CHAPTER 2

An analysis of farming systems constraints and opportunities for improvement

In 2001, an analysis of farming systems in south western Burkina Faso and their constraints was conducted based on participatory rural appraisals to develop a vision of what could be achieved by farmers with right knowledge and multi-stakeholder support in the potential 'bread basket' moist savanna ecology of West Africa for integrated crop-livestock production systems. This established a strategy of an experimental participatory approach to testing the introduction of new concepts and elements into the existing cereals- and cotton-based smallholder farming systems to:

(a) expand crop choices that would increase the production of livestock feed (dry season needs and grain concentrates for the peri-urban poultry sector) while ensuring adequate biomass supply for soil quality recovery;

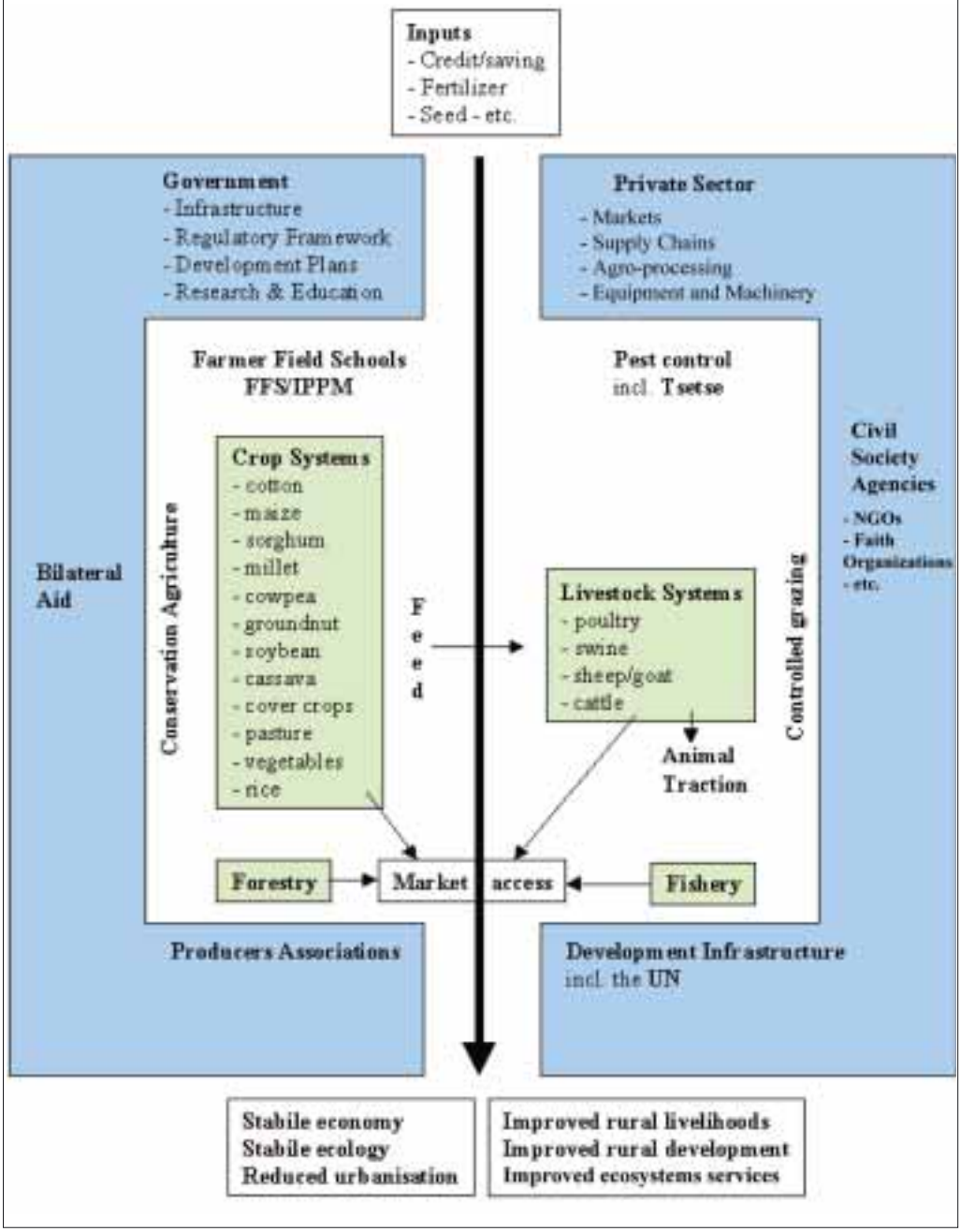
(b) integrate Conservation Agriculture practices as a means to improve and optimize soil-crop-water-nutrient management for sustainable production intensification, given the poor current state of soil nutrient fertility, variable rainfall climate, and inadequate biomass availability; and

(c) diversify and expand the range of food, feed and tree crops and their integration with livestock into the existing cotton- and maize-based systems.

The tree component provides multiple benefits including erosion control, biofuel and fruit but also a living fence to enable control of grazing to protect crop residues essential for soil protection in CA systems. The conceptual elements draw substantially from the new innovations in sustainable intensification in similar agro-ecologies in the savannas of Brazil (see also Landers, 2007[1]).

[1] Landers, J.N. (2007) Tropical crop-livestock systems in conservation agriculture: The Brazilian experience. Integrated Crop Management, Vol.5. FAO, Rome.

FIGURE 2
Overall concept of partnerships and interactions for enhancing crop-livestock interactions for sustainable development production intensification



As the PRODS/PAIA strategy formulation evolved, it became clear that the vision of what could be aimed at and achieved could be best described as the integration of crop-tree-livestock systems in Conservation Agriculture with controlled grazing and pest control as illustrated in Figure 2.

The integration between crops and livestock would be enhanced mainly through the feed (fodder and grain) supply from the diversified crop systems. The integrated production and pest management Farmer Field Schools (FFS-IPPM) would not only ensure good practices in pest control but also serve as the learning sites for new knowledge and technology, and the testing, adaptation and integration of new principles and practices such as new crops or rotations, new soil management practice, new crop husbandry practices, which would be managed through on-farm farmer-discovery benchmark sites.

Feed was considered a serious limiting component to pull producers out of poverty. Thus, new selected crops coupled to practices that address soil degradation (i.e., the need for soil health recovery) are included in the model. CA is a promising approach to rehabilitate degraded lands but living fences are required to protect crop residues from livestock, and FFS are needed to enable farmers to understand and learn the new choices and their implications. The range of benefits in productivity and crop-livestock integrations that could be offered by expanding crop choice through the introduction of new crops are illustrated in Figure 3.

Over the period 2002-2007, FAO supported a 5-year production system intensification and diversification project with the Institut National pour de l'Environnement et de Recherches Agricoles (INERA) at Farako-ba and the Direction de la Vulgarisation et de la Recherche-Developpment (DVRD) in five villages near Bobo Dioulasso in south western Burkina Faso to test and select technologies capable of overcoming the limitations associated with low productivity of the cotton-based crop-livestock production systems. This pilot project introduced and tested improved technologies for soil management, crops and livestock aimed at raising productivity through a benchmark "farmer-participatory discovery" process that not only validated their relevance but also established a body of evidence and a "community of practices" (CoP) ready to support a larger scale dissemination of the promising technologies and practices.

This publication describes the experience and 'work in progress' on a farmer discovery process of capacity building that was delivered through the FAO's PRODS/PAIA initiative to farmers in five farming communities around Bobo Dioulasso in the moist savanna zone of south western Burkina Faso to bring about sustainable production intensification and improvement in livelihoods, food security and ecosystem services (see Figure 4 for a farming systems map of West Africa).

FIGURE 3
Summary of new crop introduction and beneficial utilization by PRODS/PAIA farmers

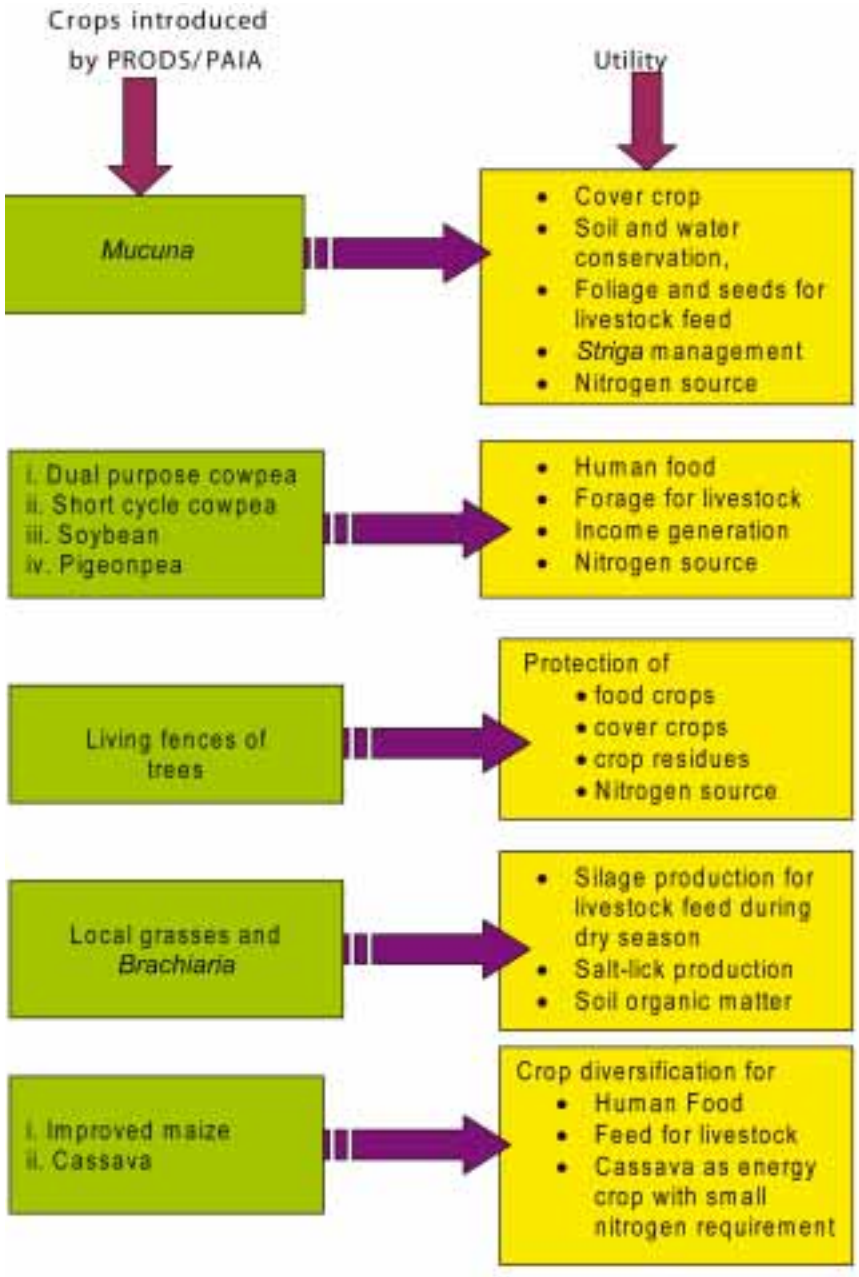
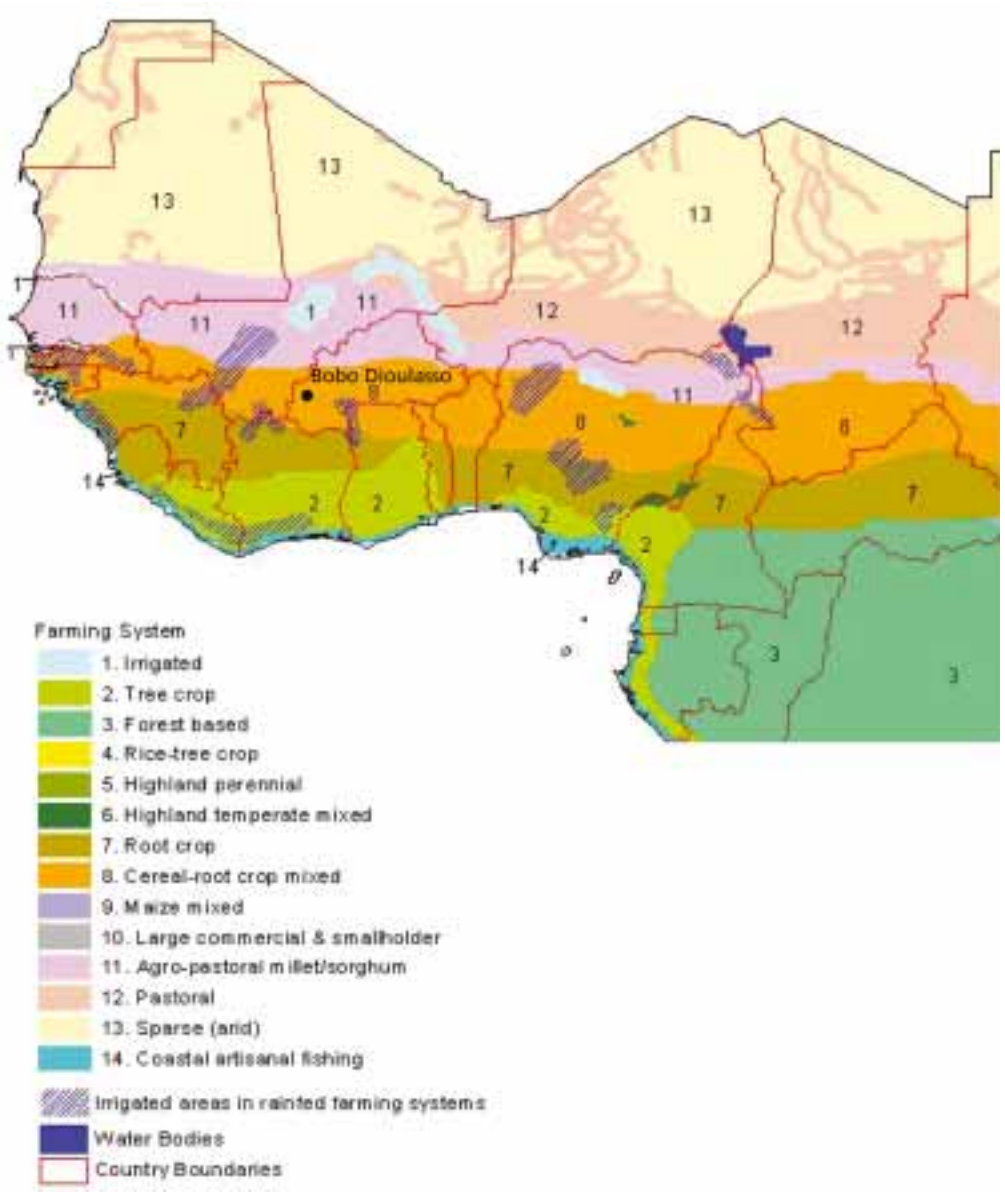


FIGURE 4

Integrated production systems in West Africa. PRODS/PAIA sites in Burkina Faso are located near Bobo-Dioulasso in farming system zone 8 dominated by mixed systems of cereal-cotton-legume crops with livestock



Source: Dixon, J. and Gulliver, A. (2001). Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. FAO and World Bank, Rome and Washington D.C.

CHAPTER 3

Implementing the PRODS/ PAIA pilot project in South Western Burkina Faso

The "entry point premise" derived from a joint FAO/CIRAD mission in 2001 was that production systems that would increase livestock feed availability of good quality during the dry season would help small holders to enhance incomes from livestock products. However, any food and feed production increase in the project area had to be accompanied by simultaneous improvement in soil moisture supply and in soil health.

For improving soil moisture supply, and therefore the length and quality of growing season, rainfall water supply and within and between year rainfall variability had to be managed such that there would be maximum effective rainfall leading to improved soil moisture regime and minimum rain water runoff and soil erosion.

For increasing soil organic matter and biotic activity, it was necessary to minimize or avoid soil disturbance while maximising return of crop residue through crop diversification and crop rotation involving legumes and live mulches, and fodder crops.

Based on evidence from other countries with similar agro-ecology, it was agreed that all the above required changes in the farming system and benefits there from are best offered by the principles and practices embodied in CA systems (see Box 2). CA systems are specifically aimed at simultaneous improvement in soil health, soil biotic activity, and soil moisture supply, leading to improvement in crop productivity and biomass output. Further, the increase in crop diversification, crop productivity and biomass output is the basis for improved integration of livestock with crops in the farming system, and increased income from livestock products (Figures 2 and 3).

BOX 2 **Conservation Agriculture**

CA is a concept for resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while concurrently conserving the environment. CA is based on enhancing natural biological processes above and below the ground. Interventions such as mechanical soil tillage are reduced to an absolute minimum, and the use of external inputs such as agrochemicals and nutrients of mineral or organic origin are applied at an optimum level and in a way and quantity that does not interfere with, or disrupt, the biological processes. CA is characterized by three principles which are linked to each other, namely:

1. Continuous minimum mechanical soil disturbance.
2. Permanent organic soil cover.
3. Diversified crop rotations in the case of annual crops or plant associations in case of perennial crops.

Conventional "arable" agriculture is normally based on soil tillage as the main operation. The most widely known tool for this operation is the plough, which has become a symbol of agriculture. Soil tillage has in the past been associated with increased fertility, which originated from the mineralization of soil nutrients as a consequence of soil tillage. This process leads in the long term to a reduction of soil organic matter. Soil organic matter not only provides nutrients for the crop, but it is also, above all else, a crucial element for the stabilization of soil structure. Therefore, most soils degrade under prolonged intensive arable agriculture. This structural degradation of the soils results in the formation of crusts and compaction and leads in the end to soil erosion. The process is dramatic under tropical climatic situations but can be noticed all over the world. Mechanization of soil tillage, allowing higher working depths and speeds and the use of certain implements like ploughs, disk harrows and rotary cultivators have particularly detrimental effects on soil structure.

Source: www.fao.org/ag/ca/

The five farming communities in the cotton zone in moist savanna zone were selected as PRODS/PAIA sites based on the existence of the following enabling conditions for agricultural change:

- Effective demand for agricultural produce arising from the urban population in Bobo Dioulasso, and elsewhere in the country, and extensive market for livestock through regional trade.
- Good ecological potential for mix-farming and diversification.

- Existence of basic experience with agribusiness and cooperative management through cotton production.
- Potential for further integration of livestock with opportunity for improvement in the supply of feed resources.
- Need for improving and rehabilitating soil health and productivity potential through CA principles and practices.
- Presence of national and international research, technical assistance and agricultural development activities involved with farming communities, e.g., Institut National pour I'Environnment et la Recherche Agricoles (INERA), National de Semences Forestieres (CNSF), Direction Regionale de l'Agriculture de l'Hydraulique et des Ressources Halienttiques des Hauts-Bassins (DRAHB/HB), Women's Association, FAO and its various initiatives including FFS, IPM training, and SPFS, CIRAD, CGIAR Centres such as IITA, ILRI, ICRAF, ICRISAT, and more recently EMBRAPA and AGRA.

Thus, project field activities were set up and implemented in farmer-discovery benchmark sites in five pilot locations in south western Burkina Faso (Karaba in Tuy Province, Klesso, Bama/Banaroudougou in Houet Province, Kounséni /Banzon and Dandé in Kenedougou Province) around 25 to 110 km from Bobo Dioulasso that offered effective demand for agricultural produce, particularly livestock products. Field activities included the on-farm testing of technologies for crop diversification and intensification, including fodder and feed development for livestock intensification, and the application of technologies for Conservation Agriculture (CA) involving minimum or no till and crop rotation and cover management for sustainability and intensification. New crops in the rotation included *Brachiaria*, *Mucuna*, soybean, dual purpose cowpeas, pigeonpea and cassava. All this formed one of the two entry points of the initiative, based on the 2001 FAO/CIRAD joint mission, to address the declining fertility levels of arable lands, and to enhance intensification of integrated systems.

In two of the five farming communities, the process of farmer-participatory discovery at the benchmark sites was linked to Farmer Field Schools for Integrated Production and Pest Management (FFS-IPPM) demonstration and training activities for pilot dissemination was set up (see Figure 5). This formed the second entry point of the initiative aimed at the development and testing of farm family dialogue and analysis of constraints and opportunities to enhance productivity and livelihoods through the intensification of the crop-livestock-forage-tree integrated production system.

A communinity planning exercise involving 15 villages around Bama and Karaba was carried out in 2002 to integrate farm households' and communities' views into PRODS/PAIA project activities and to promote their participation

FIGURE 5
An Integrated Pest and Production Management Farmer Field School (FFS-IPPM) linked to a PRODS/PAIA Benchmark farmer discovery process site

(women and men) in future project activities (see Figure 6). National crop production and extension agents worked with farmers in their fields in testing new options for production intensification and diversification, such as new dual purpose cowpea and living fences (See Figure 7). Throughout implementation of the project activities, FAO staff and the farmer groups and national partners engaged in intensive and regular consultation especially after each monitoring field visit.

FIGURE 6
A household in the PRODS/PAIA village at Karaba

FIGURE 7

National crop production and extension agents with farmers in their fields testing new options for production intensification and diversification, such as new dual purpose cowpea (foreground) and living fence (background).