Lessons learnt from a review of extensive fish farming inside family plantations economie through West Africa and of their contribution to the local value chain.

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1 Introduction

For more than a decade, integration of extensive fish farming inside smallholder's farming has been noticed as an alternative way to promote aquaculture development. Inside the plantation economies area of Western Africa, various developments have occurred. The present study analyses and compares situations from Côte d'Ivoire, Cameroon and Benin, thanks to a regional project (SYPIEX) through field data collected in those countries during 2013.

2 Materials and Methods

132 inquiries of fish farming producers were conducted in Central-West and South-West of Côte d'Ivoire and 125 in Central Region and Eastern Region of Cameroon in order to get an up to date description of rough technical and socio-economic characteristics. Inquiries and Value Chain Analyze were carried out in the three countries.

3 Results

The collected data show an interesting convergence between the two fish farming developments. The declared average ponds area is 0,67 ha for one fish farmer in Cameroon and 1,12 ha in Côte d'Ivoire, that illustrate the central function of the dam-pond which make the management of large areas easy, often associated with little derivating ponds. The pond average area is 0,30 ha in Cameroon and 0,28 ha in Côte d'Ivoire (RCI). Fish farmers combine production of various ponds: 3,65 ponds in RCI and 2,35 ponds in Cameroon. Polyculture based on *Oreochromis niloticus* is the most common practice and for the second species used, *Heterotis,* is the most favourite one. This fish farming has first a commercial function and a significant part of the producers reports fish farming as their main activity: in Côte d'Ivoire 23%., in Cameroon 24% (and in this country for Eastern and Central Region, respectively 32%. and 0%). Fish farmers are mostly farmers (92% in RCI, 61% in Cameroon). Logically the production requires mostly family workforce and the ponds have been essentially built with the household's resources. Those two characters indicate the reality of the integration of this type of fish farming that has most often an important place in the farming system. Education level fluctuates, it can be noticed that in RCI, most of the fish farmers who manage the fish farms are illiterate (63%), in Cameroon, 75% stopped their education training before the A levels. Inquiries point out a high percentage of fish farmers belonging to local professional organizations. The rate of women as fish farm managers is low, but they are involved in the fish management and often in charge of the sales. This type of fish farming concerns most of the ethnic or religious components of the local population. The average number of years of fish farming experience shows its dynamic: it is 10,17 in RCI, 10,8 in Cameroon; however this figure hides a significant difference ($p < 0,05$) inside this country, 11,4 and 6,5 for respectively the Eastern and the Central Regions ; this indicates different maturity and also a dynamism with new settings. Compilation of technical criteria (yearly production, yield) is always risky with inquiries. The quoted « yearly production » has respectively an average of 552 kg and of 353 kg in RCI and Cameroon. However, strong contradictions subsist. The declared fish breeding practices were collected and are summarized in table 1, below. The value chain analysis indicates that a large share of the added value is created in the fish production step, even if data vary and a described tendency is to supply stocking fingerlings inside local networks which is the best economic answer facing the potential high cost of the fish seeds. The fish produced is first sold on local markets, prices fluctuate around 1000 F CFA/kg in Ivory Coast to 1500 F CFA in Cameroon. When urban markets are accessible, farmed fish is preferred to other fish substitutes because of its quality. In Côte d'Ivoire and Cameroon, the added value generated by fish processor nearly doubles the one realized by the producers.

4 Discussion

Firstly, this fish farming type has become strongly settled for more than a decade and shows a dynamic. Surprisingly, this type cuts loose some clichés broadly admitted in Africa: small ponds (most often < 400 m²), fish density above 2,

small fish produced, the key need of the catfish etc. It is not confronted with a question of bad fish growth, table 1 indicates from the fish farmers' declarations that the *Oreochromis* daily growth exceeds 1g/j thanks to the use of a police fish or their natural profusion (for example, *Parachanna obscura* in the Eastern Region). Fish polyculture presents a sturdy model although it is not always understood like in the Eastern Region and with a size of the ponds similar to that of the traditional Chinese one. That underlines the need to consider that this type of fish farming generates a specific alternative path with its own research-development questioning depending of its development. Secondly, this kind of fish farming is oriented by commercial purposes. Spontaneously, products integrate the surrounding urban markets, farmed fish are easily integrated in the fish consumption supply network.

Table 1. Declared fish breeding practices of *Oreochromis niloticus.*
(stocking density, duration, and initial and final average weight).
O. n. means Orechromis niloticus. In each case, the average and the standard deviation is on the first row and the median and the number of answer on the second

Country or Region	RCI	Cameroon	Eastern Region - Cameroon	Central Region - Cameroon
Density O. n (fish/m²)	1,45 (1,75) 1,00 (37)	0,75 (0,65) 0,60 (119)	0,88 (0,67) 0,75 (90)	0,32 (0,66) 0,15 (29)
Initial weight O.n (g/fish)	17,8 (9,2) 15 (93)	20,9 (18,9) 15 (118)	14,2 (6,9) 12,3 (88)	40,7 (19,3) 30 (30)
Duration. (month/cycle)	7,9 (2,7) 7 (116)	15,3 (6,4) 12 (105)	17,2 (6,1) 16 (77)	9,9 (6,5) 12 (28)
Final weight O.n (g/fish)	283,0 (81,7) 285,7 (107)	505,4 (263,1) 450 (102)	564,5 (272,5) 500 (76)	333,3 (259,5) 333,3 (26)

The results show also contrasted situations between the Eastern and the Central Region of Cameroon. In the Central Region, the activity is new and it has developed smaller pond areas, fish cycles are shorter. A significant difference ($p<0,05$) appears in the size of the fingerlings stocked (Table 1). In the Eastern Region, increasing the production of fish in the pond dams depends on the integration of nursering production inside the fish farm or improving supply through collaborative contracts with neighbours. Analysis elements and comparison with other descriptions (PDCE, 2015), tend to indicate that even if production is smaller than in the Eastern Region, yield is higher depending on the use of bigger fingerlings and lower stocking densities. It must be underlined that intensive models in Benin, that have often benefited from subsidies, generate less added value than the traditional systems and do not resist to the suspension of subsidies' (Odjoumani, 2014). At a larger scale, kinetics of adoption are varied and depend on the local conditions (endogenous evolution in Eastern Region) but also on the technical reference and the local political frame promoted. The various field reports attest of a willingness to intensify in Côte d'Ivoire; this ongoing process is linked to local socio-economic contexts. Lessons from China are interesting with fish in ponds yield improving from 724 to 5 217 kg/ha between 1979 and 2003 (FAO, 2005).

5 Conclusions

We want to insist on two difficulties met trough this study. Only an understanding of the fish breeding system including all the fish and the ponds managed, and seeking how each fish cycle fits in the global management of the producer is in capacity to provide reliable fish production data which are also needed to provide relevant economic data. This point difficult to investigate through that kind of appraoch and needs to be deepened. In spite of the little interest given by the governments, (Nguivoum 2014, Odjoumani, 2013), governments appeal for intensive technologies, the described extensive fish farming discreetly evolves with interesting contributions to sustainable development and poverty alleviation, especially in post-forested areas. This review confirms the resiliency of these models, their ability to supply farmed fish, at an affordable price for vulnerable populations and preferred to other fish supplied. With the reinforcement of their production, fish farming products integrate longer value chains generating higher added value and lots of multiplicative positive effects.

Acknowledgements. This paper was developed in the implementation framework of the project "Ecological intensification of extensive family fish farming systems in West and Central Africa by the analysis of the innovation processes - extensive fish farming systems" (SyPiEx)". The authors thank CORAF / WECARD, the European Union and Canada and all the SyPiEx team for their financial and technical support.

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