. ROLE OF URBAN LIVESTOCK AS SURVIVAL STRATEGY AND THE EFFECT OF CONFLICTS

The combination of the current crisis situation and the evolving process of urbanization have resulted in urban poverty severe enough to jeopardize livelihoods and food and nutrition security in most African towns and cities (MAXWELL *et al.* 2000). In all of Africa, hardly 10% of those entering the labour market today can find formal employment (ATKINSON 2001) so that the informal economy, and related survival strategies, are more important than ever for the population. In that context, livestock production seems to play a role too, as mentioned by several authors (MOUGEOT 2000, NUGENT 2000, ARMAR-KLEMESU 2000).

The figures for Brazzaville and Ouagadougou (respectively 8.9 and 26.2% of the households having livestock — see tab. 1) show that the scale of engagement varies according to location. In both cities, crop cultivation remains more important for households than livestock (respectively 29.6% and 29.1%).

The comparison of living standards shows that the average household involved in crop cultivation is poorer than that keeping livestock (tabs. 4 and 6). Both groups are clearly poorer than the average household practising neither of these two activities. This confirms that livestock is a real coping strategy for poor people. The majority of the households confirm that both activities are essential for their survival. However, the motivation is different in either case. Crops are produced for home consumption whereas livestock is kept for cash generation. The incomes generated are used for various purchases, but contribute indirectly to helping the households to purchase foodstuffs.

Regarding household characteristics and sociological factors influencing livestock keeping, it appears that in both Brazzaville and Ouagadougou, previous experience of the activity is an important factor in determining whether or not people engage in it today. This confirms the statement of MOUGEOT (1994) that, in general, urban agriculture is not an activity for neophytes. Nevertheless, a minority of inexperienced urban dwellers start with livestock production, probably attracted by cash possibilities (see fig. 8, Brazzaville). This might explain the experts' opinion regarding the lack of professionalism on the part of the breeders. The analysis of the data of Ouagadougou shows that livestock is chiefly the concern of male heads of household. According to NUGENT (2000), Africa has the largest proportion of women involved in agriculture. Livestock can be different from crop cultivation both in terms of ownership and day-to-day care. This was highlighted by the surveys in Brazzaville and Ouagadougou.

Another important conclusion is that livestock is not necessarily combined with crop cultivation in the same family setting (mixed farming). Depending on

the location, livestock alone is kept in 56.9% of the households with livestock in Ouagadougou and in 37% of those in Brazzaville. The different main motivations (food versus income generation) can be one reason, but also the fact that the animal plays a role in the socio-religious customs of the family itself.

Indeed, socio-cultural factors are also very important and could be a major reason explaining the persistence of livestock in the city. Tradition, but also prestige, can be motivations even for the rich. CENTRES (1991) spoke about "cultural" owners.

Another research question sought to find out what happens in the case of conflict. The lower number of livestock keepers in Brazzaville as compared with Ouagadougou can be attributed to a higher "rurality" in Ouagadougou, but probably also to the negative effect of the civil war. Only 90 of 249 owners of small ruminants surveyed in 1993 could be interviewed again in 2002. A very small number of them (18%) still had sheep or goats in the compound, and in general 31.1% kept animals, mostly small species, like chickens, ducks and pigeons. Table 8 shows that a majority of owners in Brazzaville (77.9%) kept small species in 2002, which is significantly higher than in Ouagadougou. It is probable that the insecurity born of conflict led people to favour keeping smaller species, which are cheaper and more easily managed. This is confirmed by the fact that one of the constraints enumerated by the producers in general is the lack of financial means to start (or restart) livestock keeping.

4.2. TECHNICAL CONSTRAINTS ON LIVESTOCK PRODUCTION IN URBAN ZONES

4.2.1. Animal Production and Marketing

Urban livestock production takes in a wide variety of animal species and systems in both urban and peri-urban areas, ranging from the simple ownership of animals to industrial systems. According to the experts involved in the alumni survey, a professional sector is present in the majority of the cities of the surveyed area, but seems, at present, to be smaller in every case than the domestic sector. This confirms the current importance of domestic production. One of the consequences arising from this situation is the wide spatial distribution of livestock among a large number of households in the city, which adds to the difficulties encountered in delivering services.

Feed supply is the most frequently quoted technical constraint. And this in spite of the competitive advantage of urban livestock production over rural due to the proximity of agro-industries situated in the city, whose by-products include matter suitable as animal fodder. A distinction has to be made between roughage and concentrated feed. Indeed, roughage, indispensable as bulk in the diet of ruminants, must be transported from the countryside to the city, which negatively influences its price by making it much higher per unit of energy, than that of

concentrated feed, such as oil cake (THYS & EKEMBE 1992). As regards concentrated food, 41.2% of the experts of the alumni survey indicate that a real problem exists in their city regarding the supply of grain for industrial livestock production of monogastric animals, pigs and poultry. This may be related to man-animal competition. An interesting element is that this competition will be less pronounced where the main food of the population is other than corn and sorghum, both used in animal nutrition. Remember also the suggestion of creating a hay or roughage bank and of the better utilization of agricultural by-products.

Land-use problems are also important, due to the concentration of the population in urban zones and the tendency of these zones to occupy more and more space. Lack of space within the urban fringes is certainly an acute problem. Various factors, including, for instance, lack of space, poor housing facilities, and high prices for roughage, lead owners to allow their animals to roam free in the streets.

Free roaming creates opportunities for theft and gives rise to conflicts with neighbours. It encourages a negative attitude towards urban livestock from non-producers and those in authority (see point 4.4.). The municipal services mainly organize hunts to remove stray animals from the streets. They are then put in animal shelters, auctioned or killed. This leads to conflicts and distrust between the stakeholders and can be dramatic for poor households. The on- and off-plot classification of livestock owners (WATER-BAYERS 1995) is certainly a useful tool for identifying production systems that cope with these problems. Moving animals to peri-urban areas is often presented as a good solution, but is not conceivable for those operating on a small or very small scale.

Theft is certainly an important issue for the breeders: 24.8% of the livestock keepers in Ouagadougou and 18.5% in Brazzaville consider it as a main issue. Theft is also possible in rural areas, certainly where small ruminants are concerned (DINEUR *et al.* 1985), but there are indications that in urban areas the incidence is higher. This might be related to the concentration of the poor in urban areas.

According to 17.7% of the experts involved in the alumni survey, marketing problems are important. The literature study shows that city provisioning is quite a complex matter and competition is a real issue for urban livestock keepers aiming to sell their products at a competitive price. The link between rural and urban is manifest in the context of commercial flows, and growing cities can represent an opportunity for rural producers. This reinforces competition problems. Urban livestock producers also face competition from imported products. However, the case studies in Ouagadougou and Brazzaville show that with relatively little improvement in terms of management, the operation can be highly profitable. ENDOM (2002) highlighted also that direct selling of the animal products is more profitable than via retailers. The poor state of the roads in several African countries can also be a factor, enhancing the role of intra- and peri-urban production, especially in remote cities and in the rainy season, though we should note that

mobility constitutes a competitive advantage for livestock over crop cultivation, as most of the animals are brought alive to city markets and slaughterhouses.

4.2.2. Animal Health

The current literature regarding animal diseases in towns is relatively scant. Except for "plasticosis", the ingestion of plastic material, the urban environment does not seem to present any particular animal pathology, but what is interesting is its influence on the mode of transmission of diseases. These epidemiological aspects deserve to be studied more in depth.

Another important constraint mentioned by the experts interviewed in the alumni survey is that of service delivery, which is of lower quality in the city due to the lack of personnel, the lack of means at the level of government services and the lack of diagnostic capacity. The question is whether this problem is characteristic of the urban context. An important remark by one participant was the lack of specific knowledge about livestock production in the city and the fact that livestock production policies always emphasize the rural dimension. The alternative of transferring the provision of services to the private sector is suggested, but the higher costs this would entail are considered an obstacle. It remains nevertheless a viable alternative in the wider context of the global profitability of livestock production. Indeed, improvements in the delivery of services, even though more expensive, could, in theory, generate better incomes.

4.2.3. Livestock Waste Management

The problem of waste disposal is an important issue affecting animal production in the city. However, it should be pointed out that the livestock sector contributes only partly to the generally poor environmental conditions in urban areas (see chapter I, point 1.1.6.).

Livestock production generates urine, excrement and dead animals, which can attract flies and pollute both the soil and the groundwater (SCIALABBA 1995). Indirectly, the concentration of animal industries (slaughterhouses, dairies, ...) produces polluting effluents. On the other hand, animals can, in turn, be useful in converting organic household waste and this is not unimportant in a developing country where 50% of urban waste is still organic, compared to 14% in developed countries (RUSHBROOK & FINNECY 1988). For certain breeders, this waste can even be the most important source of feed for their animals. Excrement and other waste from slaughterhouses can, in turn, be used by market gardeners (CENTRES 1996, FOUTOU 1996).

It is important to note that only a little less than half of the experts involved in the alumni survey mention problems with waste. It is evident that the waste disposal problem presents different features in different cities, and equally clear that the levels of effectiveness and efficiency achieved in handling it, vary accordingly.

Manure management was studied in Brazzaville and Ouagadougou. In both cities approximately half the livestock owners were using manure as fertilizer for their own plots. In Ouagadougou, manure is sold in 15.8% of the cases. Approximately 40% dump it, or give it free to neighbours for their own use.

The main factor influencing manure use in Brazzaville is whether the producer has previous experience in livestock keeping. This is coherent with the overall importance of this factor in determining whether livestock production is practised in the first place. The extent to which manure is used also seems to correspond with the scale of crop cultivation, which illustrates the importance of physical proximity between the two activities. In Ouagadougou, owners combining livestock with crop cultivation and having a residence larger than 25 m² make extensive use of manure. Public servants and unemployed livestock breeders not engaged in crop cultivation make little use of it.

Unlike the dumping of other garbage or airborne pollution by cars, for example, manure and livestock wastes in general do not seem to constitute such a huge problem. However, manure management can certainly be improved.

4.3. VETERINARY PUBLIC HEALTH AND HUMAN NUTRITION ISSUES

The transmission of diseases from animal to man is a potential danger in urban livestock production (DE ZEEUW & LOCK 2001, LOCK & VAN VEENHUIZEN 2001). However, only 43% of the experts participating in the alumni survey are aware of zoonotic diseases in their city and/or obtained such medical information from the health service consulted on this subject. Only one person knows a study that gives information about zoonoses.

The transmissible disease most commonly reported, whether by the experts, or by those residents of Ouagadougou who were interviewed, was rabies (62.5%!). But this disease is not related to livestock but rather to pet animals.

These data confirm other reports that little research has been done up to now on the specific health risks connected with urban livestock production, compared with that in rural areas (FLYNN 1999, DE ZEEUW & LOCK 2001, DRESCHER *et al.* 2001).

Competition for food between man and animal is more significant where cereals are concerned (41.2%) than proteins (14.7%). We indicated above that this problem of competition for grain tends to be less important where the main food for man is not corn or sorghum, the most important grains used in pig and poultry feed. This could lead to new developments in the field of cereal production, where intensification could be accompanied by diversification, taking into account the respective needs of the population and livestock production. It is certain that production of non-grazing fast-growing species, such as poultry and/or to a lesser extent pigs (lesser because of the danger of African Swine Fever), will continue to play an important role, as a consequence of the increasing demand in cities for products of animal origin. Indeed, this tendency towards an increase

in demand is proving to be a global phenomenon, stemming from the relatively higher incomes in the city (DELGADO *et al.* 1999).

4.4. OPINION OF THE STAKEHOLDERS ON THE POSITIVE/NEGATIVE EFFECTS AND ON THE FUTURE OF URBAN LIVESTOCK

It was interesting to examine how the experts and producers involved perceive the problem of livestock in the city, its presence and future, and to compare their attitude with that of the authorities (mayors) of cities, who bear ultimate responsibility for how things develop.

Overall, the experts working in the city are aware of the importance of the phenomenon and of the constraints involved. Ninety-one percent answer that urban livestock production is increasing and only 9% consider that it is a passing phenomenon. In fact, if we analyse their argumentation, we notice that it is based on two opposite forces. On the one hand, there is a demand for animal products, and a response on the part of city-dwellers to the existing crisis, which leads people to engage in livestock production, both to supply themselves with food, and to increase their incomes. On the other hand, the legislative framework is a constraint which could put an end to this practice within a relatively short period of time. However, the likelihood of this happening must be qualified since only 44.4% of the participants consider that the laws, when they exist, are actually enforced. There is thus a sort of “real politic” or “laissez-faire” attitude evident in thinking at the official level. At any rate, coercive by-laws do not seem to make an appropriate regulatory tool.

Two other salient factors concern the current size of cities and the dynamics of city growth, a process whereby rural areas are transformed first into peri-urban, and then into urban zones. Indeed, the increase in the urban to rural population ratio, and the increasing number of cities in western and central Africa, between 1990 and 2020 (see figs. 1 and 2), show this dynamics and suggest that the phenomenon of urban livestock production might evolve in parallel with the evolution of cities, and the diversification of the activities of “multispatial households” as defined by TACOLI (1998) cited by ADELL (1999), *i.e.* households becoming more and more like urban enclaves and losing a little of their rural nature to become increasingly urbanized. Other developments in the social habits of urban dwellers (rise of the fast-food sector as a consequence of uninterrupted workdays, rise in income leading to increased consumption of animal products, ...) make the market more attractive and the presence of a closer source of animal products more competitive. Urban planners will be continuously confronted with this dynamics, to which flexible solutions rather than rigid development frameworks, appear to offer the best hope of success.

The majority of the livestock production experts interviewed (87.2%) declare themselves in favour of the activity. According to a decision tree analysis, the

researchers, as a group, are the most enthusiastic supporters, but given the restricted number of participants, this remains to be confirmed. They particularly identify beneficial effects at the household level: better food, a source of income through sales, the creation of direct or ancillary jobs, all elements favourable to poverty alleviation. City-dwellers with modest or low incomes are particularly motivated to keep urban livestock.

Additionally, and especially in the peri-urban zones, the experts consider fertilizers to be important in increasing agricultural production. Finally, from a global point of view, urban livestock production reduces the dependence of cities on rural areas, a goal which, according to MOUGEOT (1994), has existed since antiquity and has often contributed to progress in agriculture. Conscious of the constraints, 75% of the experts cite pollution and nuisance (noise, smell and dust caused by cattle crossing dirty streets) as important negative effects. Zoonoses are also mentioned.

If we turn now to an analysis of the opinion of the authorities questioned by the participants in the survey, we notice that they are much less favourable to urban livestock production. Indeed, only 32.3% are for it, 22.6% are neutral and 45.2%, thus nearly half, are downright against it. A preliminary decision tree analysis seems to indicate a difference depending on the climatic zone. This could be due to the relative importance of livestock production in the different zones. The fact that the scale of the professional sector and the degree of involvement of various social classes both play a role in their decision, indicates that the authorities' opinion is strongly influenced by socio-economic factors. This is confirmed by the positive factors enumerated by them.

On the other hand, the negative factors dominate, such as insalubrity (78%), road accidents (39% versus 5.9% by experts) and neighbourhood conflicts (11.1% versus 14.7% by experts and 0.6% and 2.3% by producers in Brazzaville and Ouagadougou, respectively). A special mention is also made as regards the negative effects on urban organization (39%), which clearly shows the conflict of interest which appears between households applying strategies of survival, and the municipal authorities aiming to present a clean and attractive city. In fact, it is usually not the breeders in the peri-urban zone, or those who work in confined areas who create problems, but rather the small breeders and the owners who allow their animals to roam freely, because they do not always have enough time and money to feed them. This has not escaped the attention of the experts.

SCHIERE (2001) also observed that the officials' opinion was different from that of producers and individual consumers, which seems logical if we consider that, in a very complex evolutionary context with many interactions, different individual stakes are involved. Here and there supporting measures to stimulate livestock production are being taken, but mainly in peri-urban and designated zones, which shows the concern of certain authorities to reconcile land development with the supply of animal-based products to the city.

4.5. GENERAL FRAMEWORK FOR INTEGRATING LIVESTOCK PRODUCTION INTO URBAN PLANNING

The various issues enumerated in the previous points, the complexity of the phenomenon and the positions of the different stakeholders all lead to the conclusion that differences of opinion should be overcome with the aim of achieving an integrated approach which would take into account the evolutionary dynamics of city growth and human activities.

Based on the concept of the rural-urban continuum the following framework was conceived as a tool to be used in an integrated approach to urban livestock production (fig. 13).

Embedded in the urban tissue, urban livestock systems interface with other urban agricultural practices (crop cultivation, forestry/orchards, and fish farming) linked by exchanges of feed and fertilizer (manure). All of these activities depend on urban land management, *i.e.* the designation of land and/or the spatial organization of the city. Urban authorities who are in charge of urban spatial organization (urban planning) are also concerned by: livestock waste management, the influence of animals on the urban infrastructure (roaming, physical damage, creation of tracks to reach the markets, ...), the veterinary public health aspects, and the necessary regulation by promulgation of by-laws. Another concern of urban authorities is the regulation of neighbourhood conflicts. Urban livestock systems also interface with agro-industries, which provide by-products, such as brewers'

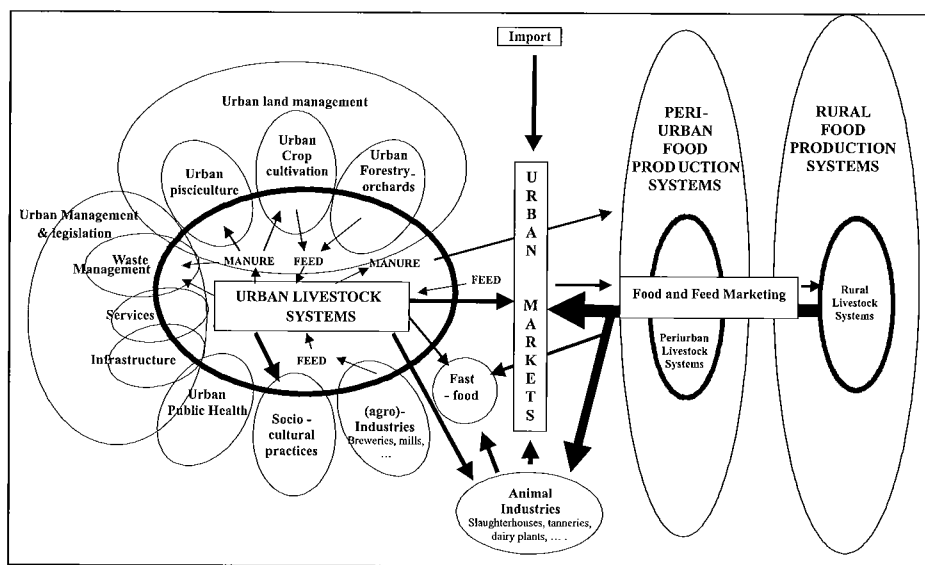


Fig. 13. — Relationships between urban livestock production and other urban factors and issues.

grain and oil cake, used as feed. Urban livestock systems supply markets and the fast-food sector. But an important role is also to provide animals for cultural and religious practices. Manure is also transported to the peri-urban areas.

The food and feed flow coming from the hinterland and the peri-urban area are important in providing enough food for urban markets, the fast-food and animal industries, *e.g.* slaughterhouses. Urban livestock systems provide families with important animal food-products, directly.

5. Conclusion

Urban livestock is of great importance for developing countries with regard to food safety in cities and the provision of quality protein nutrients in the context of a dramatic increase in the human population. Urbanization is a world trend and demographers predict that in 2025, 65 % of the world's population and approximately 50 % of the African population will be concentrated in towns and cities. Livestock is also kept in towns in developing countries, and in considerable quantity. The aim of this policy paper was to study this phenomenon and its side effects through a literature study and original surveys.

The study shows the complexity of the situation regarding urban and peri-urban livestock production, which comprises a wide variety of species, and production systems ranging from the simple ownership of animals to industrial systems. Urban livestock production has many interfaces and has to be considered within a broader urban-rural continuum. This study has suggested a framework in which this might be achieved.

The sector is subject to a wide range of constraints arising from the urban context, including feed problems, lack of space, lack of services, etc. However, in spite of the various negative effects, such as pollution, roaming in the streets, etc., urban livestock production presents quite significant social, environmental and economic opportunities.

The importance of livestock production as a survival strategy for poor urban dwellers has been sufficiently highlighted in the surveys. Mostly, people with previous experience in the field are involved. Crop cultivation is more practised than livestock keeping but the latter is more important in cash generation. It also has an important cultural and socio-religious role to play. The survey in Brazzaville showed that urban livestock production is negatively influenced by conflicts, and that there is a shift to smaller species, like poultry.

The study emphasizes the difference of perception between the authorities, other persons involved in livestock production, the experts and the producers. This difference is linked to diverging stakes within a complex context and thus to a difference in opinion about the advantages of livestock production as well as on its drawbacks. The study of manure management in Ouagadougou and Brazzaville gives an example of these divergent positions.

The future of urban livestock production in a context of evolutionary continuity seems to be dependent on the reconciliation of these various points of view and on real and pragmatic consideration of the constraints surrounding urban and peri-urban livestock production, and the nuisance it causes to health and urban hygiene. The consideration of the nuisance and its control indeed requires a common approach based on objective analysis. This should be taken into account

when setting up city survival strategies, so that urban livestock production does not remain stuck in the informal economic sector, and in illegality.

One of the aspects which seems less documented is that of the transmission of diseases to man. Indeed, although the theoretical model suggests that a high population concentration near animals and animal-based industries constitutes potential danger to public health, little evidence which may prove that cities are at a higher risk than are rural areas seems to be known to the experts who were interviewed. Nevertheless, this aspect is ethically too important to be neglected.

6. Recommendations

6.1. URBAN PLANNING

First of all, African municipal authorities must effectively recognize the existence of livestock production in their towns. Figures are currently sufficiently strong to prove that urban livestock production is still a dynamic sector. No one knows when it may decrease, but the important socio-cultural value attributed to animals in many African cultures will probably mean that animals will be kept longer for that purpose than for food and income.

Recognition by the authorities implies that they should see to it that the activity does not remain illegal. The relevant technical services should be allowed to implement new innovative solutions aimed at correctly solving the major negative effects of livestock keeping.

Recognition would allow all city dwellers to express themselves on this topic, and to come to a better understanding of the relativity of the secondary effects and the way to deal with them. An approach driven by the participatory principle, and based on problem-solving seems to offer the best chance of success. The classification tree analysis shows that urban authorities are basing their opinion partly on the presence or absence of a professional sector. Even if the domestic sector remains important, private enterprises should thus also be involved in the discussion as full stakeholders.

As urban livestock keeping has many interfaces with other components of the urban scene, there is certainly a need to use a holistic approach in studying it, and to take into account the various interactions within the framework of a rural-urban continuum. The general framework in figure 13 is proposed for studying urban livestock in that regard.

From an institutional point of view, it is important to implement mechanisms to coordinate the control of rural-urban and urban-rural trade flows. Indeed, in some countries, the urban area depends on the urban authorities and the peri-urban and rural areas on the state authorities. Those authorities have to guarantee market access to urban dwellers as well as rural producers, and have to control the quality and hygiene of the supply chain.

BONNET & DUTEURTRE (1999) concluded their study on the supply of dairy products in Addis Ababa with the statement that in the context of that commodity, both innovation and tradition are important. They proposed to consider the milk system as a contemporary monitoring system for observing changes in features of urbanization and consumption, spatial organization, productivity gain opportunities, institutionalization of the sector, the enabling capacity of laws and cultural rules. This can probably be applied in other cities too.

Another accurate tool would be the establishment of an “Urban Observation Centre”. Initiatives or proposals in that sense already exist for some African cities (*e.g.* Ouagadougou, Lubumbashi). A database with a representative number of households can be kept up-to-date on a regular basis to make ongoing surveys on different topics possible. Geographic information systems (GIS) can be helpful too in following up the evolution of the different sectors, including livestock production. Problem-solving driven multidisciplinary research can lead to an urban policy that fits with the specific environment of a given city, through appropriate citizen-friendly by-laws and urban spatial directory schemes. Once such a legal framework is available, the authorities have to be vigilant and ensure that the by-laws are really enforced.

6.2. TECHNICAL ASPECTS

Adequate participatory research, preferably through organized cooperatives or other organizations, must deliver appropriate solutions to the main bottlenecks and to appropriate institutional support services in terms of credit facilities, animal health, input supply and distribution and technical advisory services, when needed. Solutions for large-scale industrial farms are not the same as those for individual producers, and neither are the two on an equal footing as far as investment capacity is concerned. Therefore different solution packages have to be found.

The following constraints were identified as important: feed supply, lack of space, theft, problems with neighbours or other residents caused by nuisance and roaming of the animals.

As a consequence of these problems, many technicians and authorities in developing countries often start from the principle that, sooner or later, this type of animal husbandry must disappear and recommend that animal producing farms be located in the peri-urban area. Nevertheless, even if the relocation of large farms far from the city centres is a valuable long-term option, it was observed that, mainly in the interest of proximity and preventing theft, city dwellers continue to keep their animals close to them. In the medium term, one of the solutions could be that the smallest species be tolerated in town and strict rules be developed for the others. Indeed the smaller the livestock is, the more affordable it is for all groups (MOUGEOT 1994). This would also favour a harmonious transition towards an appropriate spatial organization of the city, safeguarding an often crucial source of income and food for the poorest urban population. It was also seen that, in post-war periods, smaller species are preferred to larger ones.

Small species like birds (chickens, ducks and pigeons, ...) or rodents (rabbits, ...) can be considered, but also more non-conventional mini-livestock, like guinea-pigs. In our opinion, the small size of these animals is undoubtedly one of their most significant assets, because it makes it possible to produce on small surfaces and in cloistering. It makes animal production for poor people or people with

small compounds, affordable. While modulating the number of animals, one can also, to a large extent, manage to nourish these animals with household waste, which greatly reduces dependence on external factors and eliminates roaming, the usual solution where ruminants and pigs are concerned. In addition, being less noisy and odorous than other species, these animals will cause less nuisance. Moreover, their growth potential makes it possible to have very good outputs. Their small size also makes them more easily handled by children, who often own them and have charge of taking care of them. Thus, their supply of proteins and essential amino acids will increase while they learn how to handle animals. One can thus speak of an important socio-nutritional impact (THYS 2001).

Small size species also have the comparative advantage of being profitable in a shorter period of time. Short-term credits for producers aiming to commercialize their products can be introduced. In a post-conflict phase too, the organization of feed supply and short-term credits can help in the reconstruction.

Solutions have to be found for organizing the collection of unused animal wastes at compound level, perhaps through market garden cooperatives. RAJORHIA (1999) suggested making the treatment of swine-wastes obligatory for peri-urban commercial pig farms and minimizing the use of chemical additives in the diets of all animals to avoid the contamination of wastes (and animal products). New advances in research relating to the effects of diet on pig manure odours (SUTTON *et al.* 1999) must be followed to see if applications can be found for developing countries. Manure silage may also be valuable in fattening growing bulls (MARTIN *et al.* 1998). On the other side, collection of organic garbage should be organized, perhaps simultaneously with the collection of manure for manure silage, to provide as feed. Indeed, a large part of the garbage in developing countries is still organic (RICHARDSON & WHITNEY 1995). If not used at household level, collection by the neighbourhood or on a larger scale may be profitable. Central collection would also make treating the garbage and controlling quality possible.

Delivery of animal health can be improved by: 1° the establishment of clear legislation with a good definition of the roles of both the government sector (control) and the private sector (service delivery); 2° setting of standard prices for medicines. As the current literature is relatively poor regarding animal diseases in town, research has to be carried out into this topic.

Increasing production capacity is essential. Technical training is necessary but also stimulation of awareness of food safety and veterinary public health issues (hygienic production and transport to transformation units, ...). Access to information is important too.

6.3. VETERINARY PUBLIC HEALTH

As the epidemiology of zoonotic diseases is currently largely understudied in the urban context, further studies have to be conducted in that field. For the

future, longer-term monitoring is certainly necessary for a better understanding of the problems to be achieved. Municipal services, public health and veterinary service agents should work closely together to come to a better understanding of the problems.

Meanwhile, several measures can certainly be introduced:

- Garbage, liquid and solid waste treatment: best through cooperatives;
- Progressive relocation of abattoirs or effective control of waste waters;
- Enforcement of hygienic regulations in a realistic way;
- Promotion of on-plot production systems connected to waste collection;
- Education of farmers and consumers (e.g. heat treatment of milk products, cold chain, ...).

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APPENDIX

Description of the Sample of the RIPROSAT Alumni Survey

Geographic Distribution of the Sample and the Cities Involved

Thirty-three of the questionnaires came from experts living and working in the city. Five of them work in rural areas, of whom two live in a city. Geographic distribution of the sample and cities involved are summarized in table 13 and illustrated in figure 14. No data are available on Tunisia, Congo-Brazzaville or Chad. Brazzaville was involved in the more comprehensive socio-economic study described in chapter 3.

Table 13

Geographic distribution of the sample and the African cities involved in the RIPROSAT survey 2001

Country	Answers by city	City covered	Region
Benin	1 1 (1)	Cotonou Lokossa (Rural)	West
Burkina Faso	1 2 1 1 1	Ouagadougou Bobo Dioulasso Koudougou Kaya Dori	West
Guinea	2 1	Conakry Dabola	West
Mali	1 (1)	Sikasso (Rural)	West
Niger	1 1	Niamey Maradi	West
Angola	1	Luanda	Central
Burundi	3 (1)	Bujumbura (Rural)	Central
Cameroon	2 3 1 (1)	Yaounde Douala Maroua (Rural)	Central

Country	Answers by city	City covered	Region
RD Congo	2	Kinshasa	Central
Gabon	1	Libreville	Central
	1	Moanda	
	1	Franceville	
	(1)	(Rural)	
Rwanda	1	Kigali	Central
Senegal	2	Dakar	West
	1	Thiès	
	1	Kaolack	
Togo	1	Sokodé	West
Comoro Islands	1	Mutsamudu	East
Total	41		

Table 14 gives the distribution of participants working in urban areas by climatic zone and by region of Africa. Fifty-eight percent of the data result from cities situated in Guinean zone (humid), 21 % in Sudanese zone and 21 % in arid and semi-arid zone. Western Africa is the best represented with 56 % of participants, followed by Central Africa with 41 %. A single participant comes from a city in East Africa (Comoro Islands).

Thirty-six percent of the questionnaires concern very big cities (more than 1,000,000 inhabitants), 24 % cities between 500,000 and 1,000,000 inhabitants, 20 % average cities between 100,000 and 500,000 inhabitants and 20 % cities of less than 100,000 inhabitants.

Table 14
Distribution of the survey sample by climatic zone and region

Region of Africa	Climatic zone			Total
	Arid or semi-arid	Guinean	Sudanese	
Central	1	13	0	14
West	6	6	7	19
East	0	1	0	1
Total	7	20	7	34

Professional Profile of the Sample of Participants

Fifty-one percent of participants are veterinarians, 41 % are zootechnicians and 8 % are biologists. Forty-two percent followed the basic course in tropical animal

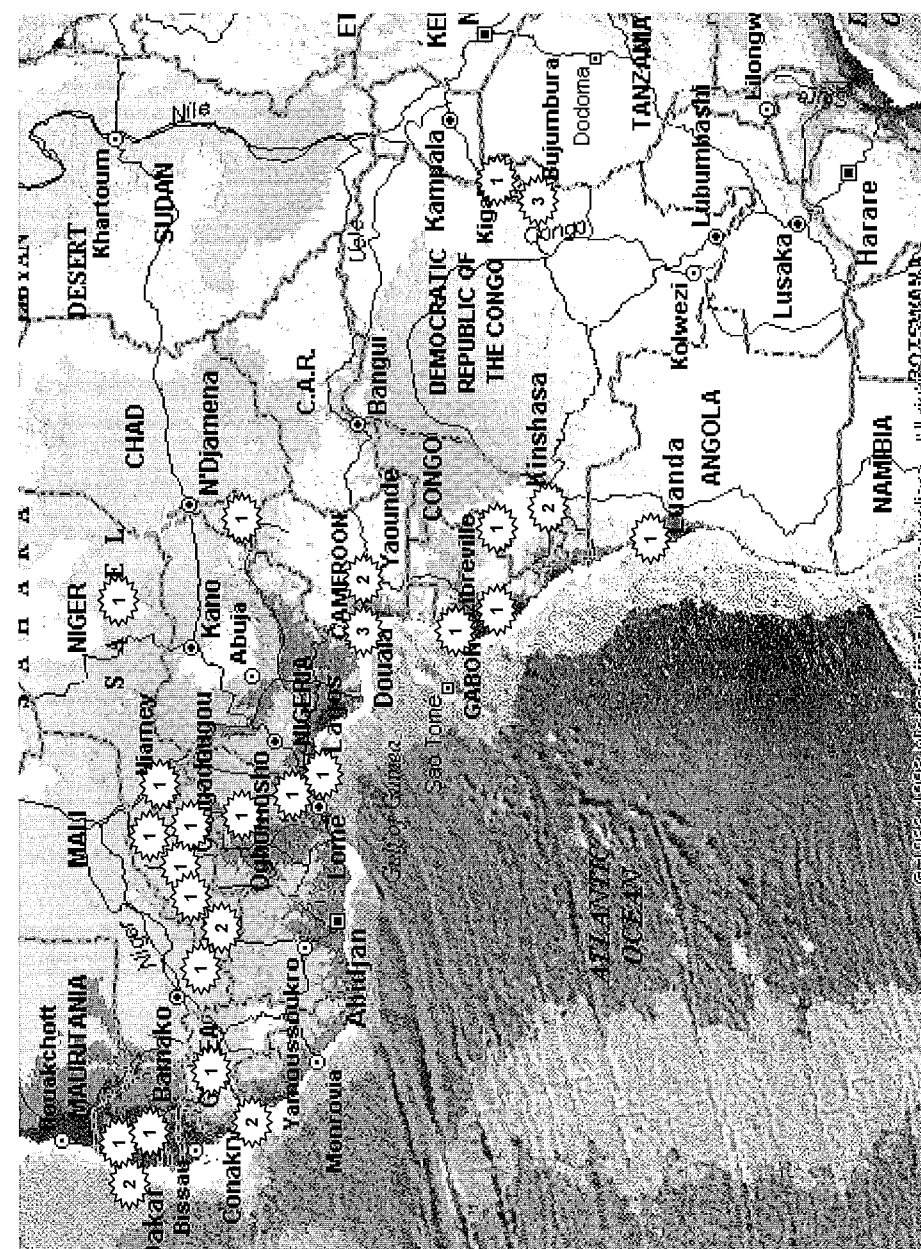


Fig. 14. — Geographic distribution of the cities covered by the RIPROSAT survey (location and number of interviewees).

health and production at the ITM (CIPSAT since 1991 or the previous courses). The majority (58 %) obtained the Master's degree in tropical animal health and production (MscVet). Nobody has a doctorate (PhD).

Eighty-seven percent are public servants, 3 % are employed by the private sector and 10 % are independent. Forty-nine percent of participants are active in research, 41 % in administration (including extension and care tasks) and the remaining 10 % are practitioners, corresponding to the 10 % of independents. Twenty-eight percent of participants are exclusively involved with animal health, 36 % with animal production and 36 % with both activities.

Five of the alumni have already participated or are going to participate in a study on urban or peri-urban livestock production.