

Traditional Lowlands Water Management in Dano, South-Western Burkina Faso

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Received 23 December 2015; accepted 9 April 2016; published 12 April 2016

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Abstract

Lowland water resources management represents a challenge of the future that calls any community. Irrigated crops are grown in some areas of Burkina Faso, others are limited by a lack of irrigation infrastructure. Due to limited crop irrigation, crops and the associated populations dependent on them, depend on rain and on climatic factors. Thus, there is a need to understand and implement traditional mechanisms for managing lowland water in Dano, where climatic and geological conditions provide a sustained source of water. Here, I use a literature review combined with field work and interviews/questionnaires to estimate the potential exploitable plains to 16,056 ha or 24% of the communal area. Management mechanisms and traditional operating systems of lowland waters were clear, which helped to set the technological level of farmers, in partial control of water management.

Keywords

Burkina Faso, Dano, South Sudanese Climate, Lowlands, Traditional Management

1. Introduction

Traditional agriculture has long fed the rural population, however, erratic rainfall since the 1970s, degradation of natural resources (soil, water, vegetation) due to population pressure have contributed to decreased agricultural yields [1] [2].

Water deficiency due to climatic and anthropogenic factors and rapid population growth has reduced the availability of water and land per capita; it is one of the main factors responsible for this evolution which is explained by the decrease of agricultural production and forest resources [3]. Meanwhile, municipal needs facing

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limited water resources have been increasing. This shows how it is essential to maintain the rural development programs, geared towards agriculture, particularly in sub-Saharan Africa. These programs have an obligation to simultaneously increase productivity, reduce poverty and improve gender equity; these are three factors that seem decisive for the improvement of food security [2]-[4].

The water supply off season for small productive activities such as gardening, fruit growing and nursery of exotic plants, helps to diversify agricultural activities and to cope with shortages of arable land [5]-[7]. Irrigation of small agricultural areas uses a variety of techniques. These have become more efficient in recent decades. This irrigation enables farmers to take advantage of the water available in rivers or aquifers to extend the production time, adding to traditional rainfall, those of dry season crops (*contresaison*) [8]-[11].

In Burkina Faso, the droughts of the 1970s and 1980s still mark deeply the lives of rural populations; they have led to environmental degradation, population movements towards the wetter areas and large cities, as well as a situation of continuing food insecurity [12]. These droughts are partly responsible for the impoverishment of populations, victims of a serious agro-ecological crisis and generate the progressive disintegration of traditional societies. The relationships between populations in dry regions and those irrigated areas are inevitably changed, evolving from a certain complementarity to forms of dependence [2] [13] [14].

With more than 2000 dams including 300 permanent and 8 large dams [15] [16] completed, often in earth and gabion baskets, and equipped with small irrigated areas downstream, Burkina Faso is a model for other Sahel-Sudanese countries. These dams are the primary means of mobilizing surface water not only for agriculture but also for drinking water needs, animal husbandry and industry. Lowlands have been the target of many small improvements (filtering dikes, rice sills spilling). Access to these improved areas is difficult and often, the cause of exclusion of dominated social groups without land guarantees; these are notably women, newcomers, pastoralists and cadets [17]-[20].

The Water Resources development program in the South-west (Ressources en Eau dans le Sud-ouest: RESO) considered sustainable management with a blueprint and concerted planning, forming the framework of development stakeholders; it supports local initiatives through sub-programs focusing on assessment and recovery of water resources. Careful monitoring of innovations is made to conduct a consultation among stakeholders and empower them, by setting up agencies, basin Committees and Local Committees for Water (Comité Local de l'Eau: CLE). However, a general regulation blur is a handicap, combined with a lack of references and weak capacity of farmers. The integrated management approach does not yet seem quite understood by the operators [18] [21] [22].

If irrigated crops are possible in some areas of Burkina Faso, others suffer more from lack of irrigation infrastructure capable to regulate the problem of rural employment. In the case of Kou valley example, farming systems of the populations are mostly organized in strict rainfall crops, in lowland and small irrigation cultures practiced on developed areas and other so-called peripheral informal perimeters. These systems are weakly intensified, undiversified and offer a low productivity [23]. Now pushed toward the lowlands, previously unexploited areas [24], populations are still mainly engaged in traditional crops depending on climatic factors, particularly rainfall [25]. It is in this context that we have to know, how are the lowlands traditionally managed in Dano?

The general objective of this study is to explain the traditional lowland management mechanisms in Dano. What is the importance of agricultural lowlands of Dano Commune which occupies a favorable position in the climate area in terms of rainfall amounts? How is it managed in the current situation of natural resource degradation, coupled with the decline in rainfall and population pressure? At what level of water control the lowlands traditional management can be located?

2. Methodology

The approach uses the traditional data collection techniques, taking into account mainly the literature review and primary data collection. This approach is described on the following points:

2.1. The Study Site

Dano commune is located between 10°58'01" and 11°19'28" N and, 2°49'48" and 3°11'20" W. Capital of the Province of Ioba, Dano covers an area of 669 km² and has 22 administrative villages. It is located at a distance of 280 km from Ouagadougou [26] [27] (see **Figure 1**).

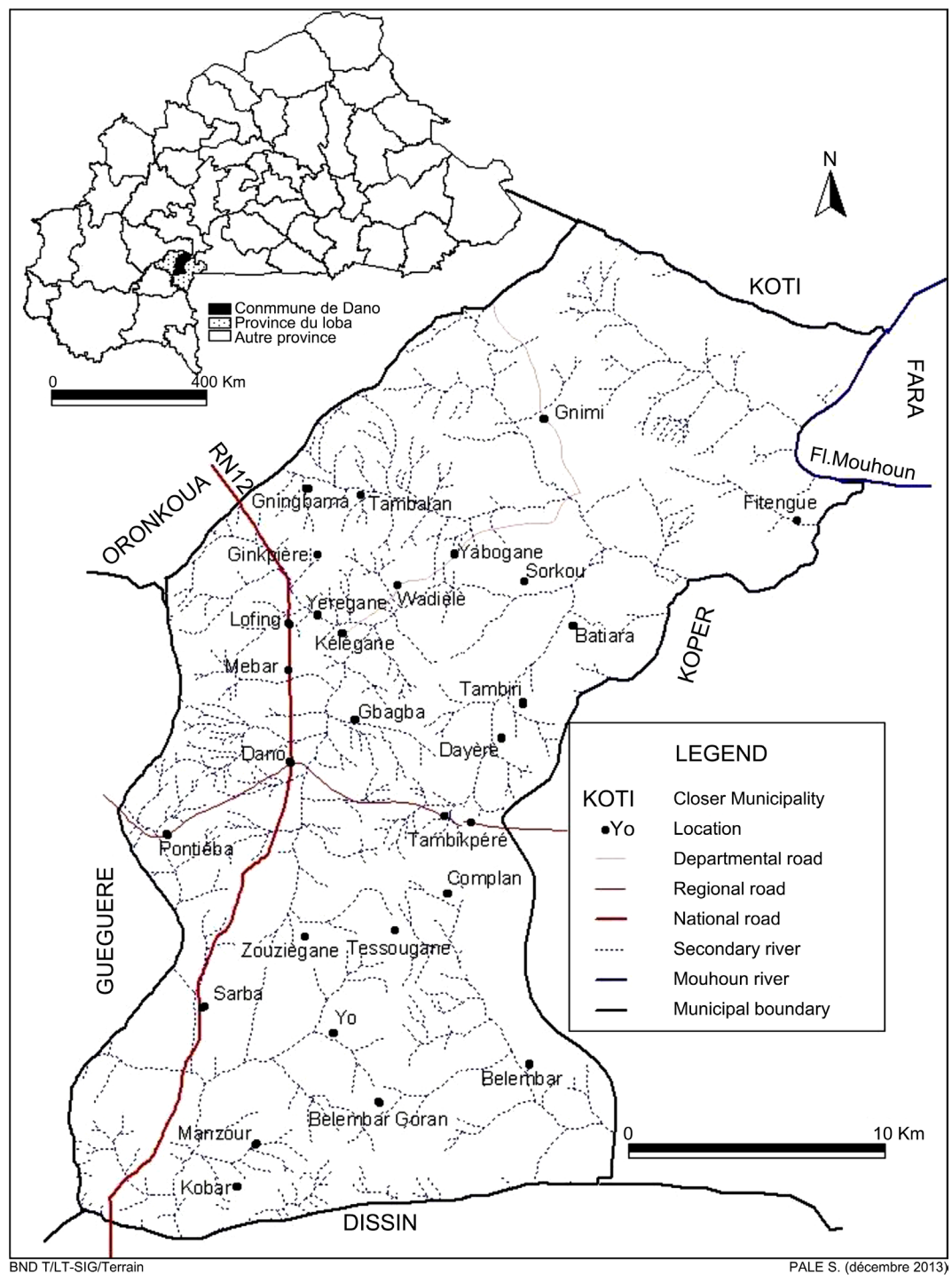


Figure 1. The town and surrounding Dano.

Climate field of Dano is South Sudan type characterized by the alternation of two distinct seasons (dry season that lasts six to seven months). The average annual rainfall exceeds 900 mm.

The town of Dano is home to a variety of ethnic groups. The majority Dagara, coexist with Pougouli, Bwaba, Mossi and Fulani. Each of these ethnic groups, while following the dictates of his social organization, respects the customs and traditions of the other [26].

Agriculture is the main economic activity. It occupies more than 90% of the population. Agricultural production

is mainly food-type. Indeed, during the 2003-2013 period, food crops (sorghum, millet, maize and rice) have held an average of 65% of planted areas against 34% for cash crops. Apart from rainfall, is practiced in the dry season, market gardening and growing small irrigation [28] [29]. Vegetable crops are grown in the lowland Lofing, around the Moutori dam and Pontieba water storage [26].

2.2. The Literature Review

In the literature, the channels used are the websites and documentation centers. Quantitative and qualitative data about study were collected through technical reports of the Ministry of Agriculture and non-governmental organizations, student dissertations and scientific articles. The relevance of the topics covered by the different authors and their areas of investigation were taken into account for the synthesis documents.

2.3. The Primary Data Collection

A survey was conducted among 96 lowland farmers in Dano Commune, particularly in sectors 3, 6 and 7 (Pontieba). The technique used is simple random sampling, without any statistical law. Interviews were also conducted with resource persons of services devolved to Dano such as the Provincial Director of Agriculture, Hydraulics and Fisheries, the Provincial Director of Environment and Sustainable Development, the municipality of Dano and the Dreyer Foundation. The collection tools used are designed to provide quantitative and qualitative data.

2.4. Processing, Data Analysis and Presentation of Results

Data from surveys and interviews are grouped according to our secondary research questions and the presentation of results in three parts. The first analysis allowed us to bring out an inventory of hydro-agricultural infrastructure in the form of a map using the Geographical Information Systems (GIS). Then, mechanisms and traditional management systems of the lowlands are mentioned and finally, an analysis is made followed by discussions to locate the degree of technological implication of this rural population particularly in lowlands water resources management.

3. Results and Discussion

The results obtained follow the implementation of a methodological approach described below:

3.1. Areas of Lowland

The integration of rice as a cereal crop enabled local people to briefly occupy the floodplains. The BUNASOLS's work in 2000 [30] have established agronomic abilities of soils for the main cereals produced in Dano, including units capable of providing double cropping, rainfall and dry crops, as shown in **Table 1**.

By observing this table, agronomic units capable of supporting rice cultivation, which most often occupy flood areas or slums, are the units 1, 2 and 3 having an average ability (S_{2n}). It's all ferruginous leached hydromorphic soils, leached ferruginous soils on indurated inclusion, waterlogged soil surface pseudogley and slightly evolved hydromorphic alluvial soils intake. The area they occupy equivalent to 24% of the total area of the municipality [27] (see **Figure 2**). These soil types also support the culture of other cereals mentioned in the above table. The other soil types, unit 3 consists of hydromorphic soils low in humus surface pseudogley (S_{3w}); unit 4 of leached tropical ferruginous soils moderately deep indurated and indurated deep leached tropical ferruginous soils (S_{3r}); unit 5, unfit for any cereal production (N_2), includes lithosols on rock, lithosols on ironstone, leached superficial indurated ferruginous tropical soils and indurated ferruginous leached deep soils [27] [31] [32].

Compared to the density of the river system, the proportion of lowland soils appears low because of the terrain. As a reminder, hills, mounds and glazes dominate the landscape Dano. However, note that 24% of potential land for rice cultivation and/or contresaison (dry crops) is not negligible. Expressed in hectares, this percentage amounts to 16,056 ha, or about 7% of the national potential [33].

So far, four sites are involved in vegetable production in the dry season; the lowland Lofing, withholding water of Ligmarè and Pontieba and the Moutori landscaped perimeter. It is the latter that is most important with 23 ha of exploiting area [31]. Except the area of Ligmarè which is purely operated traditionally, others experienced an arrangement with irrigation channels in Pontieba and Moutori, and culvert wells at Lofing.

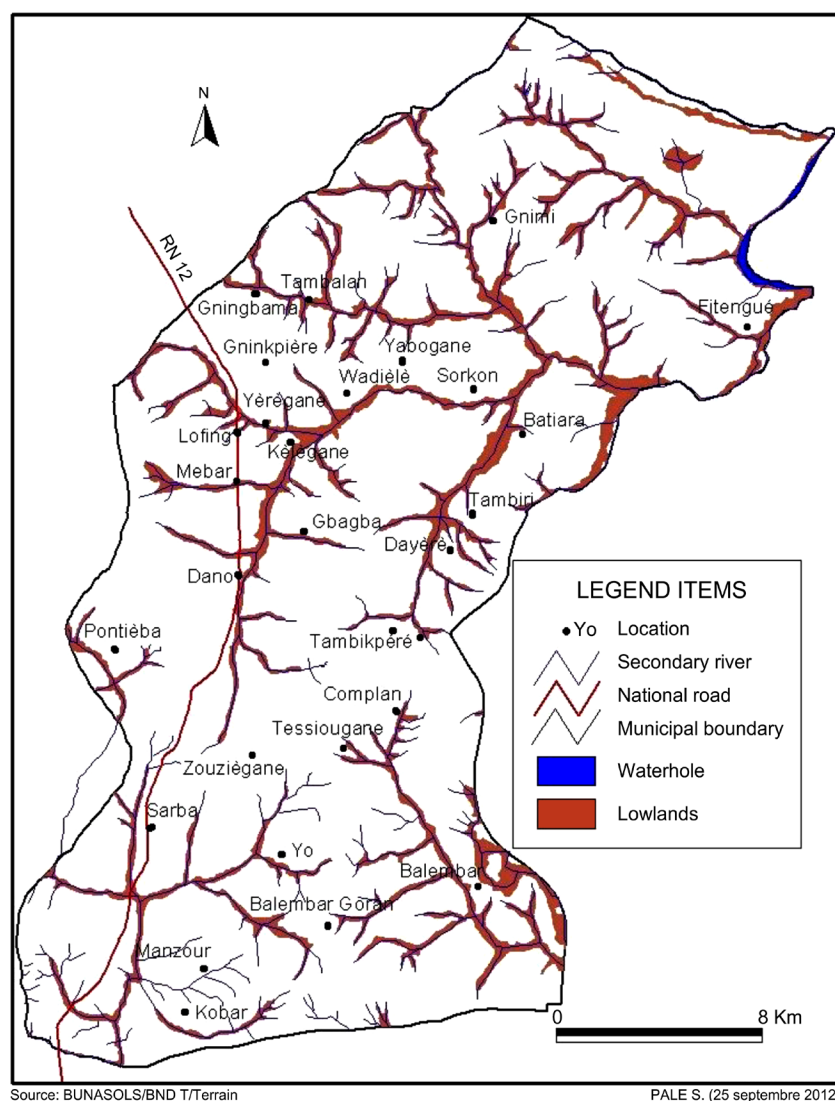


Figure 2. The extent of lowlands in Dano.

Table 1. Ability soil agronomic units for grain Dano.

Agronomic Units	Proportion (%)	Maize	Millet	Sorghum	Rice
1	10	S _{2n} [*]	S _{2n}	S _{2n}	S _{2n}
2	1	S _{2n}	S _{2n}	S _{2n}	S _{2n}
3	13	S _{3w} ^{**}	S _{3w}	S _{3w}	S _{2n}
4	35	S _{3r}	S _{3r} ^{***}	S _{3r}	N ₂
5	41	N ₂ ^{****}	N ₂	N ₂	N ₂

Source: Based AGRITECH FASO (2010).

Please note: ^{*}S_{2n} = average ability; ^{**}S_{3w}/^{***}S_{3r} = marginal ability; ^{****}N₂ = permanently incapacitated.

3.2. Traditional Management Mechanisms of Water Resources

The right to water is closely linked to that of the land which is acquired by the principle of the precedence or seniority. And control of traditional water management (TWM) systems (Gestion Traditionnelle de l'Eau: GTE) is

provided by traditional leaders who are indigenous. These TWM or GTE (in French) are governed by customary law with a village ownership [34]. Only holders' customary rights generally inherited through the oral tradition. Recently, SOME J-M [35] mentions that on the earth, the heirs are fighting to avoid spoliation operated by the state or foreign powers. Their struggle, which is not just only a defense of any property, takes the form of a crusade to ensure that land managers who received this "gift of the earth" know their rights, while remaining open to trade necessitated by (and for) the development [36]-[38].

The land crops in the lowlands are obtained by inheritance father to son, nephews and cousins. In the community, no woman can be hold land. According to the survey results, the powers of such land plots, that is to say to foreign applicants to the family, are only temporary and the owners have the right to demand it at any time [36].

The exploitation of surface waters in the lowlands is allowed for all inhabitants of the land. In the dry season, the water in the troughs is in the form of beads; in places, wells are dug to overcome the problem of watering animals and gardening. Furthermore, the animals must be kept away from existing fields, to avoid internal disputes within the village. To this end, corridors of access to water points and grazing areas are drawn.

3.3. The Traditional Lowlands Operating Systems

In the lowlands, farmers traditionally sown early in the rainy season after summary farming methods performed with the daba. The first floods come as the seedlings are large enough to support them [39]. Compared to the farmers of developed areas, those who practice purely rain-based watering, recognize that they are taking longer to produce or grow than previous. The plots are prepared before or during the first rains; it is a simple plowing by the hoe or large mounds of at least 2 square meters of 30 to 50 cm in height and spaced from each other by at least 1 m. These mounds can be made in rows or staggered; farmers prefer the latter provision to slow water currents capable of carrying some mounds.

Seedlings also follow a certain logic (as a reminder, all farmers practice mixed farming in the operating system); on mounds, corn is planted, often accompanied okra around them. Some mounds may also harbor Cucurbitaceae (gourd family), especially the squash to be harvested before the floods. The spaces between the mounds are exclusively rice (long cycle, traditional, 4 - 5 months). To slow runoff and erosion, seedlings are usually arranged in staggered rows (see [Figure 3\(a\)](#) and [Figure 3\(b\)](#)).

In the case of gardening, which lasts 3 - 4 months from November to February, the boards are inter-spaced not more than 50 cm. Common vegetables such as tomatoes, eggplants, okra, peppers, cabbage and increasingly onion are produced. Traditional operators recognize they have no control in the production of onion. [Figure 4](#) presents a technique traditional operating lowlands to Ligmarrè.

3.4. The Degree of Technological Involvement of Farmers in Traditional Management of Water Resources

Water and land are seen as divine gifts, often representing a relationship between God, genies, and human beings; they are sacred elements related to the ordering in different societies. Water resources control forms are always determined by this design [40]. The need to fill a food deficit facing erratic rainfall and a population explosion that compresses the cultural space, led farmers to focus more on floodplains [41]. Lowlands in Dano, formerly used for growing tobacco, pepper or eggplant are nowadays exploited for cultivation of cereals, including maize and rice. This enthusiasm comes from the strong climate variability that becomes elusive for farmers. The 2012 IUCN report on wetlands, with reference to flood areas or lowlands, particularly in France, confirms this argument; for her, wetlands have also long been seen as detrimental ecological environments, which would explain the many improvements made over time. Nowadays, these wetlands regress due mainly drainage for agricultural purposes [24]. Thus, rice production is growing for a decade and forcing rural people to a new civilization with water [42]-[44]. The three types of production such as irrigated rice, rice lowland and upland strict that are practiced throughout the town. Nationally, the Ioba Province is one of provinces occupying the 3rd rank rice production [45].

Rice production in Dano has become a booming business and the degree of involvement of farmers in water management is increasingly important. The peasant effort is laudable even if the majority does not have total control of agricultural water. The gradual intensification of agriculture requires more efficient water management. And a key to the problem of water for the rural world is the creation and multiplication in recent years, developed areas [46]. The results show the existence of three types of lowland occupied by farmers. First, traditionally



Source: PALE S. (June 2012).

These two pictures show two ways to carry out the mounds in the lowlands and arrangement of crops; we clearly observe the alternation of sowing on the microtopography created by farmers (corn on small hills and rice between them).

(a)

(b)

Figure 3. Arrangement of mounds and types of crops in traditional farming to lowlands in Dano.



Source: PALE S. (June 2012).

The illustration shows the boards with regular shapes separated from each other by an alley of about 50 cm. They wear tomato plants in the background and those of eggplant forward; it is the garden below the dam of Ligmarè, 15 km from Dano, further south.

Figure 4. Arrangement of boards and cultures within a garden in Ligmarè lowland (South Dano).

exploited lowlands are most prevalent; then the simple managed lowlands and finally the improved one. It should be noted here that these three groups of lowland could not be quantified. So, the degree of involvement in the peasant agricultural water management is at three levels; respectively between those who have had no training, those who have benefited from training or study tours and those who are permanently assisted by agricultural technicians [47].

The main coaching topics for those receiving assistance include the application of technical ideas, composting, respect the cropping calendar and interviews plots. The purpose of the application of this technology package is to enable producers to improve yields in their plot. Unfortunately, they often face due to insufficient number of breaks support technicians. This inadequacy of the staff hampers the normal monitoring of producers and promotes non-compliance with rules set in different arrangements [39].

At this stage, a tiny fraction of Dano rural population receives training or partial control study trips water. The majority of farmers expressed their enthusiasm to exploit in the irrigated perimeter of Moutori or, at best, to

usurp technology. Unfortunately, this technology package seems to monopolize their complex because of the lack of equipment and infrastructure, income poverty and to appropriate it as illiteracy or low educational attainment. This is a commitment, determination, and even an awareness of rural population to move to other technologies to improve crop yields; this deserves special attention of policy makers and NGOs for them.

4. Conclusions

Geological formations and exogenous agents of erosion have promoted a relief accident in the Dano Commune. It forms a dendritic network of streams rather important in more or less cramped plains. These floodplains reported in the area of the town, occupy 24% or 16,045 ha. These lowlands are traditionally run by local people. And management mechanisms are based on the prior definition of allocation with the involvement of the beneficiaries, when it comes to amenities or are provided by traditional leaders who are indigenous.

Water control is located at three levels according to the three types of lowland identified (purely traditional lowlands, simple managed lowlands and improved lowlands). Thus, it appears that only a small portion of this population has partial control of water.

Attention of policy makers and humanitarian organizations working in the field of rural development, must be paid to this population that expresses a strong enthusiasm to go to other supposedly improved technologies that can increase agricultural production in the storm system and gardener.

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