Co-construction of a local fish culture system: case study in Western Cameroon

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***Abstract**: Fish culture can be an important food source as well as a way to increase employment and income of rural populations in Africa. In most countries, however, it is not considered to be a full share activity, and, in most cases, the fish culture systems implemented by rural production do not reach their economic viability. In order to promote sustainable fish culture as well as flexible and innovative production systems, it is important that the socio-technical and organizational innovations be co-designed. To study this issue a research program in Western Cameroon developed a project with two fish farming groups organized into Common Initiative Groups.*
Two theoretical approaches are used: the sociology of translation and sciences - which considers that innovations are socially built and that the role of the research is not only to produce new techniques but to translate the different issues, so as to enrol the actors around a common question; and both action-research and intervention-research developed by sociologists and management researchers. We presented the results of the diagnosis to three groups of farmers gathered by local leaders. During these meetings, we were able to identify the actors concerned, the requests, and the stakes. We will present here the first two phases of what we describe as a Partnership-based Action-Research. The first phase consists of exploring and formalizing how the different actors will commit themselves to work together and to reach an agreement. In the second phase the co-conception of the fish culture innovation is implemented.
The main result is the groups (CIG) which were set up. They not only enable the experimental protocols but also build a language, a representation and a common way of working, as a necessary passage point (NPP), essential to any socio-technical and organisational innovation. Another important result is how the experimental protocols helped formalize the ethical framework necessary to work in partnership. In conclusion, it is important for us to learn from the methodological work accomplished - in particular to reflect on the competencies the researchers ought to develop to work with farmers. Researchers act as mediators, facilitators, translators and spokesmen of a hybrid actor-researcher group. The "technical" work is carried out according to a co-defined action plan, generally to solve a problem. The production of action-based scientific knowledge becomes a true task of the research group.

***Keywords:** partnership, action-research, fish farming, Cameroon, innovation*

Introduction

Fish farming was initially introduced in sub-Saharan Africa during the 1940s in the colonial era and various R & D and development projects were implemented during the independence stages. However, it has still not taken off at the beginning of XXIst century (FAO, 2007).
Following the CFA franc devaluation in 1994, many ponds were constructed and numerous changes took place in aquaculture plants. This is partly due to the return of young people, disappointed by city life conditions and to the liberalization of associations (Oyono et al.). Furthermore, this coincided with the crisis of coffee and cocoa, which were the primary productive speculations for money income. They have been replaced by new products such as aquaculture fish.
However, fish farming is considered to be a series of transposable techniques, and not a complex activity to be developed in an uncertain environment. Disapointed by early results and production problems, fish farmers rapidly gave up, and ponds were abandoned. Very few are currently in use. Fish farming protocols that have been mastered by the producers have never represented a viable "economic" system; when put together, they are far from sufficient for a producer wishing to develop fish farming at a commercial scale rather than a festive- or prestige-scale.

In order to study the possibility of implementing a local viable fish farming activity in Western Cameroon (Table 1), a research project is being conducted by researchers from the Agricultural Research Centre for International Development (CIRAD), the Agricultural Research Institute for Development (IRAD) and the University of Dschang (UDs).

Table 1. Fish farming in the Menoua Department in 2004:

Subdivision	Total Number of Farmers	Total Number of Registered Fish Farmers	Total Number of Ponds	Total Area (m^2)	Average Area (m^2)	Abandoned Ponds in %
DSCHANG	9278	43	84	19 842	236	36,9
NKONG-NI	13281	20	32	6 578	206	50,0
PENKA MICHEL	17355	16	26	6 320	243	23,1
FOKOUE	7080	23	53	11 699	221	56,6
SANTCHOU	7356	31	268	11 684	44	64,9
TOTAL	**54330**	**133**	**463**	**56 123**		**55,5**

(*)PNVRA data

Researchers want to develop a partnership with fish farmers to co-construct innovations to increase the economic viability of fish farming and generate scientific knowledge regarding research projects in rural environments in developing countries. (Callon 1986, Chia 2004, Liu 1997)

Therefore, researchers aim at changing fish farming and its representations by implementing, in collaboration with the farmers, production systems capable of generating a significant financial income.

Several methods and approaches have been developed over the past 20 years in order to establish a collaboration with the actors (Barlet 2006). As the top-down approach proved inefficient, a systemic approach was utilized to better understand global complex rural development phenomena. Participative approaches enabled researchers to meet fish farmers outside of their experimentation centres and laboratories. With this new way of working, research protocols and devices need to be modified, as it involves working in “sensitive” social areas. Researchers are not only there to suggest technical solutions, but, according to the phases of the process, they must make a diagnosis, formulate preoccupations as scientific issues, act as negotiators, mediators or spokesmen (i.e. they are hybrid researchers) (Callon 1986, Akrich et al. 1988).

An action research situation occurs when all actors turn to research in order to solve the problem(s) that they have to deal with. Action-Research and Intervention-Research are procedures which involve actors from the problem identification stage until the innovation design stage (Liu 1997, Hatchuel 2000, David 2000). According to the canonical model (Liu 1997), an Action-Research is carried out in four phases: review, problem formulation, experimentation and renegotiation or withdrawal. In agriculture, most Action-Research situations are created by researchers; based on a research intent, they attempt to develop and elaborate a will to change (Sebillote 2000, Chia 2004). The exploration phase is essential for Action-Research work conducted in rural areas (Diagram 1). This aspect will be developed in the first part of this paper following the description of the theoretical tools which are used. In the second part, the experimentation phase will be detailed. A specific focus will be put on the tools and devices employed for favoring the training and production of a common language required for transforming the representation that fish farmers have of their activity and the position of fish farming in their systems and local economy. In the conclusion, methodological lessons will be drawn from the work completed so far, particularly, regarding the type of skills required of researchers involved in the project. Researchers carry out mediation, facilitation, translation and spokesmen work for an actor-researcher hybrid group. Their “technical” work is performed according to a co-defined action plan and mainly represents the resolution of a problem (Akrich 1993). The production of operative scientific knowledge becomes a global task for the Action Research Group.

Action Research in action: How to co-construct fish farming innovations while accounting for the complexity of the situation

Our analysis is based on a twofold hypothesis:

1. the technical choice depends on the culture and local social structure
2. joint work results from a will to change and a research intent (Liu, 1997).

Therefore, the analysis shall remain as a grounded theory so that there is always a connection between problem solving and the production of scientific knowledge. Furthermore, not only does the project gather various disciplines, but it has them work on a transdisciplinary basis (they do not work separately on separate “pieces” of the problem, but together confront the problem in its complexity). While designing innovations, partners are also developing (inventing) a technical democracy (Callon 1998, Akrich 1993**).**

The first theoretical source implemented is the Sociology of Sciences and Translation. This is used to obtain an overall view of the problem being dealt with and results in a constant reflexiveness regarding research protocols (Callon 1986, Akrich et al. 1988). Considering that Sciences and Society are not distinct entities but are developed together can have a major impact on how a researcher works. We can no longer ignore the fact that scientific “facts” are above all social constructions. Today, when talking about development “sustainability”, development issues can no longer be considered by separating their “technical” aspects from their “social” aspects. Sociology of Sciences is used for studying "sociotechnical" problems as well as for integrating their complexity instead of attempting to pigeonhole encountered situations into narrow disciplinary issues.

The project is also based on the fact that an innovation construction process is implemented via successive “translations” used for associating individual and collective strategies and various representations of identified problems (caused by various experiences) leading to a necessary passage point that facilitates participation in a common project (Callon 1986).

These processes, that enable the translation and construction of a common language, are employed to draw the attention of and recruit various actors with similar goals (Callon 1986; Akrich, Callon et Latour 1988). Constructing innovations and reconfiguring social relationships goes hand in hand. This shows how important it is to consider the constructions of innovations from a collective action point of view (Hatchuel 2000). The idea is not to ***erase*** differences of representation in order to obtain a single representation, but to use the opening offered by collective diversity and object relationships in order to construct adapted innovations. Exploring “possible worlds” and collective explorations are joint processes (Callon et al. 2001). The quality and variety of the co-construction process and training depend on the interest of various actors in research actions and their implications. The aim is to involve “representative” people, who are concerned in different ways and follow various strategies, in order to process the problem by integrating multiple dimensions and their interactions.

Consequently, the partnership is developed according to the “possible worlds” which are explored and to the actors which they include (Segrestin 2003).

The second theoretical source originates from the first. An Action-Research approach (Liu 1997) is relevant to use, since actors are actually involved in the research work at each stage of the process. In complex situations, the limitations of certain participative approaches in which actors are less involved have been revealed. This is the case when researchers consult actors for a simple review before returning to the laboratory to discover the answer to an identified problem (Is it the real problem? Are the people who worded it legitimate? Is it questionned by others?) or when actors are interviewed on the issue of a ready-made technical package so that it could be adapted with slight modifications (Does this technology solve the problems identified by the actors? Is a post-“adaptation” possible?)

In an action-research approach, solving problems and generating knowledge go hand in hand in a process that is mainly supported by collective action. Solutions to complex problems can only be discovered in their context. Once applied, they must be constructed where the problem has occurred with the actors having to deal with it. Based on the various failures encountered by fish farming in Sub-Saharan Africa, it appeared that this activity generated this type of problem. Therefore, adopting an action-research approach was an appropriate solution. Fish can be considered under their zootechnical aspect (animal), in terms of a nutritive (food), economic (commercial good), or cultural (symbol, beliefs) value. For this purpose, the action-research approach, in addition to involving producers, includes various disciplines in order to provide a global solution to the fish farming problem under each of its aspects. It should be noted that, as action-research is a progressive process based on learning, some new disciplines have been added over time.

A partnership-type research process is based on the involvement of the actors. Their involvement is not a constant element as it is constructed and questioned during the whole process. Actors who become involved and then withdraw, their motives for involvement, and their terms and conditions

define the progress of the project. A path is drawn progressively towards a common goal. Although this goal is a research process, it represents the main purpose for research itself: learning and innovations are provided by a collective action.

The action-research canonical model suggests that action-research is generated by the intertwining of a will to change and a research intent. It has a dual purpose: solving problems and generating scientific knowledge concerning complex social phenomena. The work is performed jointly by researchers and users, and actors must negotiate an ethical contract accepted by all. It is completed by a cycle within the four phases (Diagrams 1 and 2): exploration and formalization; negotiating an ethical context; problem identification and experimentation; valorization, consolidation and renegotiation or withdrawal (Chia 2004).But what happens if no will to change has been expressed at the beginning, and if researchers are responsible for the "social demand"?

Diagram 1. Research approach

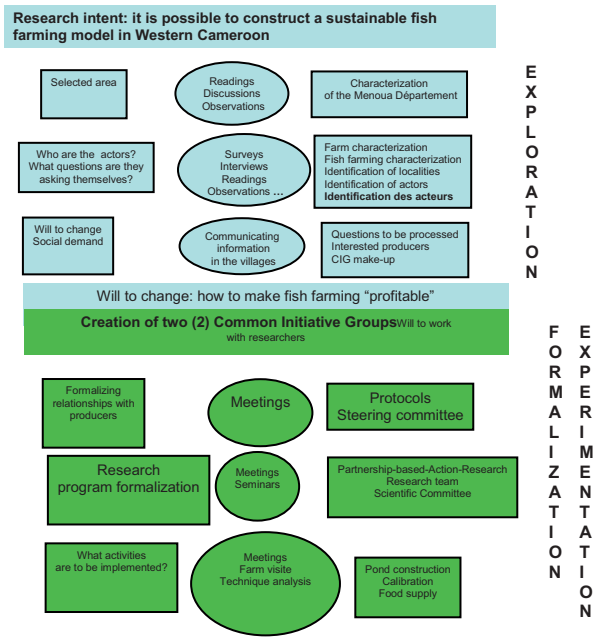
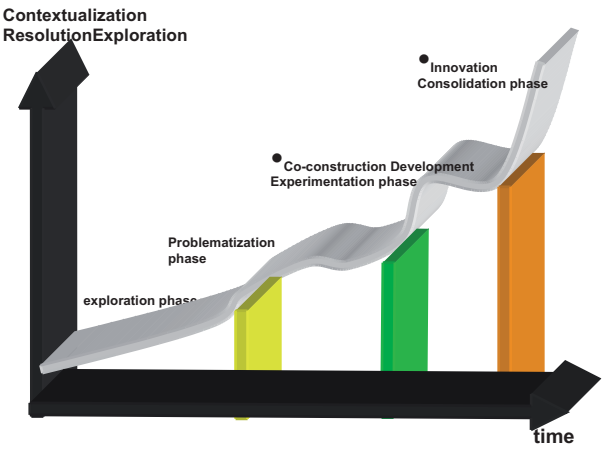


Diagram 2. Partnership-based-Action-Research phasesTime



Key exploration ensuring the success of the Partnership-based Action Research

From the identification of the actors and their logics to the definition of the common research issue

This initial phase is carried out in several steps. First, the research intent is determined and a research group is selected. Then, the institutional context is characterized. The research intent can be represented by the implementation of a sustainable fish farming model in Western Cameroon aiming to identify the technical and social characteristics of its development. Following that, an area is selected where fish farming has a meaning and where this activity has been or is still carried out. Finally, an assessment is made concerning the position of fish farming in family farms in Menoua (Western Cameroon).

This first part of the work was completed by researchers. Comprehensive surveys and interviews were organized with 133 agro-fish farmers listed in Menoua, and "resource people" were interviewed as well.

The purpose was to identify the main problems encountered by fish farmers (Table 2), and potential partners. The following questions were raised: What problem has been revealed by this review? Who

has identified this problem? Is it the "real" problem? To accept the testimonials of the fish farmers at face value is a pitfall in participative research that ought to be avoided. The primary problem is not an absolute but always stems from the actors. The researcher must then establish a common question with the rightful actors. Fish farming stakes are different for all partners and representation of this activity varies. The purpose is to develop a process for constructing a shared representation in order to enable collective action.

Table 2. Social demand expressed: (*) including unsatisfactory pond design and construction; (**) including non-profitability, difficulty degree and lack of time; (***) food availability for fish.

	DIFFICULTIES	REASONS FOR ABANDONING	EXPECTATIONS
Fry mortality	**22.4%**	**14%**	
Lack of Fry	**11.2%**	**Not mentioned**	**18.3%**
Non discussed	**16%**	**31% (*)**	**19.6%**
Lack of supervision	**21.6%**	**33% (**)**	**36.1%**
Lack of money	**9.6%**	**13%**	**1%**
Difficult sales	**8%**	**2%**	
Stolen	**11.2%**	**7%**	**16.9% (***)**

Following the review, data were sent to the producers in three areas of the department, in the presence of all agro-fish farmers wishing to participate. The researchers wanted to express what they had heard in a language which was common to both researchers and producers. Collective action was started on this basis, and since then, many translations have been carried out to enable communication.

During the first communications, researchers asked fish farmers to form groups according to proximity and affinities. Two groups were organized as a Common Initiative Group (CIG – legal unit existing in Cameroon) in order to continue their work with the researchers.

Table 3. Participative Review Phase

	June-Dec. 04	Jan.-Feb. 05	March 05	June 05
Triggering event	Research bid tender	Communicating the major points	Action proposals	Researcher school Recruiting anthropologists
Constraints	Time		In France	Language and Time
Actors	ORP Team and producers		Researchers	2 anthropologists
Actions	Inventory surveys Detailed surveys Transmitting the Partnership Common Program to producers and researchers	Validation of the major points First action ideas FSD preparation	Training: Partnership-based-Action-Research concepts and methodology	Anthropological survey in Santchou where inherited knowledge and techniques exist
Results	Actual situation of Fish farming First inventory of the "social demand" Expressing the demand with questions First agreements: producing a summary report (researchers), organization (producers	Creating 2 CIG: COPIFOPEM (highlands/Fokoué & Penka Michel); PEPISA (Mbo Plain/Santchou	Improved training for researchers	Validation of a Technique-based typology by the actors: traditional/semi-traditional/modern
Controversies	Survey supervision Fish farming is not taking off (highlands) Decline of local techniques (Mbos Plain)	Misunderstandings between researchers and producers concerning R & D distinction	Relevance of training programs in France	Qualification and function of techniques Place of Anthropology in the Partnership-based-Action-Research Device

Following a series of meetings specifying the research intent and working methodology, fish farmers and researchers decided to work together toward a common goal: *How to obtain fry and make fish farming a sustainable activity in Fokoué and Penka Michel (Intensive Fish Farming Group of Fokoué and P*Enka *Michel in Menoua:* CIG C*OPIFOPEM)? And how to valorize fry harvesting and increase fish production in Santchou (Fishermen and Fish Farmers from Santchou:* CIG-*PEPISA)?*

It can take a very long time to formulate a question (Table 3). However, this period is necessary for developing the trust and collaboration required for all future work (Duru et al. 2005; Chia et al 1994). Personal and common interests are also translated during this time. The common problem is identified by various actors. The formulated question determines the amount and quality of the actors involved: when the question changes, the actors involved (whether they are human or not human) also change. For instance, when talking about "commercial fish farming", potential consumers are included among the actors. They will not necessarily become active partners, but they will affect the construction of the necessary passage point as they will sanction the produce by purchasing or not the fish offered on the market.

A negotiated ethical context prior to experimentation

Once the information from the review has circulated, collective discussions and demonstrations are organized concerning the fish farming techniques employed by CIG members. At this stage, the three groups agreed to try out new techniques and conduct additional studies (Table 4).

Table 4. Constructing an ethical context and defining the first experimental protocols

	Oct.-Beginning of Nov. 05	Nov. 05-Jan. 06
Triggering event	Project launch	Preliminary stages of the Partnership-based-Action-Research approach Twice-monthly contract-based meetings
Constraints	Insufficient knowledge of social issues	Adequacy between traditional pond harvest and COPIFOPEM PEPISA pond carrying capacity
Actors	Researchers and CIG members	3 to 5 researchers and CIG members
Actions	Question determination	Ethical context negotiation between researchers and CIGs Seminar on farming protocols Pond preparation demonstration Validating experimental protocols with CIGs Fry price negotiation between CIGs Traditional pond harvests and pond preparation supervision
Results	Action plans: 2 axes, fries & knowledge of strategies and protocols Signing the Agreement between the 3 parties	Common representation of farming techniques Negotiated action plan Sold fries Prepared ponds Experimental protocols confirmed for Cycle 1 First observations concerning harvest procedures and ichthyological composition of traditional ponds
Controversies	Model construction relevance (common representation of the activity by the actors)	Accusation of bad behaviour Catfish variety population in the natural environment Fry price and purchasing negotiation

An agreement defining a real ethical context is negotiated and signed by the three groups. This agreement defines the general goal, commitments and duty of each partner, and the rules applied in the event of a disagreement (Table 5). In order to create a common culture between CIG COPIFOPEM fish farmers and PEPISA fry suppliers, a steering committee has been planned in the agreement. This committee comprises three CIG officials and three researchers. They meet every three months to organize the planning and assessment of the activities.

Table 5. Mutual agreements based on the contract signed by the different groups

ITEM 4: PRODUCER AGREEMENT	ITEM 5: RESEARCHER AGREEMENT
4.1. Promoting collective action and participating in the work meetings of their respective CIG	5.1. Contributing to research development in collaboration with actors
4.2. Sharing knowledge in their own CIG and, at a larger scale, with all of the actors of the Partnership-based-Action-Research project	5.2. Offering all of their knowledge to the project
4.3. Sharing technical and financial information with all of the actors of the Partnership-based-Action-Research project in aim of promoting project development (information transparency)	5.3. Communicating Partnership-based-Action-Research project results on a regular basis and in a comprehensible language
4.4. Promoting the implementation of jointly developed protocols and respecting associated instructions	5.4. Maintaining regular contact (twice a month) with CIGs
4.5. Joint application of new relevant common techniques	5.5. Facilitating relationships with other institutions and organizations likely to support the project
4.6. Enabling researchers to use data in scientific or development publications	5.6. Providing data sources in publications

A protocol was prepared for each technical or organizational "experimentation" stating the conditions regarding the involvement of producers and researchers. During the presentation of such protocols, conflicts occurred between researchers and producers, as well as among producers. Solving these conflicts (rarely in a complete and definite manner) facilitated the construction of a common language (permanent process). It indicated how to conduct the experimentation, and, in particular, how to define the involvement of producers regarding the organization, recording and transfer of data. For example, in the case of pond construction, producers must facilitate inspections and organize open days (Table 6). Experimentation becomes an innovation learning and design process for determining technical and organizational standards for the fish farming model.

Table 6. Experimental protocol and PhD subjects provided during the Partnership-based-Action-Research process

Protocols			
Structuring question	Cycle 1	Cycle 2 (appraisal in progress)	Cycle 3 (negotiation in progress)
How to develop fries and increase fish farming sustainability in Fokoué and Penka Michel (COPIFOPEM CIG)?	Characteristics of pig farming and fish farming integration potential in Fokoué and Penka-Michel (Western Cameroon)	Reducing water loss due to leaks and pond clogging dynamics	Actor coordination and market access
		Qualitative and quantitative production of fingerlings and tilapia	Socio-anthropological analysis of fish consumption-based protocols
	Characteristics of the intra-pond composter and fish farming production analysis	Optimal management of trophic inputs in ponds: C/N ratio	Cycle 2 assessment on hold
		Collective action function in the resolution of common problems	
How to promote fry harvesting and to increase fish production in Santchou (CIG-PEPISA)?	Socio-economic analysis of fish farming protocols in flood ponds and production sales	Improving the harvesting, preservation and marketing of silurid juvenile fish coming from their natural environment	Cycle 2 assessment on hold
	Characterizing flood ponds of the Mbô Plain and analyzing fish farming production factors	Collective action function in the resolution of common problems	
PhDs			
Partnership-based Research: methodology and impact of the actors' commitment in an innovative process			
Fish farming contribution to sustainable development in Family Farms (FF)			
Institutional devices and coordination procedures for promoting professional skills in local fish farming systems			
Constructing a fish farming model adapted to rural areas of Western Cameroon Highlands			

The partnership (Girin 1990 management situation) changes as new actors get involved. According to the situation, the partnership between University, research institutions and producer groups can develop into increasingly complex configurations involving various types of actors. Let us take the example of institutional actors. Initially, they are not taken into account by the Partnership-based Action-Research device. Considering the local socio-political context, and in particular the recent liberalization of associations, researchers initially decided to disclude local authorities in their new partnership. Nevertheless, CIGs are locally integrated and remain free regarding their relationships with local authorities. For instance, as opposed to CIG PEPISA, CIG COPIFOPEM offered fish to the sub-prefect during the work festival, and even invited the local representative of the Farming Ministry to their grape gathering session. As this type of practice often generates conflicts within the CIG, the researchers decided not to get involved. However, as the project evolved, contacts were made (bilateral contacts and contacts directly in relation to the Partnership-based Action-Research approach) and these new actors became progressively involved in the construction of a commercial fish farming model.

Multiple experimentation functions: trust building, and transforming representations and techniques

The first results provided a lot of information concerning the production level as well as the impacts on the representations and techniques of fish farmers. The negociated decision involved testing a series of techniques during the farming cycle. For CIG COPIFOPEM members, the first outcome was to conduct a reflexive action on certain principles and knowledge previously believed to be mastered:

- using a pond with a minimum water depth of 60 cm in order to favor fish survival and growth;
- ensuring that the water level does not decrease by more than 2 cm/day so as to avoid excessive infiltration that would waste the fertilization;
- fertilizing the pond on a continuous basis so as to maintain green water and water transparency below 30 cm;
- ensuring a minimum weight of 15 g for the juvenile fish introduced into the raceway in order to minimize mortality rates;
- associating Nile tilapia predator fish of both sexes in order to avoid fry proliferation and therefore enabling the production of large commercial fish;
- adjusting the carrying capacity and fish density according to trophic inputs and to the average weight expected at the harvest period.

Applying this knowledge has modified previous techniques and changed the producers' conventional representations.

Conflicts, misunderstandings and unexpected situations are unavoidable and contrast with the shared consensus opinion. With this contrast, the opinion is modified and a new meaning is reached. Defining a new meaning is an endless process and once empty spaces are filled, new ones appear. This is how innovations are generated and reinforced.

An example is the controversy existing between researchers and fish farmers. Fish farmers believed that a pond had to contain many fish in order to be profitable. They didn't know that fish had to be fed regularly. Researchers questionned these fish farming representations and proposed new techniques. They suggested (on the basis of their personal experience and scientific knowledge) that fry should be maintained at lower and more accurate densities. They also explained that fish, like the pigs producers are accustomed to raising, must be fed regularly. Fish farmers were torn between their will to change in accordance with the ideas expressed by the researchers and the impression of “feeding empty ponds". Were they wasting available space (the pond can contain more fish!)? Were they wasting their feed for too few fish? Furthermore, was the time and effort justified?

Despite the ethical context defined by the agreement and commitments made via the protocol, certain fish farmers went as far as to add more fish to their ponds without the researchers’ awareness. At this stage, trust still had to be built and many “free rider” phenomena (Olson 1978) were observed. Some producers wanted to reduce risks as much as possible and waited for other producers to try out the experimentation in order to benefit from their results. It would have been impossible to modify representations without the involvement and trust of certain fish farmers. Therefore, it was necessary

to wait for the first harvests which proved that the proposed techniques provided positive results. In actual fact, the changes were spectacular. Certain fish farmers were mostly obtaining tilapia weighing only 50 g after a growth period exceeding one year. After a few months, fish weighed 200 g on average (100 g for females and 300 g for males). African catfish weighing 1 kg were obtained in less than a year. This had never been seen in Fokoué before. Fish farming was largely thought of as a secondary low-profit leisure activity not requiring any specific knowledge or skill. Therefore, fish farmers were very surprised to achieve these results.

Table 7. Characteristics of harvests during the second Partnership-based-Action-Research cycle: Pond area (P), Growth Period (GP), Initial Biomass (IB), Final Biomass (FB), Weight Gain (WG), Yield (Y), Final Average Weight (FAW)

Producer	P (m^2)	GP (day)	IB (kg)	FB (kg)	WG (kg)	Y ($kg.ha^{-1}.year^{-1}$)	tilapia FAW (g)
1	350	382	18,5	112,7	94,2	2571	143±17
2	193	395	6,6	83,4	76,8	3678	198±25
3	180	320	3,5	41,2	37,7	2389	182±86
4	108	389	7,8	39,6	31,8	2763	161±29
5	160	391	3,1	122,8	119,7	6981	225±44
6	153	390	5,9	50,0	44,1	2698	209±29
7	108	390	5,6	37,6	32,0	2770	220±36
8	150	387	5,8	50,0	44,2	2781	191±44

These experimentations are used to reinforce the trust between researchers and producers, ensuring participation in the project. For the researchers, it is also another step towards identifying partners prepared to get involved in commercial fish farming. Building trust is part of the learning process of the group. Though this project creates opportunities for individual learning and modifies individual techniques, its main purpose is to enable collective learning to implementing socio-technical innovations.

Experimentation is also an intermediate objective (Vinck 1999) in the co-design of innovations.

Are the investments made following the harvest and the position of fish farming on a plant seriously modified once the first promising harvest is obtained? If this is the case, how far will fish farmers go to increase their professional skills?

Conclusion

The exploration phase is essential in any action-research approach. Actor involvement, its nature and motives, as well as the expression of the actors' will to change, remain essential to the entire research process.

Any knowledge production process (Avenier et al. 2007) is in permanent interaction with "socio-economic constraints" (Aggeri et al. 2002; Girin 1990) to which it is confronted. The researcher ought to reflect on the ways of collaborating so that fish farmers become actors for the sustainability of their fish farming activity. New techniques must make sense in regards to the entire operating strategy employed by the producer. This is why they must be co-constructed.

The research mandate is transformed with this partnership-based action research. The aim is to provide researchers with a sense of responsibility so that solving onsite problems becomes a priority. To do so, the researcher's function is important but he/she must learn how to work with other actors. Science is not an entity which is above society and does not provide ready-made solutions which only need to be applied. Science is perfectly integrated in society such as other social aspects which are included in the construction of scientific knowledge. It is therefore necessary to work on sustainable solutions involving various social actors such as social representatives, producers, consumers and NGOs. They should all work together to solve problems that are not only technical, as they affect many aspects of social life.

This project is not isolated in Cameroon, as there is an overall dynamics promoting partnership-based action research. The REPARAC program includes projects with similar approaches but has encountered various implementation problems. Action-research is a demanding approach in which producers must modify their techniques and representations, but it is above all demanding for researchers. It is sometimes difficult to go beyond the exploration phase in research projects involving

strong constraints (particularly in the case of institutional constraints). Action-research is introduced in Cameroon for development purposes. However, it has been designed in a political, social and economic context which is very different from the situation in Cameroon and thus encounters significant opposition.

In this entire action-research, trust has become an essential factor due to the collective action involving collaboration and communication requirements. In a situation such as this, where several people work together to solve problems and produce scientific knowledge, the varying information and power possessed by the participants can lend itself to mistrust; however, differing opinions can increase trust when implemented towards collective action instead of personal benefit.

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