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RESEARCH ARTICLE

STATE OF HYDRAULIC INFRASTRUCTURES FOLLOWING SUCCESSIVE FLOODS IN THE IRRIGATED AREA OF ANEKER-TAHOUA-NIGER)

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ABSTRACT

This study was carried out on the irrigated area of Aneker, Tahoua region (Niger), the objective of which is to analyze the physical state of hydraulic structures following flooding on this development. Its objective is to make an exhaustive diagnosis of the irrigation and drainage networks. The methodology consisted of the development of two (2) survey sheets, one of which was administered to irrigators and the other with ONAHA technicians. The other was used to explore a certain number of hydraulic works such as irrigation canals, protection and drainage networks, in order on the one hand to assess the physical state of these works and on the other hand to complete data collected with operators and technicians.Thus, the collected data was processed and analyzed. The results of this study show a notable deterioration of hydraulic infrastructure which affected the operating performance of the study area and development. It emerges from this study that the perimeter is faced with the problems of cracking observed on the canals, the lack of seals, the degradation of the jumpers, the presence of termite mounds, silting of hydraulic works, grassing of canals and drains. , the putting into operation of the drains. All of these problems have been observed to some degree.Thus, the water mobilization works of which 65% are in a state of siltation or even cracked and 35% are in good condition, the main canals present anomalies of which most of the latter are either broken, detached, loosened, cracked or good. The secondary canals mainly present cracks, weeding, defective seals and the degradation of the valves to a very poor degree while the degradation of the jumper and the presence of termite mounds are to an average degree. On tertiary canals, the most observed constraints are sand encroachment, cracking, degradation of valves and breakage of panels to a very poor degree while grass cover, presence of termite mounds and degradation of rider to an average degree.... For the Aneker perimeter to function well, it would be interesting to review the design or to consider the rehabilitation of certain hydraulic infrastructures.

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INTRODUCTION

A West African country, Niger covers an area of 1,267,000 km² of which only 12% is suitable for agriculture (INS, 2012). It is characterized by low rainfall and, above all, poorly distributed in time and space. In addition, the soils are poor and subject to continuous degradation. The main cereal production is rainfed and is represented mainly by millet (74.3%) and sorghum (23.2%) (Boukary et al., 2010). However, to fight against famines and food crises, the Niger authorities have adopted a policy of developing irrigated crops in the regions by creating irrigated areas where the potential exists (Sahel Sunday). Created for the most part during the years of independence of African States, hydro-agricultural developments once again aroused the interest of international cooperation after the great droughts of 1973 and 1974.

Major programs to rehabilitate the areas irrigation and creation of hydraulic infrastructures were financed with massive assistance from international aid. Whether of state origin or private initiative, the majority of hydro-agricultural developments in Africa encounter numerous difficulties and are eventually abandoned due to their unsatisfactory performance (GADELLE, 2001). Among the countries victims of these climatic hazards are certain African states where many of the developed areas are of the gravity type. This is the case in Niger where numerous material and financial resources have been mobilized for the development of the perimeters. These areas are managed by operators grouped into cooperatives and supervised by the Office National des Aménagements Hydro Agricoles, which is a state service responsible for technical

support on all irrigated areas in Niger (Mossi, 2009). The objective of this achievement is to secure farmers' income through production through better use of water, by creating a favorable environment for irrigated crops through better water management on irrigated areas. Thus the Aneker irrigated perimeter was created in 2018 by the PMERSA project, and is located in the Tahoua region. The aim of this study is to investigate the state of hydraulic structures due to flooding from 2019 to 2021.

MATERIAL AND METHODS

Material : This step concerns the design of two (2) field data collection tools which constitute our study material. On the one hand, this is an interview sheet which will be administered to irrigators in the Aneker irrigated area and ONAHA technicians at the study area. Furthermore, another technical sheet was developed to assess the physical state of the hydraulic infrastructures on the ground.

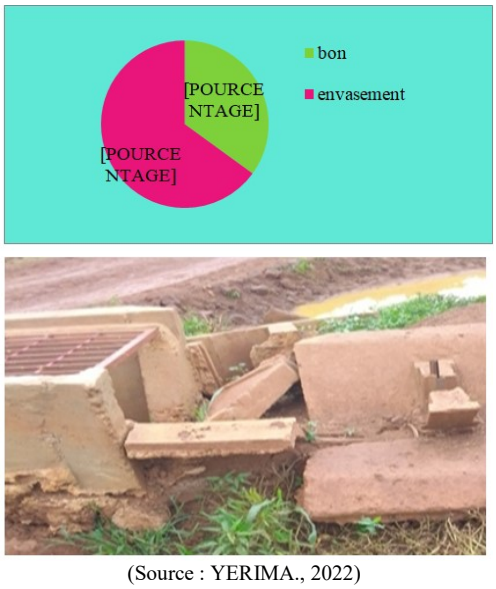
Méthodes

To achieve the objectives set, the methodology chosen is to identify the location of the perimeter before being on the ground. Subsequently, a ground truth mission was carried out to not only make contact with the operators on the one hand and on the other hand to see the few hydraulic works one by one. This will make it possible to identify as much data as possible relating to the physical state of these structures. For data collection, a survey was conducted in a formal, cross-sectional manner and in a single round. For producers, it is a question of knowing the state of hydraulic works which are located at the level of their respective GMPs (or Sections). The diagnostic sheets were analyzed and analyzed. Each is used according to the desired objectives. Thus, the state of the hydraulic structures was analyzed.

RESULTS AND DISCUSSION

Résultats

Water in take structures : The main intake structure is located upstream of the primary canal.



(Source : YERIMA., 2022)

Figure 1. State of intake structures on the Aneker irrigated perimeter

There are a few intake structures of which 65% are in a state of siltation or even cracked and 35% are in good condition as illustrated in Figure 1.

Table 1. Constraints observed on the supply canal of the Aneker irrigated area

Feedchannel	
Contraints	Degree
Cracking	++
Deterioration of joints	+++
Break	+++

Legend: +++ very bad; ++ Average; + weak

Feedchannel: The table below shows on the supply channel the most observed constraints are the degradation of the joints, the breakage has a very poor degree however for the cracks the degree is average (Table 1)

Water distribution network works

Main channels: The water distribution works are in poor condition, especially the primary and secondary canals which are currently in various degraded states. The main canals present anomalies, most of which are either broken, detached, loose, cracked or good as illustrated in Figure 2.

(Source : YERIMA.,2022)

Figure 2. Condition of a portion of the main canal at the Aneker irrigated perimeter

The table below shows on the main channels the stresses most observed are cracking and defective joints to a very poor degree on the other hand breakage and jumpers degraded to an average degree (Table 2).

Table 2. Constraints observed on the main canals of the Aneker irrigated perimeter

Main channels	
Contraints	Degree
Cracking	+++
Break	+++
Defectiveseals	+++
Degraded Rider	++

Legend : +++ verybad; ++ Average ; + weak

Secondary channels: At the level of the Aneker irrigated area, the observation is that most of the secondary canals are in a seriously degraded state. The table below shows on the secondary canals the constraints mainly observed are cracking, weeding, defective seals and the degradation of the valves to a very poor degree while the degradation of jumper and the presence of termite mounds are to a degree average (Table 3).

(Source : YERIMA.,2022)

Figure 3. Condition of secondary canals in the Aneker irrigated perimeter

Tableau 3. Constraints observed on the drains at the Aneker irrigated area

	Principal Drains	Secondary Drains	Tertiary Drains
Contraints	Degré		
Operation	+++	+++	+++
Silting	++	+++	+++
Damage	+++	+++	-
Cracking	+++	+++	+

Legend : +++ very bad ; ++ Average ; + weak

Tableau 4. Constraints observed on the secondary canals of the Aneker irrigated perimeter

	Secondary chenels
Contraints	Degree
Fissuration	+++
Enherbements	+++
Joint d'étanchéité défectueux	+++
Cavalier dégradé	++
Déchaussement	+++
Dégradation des vannes	+++

Legend : +++ very bad; ++ Average ; + weak

Tertiary chenels : On tertiary chenells, the most observed constraints are silting, cracking, degradation of valves and breakage of panels to a very poor degree while grass cover, presence of termite mounds and degradation of rider to an average degree (Table 4).

Tableau 5. Constraints observed on the tertiary canals of the Aneker irrigated perimeter

Tertiary Chenels	
Contraints	Degree
Silting	+++
Grassing	++
Cracks	+++
Degraded Rider	++
Valve degradation	+++
Removal	+++
Panel breakages	+++

Legend : +++ very bad; ++ Average ; + weak

Drainage network: In an irrigated area, the drainage network allows excess irrigation water to be evacuated as well as runoff water during the rainy season. In gravity irrigation, drains are generally open earth channels. The drainage network consists of a belt seal whose role is to protect the perimeter from runoff water during the rainy season, a main drain collecting water from secondary drains which at their level collect water from tertiary drains. At the Aneker perimeter, 53.58% of the drains are currently degraded and are more precisely in a state of siltation or and 46.42% are functional. Figure 10 below illustrates the state of the drains in the study area. All the drains at the Aneker irrigated perimeter are very defective. Table 5 explains some observed constraints.

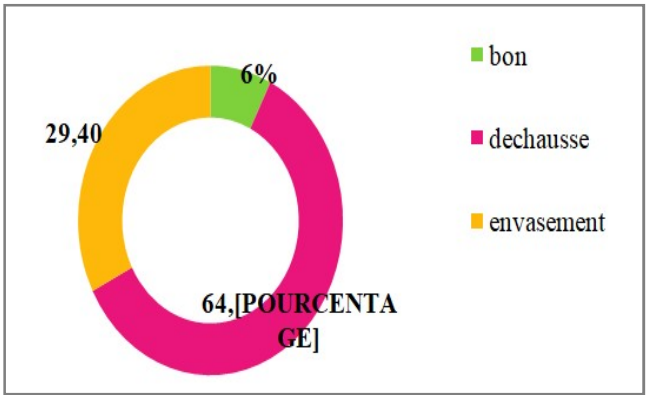


Figure 4. State of protection network (dykes) on the Aneker perimeter

Trail network: The network of tracks generally consists of a main track along the main canal, secondary tracks along the secondary canals allowing access to the hydraulic districts and tertiary tracks along the secondary canals allowing access to the plots. In the Aneker area, tertiary roads are almost non-existent due to their very degraded condition.

Protection network: dikes: The protective dikes have the essential role of ensuring the protection of the water perimeter. Following the floods of 2020, the dikes of the said perimeter gave way and there is currently no protective dike on this perimeter. Although they are ceded, we also note their state of loosening, siltation and good condition. Figure 4 illustrates that 64.60% of the dikes are exposed, 29.40% are victims of siltation and 6% are good.

DISCUSSION

The results of our surveys show that 91% of channels are degraded and 9% are defective. The operators surveyed affirm that the entire perimeter is non-functional. Water management faces several constraints at the Aneker AHA level. Indeed, all hydraulic infrastructures are experiencing advanced deterioration given their poor design. The water mobilization structures and the supply channel, the transport, irrigation, circulation, protection and drainage networks are in poor condition, very degraded, broken, cracked and are even threatened by silting. . All these constraints are due to the multiple floods experienced by the Aneker irrigated area. These results are contrary to those obtained by Tassiou (2018) on the irrigated perimeter of Djirataoua and by Moustapha (2018) on the perimeter of Konni where the two (2) authors showed that the hydraulic infrastructures are degraded mainly due to the lack of adequate maintenance of the latter and their dilapidated state. Regarding irrigation management, according to farmers, the results of our work show that 65% of them highlighted that the very degraded state of the irrigation canals does not allow good irrigation management. In addition, the degradation and disappearance of certain irrigation canals remain the greatest hydraulic constraints in the Aneker perimeter. This constraint hinders the development of crops leading to allocation restrictions. As for the question of irrigation at the Aneker perimeter, insufficient water for irrigation is the second constraint forcing producers to reduce

the cultivated space. These results are contrary to those obtained by Christoph (2012). Indeed, the author showed in his investigations that the main hydraulic constraint is due to the degradation of the protection and drainage system. These same authors underlined that the degradation of irrigation networks is a second constraint, thus harming the sufficient water supply of several plots. Compared to the management of irrigation at the plot level, the results of our study reveal that the irrigation system used is gravity and does not save water and requires adequate leveling of the plots and waste. significant amount of water. Thus, 87% of producers in the Aneker area explain that they have an irrigation problem due to the poor leveling of their plots or even abandonment of the development by the producers. The main constraint listed by this author is that the distribution, irrigation and drainage works are poorly sized and the existence of a counter slope at the level of the dividers. On the other hand, for most of the irrigators in the Aneker area, the main dysfunction of this development since the impoundment is a purely technical problem relating to the. According to the author, the main causes of the dysfunction of this newly created development are inadequacies noted in the design and implementation of the said irrigated area. These results are also similar to those of Intissar (2012), who highlighted a poor condition of the main and secondary drains and also a poor practicability of the circulation networks at the level of the irrigated areas that he diagnosed. This situation led to significant damage to the hydraulic infrastructure, flooding during the rainy season of the development due to the lack of belt sealing. All these problems mentioned, including silting and defective seals lead to a deposit of sediment in the canal and a water leak between the joints. These results are consistent with those found by SABRA (2010) on the irrigated area of Daïbéry.

The main canals are cracked, invaded by plants, damaged bridges and defective seals. But cracks and seals are the most recurring problems on the main channels. These results are in agreement with the work of Frédéric (2017) in Burkina Faso on the Bagré irrigated area. The author recorded almost the same hydraulic problems as in our case. All these problems mentioned are generally due to defective secondary and tertiary canals leading to a significant loss of water before reaching the plots. These results are not far from those obtained by ONAHA (2016) in the Konni perimeter which explains the deficiency of the secondary canals leading to a significant loss of water due to the fact that the two perimeters are distinct. In the Aneker perimeter, the tertiary canals in general are in a very advanced state of degradation due to problems such as damaged valves, water leaks in places and the presence of termite mounds, defective parcel intake often leading to to a drainage problem or even flooding of plots and water stagnation. These results corroborate the work of Rajouene (2013), in Morocco, who showed that the lack of maintenance of drains leads to flooding of crop plots and waste deposits lead to water stagnation, such is the case for the area in question.

CONCLUSION

The analysis of hydraulic structures were the objectives assigned to this study. From this study, it appears that almost all of the hydraulic infrastructures are in a very defective state. The Aneker irrigated perimeter is a new development carried out in 2018 which from its first campaign has been subject to successive floods. It emerges from the study that it is faced with numerous constraints, of which this study focused on the constraints of hydraulic infrastructures. The study shows that the irrigation and drainage networks are seriously deteriorated. This deterioration is easily observed at the level of several panels, the main canals, secondary canals, supply canal, tertiary canals. On the other hand, as for the drainage network, it is also degraded especially at the level of the main drains where some are invaded by vegetation, silting and others are put into operation and the plot drains are completely absent. The operators are concerned about the state of the perimeter and want its rehabilitation at the slightest opportunity

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