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Technical and Hydraulic Studies for the Development of a 5HA Site for Irrigation Purposes in the FADAMA2 Valley (Tahoua-Niger)

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Abstract **Original Research Article**

This article deals with the technical and hydraulic studies for the development of a 5HA site for irrigation purposes in the FADAMA2 valley, in commune 1 of Tahoua. The objective of this study is to: propose a sustainable development plan for an irrigated area of 5 ha in the said valley in order to improve agricultural productivity and the living conditions of farmers through irrigated production. The methodology adopted consisted of carrying out socio-economic, topographical, hydraulic, hydrological, pedological and environmental studies at this site. The results of the study reveal: (i) the support of the population of Founkoye for this project, (ii) the topographical surveys allowed the determination of the surface area (5 ha), (iii) the determination of the different hydrological parameters, (iv) pedological studies which made it possible to determine the suitability of the soil for irrigated crops. These results contribute to the design and sizing of the development as well as the estimated cost of the work. The summary environmental and social impact study highlighted positive and negative impacts for which mitigation measures are proposed in the environmental and social management plan. The financial analysis is carried out to determine the financial feasibility of this development project.

Keywords: Technical and hydraulic studies, site development; environmental impact; estimated cost, Fadama Valley2.

1. INTRODUCTION

Niger, located in West Africa, characterized by a vast area of 1,267,000 km² and geographical diversity, ranging from the desert areas of the Sahara to the fertile valleys of the south. Agriculture, an essential pillar of the Nigerien economy, occupies a preponderant place in the country's economy (45.2% of GDP in 2010) and employs a large part of the population while contributing to food security. However, the country faces many challenges, particularly on the climatic level, a variable climate, frequent periods of drought and rains poorly distributed in time and space. Added to these are the depletion of rainfed crop lands ; for example, the yield of millet in the Tahoua region increased from 582 kg/ha in 2001 to 475 kg/ha in 2014 (RN, 2012). In view of the above, the State has placed emphasis on the development of irrigation to ensure food security in Niger.

This development of irrigation is undoubtedly possible through the strengthening, multiplication and revitalization of the main means of production which are water and land and the development of land for the purposes of agricultural production (BM, 2008). It is with this in mind that this document was envisaged. The aim of this study is to propose a sustainable development plan for a 5ha irrigated perimeter site in the Fadama valley, commune 1 of Tahoua, aiming to improve agricultural productivity and the living conditions of farmers. Therefore, the points will be studied:

- Evaluate the irrigation needs of the crops most suited to the area;
- Develop a detailed development plan integrating irrigation techniques;
- Analyze the hydrological, pedological, environmental and financial characteristics of the valley.

This article will be based on a bibliographic review, field and office work

2. Presentation of the study area

The urban commune of Tahoua straddles the canton of Kalfou and the canton of Tahoua, both (2) in the department of Tahoua. It is located between 5° 02" and 5°23' East longitude and 14°45 and 15°01' North latitude. It is some 550 km from Niamey, the capital of Niger.

The overall potential of renewable groundwater resources each year is estimated at 1.2 billion m3 of which only 2% is exploited. The Continental Intercalaire/Hamadian aquifer whose depth of catchment works varies from 100 to 800 m and a specific flow rate of up to 16 m3/h/m. The Fadama study area belongs to the Tahoua 1 commune, as illustrated in Figure 1.

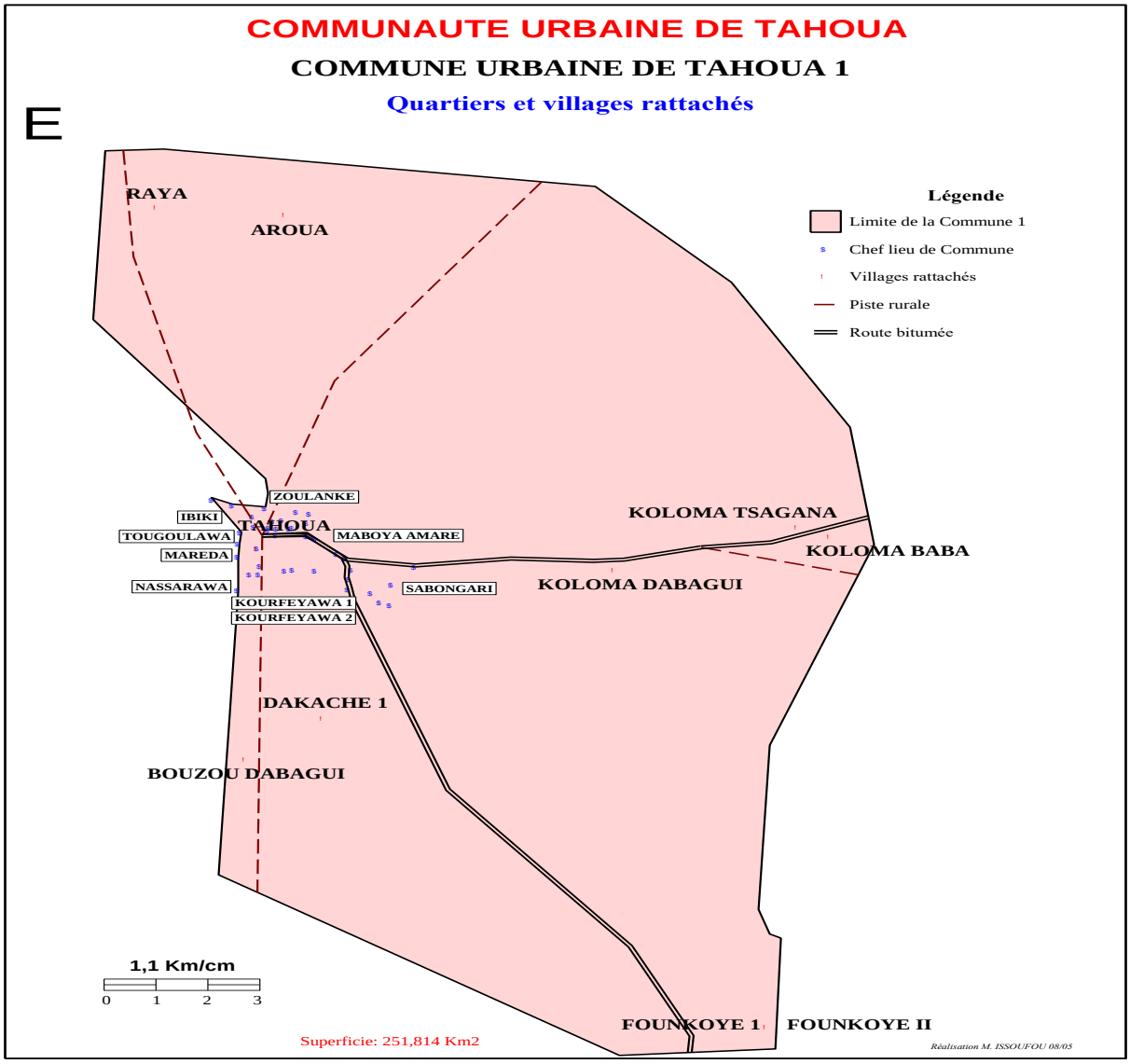

Figure 1: Administrative map of the municipal district of Tahoua 1

3. MATERIAL ET METHODS

3.1. Material

The materials used for the proper conduct of the work of this study consist of:

- ✓ A service vehicle;
- ✓ A camera for taking images in situ;
- ✓ An investigation sheet;
- ✓ A note-taking notebook;
- ✓ A laptop for analyses;
- ✓ Excel and Word software for data entry, analysis and processing;
- ✓ Two FAO software programs for calculating crop water requirements: climwat and cropwat;
- ✓ Total station with its accessories (tripod, rod and prism) for topographical studies;
- ✓ A USB key for data transfers and a GPS for location.

3.2 Methods

The success and credibility of the results of a study are predicated on the methodology.

In this specific case, the methodology adopted consists initially of researching documents and archives at the level of the departmental directorate of rural engineering of Tahoua, then of a socio-economic survey and finally of the technical study of the development.

3.2.1 Data collection

The field investigation is crucial in this study, it allows us to collect information allowing us to make a judicious choice concerning the speculations and dimensioning of the irrigation network, the constraints linked to production, the choice of the means of draining…etc.

During the visit to the site, we were first able to carry out the topographical survey with the GPS to determine the perimeter and surface area. The operation consisted of first determining the points which will constitute the framework of the work. For this purpose, a polygon of four points and an antenna were identified for carrying out the survey. The rectangular coordinates of all the different points were recorded using GPS.

3.2.2 Data processing and analysis

It relates to the processing and analysis of all the different data collected in the field to lead to the technical study.

Indeed, all the data collected will make it possible to carry out technical studies which must provide precise answers on the following aspects;

- Topographic study;
- Soil study;
- Hydrogeological study:
- Agronomic study;
- Socio-economic study;
- Environmental assessment of the development project.

3.2.3 Socio-economic study mission

A general assembly was held at the site level in order to collect the aspirations of the populations on the dynamic situation of the site under study.

Wishes were expressed by the populations questioned to make this valley productive as before in order to limit the massive rural exodus of able-bodied workers.

It was gathered during this study, the need expressed by the producing populations at the site level to be able to benefit equally from all the lands. They also want respect for integrated and concerted management of water and land resources.

4. RESULTS AND DISCUSSION

4.1. Results

4.1.1 Topography study

The topographical work for our case allowed us to appreciate the shape and topographical characteristics, to determine the surface area of the land which provides information on the site and allows us to make judicious use according to the objective to be achieved. The topographical work is subdivided respectively into two (2) stages:

- Field survey (field work);
- Data processing and plan determination (office work).

4.1.2 Topographic survey in the field

The field work consists of reconnaissance of the site in order to determine the working method, the composition of the topographical team and the materials to be used.

4.1.3 Data processing (office work)

Generally speaking, all the data collected in the field was analyzed and processed in the office with a view to designing and sizing the development.

The data collected in the field is processed on a computer before being transformed for the purpose of developing the plan. The following steps are performed:

- Data entry and calculation of coordinates in Excel;
- Transformation of data into TXT (Text: Tabulator-separator);
- Development of the plan;
- Dressing and tracing of level curves

4.1.4 Soil study

In the study of land development for agricultural production, the pedological study makes it possible to determine the suitability of the soil for suitable crops. Table 1 provides a summary of this study.

Table 1: Summary of the soil study at the Fadama 2 site level

Municipality	Site	Pedological Suitability of the Site	Dominant soil type	Amendment	Nature of the amendment
Municipality of Tahoua 1	Founkoye Fadama 2	Excellent	Sol limoneux et sol argileux	No	

4.1.5 Socio-economic study

We had to speak with the future beneficiaries in order to gather their points of view in relation to the development of the site. Table 2 gives the results of this interview.

Table 2: Summary of the Fadama 2 socio-economic study

Department	**Municipality**			**Distance from site**	
Tahoua	Municipal district of Tahoua 1			1 km from the site	
Site	Land Status	Motivation of the population	Contraints	Proposal of solutions	**Recommendations**
Founkoye Fadama 2	Family (heritage)	Site operated for 20 years, with a workforce of 11 operators	• Transformation and conservation; • Marketing problem; • Thorn fence on part	Arrangements and training for producers on innovative practices	Regular monitoring and maintenance, developing a sense of belonging among the entire population

4.1.6 Agronomic studies

a.) Calculation of water needs in Fadama 2

Calculations of crop water requirements were made using CLIMWAT and CROPWAT software developed by FAO.

The basic data used are those of the Tahoua meteorological station taken from the FAO database contained in the tables below:

Table 3: Reference Evapotranspiration (FTO) at Fadama 2

Month	**Darkness**	**Section**	**Tmoyen**	**p/100**	**Coefficients**				**ET0/month**	**ET0/day**
					0,03114	0,2396	45,7	813		
January	16,9	31,9	24,4	0,0798	0,999416	1928,08			153,77	5,13
February	18,8	34	26,4	0,0744	1,061696	2019,48			159,52	5,32
March	22,8	39,4	31,1	0,0843	1,208054	2234,27			227,54	7,58
April	27,2	41,2	34,2	0,0842	1,304588	2375,94			260,99	8,70
May	29,3	41,1	35,2	0,0895	1,335728	2421,64			289,50	9,65
June	26,2	37,7	31,95	0,0876	1,234523	2273,12			245,82	8,19
July	24,8	35,1	29,95	0,0901	1,172243	2181,72			230,43	7,68
August	24,9	34,6	29,75	0,0879	1,166015	2172,58			222,67	7,42
September	25,1	37,3	31,2	0,0826	1,211168	2238,84			223,98	7,47
October	24	38,4	31,2	0,0827	1,211168	2238,84			224,25	7,48
November	20,23	36,1	28,165	0,0778	1,116658	2100,14			182,45	6,08
December	**17,8**	**32,9**	25,35	0,0789	1,028999	1971,5			160,06	5,34

Reference: Tahoua meteorological station

Four (4) most dominant speculations on the crops practiced and envisaged after the development were retained for the calculations of water requirements with the CLIWAT and CROP WAT software. These are corn, onion, cabbage and potato.

b.) Calculation of the maximum evapotranspiration of the speculations planned for Fadama 2

Table 4 gives the monthly ETM of corn on the Fadama 2 site to be designed using CLIMWAT and CROPWAT software.

Table 4: Calculations of monthly corn ETM at Fadama 2

Month	**Period**	**Cycle**	**Duration of phases (day)**	**ET0/j**	**Kc**	**ETM/p**	**ETM/month**
December	20	Initial	20	5,335	0,30	32,01	76,62
December		Initial		5,335	0,30		
December	11	Growth	35	5,335	0,76	44,60	
January	24	Growth		5,126	0,76	93,49	139,06
January		Growth		5,126	0,76		
January	7	Mi-saison	40	5,126	1,27	45,57	
February	28	Mi-saison		5,317	1,27	189,08	189,08
February		Mi-saison		5,317	1,27		
March	5	Mi-saison		5,317	1,27	33,76	**191,52**
March	26	Off-season	30	7,585	0,80	157,76	
March		Off-season		7,585	0,80		
March		Off-season		7,585	0,80		
April	4	Off-season		8,70	0,80	27,84	27,84
Total	**125**		**125**				**624,12**
Total ETM/ corn cycle							

b.1) ETM calculations for onions

Table 5 gives the monthly ETM of corn on the Fadama 2 site to be designed using CLIMWAT and CROPWAT software.

Table 5: ETM calculations for onion cultivation

Period	Duration	ET0/day	Kc	ETM	ETM/Oct
1/10 -12/10	11	7,48	0,6	49,368	134,64
12/10-23/10	11	7,48	0,6	49,368	
23/10-31/10	8	7,48	0,6	35,904	
30/10-3/11	2	6,08	0,6	7,296	109,44
2/11-13/11	11	6,08	0,6	40,128	
13/11-24/11	11	6,08	0,6	40,128	
24/11-30/11	6	6,08	0,6	21,888	
30/11-5/12	5	5,34	1,05	28,035	**173,817**
5/12-16/12	11	5,34	1,05	61,677	
16/12-27/12	11	5,34	1,05	61,677	
27/12-31/12	4	5,34	1,05	22,428	
31/12-7/01	7	5,13	1,05	37,7055	96,957
7/01-18/01	11	5,13	1,05	59,2515	
Total ETM/ onion cycle					**514,854**

b.2) Calculation of ETM chou at Fadama 2

Table 6 gives the ETM calculated for cabbage at Fadama 2 using CLIMWAT and CROPWAT software.

Table 6: Calculation of ETM for cabbage at Fadama 2

Period	Duration	ET0/day	Kc	ETM	ETM/Month
1/02 -9/02	9	5,32	0,5	23,94	86,98
9/02-18/02	9	5,32	0,5	23,94	
18/02-27/02	9	5,32	0,5	23,94	
27/02-31/02	4	7,58	0,5	15,16	
31/02-5/03	5	7,58	0,75	28,425	176,43
5/03-14/03	9	7,58	0,75	51,165	
14/03-23/03	9	7,58	0,75	51,165	
23/03-30/03	7	8,7	0,75	45,675	
30/03-2/04	2	8,7	1,05	18,27	**264,915**
2/04-11/04	9	8,7	1,05	82,215	
11/04-20/04	9	8,7	1,05	82,215	
20/04-29/04	9	8,7	1,05	82,215	
Total ETM/Cycle du chou					**528,325**

b.3) Calculation of potato ETMs at Fadama 2

Table 7 gives the calculated ETM of cabbage at Fadama 2 using the CLIMWAT and CROPWAT software.

Table 7: ETM calculations for potatoes at Fadama 2

Month	Phases	Duration of phases	ET0/j	Kc	ETM/p	ETM/Month
December	Initial	25	5,335	0,50	66,69	91,34
December	Initial		5,335	0,50		
December	Growth	30	5,335	0,77	24,65	
January	Growth		5,126	0,77	94,72	135,98
January	Growth		5,126	0,77		
January	Mid- season	45	5,126	1,15	41,26	
February	Mid- season		5,317	1,15	171,22	171,22
February	Mid- season		5,317	1,15		
March	Mid- season		5,317	1,15	61,15	**180,61**
March	Off- season	30	7,585	0,75	119,46	
March	Off- season		7,585	0,75		
April	Off- season		8,700	0,75	58,72	58,72
Total cycle		130				
	Total ETM/ potato cycle 637,87					

c.) Summary of ETM and monthly water needs

Table 8 gives a summary of ETM and monthly water requirements at the Fadama 2 site using CLIMWAT and CROPWAT software.

Table 8: Summary of ETM and monthly water needs at the Fadama 2 site

Cultures	ETM /cycle	ETM/ peak month	Water requirement per peak month	Water requirement L/m^2/day
But	624,121	191,523	191,523	6,178
Onion	514,854	173,817	173,817	5,794
Tomato	412,830	178,089	178,089	5,936
Cabbage	528,325	264,915	264,915	8,831
Potato	637,871	180,61	231,801	5,826

The result of this table shows that the highest ETM/cycle is that of potato (637,871 mm) and the highest ETM of the peak month is that of cabbage (264,915mm/month = 8,831 L/ m² /d). The calculations of water requirements were carried out on the basis of the ETM of the peak month of cabbage which is the most unfavorable case to cover the needs of all the plants considered and over all the cultural phases of their vegetative cycle.

d.) Calculation of raw water requirements on the Fadama 2 site

Table 9 gives the calculation of raw water needs on the Fadama 2 site (Founkoye).

Table 9: Calculation of raw water requirements on the Fadama 2 site (Founkoye)

Site	Determined area (ha)	Retained surface area (m^2)	Irrigable Area (80%) (m2)	Daily water requirement per m2 (l/m^2) day	Network efficiency (California)	Total water requirement of plants		Autre besoin (5%)	Besoin brut
						l/day	m^3/day	m^3/day	m^3/day
Founkoye Fadama 2	5	50000	40000	8,83	85%	415529,412	415,529	20,776	**436,306**

By considering the daily water requirements and the efficiency of the network, the gross water requirement is determined: the result obtained is 436.306m3/D.

4.1.7 Determination of water points for irrigation water (boreholes)

Table 10 gives the determination of water points for irrigation water supply for the Fadama 2 site.

Table 10: Determination of water points for irrigation water supply for the Fadama 2 site

Sites	Gross surface area (Sb) retained (m^2)	Net irrigable area (m^2) 90% of (Sb)	Gross water requirement (BB) per site		Flow rate mobilized per site to satisfy the irrigation dose	Flow mobilizable by drilling	Number of drilling 15m3/h necessary	Number of drilling retained
			m^3/j	m^3/h	m^3/h	m^3/h		
Founkoye Fadama 2	50000	45000	467,47	58,43	57,85	15	3,86	4

The choice of the number of boreholes retained is due to the fact that the irrigation will not be continuous over the entire surface area of the sites but according to water towers and that only half of the land will be irrigated per day.

Table 11 gives the Hydraulic, Geological and Hydrogeological report at Fadama 2.

Table 11: Hydraulic, Geological and Hydrogeological Report at Fadama 2 site

City of Tahoua								
N° of order	**Department**	**Municipality**	**Site**	**Water sources**	**Types of tablecloth**	**Table depth (m)**	**Static level of the water table (m)**	**Drawdown level (m)**
5	Tahoua	Municipality of Tahoua 1	Founkoye Fadama 2	drilling	phreatic	20	10	

4.1.8 Calculation of the number of water points required for the site

Table 12 gives the determination of water points (boreholes) for the Fadama 2 site.

Table 12: Determination of water points (boreholes) for the Fadama 2 site

Sites	**Gross surface area (Sb) retained (m^2)**	**Net irrigable area (m2) 90% of (Sb)**	**Gross water requirement (BB) per site**		**Flow rate mobilized per site to satisfy the irrigation dose**	**Flow mobilizable by drilling**	**Number of drilling 15m3/h necessary**	**Number of drilling retained**
			m3/j	m3/h	m3/h	m3/h		
Founkoye Fadama 2	50000	45000	467,47	58,43	57,85	15	3,86	4

By setting an objective of 15m3/h flow rate per drilling to be carried out, the number of drillings necessary to irrigate the irrigable areas of the site is calculated.

4.1.9 Sizing of structures and means of drainage

Basic data

The basic data used in the design of structures and means of drainage are, among others:

- The area of the perimeter;
- The depth of the water table;
- The depth of the projected drilling;
- The static level;

Table 13 shows the basic data on the sizing of structures and means of drainage.

Table 13: Basic data on the sizing of structures and means of drainage

Sites	**area (ha)**	**Table depth (m)**	**Depth of projected drilling (m)**	**Static level of the water table (m)**
Founkoye Fadama 2	5	20	25	5

4.1.10 Determination of the HTM, characteristics of the pumps and solar generator

The total head was calculated by the Manning Strickler formula using the spreadsheet developed by the Ministry of Hydraulics.

$$HMT = Hgéo + \Delta H + \frac{\Delta P}{\rho \times g}$$

• Hgeo: level difference between the level of the suction plane (dynamic level) and the discharge level at the water tower level (in m);
• ΔH: pressure losses in the supply pipe (in m);
• ΔP: pressure variation between suction and discharge point;
• ρ: density of water (in kg/m3);
g: acceleration of gravity (in m/s2).

Table 14 gives the HTM, characteristics of the pumps and the solar generator for the Fadama2 site.

Table 14: HTM, characteristics of the pumps and the solar generator for the Fadama2 site

Site	**Depth of planned drilling (m)**	**Calculated HMT (m)**	**HMT retained (m)**	**Choice of solar submersible pumps (15m3/h) (GRUNDFOS)**	**Inner bore diameter (mm)**	**Solar generator (Wc)**
Founkoye Fadama 2	25	23.56	25	SP 17-3 MS 402	180	3406

After calculating the HMT and depending on the flow rates retained, the choice of pumps was made using the GRUNFOS chart, the result is summarized in the table above

4.1.11 Sizing of the System on the developed site

After determining the boreholes, pumps and solar generators, the development plan is designed on the basis of the topographical plan and taking into account the configuration of the land, in particular its topography and its geometric shape. Then using a spreadsheet the diameters of the pipes are determined.

Remember that two networks are chosen according to their effectiveness depending on the type of culture. The semi-Californian network for market gardening and sprinkler irrigation for forage crops.

For the Californian network, each borehole supplies 3 to 4 storage basins from which a distribution ramp carrying watering terminals is connected.

Taking into account the data obtained above, a diameter of ϕ90 is adopted for the delivery pipes and ϕ63 for the distribution ramps for the Californian network.

For the sprinkler irrigation network, the main pipes are ϕ63 and the secondary pipes and booms are ϕ50 in diameter.

4.1.12 Financial analysis of the development work on the Fadama 2 site

a.) Investment Summary

Table 15 gives a summary of the investment in development work on the Fadama 2 site.

Table 15: Summary of the investment in development work on the Fadama 2 site

Department	Municipality	Site	Amount of PPI market gardeners network	Closing amount	Basin Amount	Drilling amount	Total amount for the site
City of Tahoua	District Municipality 1	Founkoye Fadama 2	7 651 000	12 651 333	6 812 796	36 290 000	63 405 129

b.) Calculation of financial profitability

Two sites were selected to verify the financial profitability of the project, one for the market gardening sites and another for the forage crops.

Dewatering means: Solar submersible pump

Irrigation system: semi-California

Area exploited: 5 ha

Table 16 gives the calculation of the financial profitability of the development work on the Fadama 2 site.

Table 16: Calculation of financial profitability of development work on the Fadama 2 site

Label	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Produits						
Tomato	-	4 640 000	4 872 000	4 918 400	4 964 800	5 011 200
Patato	-	5 856 000	6 148 800	6 207 360	6 265 920	6 324 480
Onion	-	28 800 000	30 240 000	30 528 000	30 816 000	31 104 000
Total product	**-**	**39 296 000**	**41 260 800**	**41 653 760**	**42 046 720**	**42 439 680**
Charge						
Development cost	53 629 111	-	-	-	-	-
Inputs	-	105 000	105 000	105 000	105 000	105 000
Workforce	-	150 000	150 000	150 000	150 000	150 000
Total Charge	**53 629 111**	**255 000**	**255 000**	**255 000**	**255 000**	**255 000**
Chash Flow	**- 53 629 111**	**39 041 000**	**41 005 800**	**41 398 760**	**41 791 720**	**42 184 680**

Table 17 gives the investment cost and the rate of return for the development work on the Fadama 2 site.

Table 17: Investment cost, rate of return on development work on the Fadama 2 site

Investment cost	53629111
Rate of return	12%
duration of the site development project (year)	5

Table 18 gives the investment cost and the rate of return for the development work on the Fadama 2 site.

Table 18: Investment cost, rate of return on development work on the Fadama 2 site

Element	Abbreviation	Values	Interpretation
Net Present Value	**VAN**	**93 881 431 CFA**	Rentable
Internal rate of return	**TRI**	**70%**	Profitable
Profitability Index	**IP**	**2,75**	Profitable

Table 19 gives a summary of the environmental report of the development work on the Fadama 2 site.

Table 19: Summary of the environmental report of the development work on the Fadama 2 site

Ville de Tahoua							
N° of order	**Department**	**Municipality**	**Site**	**Main environmental threats**	**Main Social Threats**	**Mitigation measures**	**Mitigation measures**
5	City of Tahoua	District Municipality 1	Founkoye Fadama 2	No major risk	None	None	None

5. DISCUSSION

The development of a 5 ha area in the Fadama valley, commune of Tahoua, represents an ambitious project aimed at improving agricultural productivity, food security and the living conditions of farmers. This project requires a multidimensional approach that integrates topographical, pedological, hydrological and hydrogeological, environmental and socio-economic considerations.

Therefore, a detailed study of the irrigation infrastructure in place is important to ensure that the new developments are complementary and effective. This is supported by Tappan *et al*., (2009) and UNDP (2016) who emphasize the need to assess existing irrigation infrastructure before launching a new development project.

The soils of the Fadama valley are mainly heavy soils (loamy and clayey), rich in nutrients but infiltration is very low. Water may sit for a long time or run off leading to flooding or water erosion. During our interview, the beneficiaries wanted the developed site to be protected from water erosion. The work of KANE *et al*., (2020) and Zin (2020) corroborates our results. Indeed, for developed land with heavy soil, they recommend the use of soil conservation techniques, such as terraces and retaining walls, to limit erosion.

Regarding the socio-economic study, at all stages of the development project, the beneficiaries were involved and claim to be optimistic about the success of this development of the Fadama2 valley. These results are consistent with those by Saidou (2019) and Farrington (1999) who emphasize the importance of the approach that promotes the involvement of communities in decision-making. This method not only makes it possible to better identify the specific needs of producers, but also to increase the ownership of projects by beneficiaries. They emphasize that irrigation systems designed in consultation with end users are more responsive to local conditions. Maiga's studies (2013) focused on the impact of irrigated developments on agricultural yields in the Tahoua region. The results show a significant increase in yields thanks to the introduction of appropriate irrigation techniques. Farms that have benefited from an irrigated area have recorded production gains of up to 50% compared to traditional methods. This confirms our results, in fact according to the financial analysis of our study, the site once developed will increase the income of the beneficiaries, making it possible to reduce poverty and fight against food insecurity in the area.

6. CONCLUSION

The development of irrigation is the tangible solution to fill the significant food deficit during each agricultural season in order to sustainably maintain the food and nutritional security of the populations benefiting from the development of the site.

The general objective of this study is to propose a sustainable development plan for a 5ha irrigated perimeter site in the Fadama valley, urban commune1 of Tahoua, aimed at improving agricultural productivity and the living conditions of farmers. Thus, preliminary technical studies were carried out, namely: (i) socio-economic study, (ii) topographic, (iii) pedological and (iv) hydrological. The conduct of these studies allowed the use of many tools and devices both in the field (survey tools, topographical, geotechnical and pedological devices) and in the office (software and other supports).

The results of these studies were conclusive and made it possible to make a positive decision on the technical feasibility of the development. This is how the results from hydrological, topographical and geotechnical studies were decisive for the proposal of a development plan. To do this, the cost of the work was estimated for a total amount of 63,405,129 FCFA. Therefore, the implementation of our development

proposal must absolutely rely on the lessons learned from the bibliographic review, in particular on the importance of community participation and training. By integrating these elements, we have a better chance of ensuring not only the economic viability of irrigation, but also its positive social impact on the FADAMA 2 Valley community.

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