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Evaluation of the performance and constraints of lowland rice farming in the department of Bouaflé (Central-West of Côte d'Ivoire)

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Abstract

This study assessed the performance and constraints of lowland rice farming in Bouaflé Côte d'Ivoire. It was based on an inventory of lowland areas, an analysis of human potential, and a characterization of farming systems, using documentary data and field surveys. The results indicated that, despite significant natural potential, the lowlands were mostly undeveloped and highly dependent on rainfall. The land use rate was high, but yields remained low (1.5 to 3.5 t/ha) due to limited access to inputs, mechanization, and financing. Production is carried out primarily by a young , largely non-native, and poorly educated workforce, which limits the adoption of technical innovations. These results highlight the need for investments in water management, capacity building for producers and improved access to agricultural services, in order to sustainably increase productivity and strengthen the contribution of lowland rice farming to food security in Côte d'Ivoire.

Keywords: Lowland rice cultivation; Agricultural performance; Production constraints; Hydro-agricultural development; Bouaflé; Côte d'Ivoire

1. Introduction

Rice (*Oryza sativa* L.) is one of the world's major cereal crops and a staple food for more than half the world's population. Global paddy rice production is estimated at over 750 million tons, with a high concentration in Asia, which accounts for nearly 90% of global production, while Africa contributes only a small proportion, estimated at around 5% [1, 2].

In sub-Saharan Africa, demand for rice is growing rapidly due to population growth, urbanization, and changing dietary habits [3]. However, production remains insufficient to meet this increasing demand, leading to greater dependence on rice imports. This situation poses a major challenge to food security in the region.

In Côte d'Ivoire, rice occupies a strategic place in food systems and is now one of the main sources of energy for urban and rural populations. National consumption is estimated at over 1.5 million tons of milled rice per year, with average per capita consumption constantly increasing [1, 4]. However, national production remains insufficient to meet this demand, with a self-sufficiency rate of approximately 40 to 50%, despite the efforts made by the State [5].

This production deficit appears paradoxical given the country's significant natural potential for rice cultivation. Indeed, Côte d'Ivoire has a favorable climate characterized by rainfall between 800 and 1800 mm, as well as vast areas of lowland that are still under-exploited, representing significant potential for the intensification of rice production [1, 6].

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Faced with this situation, the Ivorian government has initiated several programs aimed at promoting rice cultivation, notably through the National Rice Program (PNR), with lowland development projects across the country. However, despite these initiatives, national production remains insufficient due to constraints related to access to inputs, agricultural infrastructure, and farming practices [7, 8, 9].

Furthermore, the Marahoué region, of which Bouaflé is the regional capital, although recognized for its agricultural potential, is not among the country's main rice-producing areas and benefits from few hydro-rice development projects. This situation justifies the need for a study on lowland rice cultivation in the Bouaflé department.

This study aims to evaluate the performance and constraints of lowland rice cultivation in this department. More specifically, it will involve inventorying existing lowlands, assessing their human potential, and their current state of cultivation.

2. Materials and Methods

2.1. Study Area

The study was conducted between March 2019 and February 2020 in the department of Bouaflé (Marahoué region, Centre-West of Côte d'Ivoire), between 6°55'–7°13' N and 5°28'–6°01' W (Figure 1). The investigations covered seven sub-prefectures: Bouaflé, Zaguiéta, Bonon, N'Douffoukankro, Bégbessou, Tibétia, and Pakouabo. The topography of this department is characterized by alternating plains and low granite plateaus. The plains contain numerous lowlands suitable for lowland rice cultivation [10]. The climate, of the tropical transitional type (Baouléan climate), is characterized by an alternation of two rainy seasons (March to June and mid-August to October) and two dry seasons (July to mid-August and November to March). The average rainfall is 1,150 mm/year with an average annual temperature of 26.8°C [11]. The soils are primarily deep ferralitic, while hydromorphic soils occupy the lower slopes and the floodplains of the Bandama and Marahoué rivers [12].

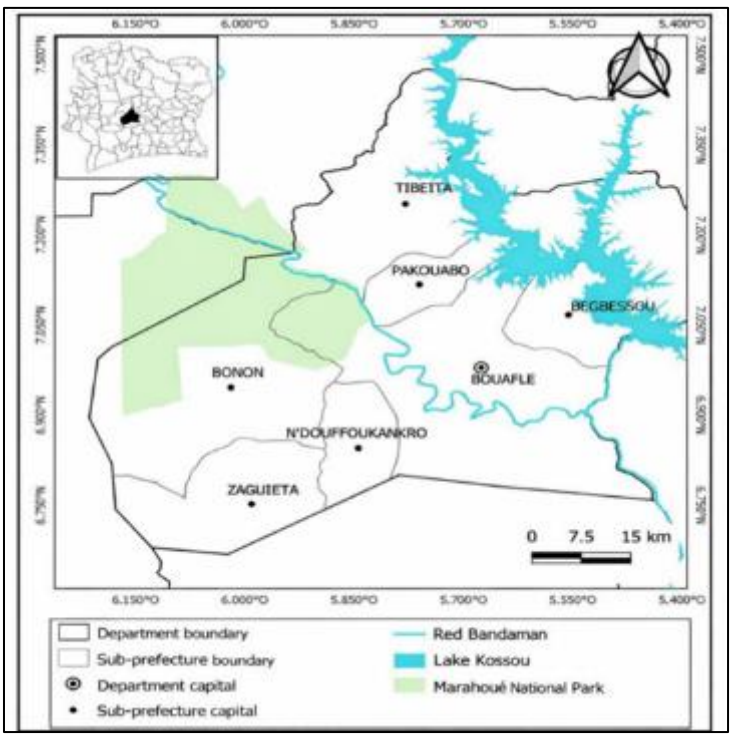

Figure 1 Geographical location of the study area

2.2. Lowland Inventory

The lowland inventory phase relied on collaboration with public technical support structures, namely: the National Agency for Rural Development Support (ANADER), the Agency for the Development of the Rice Sector (ADERIZ), and the Regional Directorate of the Ministry of Agriculture and Rural Development of Bouaflé (DR-MINADER). The use of archives provided by these structures enabled the collection of crucial data on lowland rice cultivation (distribution of

lowlands by sub-prefecture, area of lowlands, water supply regime, type of development, etc.). Subsequently, a field survey was conducted in the seven sub-prefectures of the Bouaflé department. This survey work first confirmed the validity of the documentary data and, secondly, precisely geolocated each lowland using GPS receivers.

2.3. Assessment of the Human Potential of Lowland Areas

The assessment of the human potential of the lowland areas was based on a cross-referencing approach. Initially, we used records of rice farmers from the databases of technical organizations (ANADER, ADERIZ, and DR-MINADER) and COVIMA (Cooperative of Food Producers of the Marahoué region). Comparing these different sources allowed us to consolidate the information gathered, such as the gender, number, age, origin, and education level of the rice farmers.

Subsequently, this work was supplemented by direct investigations, combining field surveys and telephone interviews with rice farmer leaders in each concerned locality. These exchanges enabled us to accurately count the number of farmers and to incorporate a breakdown by gender for each site, as well as the age and education level of the rice farmers.

2.4. Assessment of the State of Lowland Farming

The assessment of the state of lowland farming was based on a mixed methodology combining documentary research and fieldwork. The initial phase consisted of a documentary analysis conducted with technical support organizations. This step allowed for the consolidation of existing inventories and the characterization of the overall farming context at the regional level. This approach was complemented by a cross-sectional survey conducted with a sample (n) of 79 rice farmers, representing a sampling rate of 9.12% (1/11th) of the target population. This choice of 1/11th represented a compromise between statistical representativeness and the logistical constraints related to the dispersion of the 25 study sites. The sampling, stratified by geographic area, covered seven sub-prefectures: Bouaflé (n = 29 across 11 sites), Zaguiéta (n = 15 across 4 sites), and Bonon, N'Douffoukankro, Bégbessou, Tibétia, and Pakouabo (n = 7 across 2 sites per locality).

The unit of observation was the rice plot, considered as a production system including the farmer, labor, means of production, and technical practices. Data were collected using individual questionnaires structured around the following axes: total area of available lowland, total area of cultivated lowland, farming systems, and rice production levels.

2.5. Data Processing

The collected data were first manually analyzed, including questionnaires sent to rice farmers and documents provided by extension services. The digital processing was then structured around three tools: Microsoft Word (version 2021) for writing, Microsoft Excel (version 2021) for compiling data into tables and figures, and ArcGIS Pro (version 3.4) for spatial analysis of GPS coordinates and map production.

3. Results

3.1. Lowlands' Physical Characteristics and Spatial Distribution

The field survey conducted in the Bouaflé department identified 49 main lowlands. These wetlands covered a total area of 793 hectares. The spatial distribution of the surveyed lowlands is shown in Figure 2.

The distribution of the lowlands was dominated by the sub-prefecture of Bouaflé, which totaled 397 ha distributed across 26 sites. It was followed at a distance by Pakouabo (130 ha across 2 sites) and Zaguiéta (99 ha across 7 sites). The other sub-prefectures, such as N'Douffoukankro, Bonon, Tibéita, and Bégbessou, occupied smaller areas, ranging from 70 ha to 16 ha. Of the 49 sites, only five reached or exceeded 50 ha, notably N'guetta Kouakoukro which is the largest with 100 ha (Table 1).

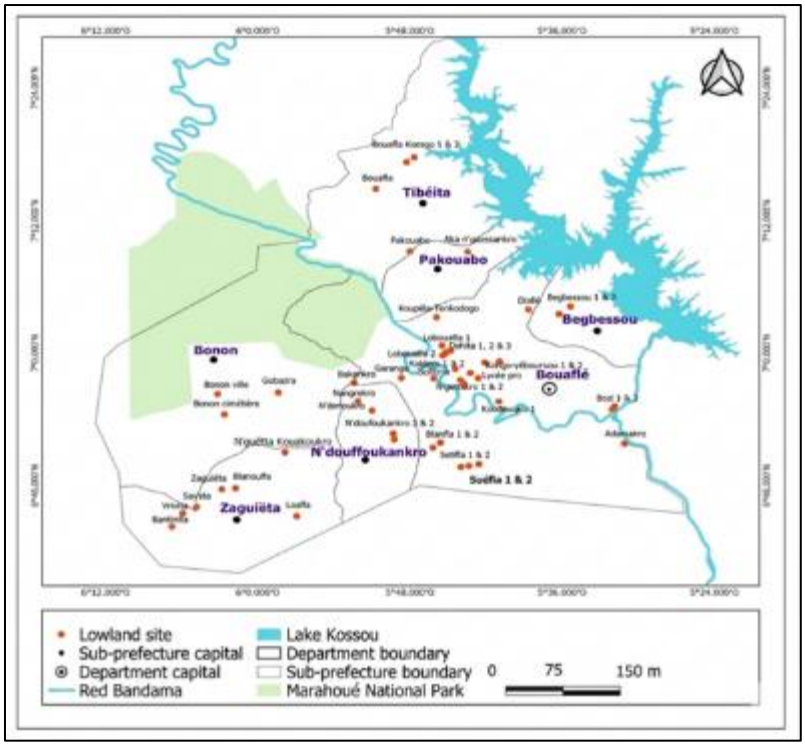

Figure 2 Location of the main lowland sites in the Bouaflé department

3.2. Water and Technical Characteristics of the Lowlands

The water regime of the lowlands in the Bouaflé department is defined by its strictly temporary and rain-fed nature (Table 1). The water supply for these ecosystems relies exclusively on rainfall, resulting in a direct dependence on local rainfall variability. Consequently, almost the entire network of lowlands undergoes complete drying up during the dry season (November to February), rendering these areas unusable for off-season agriculture due to a lack of residual water reserves.

The morpho-technical analysis of the lowlands in the Bouaflé department revealed a marked predominance of unstructured sites. In a sample of 49 inventoried lowlands, 98% (i.e., 48 units) presented a state of undeveloped land or, at best, rudimentary infrastructure (Table 1). These so-called "basic" developments result exclusively from local farmers' initiatives. They are characterized by a division into plots delimited by quickly constructed earthen dikes. At the departmental level, only one notable exception has been identified: the Garango lowland, located 3 km from the town of Bouaflé. Although this site has undergone partial development, it remains structurally unfinished.

Table 1 Characteristics of the lowlands inventoried in the department of Bouaflé

Locality	Number of lowlands	Area (ha)	Water supply regime	Type of development
Adamakro	1	05	Temporary	Undeveloped
Aka N'guessankro	1	50	Temporairy	Undeveloped
Bakarykro	1	06	Temporary	Basic
Bantinfla	1	50	Temporary	Undeveloped
Bégbessou	2	03	Temporary	Undeveloped
		03	Temporary	Undeveloped
Blanfla	2	10	Temporary	Basic
		05	Temporary	Undeveloped
Blanoufla	1	20	Temporary	Undeveloped

Bouafla (Tibéita)	3	03	Temporary	Undeveloped
		05	Temporary	Undeveloped
		10	Temporary	Undeveloped
Bouaflé Lycée Pro.	1	5	Temporary	Basic
Bouaflé Solibra	1	8	Temporary	Basic
Bonon	2	20	Temporary	Undeveloped
		05	Temporary	Undeveloped
Bozi	2	06	Temporary	Basic
		06	Temporary	Undeveloped
Déhita	3	15	Temporary	Basic
		10	Temporary	Basic
		07	Temporary	Basic
Diallé	1	10	Temporary	Undeveloped
Garango	1	22	Temporary	Partially developed
Gobazra	1	50	Temporary	Basic
Koudougou	1	15	Temporary	Undevelop
Koblata	2	15	Temporary	Basic
		10	Temporary	Basic
Kongo Yebouessou	2	20	Temporary	Basic
		05	Temporary	Undeveloped
Koupéla-Tenkodogo.	1	10	Temporary	Basic
Loafla	1	20	Temporary	Undeveloped
Lopouafla	2	20	Temporary	Basic
		15	Temporary	Basic
Nangrékro	1	25	Temporary	Undeveloped
N'dènoukro	1	10	Temporary	Undeveloped
N'douffoukankro	2	20	Temporary	Undeveloped
		15	Temporary	Basic
N'gattakro	2	10	Temporary	Basic
		04	Temporary	Basic
N'guetta Kouakoukro	1	100	Temporary	Undeveloped
Pakouabo	1	80	Temporary	Undeveloped
Sayeta	1	10	Temporary	Undeveloped
Siétinfla	2	25	Temporary	Undeveloped
		03	Temporary	Undeveloped
Suéfla	2	05	Temporary	Undeveloped
		03	Temporary	Undeveloped
Vrigrita	1	05	Temporary	Undeveloped

Zaguieta	2	09	Temporary	Undeveloped
		05	Temporary	Basic
Total	49	793		

3.3. Sociodemographic Characteristics and Workforce Structure

Document analysis, supplemented by field investigations, revealed a population of 866 rice farmers cultivating the lowlands at the departmental level. These producers were overwhelmingly composed of non-natives from the north of the country (49.42%) and non-natives from Burkina Faso (40.30%). Indigenous people represented 10.28% (Figure 3). This workforce exhibits a heterogeneous spatial distribution across all the surveyed sites. Demographic analysis revealed a strong male predominance in this activity: of the total number, 603 producers are men (69.63%) compared to 263 women (30.37%). This gender structure translates into a high masculinity ratio of 229.27%, indicating that the male presence is more than twice that of women in the lowland rice systems of the Bouaflé department (Table 2).

The demographic study indicated a population comprised exclusively of adults (≥ 25 years). The age structure was characterized by a clear predominance of young working adults, who represented 69% of the sample. More specifically, the 25-35 age group constituted the largest group (47%), followed by producers over 45 (31%) and those aged 35-45 (22%), as illustrated in Figure 4.

The human capital analysis revealed a low level of education among the population of producers working the lowlands of the Bouaflé department. The survey results showed a complete absence of university education (0%). The educational structure was characterized by widespread illiteracy, affecting 60% of the sample. Only 25% of farmers had completed primary school, while a minority (15%) had access to secondary education (Figure 5).

Table 2 Distribution of rice farmers by locality and gender

Locality	Number of operators	Man	Man rate (%)	Women	Women rate (%)
Adamakro	05	02	40	03	60
Aka N'guessankro	40	23	57,50	17	42,50
Bakarykro	15	11	73,33	04	26,66
Bantinfla	100	86	86	14	24
Bégbessou	09	07	77,78	02	22,22
Blanfla	15	15	100	00	00
Blanoufla	07	04	57,14	03	42,85
Bouafla (Tibéita)	37	37	100	00	00
Bouaflé Lycée Pro	05	04	80	01	20
Bouaflé Solibra	06	06	100	00	00
Bonon	14	14	100	00	00
Bozi	13	11	82,66	02	17,33
Déhita	42	42	100	00	00
Diallé	13	11	84,46	02	15,38
Garango	100	09	09	91	91
Gobazra	11	04	36,36	08	63,63
Koblata	22	22	100	00	00
Kongo-Yebouessou	75	62	82,66	13	17,33

Koudougou	26	03	11,53	23	88,46
Koupala-Tenkodogo	15	02	13,33	13	68,66
Loafla	10	07	70	03	30
Lopouafla	36	36	100	00	00
Nangrékro	15	12	66,67	03	33,33
N'dènoukro	12	10	83,33	02	16,67
N'douffoukankro	80	60	75	10	25
N'gattakro	20	14	70	06	30
N'guetta-Kouakoukro	28	25	89,28	03	10,71
Pakouabo	43	31	72,10	12	27,90
Sayeta	07	05	71	02	28,57
Siétinfla	12	09	75	03	25
Suéfla	10	07	70	03	30
Vrigrita	12	08	66,66	04	33,33
Zaguieta	11	04	36,36	07	63,63
Total	866	603	69,63	263	30,37

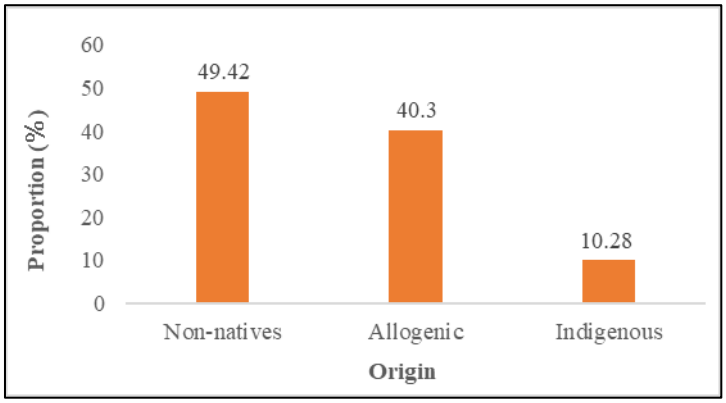

Figure 3 Distribution of rice farmers by origin

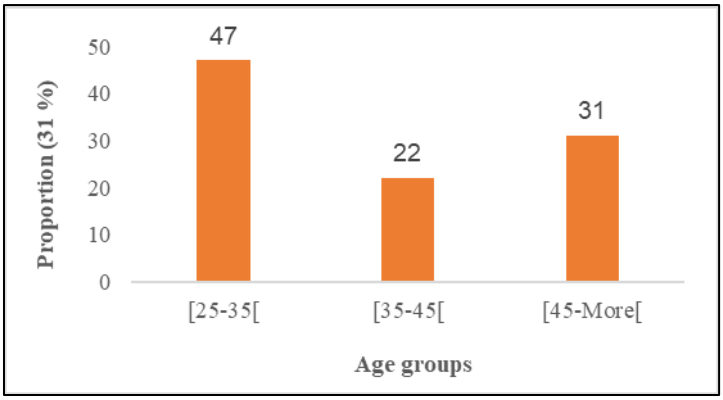

Figure 4 Repair of rice farmers by age

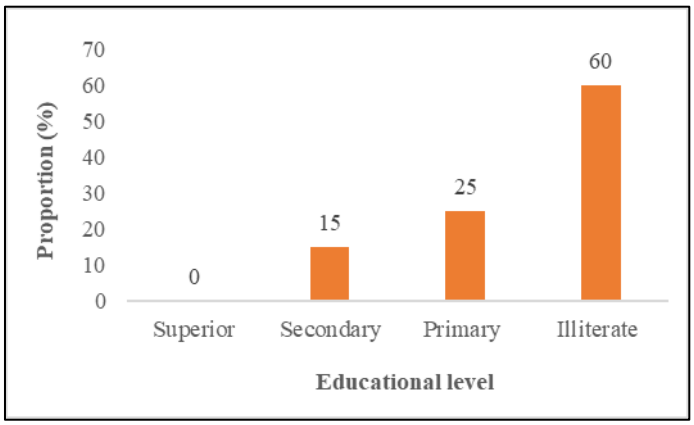

Figure 5 Distribution of rice farmers by education level

3.4. Level of Exploitation, Farming System, and Productivity of Lowlands

The analysis of lowland exploitation in the Bouaflé department revealed particularly intensive agricultural development. Of a total inventoried area of 793 hectares, 644.5 hectares were actually cultivated, representing an occupancy rate of 81.27%. While this overall rate indicates high anthropogenic pressure on these ecosystems, the spatial analysis revealed heterogeneity in site use. Indeed, land saturation (100% exploitation) was observed in only two of the 49 units surveyed, namely the Garango and Bakarykro lowlands (Table 3).

Lowland farming was structured around two cropping systems: rice cultivation and market gardening (Table 3). Surveys revealed two types of cultivated rice varieties. Firstly, improved varieties, represented by Wita 9 and Bouaké 189, were grown from certified seeds distributed by agricultural research organizations such as the National Center for Agronomic Research (CNRA) and AfricaRice. Secondly, local ecotypes were identified under the names "Ouédraogo," "Agniman," and "Danané." For these traditional varieties, farmers practice self-sufficiency by harvesting approximately 20% of the paddy rice from the previous season. Phenologically, the rice cultivation calendar was dominated by a single growing season extending from the end of February to July. Nevertheless, increased agricultural activity has been observed in certain urban and peri-urban lowlands of Bouaflé, where a second growing season is conducted from August to December. The market garden crops grown in these lowlands include okra, cabbage, tomato, eggplant, lettuce, cucumber, and zucchini. These crops are cultivated in rotation with rice (off-season system), thus optimizing land use between two cereal cycles. This activity remains marginal at the regional level, however, representing only 11% of the cultivated areas, located mainly in the urban and peri-urban lowlands of Bouaflé, Bonon, and Pakouabo.

Analysis of data from field surveys and documentary sources indicated that paddy rice yields in the lowlands of the Bouaflé department range from 1.5 to 3.5 t/ha per growing cycle. A spatial disparity in productivity was observed: the urban and peri-urban sites of Bouaflé, Bonon, and Zaguiéta recorded the highest yields, ranging from 2.5 to 3.5 t/ha. Optimal production levels were found in Garango, consistently reaching 3 to 3.5 t/ha (Table 3).

Table 3 Level of exploitation of lowland areas, crops grown and rice production

Locality	Available area (ha)	Exploited area (ha)	Exploitation rate (%)	Type of culture	Rice Production (ha)
Adamakro	5	4	80	Rice	2.5 to 3
Aka N'guessankro	50	46	92	Rice	1.5 to 2,5
Bakarykro	6	6	100	Rice	2.5 to 3
Bantinfla	50	45	90	Rice	2 to 2.5
Bégbessou	6	4	66,66	Rice	1.5 to 2
Blanfla	25	20	80	Rice	2 to 2.5
Bouafla (Tibéita)	19	18,5	97,37	Rice	2
Blanoufla	20	16	80	Rice	
Bouaflé- Onuci	5	3	60	Rice	2.5
Bouaflé- Solibra	8	5	62,50	Rice	2.5
Bonon	25	22	88	Riz & Vegetable crops	2 to 2.5
Bozi	11	8	72,72	Rice	2.5
Déhita	32	26	81	Rice & Vegetable crops	2.5 to 3
Diallé	10	6	60	Rice	1.5 to 2
Garango	22	22	100	Rice & Vegetable crops	3 to 3.5
Gobazra	50	35	70	Rice	2 to 2.5
Koblata	25	20	80	Rice & Vegetable crops	2.5 to 3
Kongo-Yebouessou	25	19	76	Rice & Vegetable crops	
Koudougou	15	14	93,33	Rice & Vegetable crops	2.5 to 3
Koupéla-Tenkodogo	10	8	80	Rice & Vegetable crops	2.5 to 3
Lopouafla	25	15	60	Rice Rice & Vegetable crops	2.5 to 3
Loafla	20	11	55	Rice	
Nangrékro	25	19	76	Rice	1.5 to 2
N'dènoukro	10	7	70	Rice	
N'douffoukankro	35	29	82,85	Rice	1.8
N'gattakro	14	12	78,57	Rice & Vegetable crops	2.5 to 3
N'guetta-Kouakoukro	100	80	80	Rice	2.5 to 3
Pakouabo	80	75	93,75	Rice & Vegetable crops	1 to 2.5

Sayeta	10	7	70	Rice	
Siétinfla	28	24	86	Rice	
Suéfla	8	5	62,50	Rice	
Vrigrita	5	3	68	Rice	
Zaguieta	14	11	78,71	Rice	2.5 to 3
Total	793	644,5	81,27		

4. Discussion

The exploitation of lowland ecosystems in the Bouaflé department is characterized by intense human pressure (0.91 ha/producer), revealing a saturation of the plateaus that is pushing farmers towards these marginal lands. This dynamic is based on a massive predominance (89.72%) of non-native (Senoufo and Malinké) and non-native (Burkinabé) populations, confirming the analyses of [13] according to which Ivorian rice production growth is driven by the expansion of cultivated areas rather than by a technological leap. Furthermore, the predominance of these populations in rice farming is explained by their attraction to the economic potential of the natural resources in the study area. As indicated in [14], these actors prioritize commercial rice farming over subsistence production. An analysis of [15] demonstrates that irrigated rice in hydro-agricultural development plays a key role in poverty reduction and the economic integration of migrants. The withdrawal of the local population (10.28%), deterred by the arduous nature of the work, has established a rent-seeking land market (1 hectare of lowland in exchange for 2 100-kg bags of rice), a contractual model whose precariousness for migrants, given the risk of unilateral renegotiations, is highlighted in [16].

Lowland rice farming in Côte d'Ivoire is characterized by a duality between persistent structural constraints and specific local socio-cultural dynamics. While overall female participation in the Bouaflé department is capped at around 30.37%, in line with the low rates observed in other regions such as Haut-Sassandra (7.53% according to [17]), localities of Burkinabé origin such as Garango and Koudougou show exceptional rates of female participation ranging from 70% to 91%. This cultural predominance, where rice cultivation is traditionally the domain of women, contrasts with national institutional barriers: in Côte d'Ivoire, although women account for a significant share of food production, only 10% of farmers are women, and their access to secure land ownership remains marginal [18]. This imbalance is exacerbated by a gendered division of labor where women are often relegated to post-harvest and marketing activities, suffering an average productivity gap of 44% compared to men due to limited access to inputs and credit.

The predominance of youth within the rice-growing population of the Bouaflé department, reaching 69%, highlights the central role of lowland areas in the local economy, even though this workforce is largely composed of out-of-school individuals [15]. This situation reflects trends observed in other regions of Côte d'Ivoire, particularly in the Guiguidou area of Divo in the Southwest, where hydro-agricultural development policies have promoted the integration of 70% of young people in order to combat social instability and rural exodus [19]. However, the effectiveness of this integration does not depend solely on access to land; it is closely linked to the producers' ability to adopt intensive technologies. Indeed, educational insecurity often hinders the optimal use of inputs, while access to credit and technical training remains an essential lever for increasing the productivity of these young farmers [20]. Therefore, the transformation of this subsistence rice farming into a competitive sector requires targeted support policies, capable of converting this demographic dynamic into a real engine of sustainable development for Côte d'Ivoire [21].

Analysis of the education level of rice farmers in the study area reveals a predominance of illiteracy (60%), a trend that corroborates historical observations in [14] and underscores the persistence of regional educational disparities in Côte d'Ivoire, particularly among populations originating from the North (Senufo and Malinke). This human capital deficit, characterized by low primary (25%) and secondary (15%) school enrollment, constitutes a major obstacle to agricultural modernization, limiting both the adoption of technological innovations and the efficiency of farm administration [3]. Indeed, as [22] points out, producers' illiteracy restricts access to technical information and hinders the transition to more competitive precision rice farming.

Comparative analysis of lowland farming in Côte d'Ivoire highlights the crucial role of hydro-agricultural infrastructure in land optimization: while in the Bouaflé department, dependence on rainfall limits development to 81.27%, leaving 150 ha uncultivated due to incomplete flooding of the edges [1], the Guiguidou perimeter in Divo (Southwest, Côte d'Ivoire) demonstrates full exploitation of its 442 ha thanks to complete water management [19]. This structural disparity confirms that the lack of water control infrastructure remains the main obstacle to rice intensification [23],

underscoring the urgent need to reduce yield disparities through targeted technical investments to ensure regional food security [24].

The study area is undergoing strategic crop diversification, where rice cultivation is systematically alternated with off-season market gardening. While the departmental average is limited to a single annual harvest, some urban and peri-urban sites (Déhita, Lopouafla, Garango, etc.) optimize water resources to carry out two rice-growing seasons per year. This dynamic is supported by investments in water management, making it possible to achieve potential yields of 3 to 4.9 tonnes/ha by 2030, compared to approximately 2.5 t/ha currently for undeveloped lowland areas [1]. Market gardening occupies about 11% of the cultivated land and is concentrated in the areas of Bouaflé, Bonon, and Pakouabo. This off-season activity helps stabilize household incomes in the face of climatic uncertainties and the seasonality of rice production. Recent studies conducted by [25] confirm that market gardening in lowland areas constitutes a resilient alternative to the conventional agricultural crisis.

The yields observed in the lowlands of the Bouaflé department (1.5 to 3.5 t/ha) fall within the lower range for unimproved lowland rice cultivation in West Africa, often characterized by low technical intensity. Our results corroborate the work of [26], which highlights that the limited use of certified seeds and chemical inputs remains a major obstacle to achieving yields in Côte d'Ivoire. Unlike the intensive systems of the Office du Niger or the Gao zone in Mali, where mechanization and input use rates reach 95 to 100% with yields exceeding 4 t/ha [27], Bouaflé suffers from a structural investment deficit. The absence of specialized cooperatives in Bouaflé constitutes a barrier to entry for mechanization. The experience of the Rice Producers' Cooperative (COPRORIZ) in Yamoussoukro (Central Côte d'Ivoire), reported by [28] and confirmed by studies on the dynamics of agro-industrial hubs, demonstrates that grouping producers facilitates access to agricultural equipment rental and maintenance services [29]. In Bouaflé, membership in generalist structures such as COVIMA (Marahoué Food Crop Cooperative) dilutes the specific services needed for rice cultivation (rototillers, threshers), thus limiting the marginal productivity of labor. The high cost of inputs relative to net profits is the main reason for underutilization cited by producers in Bouaflé. This situation is exacerbated by the volatility of world prices and the lack of institutional agricultural credit. To overcome this constraint, recent research recommends the integration of biological solutions, such as composting with rice straw, to maintain soil fertility at a lower cost [30]. Furthermore, achieving rice self-sufficiency in Côte d'Ivoire by 2030 depends on transforming these traditional lowland areas into better-developed irrigated perimeters capable of withstanding increasing climate risks.

5. Conclusion

This study shows that lowland rice farming in the Bouaflé department, despite significant natural potential, remains constrained by insufficient hydro-agricultural infrastructure, a strong dependence on rainfall, and a low level of technical intensification. Although land use rates are relatively high, productivity remains limited due to restricted access to inputs, mechanization, and financial resources. Production relies heavily on a young, predominantly non-native, and poorly educated workforce, which is both an asset and a constraint for the adoption of improved practices. The weak organization of producers and gender inequalities also limit the system's performance. Improving the sustainability and productivity of these systems requires targeted investments in water management, capacity building for producers, and better access to agricultural services. These interventions are essential to increasing production efficiency and contributing to food security in Côte d'Ivoire.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed

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