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Chapter 14

Songhai model of integrated production in Benin

Gaston Agossou, Gualbert Gbehounou, Godfrey Nzamujo, Anne-Sophie Poisot, Allison Loconto and Caterina Batello

14.1 INTRODUCTION

This chapter introduces an innovation within the agriculture sector in Benin: the Songhai Centre's integrated production model. The centre focuses on an integrated production system, but its innovation is in creating a solid network of regional hubs that excel in sustainable production and have established local markets for sustainably produced goods that are accessible and affordable for the majority of the population.

The agricultural sector in Benin comprises some 550 000 farms, mainly small family farms focusing essentially on mixed food crop farming and small animal farming. More than 60 percent of male workers and 36 percent of female workers in full employment are in agriculture (second General Population and Housing Census [RGPH2], INSAE, 2004). Approximately 34 percent of farms have less than 1 ha of land, while only 5 percent of farms in the south of the country and 20 percent in the north boast more than 5 ha (MAEP, 2011). Current production methods are still predominantly based on extensive systems that are highly dependent on natural resources. Significant progress can increasingly be observed with the creation of modern farms (orchards, intensive small animal farming, fish farming, etc.) by private promoters.

Generally speaking, the agricultural sector represents 70 percent of all employment, generates between 70 and 80 percent of export revenue and accounts for 15 percent of state revenue. Its contribution to the gross domestic product (GDP) of the primary sector, which includes agriculture, stock farming, fishing and forestry, has grown steadily from 351 billion CFA francs (XOF) in 2003 to 490 billion in 2012. We observe a regularity in the ratio (38 percent) of the contribution of the primary sector and GDP at constant prices. More than 72 percent of this contribution is provided by the agriculture subsector. Nevertheless, agriculture in Benin remains essentially a prime example of subsistence farming with a low level of mechanization and with little use of technologies and improved inputs. It is consequently unattractive to the younger generation who prefer to invest in new non-agricultural activities such as the sale of black market petrol and driving motorcycle taxis, if indeed they do not head to neighbouring Nigeria to sell their labour.

There are a number of sustainability problems within the Beninese agriculture sector. First, farmers still use only a little organic fertilizer and few phytosanitary products for crop cultivation, and few veterinary products or improved inputs for

livestock. This limited use of the essential inputs for production is key to explaining the considerable productivity gap between results obtained by producers and those obtained in research trials. Small traditional tools also remain predominant in most farming practices, which means that a great deal needs to be done in terms of mechanization, processing and post-harvest storage in the agricultural sector.

Second, the funding situation in the sector continues to be marked by a mismatch between capital costs and internal profitability, resulting in difficulties in paying back loans and producer over-indebtedness. Production value chains are not competitive and, with the exception of the cotton value chain, the collection and marketing channels for agricultural products have little or no formal structure. The rate of adoption of innovations remains low because these new technologies are not always suitable and/or producers are not always aware of them. There is therefore a need to develop appropriate technologies at the research stage, to give producers the capacity to adopt these technologies by means of extension and support/advice and to train a large number of people who will be capable of training others.

Third, Benin has considerable natural resources (water, land, flora and fauna), enabling agriculture to form the foundation of its economic and social development. However, there is no consistent operational strategy for the promotion of agriculture and particularly the development of managed agricultural cropland (including the rehabilitation of agricultural tracks), which is much needed within this sector. Beninese agriculture generally remains at the mercy of the vagaries of the weather; producers are bound by seasonality with somewhat inconsistent harvests demonstrating peaks and troughs with huge losses. Globally, the country's agriculture remains almost exclusively rainfed, extensive and pastoralist, based on a traditional slash-and-burn system. Moreover, livestock rearing is not integrated with crop cultivation. This system is confronted by the three challenges of productivity, competitiveness and sustainability that are necessary in order to satisfy the food and nutritional needs of a constantly growing population, and to procure currency for the economy while protecting the productive base of natural resources for future generations.

Fourth, there are clear environmental pressures on current land-use practices. Forest resources, which cover 65 percent of the country (approximately 73 450 km²), have been deteriorating for several decades because of the combined impacts of anarchic extension of agricultural and pastureland, practices not conducive to the sustainable management of natural resources, bush fires and plantation fires and soil nutrient depletion. The uncontrolled use of forest resources to satisfy the population's needs in terms of lumber and household energy is one of the main factors contributing to this deterioration and represents a serious threat to the preservation of national forest reserves. According to a study conducted by FAO in 2006 (MAEP, 2011), the rate of deforestation in Benin is estimated at 70 000 ha/year. The actions being developed to protect and manage forest resources are not yet able to compensate for the forest resources needed to satisfy the population's demand for fuel, lumber and agricultural production.

Finally, land registration leading to landownership remains inaccessible for the majority of the population because of the cost and complexity of the procedure (less than 1 percent of all land is registered in Benin). Consequently, almost all land continues to be governed by customary law characterized by secular rules and

practices that are not documented in official registers, which serves as a source of insecurity, particularly in regions subject to a high level of agricultural land pressure (MAEP, 2011).

Given these environmental, social and economic sustainability challenges, attempts to ensure the sustainability of agricultural production is at the heart of all development policies within the sector in Benin. In the Strategic Recovery Plan for the Agricultural Sector (PSRSA) (MAEP, 2011), a number of measures are planned to guarantee this sustainable agricultural development:

- definition and implementation of a specific operational plan relating to soil fertility management with a view to ensuring sustainability of farming systems;
- integrated water resources management (IWRM), in particular by means of equity and solidarity between users in terms of space and time;
- definition of a sustainable fisheries resources management plan.

The sustainability of agricultural production in Africa is the challenge for which the Songhai Centre intends to provide a tangible solution. This involves providing the populations with healthy agricultural products at a lower cost. The emergence of single-crop farming (in particular cash crops) with an increasingly pronounced use of large quantities of chemical fertilizers and pesticides is not conducive to protecting the environment and natural resources for future generations. Sustainability of agricultural production corresponds to a rationale of food security that will allow African populations to enjoy a better lifestyle and grow older better, and that will also prevent illness.

The Songhai model focuses on the need to raise the level of Africans by creating entrepreneurial skills, while providing effective solutions to the problems of food insecurity, climate variability, wasteful use of natural resources and constant increase in youth unemployment. The model develops technical, moral and entrepreneurial skills within the local communities in general and among young people in particular through effective and functional training programmes within the framework of regeneration or an autonomous economic system. In this system, care is taken to promote the relative advantages of individuals, communities and regions to ensure efficiency and increased synergy.

Data used in this case study were collected during 2013 as part of a sustainability assessment of the Songhai integrated production model, carried out by FAO (Agossou, 2014). The case study presents highlights from this study and focuses on the questions pertinent to this book, which is on the innovative institutional arrangement that enables the Songhai Centre to link its sustainable production model with markets for sustainable products within Benin. This article will present: (i) the institutional innovation; (ii) description of the sustainable practices developed at the Songhai Centre; (iii) description of markets; (iv) results and advantages; and (v) recommendations for the replicability of this approach.

14.2 INSTITUTIONAL LANDSCAPE

Legislative and regulatory context

In Benin, public policies in general and agricultural development policies in particular are often oriented towards increased productivity and growth with a view to satisfying the needs of a rapidly growing population. Sustainability is not excluded

from concerns, as seen in the vision laid out in PSRSA: "... make Benin a dynamic, competitive, attractive and environmentally friendly agricultural power by 2015, which creates wealth in line with the economic and social development needs of the population" (MAEP, 2011).

At the legislative, regulatory and institutional level, there is no national code of conduct, nor is there a directorate in a ministry or a special national programme relating to agricultural sustainability that focuses exclusively on ecological or organic agricultural practices. However, in several existing regulatory provisions relating to agriculture, food, trade and the environment, allusions are made to sustainable agriculture, organic agriculture or the ecological balance and health of the population (OBEPAB, 2013). For example, Law No. 98-030 of 12 February 1999, constituting the framework law on the environment in Benin, and defining the foundations of environmental policy in the country, takes advantage of the main keys of environmental policy such as:

- the precautionary principle and the polluter pays principle;
- the orientations of PSRSA for the promotion of specific fertilizers and other organic inputs for the sustainable management of soil fertility and for the rational use of agricultural equipment suitable for all farming operations;
- staggered targeted control (STC) promoting threshold application, which is less polluting for the environment than conventional programmes for cotton phytosanitary treatment;
- the increasingly numerous organic agriculture initiatives.

Beyond these provisions promoting sustainable agricultural practices, it must be acknowledged that the general trend is towards the adoption of polluting practices to obtain immediate quantitative results with a view to resolving present-day problems. The issue of preserving natural resources to enable future generations to satisfy their needs has not always been of prime concern. A perfect illustration of this general trend is the importance accorded to conventional cotton in Benin. Every year, the promotion of this crop requires the efforts of all, and the majority of the country's resources. Producers use large quantities of chemical fertilizer, with an average of 67 377 tonnes of fertilizer used over the decade 2001/2002 to 2011/2012, representing 45 327 tonnes of NPK, 19 446 tonnes of urea and 2 605 tonnes of potassium chloride (KCl) (UEMOA, 2013).

These different requirements in favour of conventional agriculture call on the majority of resources and efforts to the detriment of sustainable practices such as those advocated by the Songhai integrated agricultural production model.

Stakeholders of sustainable agriculture in Benin and partnership networks

Within Benin, Ecological Organic Agriculture (EOA) networks have been developed to promote ecological and/or organic agriculture. Some of these networks carry out activities such as information, training and advocacy aimed at changing people's behaviour, while others develop products for local, regional and/or international markets in addition to these activities. Structures promoting EOA include OBEPAB, the Songhai Centre, the Réseau de développement de l'agriculture durable [sustainable agriculture development network] (REDAD), Bio Phyto Collines, CIEVRA [International Centre for Experimentation and Development

of African Resources], Centre LABEL Bénin [shopping centre], JINUKUN and KARETHIC. The secondary entities promoting EOA include the Directorate of Agriculture (DAGRI), the Directorate of Agricultural Advice and Operational Training (DICAF), MEHU (Ministry of Environment, Housing and Urbanism)/DGE [General Directorate for the Environment], ABePEC [Benin Trade Promotion Board]/Ministry of Trade and the German Agency for International Cooperation (GIZ). There are numerous partnership networks in EOA in Benin, foremost among which are those of the Songhai farmers, organic cotton, organic market gardeners, Bio Phyto, KARETHIC natural shea butter and REDAD. The organic pineapple network is important for local consumption but, more important to seize the export opportunities available is the Plateforme de l'agriculture biologique et écologique [organic and ecological agriculture platform] (PABE).

14.3 INSTITUTIONAL INNOVATION: THE SONGHAI MODEL

Brief history, activities and objectives pursued

The promoter of the Songhai approach is the Dominican friar Godfrey Nzamujo, supported by a group of Africans keen to return Africa to its former glory by restoring the fundamental values of courage, creativity, a sense of the common good,

PHOTO 14.1
The Songhai symbol



discipline and solidarity, which are tending to disappear from the habits of young Africans. Created in 1985, the centre derives its name from the powerful, flourishing and prestigious West African empire of the fifteenth century: the Songhai Empire, which evokes pride and hope for a dignified and prosperous Africa.

The Songhai initiative has two components: the first is the development of a functional, competitive and efficient agricultural system (parent farm); and the second the incubation of agro-entrepreneurs and promotion of services to increase their productivity, thereby creating a snowball effect through the formation of a critical mass of young agricultural entrepreneurs and the creation of a framework conducive to the successful development of producers across the African continent.

The Songhai model incorporates three key sectors of the economy into a network. It is organized in such a way as to create synergy and complementarity. It is an industrial cluster model, a model of a productive and autonomous "green rural town". The model ensures perfect integration between primary, secondary and tertiary production. The network focuses on the development of appropriate innovative technologies and training. Primary production relates to vegetable crops, annual crops, perennial crops, stock farming and fish farming. This diversified production (mixed farming and stock farming) was designed to facilitate technical synergies and complementarities between the different links while ensuring better promotion of the environment than mono-specialized systems. No link functions without a relationship with one or more other links. This new approach is based on the imitation of nature (biomimicry). It incorporates principles such as mutuality, synergy, symbiosis, interrelations, complementarity and networking. It contributes to the development of new, authentic and noble values and technologies.

Training, extension and communication

Training is one of the key missions of the centre. It is organized in all the Songhai centres (Porto-Novo, Kinwedji, Savalou and Parakou) and remains essentially practical in nature (about 75 percent of the total duration). The approach adopted is that of the master and apprentice (mentor-mentee, learning by doing) and the training is based on a system of values, knowledge and expertise.

The centre primarily trains two categories of people: pupils and trainees. Training for pupils is reserved for young people of Benin who have dropped out of school and wish to become agricultural entrepreneurs. This training lasts for 30 months, 18 months of which focus on practical training divided into a common core lasting three months and 15 months of specialization with crop farming as the common module. Pupils complete the training with 12 months of application, either in a regional station or on their own farm. They launch their farms on the basis of a business plan defined and approved at the end of the first phase of training and are monitored during this final phase. At the end, a positive evaluation will enable them to obtain an agricultural entrepreneur's diploma and thus to set up business.

Trainee training lasts between one and 18 months and is open to all nationalities. Those participating in the training are socio-economic entrepreneurs, agricultural professionals who want to specialize, students of agricultural colleges and agronomy faculties and senior officers in public or private administration.

The training provided at the Songhai Centre is based on a non-material foundation, comprising a system of human, moral and ethical values: commitment,

thoroughness, discipline, excellence, and punctuality and honesty at work. This training forms people who can put on the moral and technical cloak of authority, enabling them to steer their own lives. They are endowed with the functional skills necessary to create and manage a viable agricultural holding with a view to helping to stimulate the local community.

The extension approach founded on expertise relies on those trained at Songhai who, by implementing the agricultural and para-agricultural production techniques received at the centre, act as a relay in their respective environments. This is combined with the initiative of the Songhai Centre which, having noted the low agricultural productivity of farming areas, has recruited and trained a number of producers. The production zones therefore serve as extension areas and are accessible to all. The centre receives more than 20 000 visitors per year, primarily from Benin and the countries of the subregion, who come to draw inspiration from the model.

The Songhai Centre has also implemented the purchasing office's policy that enables inputs to be provided to Songhai farmers and other producers. These are, in particular, high-quality seed and appropriate technological packages for the production of raw materials (maize, soybean, rice) in sufficient quantity and quality. As the parent centre, Songhai has introduced industries that can facilitate the processing of products from farmers in its purchasing office network. A rationale of traceability is also introduced with a view to guaranteeing product quality. The centre thus procures its supplies from the network of Songhai entrepreneurs and in exchange represents a key marketing outlet for them.

The Songhai Centre's communication strategy, based on the internal production and dissemination of audio documents, overcomes the deficit created by the unavailability of radio frequency. Newsletters are produced and disseminated in house and to partners, and there are documents on conservation/low-till agriculture and organic agriculture. There are also documents from the World Bank, International Fund for Agricultural Development (IFAD), FAO and other development and sustainable agriculture bodies as well as scientific journals and publications on the selection of plants and biotechnology.

Innovation combines business and research institute approaches while using the concept of an authentic green rural town. Songhai is active in research and development, implementing its technological platform (technology park) with several innovative technologies. The park is used for the development of African agriculture by providing solutions to the numerous difficulties faced by producers and that make agriculture appear a gruelling and unattractive activity. These include access to quality genetic inputs, the fight against pests, soil fertility management, irrigation and weed management. Once tested and proven, these technologies are turned into production factors through the industrial park composed of the production units. Particular emphasis is placed on simple and accessible new agricultural technologies that treat nature and the environment as partners and give pride of place to the values of the resulting products. The different production workshops at the centre are:

- primary production, including crop production, stock farming and fish farming;
- secondary production: agro-industry with plastic recycling and bottle production units;
- tertiary production: the services at the start and end of the system – training, communication, marketing, library and reception.

Administration and management of the centre

The Songhai Centre is administrated by a Board of Directors consisting of volunteer resource persons with proven experience and who, through their positions, provide the necessary support for the development of the centre. There is also a think tank. The day-to-day management is carried out by a team of management executives under the aegis of the General Manager. The organizational chart presented in Figure 14.1 highlights the different levels of responsibility and the relationships that ensure good governance of the activities at head office and in the regional centres.

Sustainable practices: Songhai, sustainability as keynote

Autonomy, the cornerstone of sustainable agricultural systems (Vilain *et al.*, 2008), is the foundation on which the agricultural practices developed by the Songhai Centre are built. The three components of the model are primary production, agro-industry and services.

Primary production includes annual crops, perennial crops, stock farming and fish farming. This diversified production (mixed farming and stock farming) was designed to facilitate technical synergies and complementarities between the different links while ensuring better promotion of the environment than mono-specialized systems. No unit functions without a relationship/link with one or more other unit (Agossou, 2014).

Because of the synergies inherent in the model, the functional relationships between the units are highlighted in the presentation. Thus, stock farming is presented with the production of organic fertilizers that represents the entrance to the model, while crop production is presented with livestock fodder and stock farming with fish farming.

Stock farming and the production of organic fertilizers

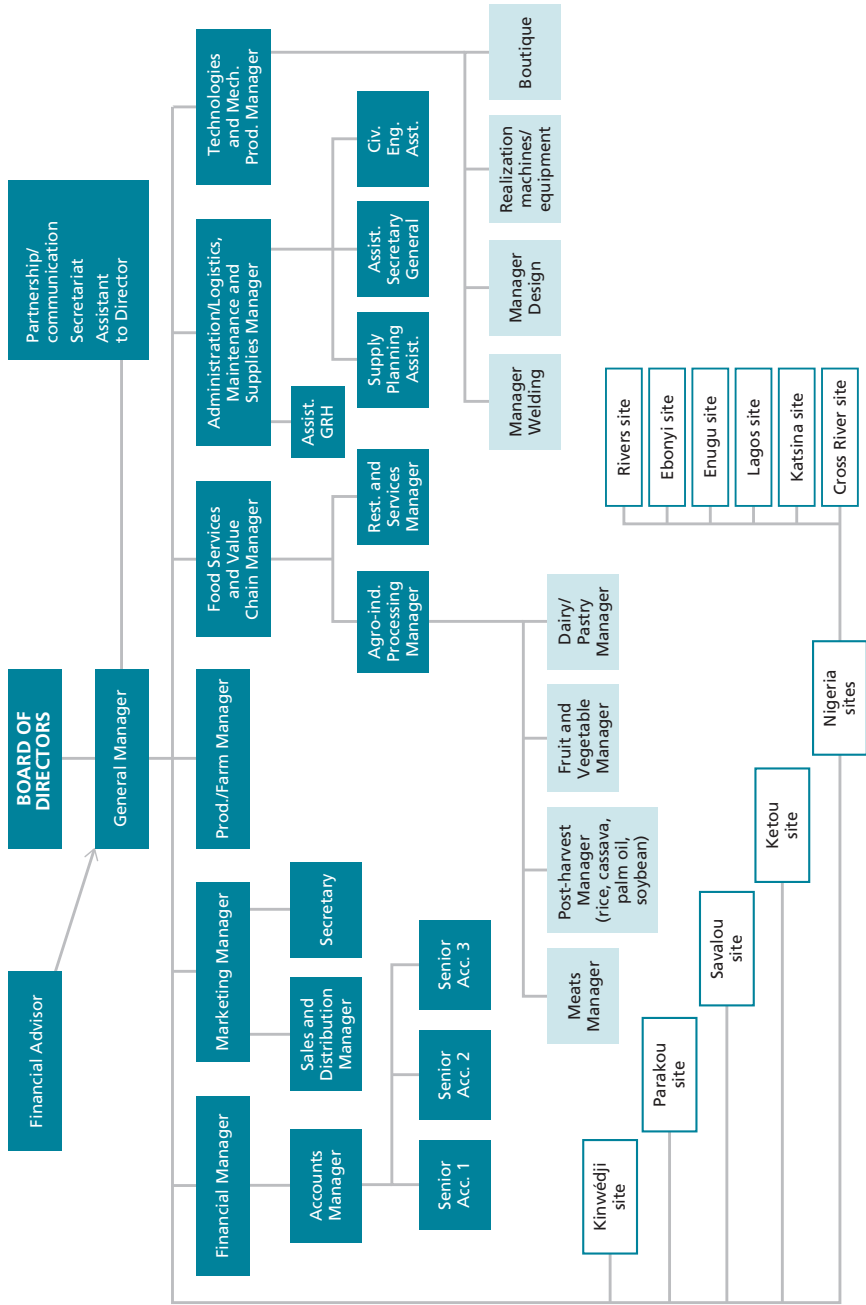
The stock farming activities of the Songhai Centre (Porto-Novo and regional sites) concern several species, all eaten in Benin, namely:

- poultry, such as quail, hens (Cou-nu, Sussex, Rhode Island red, red), turkey, guinea fowl, geese and ducks;
- rabbits, with breeds including Californian, Fauve de Bourgogne, local, French Papillon and New Zealand;
- pigs, with large whites, Landrace and crossbreeds;
- cows, with Goudaly and Borgou breeds;
- Djallonke sheep.

These forms of farming are the main sources of organic material fertilizing the soil on which annual and perennial crops are farmed.

Breeding caged hens allows droppings to be collected in two different ways. First, they may be collected on a mat, without being mixed with the soil. In this case, they are placed directly in a digester to produce biogas for heating in agro-industry and for cooking, for the benefit of the pupils and trainees at the centre. This biogas production gives rise to a liquid effluent that constitutes a rich fertilizer for different crops. Droppings may also be collected from huts on stilts, periodically mixed with ramial chipped wood (RCW) and soil for a period of six months, and regularly inoculated with micro-organisms that effectively manage odour. They are then col-

FIGURE 14.1
Songhai organizational chart



Source: ???.

lected and piled into heaps that are regularly turned to make compost and use as an organic fertilizer on farmed land.

For some time, thanks to the development of technological soil fertilization platforms, effective micro-organisms (EMs) have been used to strengthen the fertilizing power of liquid effluents from the production process and that of the compost manufactured. The effluents and compost are watered with solutions of these EMs. The result is remarkable on soil treated with these organic fertilizers both for annual and perennial crops. In Songhai language, this fertilization “feeds the soil which, in turn, once transformed into a super soil, feeds the plant”.

As with the droppings of laying hens, the manure of all other animals reared are used to manufacture super soils. Since the soil is the plant’s “home” and larder, stock farming is a key component of the integrated agricultural production system developed by Songhai.

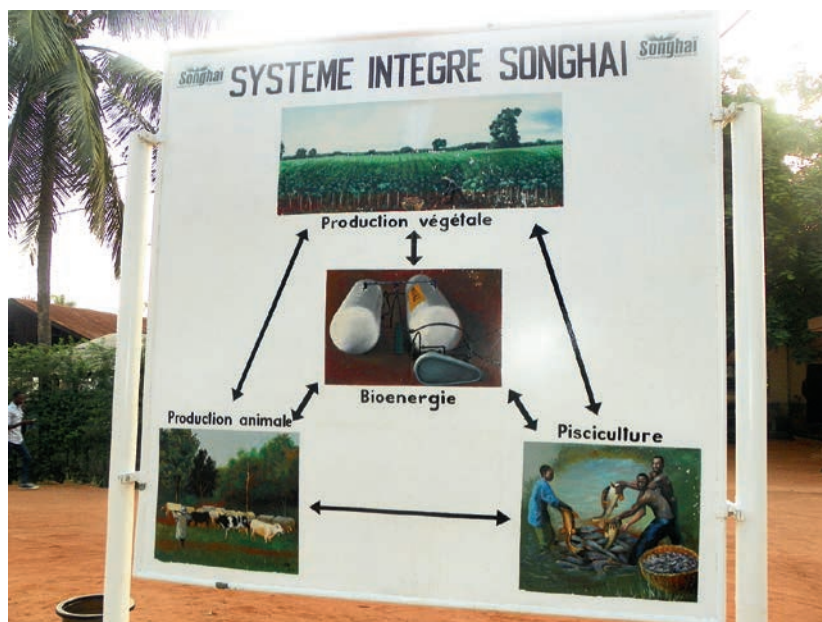
In the Parakou and Savalou centres, and in particular with ruminants, the system of *kraalage* is adopted, which involves ranching these animals on plots of land intended for crops. They defecate on the land and the soil is then ploughed before being sown (basic organic fertilizer).

Crop production and livestock fodder

Stock farming serves to produce super soils on which annual and perennial crops are grown. In return, production of these crops serves first and foremost to feed

PHOTO 14.2

Songhai integrated agricultural production system



the animals reared. With regard to animal fodder, feed produced in agro-industrial workshops uses raw material from the crop production workshop, primarily maize, soybean, cassava and *moringa*. Maize is the main cereal used to produce feed served to animals. Rice, and in particular rice bran, is also an important ingredient of the feed. Soybean is the most frequently used source of vegetable protein found in animal feed. Cassava root is an excellent foodstuff for pigs and is also used in other livestock fodder. Cassava leaves are also much appreciated as feed for laying hens, which then produce eggs with a rich yellow colour, a quality sought by consumers.

Crop production, stock farming and fish farming

Fish farming at the Songhai Centre has impressive results and stock farming plays an important role in feeding the fish. The centre has maggot farms to produce maggots that are eagerly eaten by the fish since they are rich in proteins and amino acids. Animal droppings, in particular from pigs and cane rats, are collected and placed in open pits together with rotting animal waste from meat (viscera, unused meat leftovers). Through the fetid smells they release, the maggot farms attract flies that land on them to feed and lay the maggots that are then collected to feed the fish.

PHOTO 14.3

Red Royale papaya trees growing on super soil, Porto-Novo centre



The centre has recently made progress with the development of technological platforms for the management and protection of genetic inputs; soil fertilization and regeneration; improved agricultural production techniques (production in tropical greenhouses for hot countries, irrigation) and livestock fodder production; use of EMs; implementation of the plastic mulching technique to reduce the arduous nature of agriculture and make it more attractive to young people; and the development of animal and fish genetic inputs (e.g. Songhai tilapia, which can reach 500 g in six months).

Secondary production: agro-industry

Stock farming products, primarily meat, are not often delivered to the consumer in their raw state. The centre (mainly in Porto-Novo) processes them to add value. Similarly, crops are processed before being delivered to the consumer in the form of semi-finished or finished products. This processing is carried out in three industrial units. Processing workshop 1 handles meat, smoking, syrup production, pasties and dairy products. Workshop 2 handles the processing of palm fruit (palm oil, palm kernel oil and palm kernel cake), processing of cassava to produce *gari*, rice husking, production of roasted almonds and production of soap. Processing workshop 3 handles plastic recycling, bottle production, pretreatment and filling operations for the production of water, juice, tomato and mango concentrate, etc. With a capacity of 6 000 bottles per hour, this new installation strengthens the network of agricultural entrepreneurs supplying raw materials, pineapple, mango and baobab powder.

PHOTO 14.4

Cattle ranching for organic soil fertilizers (*kraalage* system), Parakou centre



Markets for sustainable products and services: building the local market

OBEPAB (2013) described the markets for ecological and organic agricultural products in Benin as follows:

- local markets comprising demand recorded in the production zones;
- urban markets in the major cities, in particular Cotonou, where the products most in demand are foods declared to be organic, natural or vegetarian; organic vegetable products; organic papaya; non-conventional stock farming products (chickens, local breeds of guinea fowl) and non-wood forest products;
- the subregional market, in particular the Economic Community of West African States (ECOWAS), Nigeria, the Niger, Mali and Burkina Faso where there is high demand for natural shea butter, organic pineapple and pineapple juice;
- the international market, with demand for certified organic products (organic cotton, cotton made in Africa, natural shea butter, organic pineapple, organic soybean and organic papaya).

Markets for Songhai products and services are primarily local markets. The centre's aim is to produce for the well-being of the communities living near the other centres. Production is therefore primarily intended for local markets, and thus local consumers. Within Benin, the main markets are in Porto-Novo, Cotonou, Parakou, Savalou and Lokossa, as well as in other towns around the country.

Four product categories are marketed: seed, inputs (organic fertilizer and organic livestock fodder), fresh produce (fruit, vegetables, meat and eggs) and processed products. The processed products in particular are labelled Songhai (fruit juice, purified water, yoghurt, soap, soybean oil and pastries). Honey is also a reference

FIGURE 14.2
Monthly change in turnover in 2011 and 2012



product of the Songhai Centre and many customers know the centre for the honey it sells. Eggs are currently the product most sold. Sales figures show that peak sales occur at the end of the year (Christmas period). The trend was more or less the same in 2011 and 2012, with a slight increase in total sales in 2012 (a total of XOF350 005 510, or approximately US\$700 000).

The centre does not use intermediaries outside the Songhai network. All sales logistics are managed internally by Songhai. With its trucks, the centre implements logistics and delivers to the points of sale, supermarkets and wholesalers. The customers or consumers of Songhai products can also purchase products on site via the on-farm shops. For products such as vegetables, consumers can visit the farm and choose the products themselves. The centre also has a delivery office in town to facilitate purchases for people who cannot go to the farm. Finally, the reception and restaurant services at each regional centre also represent a convenient means of providing the population with Songhai products.

Both trade internal to the Songhai network and sales of processed products are managed by the centralized sales unit within the Porto-Novo hub. The regional sites are charged with sales of inputs and fresh produce at their sales points, while the overarching marketing strategy for the centre is centrally handled. Non-negligible quantities of fresh produce and cleaning products are also sold internally to the centre's catering service, students' canteen and workers' and visitors' restaurant. Certain products, such as eggs and poultry, are sold to hotels and other private distributors.

The markets for processed products are relatively diversified. At the end of November 2013, the centre's marketing team launched a marketing strategy to target sales of specific products, such as mangoes and pineapples to hotels in Cotonou, to different market outlets. When the local market is satisfied, the products are sold in other markets. This is the case for drinks on the Nigerian market, thanks to the installation of pretreatment and filling chains for the production of water and juice. Agricultural machines are sold in several countries within the region including Nigeria, Togo, Ghana, Côte d'Ivoire, Liberia, Sierra Leone and even as far afield as the Congo and the United Republic of Tanzania.

Employees at the Songhai centres and farmers who received training at the parent centre provide a ready consumer base for Songhai products. Yet there is also a wider consumer population made up of people concerned for the well-being and maintenance of the environment and those who specifically seek organic/sustainable products. Consumers, who are aware that they are buying more sustainable products, are ordinary consumers who buy their products from the Songhai shops at the head office in Porto-Novo and on the regional sites. The trainees, partners and visitors to the centres are also consumers of Songhai products and account for 60 percent of total sales.

All products are labelled with the Songhai brand and these labels provide sufficient information about the health benefits of the products. Some processed products (juice and yoghurt) have the word "bio" on them. Thus, the consumer can find the following information on the label: product name, ingredients used in the product, nutritional values, expiry date and addresses/contact details of the Songhai production centre. This information is in French and English to facilitate access to the products for a wide range of consumers.

Consumers buy sustainable products because of the comparative advantages these products enjoy over conventional products, primarily in terms of quality. Products from the Songhai sustainable production model are healthy and the consumer runs no risk of finding residues from chemical inputs. Songhai products (tomatoes, eggs, purées, jams, smoked chicken, etc.) keep better than conventional products. Juices are natural with no additives or colouring. Songhai also incorporates the natural virtues of its probiotic micro-organisms into these products, thereby endowing them with enhanced value for well-being. Another advantage for the consumer is the relatively affordable price adopted by Songhai, which takes account of the consumers' budget.

To satisfy the demand of an increasing number of customers, the Songhai Centre has developed an active communication strategy and adopted a marketing plan that is centrally managed, which takes account of consumer demand and expectations. This plan combines a direct sales strategy and a network of distributors. The marketing team itself organises tasting sessions for new products in order to bring them to the attention of consumers. Canvassing, attentiveness and communication operations are continuously carried out with customers.

The pricing policy adopted allows the Songhai centres to resist price competition from the local market, since Songhai applies lower prices for an equivalent quality. With the production system based on the "low-input agriculture" principle, products from the Songhai model benefit from this advantage as 90 percent of inputs necessary for their production are available on site. In the current plan (end 2013), the marketing circuits for processed products remain oriented towards the Nigerian market as a result of the trade liberalization in place. Over time, the introduction of the marketing plan has led to greater awareness of the demands made by consumers who now distinguish between the quality of the Songhai products and that of others. Diversification has also been a key priority of the Songhai strategy – diversification of the supply of products and diversification of the buyers and/or distributors. In the medium term, this will facilitate a significant presence of Songhai products on the market.

The challenge for the marketing programme will be to ensure effective continuity management of the supply of raw materials for the Songhai processing industries, which add value to the raw products. Moreover, it is important for the marketing unit to continue facilitating dialogue with buyers/distributors with a view to ensuring satisfaction in terms of quality and quantity. Demand for processed products is steadily climbing, and in 2013 and 2014 outpaced supply.

14.4 RESULTS: SOME ADVANTAGES LINKED TO THE EXISTENCE OF THE SONGHAI CENTRE

In the short and medium term, Beninese farmers will be able to derive certain advantages from the existence of the Songhai centre. The integrated agricultural production model will become increasingly common among farmers who are beginning to see the inconsistency and counterperformance of conventional agriculture. In the southern region of Benin, land constraints are forcing farmers to abandon extensive farming practices. They have to adopt sustainable intensification, making do with less land.

The Songhai integrated agricultural production model has numerous advantages for the community.

- Training young people who have dropped out of school, or university graduates, in entrepreneurship. With practical work accounting for 75 percent of the training, it offers them the opportunity to set up their own businesses, thereby avoiding an inflated number of job seekers.
- Supply of sustainable agricultural products with an organic label, which have huge advantages for consumer health, unlike conventional products that may contain residues of the chemical inputs used.
- Supply of services – in great demand – provided by the assembly workshops for agricultural machinery and agrifood processing equipment.
- Recycling of scrap metal and plastics that lie in the street and pollute the urban landscape.

Songhai is a training centre for rural entrepreneurship providing both short, technological training courses and longer training courses promoting the emergence of entrepreneurs and leaders. Since its creation, Songhai has trained 7 500 people.

IDEA method for evaluating sustainability

IDEA (Indicateurs de durabilité des exploitations agricoles) [Farm sustainability indicators] is an analytical tool that can be used at farm level to evaluate sustainability, based on a system of 41 sustainability indicators covering the three dimensions of sustainability (agro-ecological, socioterritorial and economic) (Vilain *et al.*, 2008). The agro-ecological scale of indicators covers environmental concerns such as diversity, organization of space and farming practices; the socioterritorial scale includes social aspects of the farm such as quality of products and land, employment and services, and ethics and human development. The economic indicators fall under the categories of economic viability, independence, transferability and efficiency. Using the IDEA diagnostic method, a recent study conducted by FAO evaluated the sustainability of the Songhai integrated agricultural production model and that of 35 Songhai farmers located in different agro-ecological zones in Benin (Agossou, 2014). These evaluations highlighted the strengths and weaknesses of the Songhai model in terms of sustainability and identified, particularly for farmers, the changes they could make on their farms to enjoy greater sustainability.

The Songhai model demonstrates numerous strengths at all levels of sustainability, in particular with regard to agricultural practices at agro-ecological level. The restrictive element in the sustainability of the model is the socioterritorial element. The Parakou and Lokossa sites demonstrate a sustainability that is limited at the agro-ecological level, whereas the Savalou site is limited in terms of socioterritorial sustainability. The challenges raised by reproducing the Songhai model on a grand scale concern the optimization of water, production of organic fertilizers, pest control using organic products, and agricultural mechanization.

Songhai farmers' activities are characterized by a sustainability limited at socio-territorial level. To achieve a greater level of sustainability, scope for progress available to these farms can be found in the domestic diversity and special organization elements (agro-ecological level); the product quality, employment and services elements (socioterritorial level); and the economic viability element (economic level). The difficulties encountered by these farms in attempting to achieve a greater level of sustainability primarily concern inadequacy of funding and the unavailability

of certain factors of production (certified seeds, fry, and livestock). In addition to the families of employees (15 000 people in total), of trainees (30 000 people) and of the farms created (7 000 people), the population benefiting from Songhai can be evaluated at 100 000 people since the centre was founded 30 years ago. The impacts of Songhai must also be measured in relation to the machine tools produced in the centre to increase productivity and reduce the toil of agricultural work. Other elements should be taken into account such as the new varieties of plants introduced, the creation of telecentres, the development of new crops (*Jatropha* for the production of energy) and livestock. Every year, 20 000 visitors come to Songhai and are introduced to the integrated production system and the functioning of green cities.

The model of economic development in rural areas – the rural green city promoted by Songhai – is easily adapted to the agro-ecological and socio-economic context of West Africa, where it is currently established in 15 towns. It is not simply an infrastructure project but also a method of generating sustainable, inclusive rural growth through the creative use of the local resources available, thereby helping to resolve the problems of poverty, unemployment and the rural exodus. The solution provided by Songhai demonstrates a certain originality in this approach to transforming people and their communities. Consequently, the Songhai model was promoted by the United Nations system in 2008 as a holistic model of development to be adopted by states in their efforts to change the precarious socio-economic situation experienced by the population. Since then, the model has been reproduced in several countries within the subregion and across the continent (Nigeria, Sierra Leone, Liberia, the Congo, Malawi and Guinea). Other developing countries (Ghana, Côte d'Ivoire, Senegal, Burkina Faso, Kenya, Togo and Gabon), as well as countries outside the continent of Africa (for example, Haiti) have also voiced their interest.

The people involved in disseminating the Songhai model within the region are the trainees who have spent time in the Songhai centres, governments, economic operators and company managers. The projects designed to replicate the Songhai model within the subregion are promoted by states or by individuals. They are tasked with mobilizing financial resources via their partners while Songhai provides technical expertise.

The Songhai Centre incorporates three key sectors of the economy into a single organizational form that links sustainable practices to local markets. It is organized in such a way as to create synergy and complementarity between sustainable production methods based on an integrated production system that includes vegetable, pulse, cereal and fruit crop production; livestock raising; aquaculture; and biogas production. It includes an industrial cluster model, where artisanal and modern food processing takes place (e.g. fruit juice, snacks, popcorn, baked goods, bread, fresh cuts and cured meats, soap, plastic recycling, plastic buckets). The centre also organizes the production and sale of sustainable inputs (seeds, manure, compost and EMs), provides agritourism and Internet services, and is involved in developing appropriate technologies for sustainable production.

The Beninese network is currently made up of the main demonstration site in Porto-Novo and five satellite centres in regional urban centres that source, when necessary, from surrounding rural farms. No link functions without a relationship to one or more of the other links and the satellites are governed through a centralized, hierarchic chain of command that permits horizontal linkages between net-

work members. There is a central procurement and marketing service that organizes the procurement of raw materials for processing and sales of processed products from the Porto-Novo hub. However, each satellite is also responsible for local sales of its fresh produce and artisanal processed goods. In 2014, 54 percent of the value of finished products was internal to the network and 46 percent constituted product sales with a value of XOF4 185 694 831 (US\$7 040 540), of which the off-farm sales of finished products accounted for XOF1 533 743 462 (US\$2 579 830). We may conclude that the Songhai Centre has effectively created three levels of markets: (i) markets for sustainable inputs (seeds, bioproducts and machines) between the hub and each regional site and farmers; (ii) markets for sustainable products (both fresh and processed); and (iii) markets for food service and hospitality.

The Songhai model can be considered an institutional innovation, because the actors in the network have had an active role in defining “organic” in Benin through their use of labelling for consumers. As of 2015, Songhai began a partnership with the Ministry of Agriculture to manage national projects for youth training in agriculture (changing the rules), and with its efforts has created an organizational model that is being replicated in other countries (the actors who use and enforce the rules). In fact, in 2014, the largest revenue from a single source came from the corporate fees received from Nigerian operations.

14.5 CONCLUSIONS AND RECOMMENDATIONS

Agricultural development policies in Benin emphasize the need to promote sustainable agricultural practices in order to maintain the productive base of natural resources for future generations. This political will is nevertheless slow to take tangible form in the legislative and regulatory texts obliging the operators concerned to adopt best practices. A documentary review showed that several existing regulatory provisions concerning agriculture, food, the environment and trade contain allusions to sustainable agriculture. Furthermore, associative movements were observed that have redoubled their efforts to promote organic and ecological agriculture. These associations develop financial, technical and complementary partnerships with each other and with associations in the countries of the North.

The Songhai integrated agricultural production model, launched in Benin in 1985, is one such initiative promoting sustainable best practices in the agricultural sector. Through the perfect integration of crop production, livestock farming and fish farming, this model generates a synergy and complementarity among its different links, while ensuring zero waste. Similarly, it obeys the principle of autonomy, the cornerstone of sustainable agricultural systems (Vilain *et al.*, 2008).

The best practices put forward by the Songhai model concern:

- effective integration synergy between crop production, stock farming and fish farming;
- autonomy (and thus non-dependence) of the farm insofar as the main factors of production come from the farm itself;
- zero waste as nothing is thrown away on the farm – anything that can be considered a waste product in a given sector is reused as a factor of production in another sector;
- organic orientation given to farms that use no chemical inputs and only organic inputs (compost, manure, organic pesticides);

- promotion of produce on site through the development of different processing workshops enabling farms to acquire sufficient value added;
- promotion of marketing services, helping to create loyalty among customers who are attached to the centre’s organic products;
- practical training given to young agricultural entrepreneurs wishing to set up business in the agricultural sector and to replicate the integrated agricultural production model promoted by the Songhai Centre.

To “spread the message”, the Songhai initiative provides annual training – primarily practical in nature – for numerous young farmers (almost 7 500 trained since its creation) who are called on to replicate the model across the subregion.

According to all observers, the Songhai integrated development model has proved its worth in managing the complexity involved in meeting the following:

- increasing demand for training;
- creation of new activities (rural energy training centre, electricity power station with Electricité de France (EDF), where the role of EDF is to contribute to optimizing expertise in producing and distributing renewable energy through the implementation of energy production poles, development of bacterial culture, etc.); and
- requests from governments from all regions of Africa to install Songhai centres.

Without endangering its achievements, Songhai is faced with four challenges.

1. Need for new leaders capable of promoting new actions.
2. Management capacity building for current unit managers to ensure the continuity of the Songhai centres.
3. Training of people from other African countries or elsewhere promoting projects similar to the Songhai initiative.
4. Training of project managers in rural companies (in the energy sector, for example) within the subregion for development projects of NGOs or semi-private operators.

The other challenges of the Songhai production model primarily concern its large-scale reproduction and replication at small-scale producer level. These challenges are optimization of water, production of organic fertilizers, pest control with organic products and agricultural mechanization (Agossou, 2014).

Water and its permanent availability are essential for the system to work. As an increasingly scarce resource, water use requires highly economic irrigation measures such as the drip system, which is a best practice in terms of sustainability. The technique of plastic mulching recently introduced at the Songhai Centre increases this water-saving process by limiting direct evaporation from the soil and through soil moisture retention. While differing species allow organic fertilizers to be produced (compost, liquid effluents), the shift to a larger scale may raise the question of covering needs for organic fertilizers in light of the large quantities required by unit of surface area. Pest control through organic pesticides is also a challenge for large-scale replication of the model. For certain attacks deemed to be severe, the use of small additional quantities of chemical pesticides should not generate any major pollution pressure and therefore not compromise the sustainability of the system.

Finally, on a large scale, mechanization is necessary, although this is a double-edged sword. It saves time and reduces the arduous nature of the work, but measures must be taken to protect the soil as a resource as sustainable agriculture endeavours to protect the food potential of the future.

Small-scale farmers find difficulties in replicating the model in terms of funding for their farms in order to procure agricultural equipment and construct the necessary infrastructures; the unavailability of organic factors of production; and the unavailability of agricultural land in the southern part of Benin.

The political authorities in Benin have taken action to prove their commitment to best practices designed to ensure the sustainability of agricultural systems in the country. They should nevertheless pursue their action by establishing specific legislative and regulatory texts obliging the actors in the sector to develop best practices with a view to protecting natural resources for future generations. The Promotion of Agricultural Entrepreneurship Programme (PPEA) sponsored by the United Nations Development Programme (UNDP), which is managed by Songhai in Benin for the Beninese Ministry of Agriculture, is a technical initiative that is worthy of support from other similar entities and could be expanded to reach more young agricultural entrepreneurs.

The Songhai model has demonstrated that it responds to the specific sustainability challenges in the country, is culturally and socially appropriate, technologically advanced and economically viable. Therefore, the process of replicating the Songhai centres should be pursued and it is desirable for each of the rural communes in Benin to create their own Songhai centre, that could be linked up to the national network, so that all farmers have the possibility of benefiting from this integrated agricultural production model. The difficulties for farmers to replicate the model at farm level lie in obtaining funding for their farms and the unavailability of livestock, fry and seeds. With more of these innovation hubs in rural areas, more support would be available for individual farmers.

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