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Agro-Morphological Parameters and Yield of Taro (*Colocasia esculenta*) Under Endogenous Soil Fertility Management Practices in the North Sudanian Zone of Burkina Faso

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Abstract **Original Research Article**

In the commune of Sourgoubila, province of Kourwéogo (Burkina Faso), taro production by women is a long-standing practice that takes place on degraded land that they have reclaimed through endogenous agricultural practices. The objective of this study is to assess the effects of different soil fertility management practices and to determine the agro-morphological parameters and yield of taro under endogenous soil fertility management practices. To this end, soil sampling was initially conducted in soils under sustainable land management practices in the villages of Sourgoubila and Guèla. Subsequently, morphological parameters and taro yield were determined under endogenous soil fertility management practices for a period of two years. Regardless of the site, the endogenous practices employed by women to reclaim degraded soils under taro cultivation resulted in a 162% increase in total soil carbon and a 0.54 unit increase in pH. The endogenous soil fertility management practices employed at Guèla and Sourgoubila resulted in a significant increase in the assimilable phosphorus content, with a 60% increase observed at Guèla and a 246% increase observed at Sourgoubila, in comparison to the soil without management. The most favourable growth parameters were identified with the endogenous soil fertility management practices employed by women at the Sourgoubila site, regardless of the type of variables observed. The plant height exhibited a range of 85 to 105 cm at Sourgoubila and 76 to 96 cm at Guèla in 2022 and 2023, respectively. On average, the height of taro plants increased by 24.60% annually. The leaf length and width exhibited a range of 35 to 40 cm, with an average leaf length increasing by 11.36% per year. The number of pups varied from 5 to 8, with an annual decrease of 24%. The results indicate that there is no significant difference between the two sites in terms of yield, with an average yield of 10 t/ha. The reclamation of degraded land for taro cultivation by women represents an innovative approach that could contribute to a sustainable improvement in soil quality.

Keywords: *Taro, Soil Fertility, Women, Burkina Faso*.

I. INTRODUCTION

Soil and climatic conditions in the Sudano-Sahelian zones are major obstacles to achieving food security (Coulibaly *et al.*, 2022; Roose *et al.*, 2013). Indeed, soils are in an advanced state of degradation, requiring the implementation of restoration and rehabilitation techniques to ensure their sustainable exploitation. A large number of studies have documented on water and soil conservation techniques in the Sudano-Sahelian strip (Roose *et al.*, 2013; Abdou *et al.*, 2020; Sawadogo *et al.*, 2008). These include zaï, mulching, stone bunds, and agroforestry techniques, etc.

However, for socioeconomic reasons, many techniques, although adapted to agroecological conditions, are not widely adopted by farmers (Sakandé *et al.*, 2022).

In response to demographic pressures and cultural constraints, women in the central region of Burkina Faso, which has a semi-arid climate, have developed initiatives. These initiatives involve the reclamation of degraded land for the production of taro (*Colocasia esculenta*), a tuber crop.

Root and tuber crops are of vital socio-economic importance. They are cultivated for their underground organs, which are an important source of energy in the human diet due to their high carbohydrate content (Nout, 1991). Taro *(Colocasia esculenta)* is an herbaceous plant of the Araceae family. It is consumed by more than 400 million people worldwide (Bown, 2020; Ivanic et Lebot, 2000). According to (Varin and Vernier, 1994), the inhabitants of Samoa in the South Pacific derive a significant caloric intake from the consumption of Araceae. It ranks fifth among tubers worldwide after potato, sweet potato, cassava, and yam (Agropolis-Museum, 2000; Bamidele *et al*., 2014; Houngbo *et al*., 2015). In Burkina Faso, *Colocasia esculenta*, commonly known as taro, is a plant cultivated locally for its tubers (Bamabra, 2019). It is a reserve food rich in vitamins (A, B, C, etc.) and mineral salts, including calcium and iron, which are necessary for maintaining good health (Amaglah et Nyarko, 2012; Traoré, 2006). Despite this nutritional importance, there have been few scientific studies on Araceae in the North Sudanian zone of Burkina Faso. Nevertheless, a few studies have been conducted on the agro-morphological characterization of a collection, as well as on agricultural practices and food biotechnology in western and southwestern Burkina Faso and in some countries of the subregion, including Ghana, South Africa, Benin, Cameroon, etc. (Aquaah, 2012; Dede, 2016).

The agronomic potential of taro suggests that the development of these genetic resources, along with cassava, yam, and sweet potato, would contribute to dietary diversification and food security in Burkina Faso (Birame, 2016). Women in the commune of Sourgoubila in the North Sudanian zone of Burkina Faso, who face difficulties in accessing arable land, produce taro on degraded land that they reclaim through endogenous soil fertility management practices. Furthermore, these local practices enable rural women to cope with the effects of climate change, land degradation, and the scarcity of arable land.

In light of the above, the following research question is proposed for this article: What are the agro-pedagogical performances of endogenous soil fertility management practices under taro (*Colocasia esculenta*) cultivation in the area?

It is postulated that endogenous soil fertility management practices can enhance soil chemical properties in comparison to conventional practices for the reclamation of degraded land.

The objective of this article is twofold. Firstly, the article seeks to assess the comparative effects of endogenous soil fertility practices and conventional soil fertility management practices on soil chemical properties. Secondly, it aims to determine the agro-morphological parameters and yield of taro under peasant land management practices.

2. MATERIALS AND METHODS

2.1. Study Sites

The commune of Sourgoubila is one of five (05) communes in the province of Kourwéogo in the Plateau Central region/Burkina Faso.

The commune is situated 37 km from Boussé, the provincial capital, 35 km from Ouagadougou and 70 km from Ziniaré, the regional capital. It covers an area of 491 km^2 between 12°24'54" north latitude and 1°48'35" west longitude. It is located to the east of the commune of Ouagadougou (in the province of Kadiogo). Figure 1 shows the geographical location of the study area.

2.2. Biophysical Characteristics

Climate:

The commune of Sourgoubila is situated within a Sudano-Sahelian climate zone. The region is distinguished by two alternating seasons: a long dry season from November to May and a rainy season from June to October. Rainfall levels fluctuate from one year to the next. The annual rainfall during the rainy season ranges from 600 to 800 millimeters (PCD-AEPA, 2009).

Vegetation:

The vegetation is shrubby savannah with some trees and a predominance of annual grasses. The vegetation is characterized by the presence of woody species including *Vitelaria paradoxa* (shea), *Parkia biglobosa* (cowpea), *Lannea microcarpa* (grape), *Adansonia digitata* (baobab), *Tamarindus indica* (tamarind) and *Faidherbia albida*. Additionally, sacred groves, which are typically dominated by *Anogeissus leocarpus*, are prevalent in villages, Gallery forests which are dominated by Sudanian species such as *Khaya senegalensis*, Daniella olivera and Mitragyna intermis are also common (PCD-AEPA, 2009).

***Soil under Taro Crops*:**

The majority of the commune is comprised of ferruginous and sandstone formations. Additionally, clayey and sandy soils are present in some areas. The soil types are coarse mineral soils, ferruginous soils and hydromorphic soils (PCD-AEPA, 2009). The women of Sourgoubila cultivate taro on degraded soils that they have reclaimed through endogenous practices learned from past generations. The women employ rudimentary tools such as the daba, to break up the surface layer of clogged soil to a depth of 15 to 20 cm thereby improving its water infiltration capacity. Subsequently, a combination of organic fertilizer and crop residues is added in order to enrich and loosen the soil. The soils of the prepared plots on which the seedlings are planted are covered with a portion of crop residues, shea leaves or any other tree previously dried near the plots. This is done to conserve soil moisture and reduce evapotranspiration.

Each year, a layer of grass or leaves, measuring between two and three centimeters, is added to the soil. This layer is derived from dead tree branches (shea and others) or crop residues. Its purpose is to provide cover against wind and water erosion and to stimulate the activity of soil macrofauna, especially termites. In addition to these residues, the women apply organic manure in conjunction with manual tillage. The production cycle is illustrated in steps 1 to 4.

Step 1	**Step 2**	**Step 3**	**Step 4**
			
Photo 1: Degraded soil in Sourgoubila	**Photo 2: mulching the plot with harvest residues**	**Photo 3: Taro plot during the vegetative cycle**	**Photo 4: leaf fall during the ripening phase**

2.3. Plant Material

The plant material for the study consisted of *Colocasia esculenta* plants, which are commonly referred to by the generic name of taro, known as the local variety. Survey data from this locality indicate that the tubers cultivated by the women have been derived from seeds that have been transmitted from generation to generation for approximately 50 years. Two sites were subjected to study. The two sites were Sourgoubila and Guèla. The two localities were selected for study based on their social organization and the taro cultivation system employed. The first seedlings were planted using cuttings from the previous harvest. The planting was conducted by the female farmers on May 12 and May 27 in plots that were 30 to 40 cm in height. The cuttings were planted at a distance of one meter apart. The cuttings were placed in holes and covered with soil in order to facilitate their emergence. Weeding was conducted on two occasions during the vegetative cycle of the plants. Thus, the first weeding occurred in July and the second in August of each year (2022-2023) in order to ensure good plant growth. Following this period, the plants are left to themselves and tubers are formed.

2.4. Methods

The experiment was designed to compare the land management practices of taro female farmers with conventional sustainable land management practices found in the Sourgoubila area with regard to soil properties.

The term "endogenous soil fertility management practices" was defined as practices that consist of digging holes of varying shapes 15 to 20 cm deep in the soil to collect runoff water, and covering the soil each year with a 2 to 3 cm layer of grass or dead leaves from tree branches (shea and others) or crop residues.

The conventional practices for reclaiming degraded land correspond to the current land management techniques (stone bunds, fallow, crop rotation and intercropping) used by farmers in the North Sudanian zone of Burkina Faso.

The experimental design used was a Fisher block with three replicates corresponding to three farmers' fields. This design was utilized to compare the effects of land management practices on soil chemical properties. The treatments applied were a combination of the two factors with 3 replicates, giving a total of eight treatments (Table 1).

Table 1: Treatments conducted in the Study

Main factor	**Secondary factors**		**Number of replication**
Sourgoubila	ST	Women's Taro plot in Sourgoubila	03
	SN	Non-amended plot in Sourgoubila	03
	SC	Stone bunds at Sourgoubila	03
	SJ	Fallow in Sourgoubila	03
Guela	GT	Women's Taro plot in Guela	03
	GN	Non-amended plot in Guela	03
	GC	Stone bunds in Guela	03
	GJ	Fallow in Guela	03

Plots of 25 m^2 for the taro practice and 50 m^2 for the other practices were randomly selected for the trial.

To assess the impact of endogenous land management practices by women on the growth, development and yield of taro, a peasant system was set up.

Therefore, the landscape of each village corresponding to the treatments was employed to identify three taro fields, which constituted a three-repetition peasant system with three blocks (Photo 4). Each block was subdivided into 10 m^2 plots, with a 50 cm path separating them. Taro was planted in staggered rows within the plots with twenty-five (25) cuttings or more depending on the plot size. Three (03) plots were selected for each block. This resulted in a total of nine (09) plots per site. In each plot, three (03) taro plants were randomly selected to serve as the observation units, taking into account the boundary effect. This resulted in a total of twenty-seven (27) plants per site.

2.5. Data Collection and Statistical Analysis

The data collection process commenced with soil sampling. Second, it included agromorphological parameters and taro yields.

Soil Sampling:

Soil sampling was conducted in both taro production sites, Sourgoubila Taro (ST) and Guela Taro (GT). A total of five (05) composite samples were collected along the diagonals and at the center of each taro plot in both production sites (Sourgoubila and Guèla), as well as in plots with other soil fertility management practices in the two villages. These included soils with stone bunds, non-amended soils and fallow soils. Parameters such as pH, OM, N, C/N, total phosphorus, assimilable phosphorus, total potassium and available potassium were analyzed in the soil-water-plant laboratory of the GRN/SP program of INERA-Farako-Bâ.

Collection of Agro-Morphological Data on Taro:

Agro-morphological data on taro were collected 85 days after the sowing and it included the following parameters: plant height, number of leaves, leaf length and width, and the number of pups (direct shoots). The yield (t/ha) was evaluated at the time of taro harvest by means of yield squares.

Statistical Analysis of Data:

The analysis of variance and separation of means were employed to determine differences between treatments via GENSTAT 11 edition software. The Fisher test was used to compare means when the analysis of variance indicated significant differences between treatments at the 5% probability level (Steel *et al.*, 1997).

3. RESULTS

3.1. Soil Ph, C, C/N Status under Different Land Management

Table 2 presents the soil chemical parameters at the various taro production sites. In general, the taro plots at both sites exhibited pH values that were close to neutral (GT: 7.02±1; ST: 7.62±0.06). In comparison to the non-amended soil, the endogenous land management practice employed by women under taro cultivation at Sourgoubila resulted in an increase in soil pH of 0.54 pH_water units. Compared to soil with stone bunds at Sourgoubila and Guèla, the endogenous practice of land management under taro cultivation by women at Sourgoubila resulted in pH-water increases of 2.48 and 1.98 pH units, respectively. For total carbon, statistical analyses indicate that there is no significant difference (p<0.153) between the two taro production sites. Compared to the non-amended land at Sourgoubila, the taro plots at Sourgoubila resulted in a 162% increase in soil carbon. Compared to the soils with stone bunds at Sourgoubila, the continuous taro cropping plots recorded over 1.9 times more soil carbon. Compared to the soils with stone bunds at Guèla, the continuous taro plots at Guèla resulted in a 20.30% increase in soil carbon. The plots under continuous taro cultivation at Sourgoubila and Guèla demonstrated the highest C:N ratios.

Table 2: Chemical parameters of soils under different land management

Treatments	pH_water	Carbon (%)	C/N
GT	7.02±1[a]	1.01±0.8[ab]	12.05±2.76[a]
GJ	5.72±0,3[bc]	0.631±0.72[cd]	11.69±3.51[ab]
GC	5.67±0,5[bc]	0.84±0.02[ab]	11.60±1.8[abc]
GN	6.65±0,9[ab]	0.87±0.3[abc]	10.56±1.7[abc]
ST	7.62±0.06[a]	1.18±0.22[a]	13.12±1,6[a]
SJ	5.76±0.03[ab]	0.94±0.04[abc]	11.31±1,5[abc]
SC	5.14±0.15[c]	0.97±0.23[ab]	12.72±1,2[ab]
SN	7.08±1[a]	0.45±0.16[d]	9.12±1,23[b]
Pr > F	***0.003***	***0.009***	***0.05***

NB: Means followed by the same letter within the same column are not statistically different at the 5% threshold according to Fisher's test.

Legend:

ST : Endogenous land management practices of the women of Sourgoubila Taro ; **SN :** Non-amended at Sourgoubila; **SC :** Stone bunds at Sourgoubila ; **SJ :** Fallow et Sourgoubila ; **GT :** Endogenous land management practices of the women of Guèla Taro; **GN :** Non-amended at Guèla ; **GC :** Stone bunds at Guèla ; **GJ :** Fallow at Guèla

3.2. Soil N, P and K Status under Different Land Management

Table 3 presents the chemical parameters including nitrogen, phosphorus and potassium contents of soils under different cropping systems. The results of the statistical analyses indicate non-significant differences in total nitrogen, total phosphorus, total potassium and available potassium contents for soil fertility management practices under taro cultivation in Guèla and Sourgoubila. In comparison to the non-amended soils in Guèla and Sourgoubila, soils with continuous taro cultivation in Guèla demonstrated a 75% and 185% increase in total soil nitrogen, respectively. Conversely, no significant differences were observed between the other soil fertility management practices in terms of total soil nitrogen content. As for the soil management practice under taro cultivation in Sourgoubila, there was a 296% increase in assimilable phosphorus content. In comparison with the non-amended soils, the soil management practices under continuous taro cultivation at Guèla and Sourgoubila resulted in an increase in assimilable phosphorus content by 107 and 41%, respectively. Compared to to non-amended soils, the plots under continuous taro cultivation exhibited available potassium content that was 3.5 times greater. With the use of stone bunds, an increase of 1.67 mg/kg of available potassium was obtained. In contrast, the soils with stone bunds exhibited less than twofold the available potassium content of continuous taro soils. The same trends were observed in Guèla. Indeed, continuous taro cultivation resulted in an 80% and 153% increase in available potassium compared to non-amended soils and soils with stone bunds, respectively.

Table 3: Chemical parameters of soils under different land management

Treatments	**Total_N (%)**	**Total_P (mg/kg)**	**Bray1_P (mg/kg)**	**Total_K (mg/kg)**	**Av_K (mg/kg)**
GT	0085±0.11[a]	330.22±132.40[a]	5.41±2.12[a]	520.19±74.32[ab]	126.11±45.32[ab]
GJ	0.051±0.07[b]	131.02±99.20[cd]	4.41±3.58[d]	585.44±127.86[a]	27.90±12.05[c]
GC	0.06±0.01[ab]	150.63±73.72[bcd]	7.29±1.81[ab]	538.26±146.8[ab]	53.93±22.84[c]
GN	0.082±0.01[ab]	212.85±102.82[abc]	5.14±22.87[bcd]	587.19±97.86[ab]	70.37±55.47[bc]
ST	0.089±0.006[ab]	225.59±34.82[abc]	7.937±0.23[a]	440.39±129.46[ab]	160.15±8.39[a]
SJ	0.085±0.01[ab]	261.11±22.28[ab]	4.43±1.63[cd]	456.71±74.74[ab]	58.86±5.43[c]
SC	0.077±0.01[ab]	125.56±49.66[cd]	4.14±2.67[cd]	407.77±28.25[bc]	77.61±60.67[bc]
SN	0.049±0.01[b]	66.23±77.46[d]	2.5±0.77[d]	195.73±4.67[c]	46.04±9.11[c]
Pr > F	***0.03***	***0.007***	***0.01***	***0.006***	***0.005***

NB: *Mean values followed by the same letter within the same column do not differ significantly at the 5% level according to Fisher's (F) test.*

Legend:

GN : Non-amended at Guèla ; GC : Stone bunds at Guèla ; GJ : Fallow at Guèla ; ST : Endogenous land management practices of the women of Sourgoubila Taro ; SN : Non-amended at Sourgoubila ; SC : Stone bunds at Sourgoubila ; SJ : Fallow at Sourgoubila ; GT : Endogenous land management practices of the women of Guèla Taro; Pr : Probability ; T_N : Total Nitrogen ; T_P : Total phosphorus ;

P_Bray1 : *Assimilable phosphorus* ; T_*K : Total Potassium ; Av_K : available Potassium.*

3.3. Parameters Observed in Taro by Study Site

Table 4 illustrates the observed variation in the taro production parameters across different sites. The results of the analysis of variance indicate a highly significant difference between the sites for the parameter height (cm) at the 5% threshold. For the parameters number of leaves, leaf length (cm), leaf width (cm) and number of pups, the difference between the two observation sites is significant at the 5% threshold. The Sourgoubila sites recorded the best morphological parameters, regardless of the type of variable observed. Height varied between 85 and 105 cm in Sourgoubila and 76 and 96 cm in Guèla in 2022 and 2023, respectively. The average taro height increased by 24.60% per year. In comparison to the Guèla site, the endogenous soil fertility practices at Sourgoubila resulted in an average increase in plant size of 11.18% per year. The average leaf length exhibited an increase of 11.36% per year. Relative to the practice of soil fertility management at Guèla, the practice of soil fertility management led to an average increase in leaf length of 14.2% and 8.57 per year, respectively. The number of pups per year decreased. A 24% reduction in the number of pups per year was observed. On average, each pup produced one tuber, with the main cutting bearing a tuber.

In terms of yield, statistical analysis indicates that there is no significant difference between the two sites. The average yield was 11.36 t/ha. The average yields for Sourgoubila and Guièla were 13 and 9 t/ha respectively.

Table 4: Agro-morphological parameters observed on taro depending on the site

Parameters	Years	Sites		Pr > F
		Sourgoubila	Guiela	
H (cm)	2022	85.37±16[a]	76.11±15[b]	*0.04*
	2023	105.07±19[a]	95.11±14[b]	*0.03*
L (cm)	2022	40.19±6.4[a]	35.19±6.8[b]	*0.34*
	2023	42±5.8[a]	38.7±5.1[b]	*0.03*
W (cm)	2022	29.28±5.3[a]	26.05±4.6[b]	*0.007*
	2023	32.44±4.6[a]	29.88±3.6[b]	*0.03*
NF	2022	5.519±0.5	5.6±0.58	*0.02*
	2023	5.037±0.6	5.074±0.6	*0.82*
NR	2022	8.11±2.8	7±3.4	*0.19*
	2023	5.37±1.47	5.44±1.8	*0.87*
Yield (t/ha)	2022	13±6.8	10±7.2	*0.3*
	2023	9±3.4	9.03±3,5	*0.5*

***NB**: Means followed by the same letter within the same column are not statistically different at the 5% threshold according to Fisher's test.*

***Legend**: **H (cm)**: Height in centimeters; **W (cm)**: width in centimeters; **L (cm)**: Length in centimeters; **NF**: Number of leaves**; NR**: Number of pups*

4. DISCUSSION

4.1. Effect of Endogenous Soil Fertility Practices on Soil Chemical Parameters under Taro Cultivation

Peasant soil fertility management practices have also contributed to an increase in the C/N ratio, which plays a pivotal role in the decomposition of soil organic matter and the availability of nutrient. Subsequent applications of dead leaves in conjunction with animal manure to initially degraded plots result in an improvement in soil fertility. This improvement could be attributed to an increase in biological activity, as evidenced by C:N values of approximately 12. This helps to make mineral elements available to the plant. The same observations were made by (Koulibaly *et al*., 2017) in cotton cropping systems. Consequently, residue management practices in conjunction with the application of stable manure and manual tillage of the soil by the taro female farmers have unquestionably contributed to the improvement of soil quality for the cultivation of this crop. In addition, this type of system is analogous to mulching, which, when combined with the incorporation of organic matter from diverse sources subsequent to subsoiling, permits the decomposition of the plants by termites. The practice of no tillage, or the annual incorporation of organic matter and crop residues into the soil, has been shown to increase organic matter and nitrogen levels, as well as reduce soil acidity in taro production. Furthermore, the maintenance of residues on the surface of the manually decompacted plots, together with the regular addition of crop residues and stable manure, influenced the dynamics of organic matter, promoting its accumulation on the soil surface without impoverishment in the depth. This also improved the quality of the initially crusty soil by improving the pH, total nitrogen content, assimilable phosphorus, and available potassium (Coulibaly *et al*., 2018) Crop residues and other dead leaves contain organic phosphorus and organic nitrogen that are readily available to microorganisms (Alam *et al*., 2014). These crop residues are sources of organic matter. The capacity of organic matter to release mineral elements in a slow and consistent manner is likely to have contributed to the enhancement of soil chemical properties (Sanon *et al*., 2021). This situation allows for the availability of macronutrients to taro plants. Tillage practices can readily impact the availability of phosphorus. Similar observations were made by (Belmakki *et al*., 2013) in a no-tillage system without crop residues and a no-tillage system with 100% crop residues in Morocco. The low level of soil disturbance caused by women's endogenous practices results in a relatively stable soil environment, which is favourable to biodiversity and micro or macrofauna activities and allows the release of nutrients, especially phosphorus.

4.2. Agro-Morphological Parameters and Taro Yields under Endogenous Soil Fertility Practices

Conversely, the monitoring of the evolution of the growth parameters indicated that the taro exhibited a robust vegetative development. In fact, for all the agro-morphological characteristics studied, the plants gave low values in comparison to the performance levels documented in the literature (Angomi *et al*., 2015). According to (Ivanic et Lebot, 2000), the leaf blade length ranged from 30 cm to 80 cm, width from 20 cm to 50 cm, and the petiole length from 30 cm to 1.5 m. These results corroborate those of (Bambara, 2019), who states that all taro plants in an agronomic trial gave low values for all characters. This is due to the local varieties used and the lack of mastery of taro cultivation techniques by women. The results of this study are consistent with those of (Boampong *et al*., 2018), who, while investigating the morphological characteristics of some taro varieties in Ghana, observed that taro plants height ranged from 66 to 110 cm with plant densities similar to those of this study. The values obtained at 85 days after sowing for all the observed parameters indicate that there is no significant difference in the number of leaves. This could be explained by the tuberization process. These results are consistent with those obtained by (Caburet *et al*., 2007), who observed that a reduction in the total number of leaves per plant, a decrease in the length of the petiole and a slowing down of the development of new sprouts are indicative of tuber ripening. The growth of plants in the two study areas exhibits differences in all characters except for the number of leaves. This discrepancy can be attributed to the brief period spent on the plot in Guèla. In addition, the brief period of fertilizers or soil amendments application may also influence the decomposition of organic matter, resulting in a reduction in nutrient availability (15 days prior to sowing). It should be noted that the presence of soluble phenols could potentially have a negative impact in this case, as this element is known to inhibit the decomposition of organic matter (Diallo *et al*., 2015; Diallo *et al*., 2019. Indeed, the nutrient reserves (especially nitrogen) from decomposition are insufficient to ensure good growth of taro plants in the Guièla area. The suppressive effect of endogenous practices in Guièla is due to the high proportion of stems and branches in the harvest residues used. According to studies by (Diack et Loum, 2014), twigs decompose at a slower rate than leaf litter due to their lignin content.

Furthermore, the soil analysis has revealed that Sourgoubila plots have elevated levels of nitrogen, phosphorus and potassium. In fact, the combined effect of nitrogen and phosphorus on these plots is beneficial to the plants, in addition to the metabolic function that phosphorus plays for the plant. The potassium in these soils may facilitate the strengthening of the cell walls of taro plants and the enlargement of their leaf surface, thereby contributing to an increase of canopy photosynthesis and the growth of the taro crop on Sourgoubila sites. The women of Sourgoubila have made taro production their priority activity. This discrepancy may also be attributed to the proficiency of Sourgoubila women's group in the technical aspects of taro cultivation. This group is organized and likely possesses some experience in taro production. Failure to adhere to certain agronomic practices can result in adverse effects on taro growth and yield. It can be observed that the sites with the most favourable agronomic parameters also exhibit the highest taro yields. This indicates a positive correlation between growth parameters and taro yield. Similar results were obtained by (Boampong *et al*., 2018) in Ghana. The results also indicate a correlation between site chemical parameters and taro performance. In fact, the optimal levels of carbon, nitrogen, phosphorus, and potassium are observed in plots under taro cultivation. This suggests that macronutrients are crucial for the growth and development of taro. The number of leaves is not variable as taro plants follow a uniform developmental process. As stated by (Bambara, 2019), the rate of leaf renewal until maturity is dependent on climatic factors and the stage of plant development. The yields obtained at the two sites are lower than those reported by several authors including (Angomi *et al*., 2015; Mulugeta *et al*., 2014)). However, the yield outcomes are comparable to those reported by (Anand *et al*., 2017; Zarata *et al*., 2004). With a spacing of 1 m × 1 m, the yield was 11.36 t/ha. On the other hand, (Anand *et al*., 2017) recorded a yield of 11.7 t/ha at a spacing of 1 m × 0.5 m in Ghana. The yield of taro is dependent upon the number of tubers produced per unit area rather than the size of each individual tuber. This implies that the augmented total tuber yield was attributable to the elevated number of plants per unit area, which intercept solar radiation and consequently enhance photosynthesis per unit area. Furthermore, it is possible that closer plant spacing may have the additional benefit of complete ground cover, which effectively suppresses weeds and contributes to higher yields. This may provide an explanation for the results obtained under the study conditions. The results of this study are consistent with those of previous studies by Zarata *et al*., (2004) and Anand *et al*., (2017). A 9% reduction in taro yield was observed during the second year of cultivation, attributed to lower precipitation levels observed in 2023. The observed decrease in yield may be attributable to insufficient water and poor mineralization of organic substances by microorganisms.

5. CONCLUSION

The objective of this study was to assess the comparative effects of land management practices and conventional soil fertility management practices on soil chemical properties and to study the agro-morphological parameters of taro (*Colocasia esculenta*) under endogenous soil fertility management practices in the North Sudanian zone of Burkina Faso. The analysis indicates that endogenous soil fertility management practices enhance soil chemical properties in comparison to conventional practices for the reclamation of degraded land.

The most favourable morphological parameters were observed on the Sourgoubila sites by women who are organized in cooperatives, regardless of the type of agro-morphological variables observed.

The implications of this study, from the perspective of the reclamation of degraded land by taro female farmers, suggest that taro deserves greater attention because of its social value and economic potential in the villages of Guèla and Sourgoubila. Further study is needed of the characteristics of taro and the taro cultivation system in order to capitalize on the opportunities offered by this practice.

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Author Contributions

APKG and AS planned and conducted the experiments. ADC facilitated in data analysis and help in article formating. MPS and HBN supervised the experimental work.

Conflicts of Interest

The authors declare that there is no conflict of interest. Data Availability Data presented in this study will be available on a fair request to the corresponding author.

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