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Eduardo Chia, Syndhia Mathe, Helene Rey-Valette

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Eduardo Chia[1], Syndhia Mathé[2], Hélène Rey-Valette[3]

[1] INRA / CIRAD, UMR Innovation, Montpellier SupAgro, 2 place Viala, 34060 Montpellier cedex 1, France, eduardo.chia@cirad.fr
[2] Univ. Montpellier I, CEP/LASER, CS 79 606, 34 960 Montpellier cedex 2, France, mathe.syndhia@univ-montp1.fr
[3] Univ. Montpellier I, LAMETA, CS 79 606, 34 960 Montpellier cedex 2, France, fvhr@wanadoo.fr

Paper Topic: Innovative collaborative schemes among research, business and governmental organizations.

Abstract

Based on the assumption that innovation is a social construction which can only result from a simple scientific injunction or proposition, this article emphasizes the significance of organizational innovations in relation to sustainable development. Innovation requires a structuring framework for organizing actor participation, i.e. the interactions between multiple stakeholders including researchers. The methodological protocol described and employed for the co-construction of indicators concerns the implementation of sustainable development indicators in fish farming. After recalling the epistemological foundations of their approach to innovation, the authors describe the structure and interest of the methodological protocol that they have developed in the second section. This protocol is used for facilitating the appropriation of a new reference system by integrating actors' representations. Furthermore, it is organized according to an interrelation pattern: principles, criteria and indicators. This approach enables indicators to be constructed based on criteria, which themselves are defined by principles. These principles account for actors' representations and issues. The application of this approach involves an individual selection phase of principles and criteria and then the collective approval by stakeholders. Its application to pilot sites has enabled to draw up a reference check list including 17 principles, which are then broken down into criteria and indicators. It can then be recomposed and adapted infinitely according to the characteristic needs and expectations of each application. The implementation of this check list therefore represents, for users, an intermediate object facilitating co-construction. The third section proposes an illustration of the procedures employed for its implementation in diversified aquaculture systems. The authors detail the results for Mediterranean fishfarming by showing that the approach can be used for comparing viewpoints and for generating the emergence of compromises around common principles and criteria. Lastly, the authors list the simple and double loop learning processes which were used during the experimentation of the approach.

Introduction

Innovation has become a major issue in our societies. It applies to firms which must innovate, today, more than in the past, if they want to maintain their position and take over market shares, etc. It also acts as a collective process, particularly for satisfying the new requirements of our Society regarding the protection of natural resources or sustainable development. Innovation is not a simple technical modification or the introduction of a new technique, it is socio-technical and organizational. Since several years, different disciplines (Sociology, Economics, Management Sciences) have studied innovations as socio-technical phenomena (Flichy, 1995; Akrich et al., 1988; David 1996). David (1996) proposes (based on Hatchuel and Weil, 1992) to analyze organizational innovations based on an interacting 3D grid: i) technical substrate, ii) managing philosophy and iii) simplified vision of the organization. The aim is to understand how actors view innovations as well as the role played by research in this process. During the implementation of sustainable development indicators in aquaculture, we have developed an approach for associating stakeholders to the definition of sustainable development principles and criteria so that appropriate indicator systems are determined by the actors. We believe that in order to implement sustainable development at a local level, a majority of actors must be involved in the process of defining future actions, i.e. implementing a common project and language in order to co-design innovations. Producing

socio-technical or organization innovations requires plans enabling or facilitating learning processes, which are both individual and collective, but also technical and organizational.

The purpose of this article is to describe the method that we have developed and which has been used for writing a guide for the co-construction of sustainable development indicators in fishfarming. The first part will include a description of the co-construction approach based on the reference context that has been chosen for organizing actor participation in the definition of aquaculture sustainable development indicators. The methodological protocol is structured so as to define indicators based on criteria which themselves are determined from principles accounting for actors' issues and representations. The connection between principles, criteria and indicators is used by actors involved in the approach not only for exploring the possibilities for elaborating a future project, but also for exploring possible options. This construction based on a "Principles, Criteria and Indicators" (PCI) system represents the main type of organizational innovation in the sense that it is used for constructing a structuring framework for organizing the participation process. Over the mean-term, this innovation conditions the emergence of other innovations, which necessarily involve the implementation of sustainable development. Our approach is based on the following assumption: sustainable development does not just concern individuals and is not the outcome of individual actions as it requires an organized and collective action carried out by actors and not individuals. Whilst the second part of this article presents the results from the experimental application of this approach on one of the study sites i.e. the Mediterranean, in the conclusion, we attempt to explore the complex relationships existing between innovation and the learning process by underlining the significance of implementing organizational innovations in aim of facilitating socio-technical innovations.

I.- Co-design based on a participation structuring framework

In relation to this aquaculture sustainable development indicator elaboration project[1], we have implemented a methodological protocol based on the assumption that co-construction enables actors to adapt rules more easily and facilitates the appropriation of sustainable development. It will be easier for actors to familiarize themselves with co-constructed rules as they will be using part or all of their justification system in these rules. On the basis of this assumption, we propose a methodological protocol which focuses on the representations of local actors and stakeholders (producers, others actors from aquaculture sector and institutional actors) and on a systemic approach involving three components: production systems, control systems and the territory.

Representations have been studied through very open face-to-face surveys on how actors view their current activity, sustainable development and the changes related to its implementation. These surveys were conducted on five study sites (the Philippines, Cameroon, Indonesia, Cyprus and France) which are representative of various technical systems (cages, pools, ponds), territorial typologies (littoral or rural territories) as well as of control systems and

[1] This research project is part of the Agriculture and Sustainable Development Federating Program funded by the National Research Agency (ADD-ANR). It associates 5 research institutions (Cirad, Ifremer, Inra, IRD and the University of Montpellier 1) and mobilizes a multi-disciplinary team of fifteen researchers).

degrees (informal or formal as well as slightly or extremely demanding). The textual analysis of the interviews enabled to identify key questions related to the main sustainable development issues such as viewed by aquaculture system actors. 17 major issues were identified overall for stakeholder actors (see Table 1).

Prompted by our methodological approach, we based our analysis on the identification of issues close to actors' representations and not on traditional sustainable development pillars. This type of approach, which has been favoured since several years in relation to the local implementation of sustainable development, enables to take into account the integrated character of sustainable development. Bilateral or multilateral interactions between social, economic, environmental and institutional components are accounted for via a transversal design of choices made by Society. It is then possible *a posteriori*, once issues have been identified, to classify them per pillar according to their characteristics so as to respect the balance of relative weights between the four key principles of sustainable development (Table 1).

Table 1: Different learning processes based on co-construction approach

Pillar	Title of the principle	Quantity
Technico-economic pillar	P7- Increasing the capacity for dealing with uncertainties and crises P8- Reinforcing the durability of facilities P13- Developing plans for quality, certification and traceability labelling approaches in aim of reinforcing product quality P16-Respecting animal welfare and health	**4**
Environnemental pillar	P2- Ensuring the protection of natural resources P3- Improving the ecological yield of the activity P4- Maintaining and valorizing biodiversity P5- Adapting the activity to the environment carrying capacity	**4**
Social pillar	P1-Contributing to the food supply of societies P9-Reinforcing the professional identity of fish farmers P10-Reinforcing the social investment of aquaculture firms (working conditions, quality of life, etc.) P11-Contributing to the reinforcement of social relationships and social cohesion P12-Contributing to the creation of economic activities for reducing poverty (associated sector and system)	**5**
Institutional pillar	P6-Promoting aquaculture as a national planning component P14-Implementing incentive institutional plans enabling the participation of fish farmers and stakeholders in aim of improving regulations P15-Reinforcing research and information related to this sector P17- Reinforcing the effective role of the Government in the implementation of sustainable development	**4**

Based on surveys, the study of aquaculture systems (production systems, control systems and interactions with the territory) has enabled to establish a connection between issues and current practices and therefore to provide action strength to identified issues. This relationship between the "wishes" expressed for the future by actors and their action potential has been represented by using the principles, criteria, indicators method (PCI method). This method is used for establishing a connection between issues, actions and positioning. Criteria represent an intermediate level between principles and indicators, which concerns programming and action in the different sustainable development dimensions. Positioning is provided by actors to indicators as it enables them to become aware of the distance separating reality from the objectives that have set themselves via the issues they have revealed. In this sense, indicators represent a planning system. By using these tools, actors agree on what is to be done and how to do it. In this method, due to the relationship described above, issues are obviously going to

be the determining components for criteria and indicators, i.e. for the actions which will be conducted and their follow-up. However, issues vary over time i.e. they will become more or less significant and new issues will appear. Thus, sustainable development is defined by Marmont (1999) as the formulation of a project through negotiations and dialogue, a project which is continuously reformulated due to the unstable character of issues and relationships existing between actors. Consequently, the ranking of PCIs will be renewed over a more or less long period. It is recalled that as PCIs have generated the implementation of an observation system for monitoring the progress of sustainable development objectives, it is necessary to ensure indicator durability for this follow-up to be operational and relevant. Sustainable development is a long-term process and the methods enabling its appropriation by actors are progressive. These PCIs can be considered as intermediate objects (Vinck, 1999) which will be used by actors for discussing and building a common sustainable development reality.

Participation to this approach generally involves organizational innovations. Traditionally, actors, particularly those from the productive sector, have a horizontal vision of their activity i.e. a "system-based" vision in which their concerns are mainly related to suppliers (feed and fry) and customers (wholesalers and retailers). This vision will become broader because regulations for production and its environment (ecological and socio-economic) play an increasingly significant role in production strategies. Producers must respect international and local regulations concerning water use (Water law in France and Europe), site selection (ICPE[2] rules in France), environmental protection (law of the 5th of August 1996 regarding Environmental Management in Cameroon), exports (The Export Development Act and The Fisheries Code in the Philippines), food safety (HACCP[3] principles) and the local development strategy (rural code in France, competitiveness pole policies). Producers will need to widen their operating scope and adopt a territorial vision of their activity including the regulatory system[4], social community (civil society, users and local networks) and the ecosystem in which they are positioned, particularly the impact of their activity on the services ensured by this ecosystem. Management rules and procedures to be respected in fishfarming are constructed within regulatory systems by decision-making structures, which very often have very little connection with the productive sphere. The actors from these systems typically have a very administrative (vertical) vision of the sector and aim to answer global objectives which are not always compatible with the true onsite situation. However, due to the “participation” component in sustainable development, co-constructing objectives and rules related to territorial development is recommended so as to compensate for dysfunctions between scales and actor profiles. Thus, organizing an advisory panel between actors from the territory seems to be a solution enabling each person to be informed of individual constraints and objectives. This discussion structure refers to the eco-citizen participation model (Claeys-Mekdade, 2006) which acts as an interface between decision-makers and militants. Only, coordination within this structure is not easy as it requires an effective organization of actor systems, which involves informal discussions, negotiations and concerted decision-making (Billé, 2006). Using PCIs as a discussion object within this structure is a solution for coordinating actors in an effective manner. Actors will be able to familiarize themselves with the PCIs by using the shifting, adaptation, extension and diversion strategies of this object (Akrich, 2006). Thus, they will contribute to organizing the discussion structure and represent an “extra-social” means (Strum and Latour, 2006) which,

[2] Facility Classified for the Environment

[3] Hazard Analysis Critical Control Point

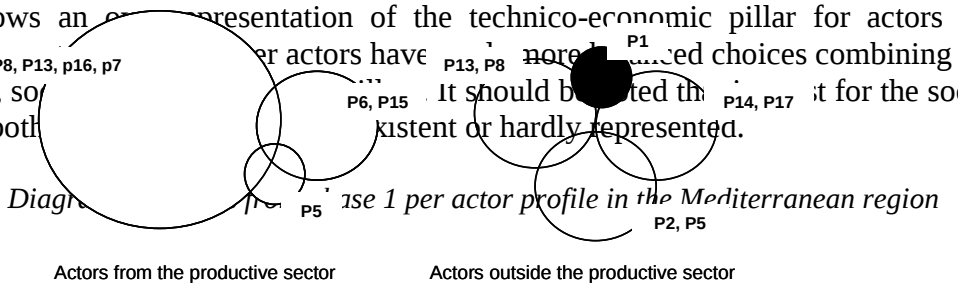
[4] “All management procedures (« which combine management measures and the institutions in charge of their implementation and control) affecting one or several productive systems in interaction” (Rey et al., 1997)

combined with the discussion, will facilitate coordination. Following this coordination phase, actors from the production sphere, control system and social community will be able to develop a transversal vision, i.e. they will be able to take into account all of the elements from the system (aquaculture systems) of which they are part when making a decision. When a fishfarmer produces fish or when an institutional official legislates, they are both aware that they are each creating a more or less coordinated collective action (Callon, 2006) in the aquaculture system. In this sense, implementing an approach structured by the PCIs is an organizational innovation as it can not only be used for controlling actions but also for exploring new options, for (re)-defining objectives and for agreeing on what has to be achieved (action guide and operation) for implementing sustainable development.

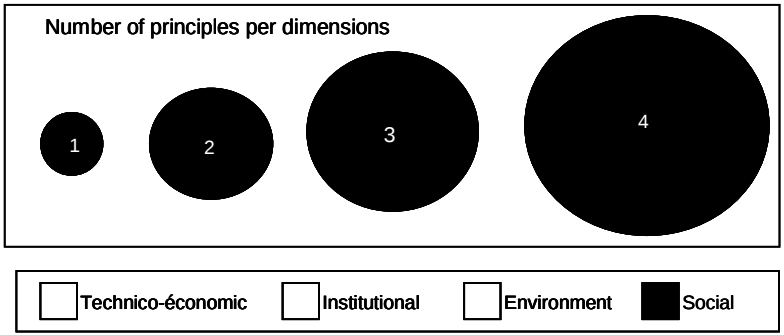
II.- Results: Facilitating the construction of a common project in relation to sustainable development

In this section, we will present the main and immediate outcome of our approach when applied on the five study sites .i.e. the principle and criteria choices made by actors from the aquaculture systems of the five study sites. A criteria and indicator check list has been drawn up based on issues and representations. This list is therefore a general list in which, according to local situations, actors from each aquaculture system can discuss and select a reduced list of principles, criteria and indicators representing local expectations and their vision of sustainable development. This procedure has been carried out in two phases. Firstly, principles and criteria are ranked, and secondly, the new list with selected principles and criteria is approved.

In the first phase, actors identify principles and rank all criteria according to a qualitative graduation from “priority” to “secondary” including a "to be included later” comment. Thus, actors can express the value judgement that they have regarding the notion of sustainable development in aquaculture. This phase concerns the individual choices made by the actors so that they are not affected by strength or power conflicts between the different actors and provides interesting results concerning the choices made by actors regarding principles. Individual results have be aggregated by distinguishing two sub-groups: actors belonging to the productive sector (producers and the others actors from aquaculture sector) and actors which do not belong to this sector (actors related to the fishfarming environment, belonging to the control system or territory (social community)). It is then possible to confront both points of view. Results will be presented in this section for the study site in the Mediterranean area which includes fishfarming in Cyprus and in French Mediterranean areas (Provence Alpes côte d’azur and Corsica – *see Diagram 1*). The distribution of selected principles (Sourget, 2007) shows an [illegible] representation of the technico-economic pillar for actors from the product[illegible]er actors have [illegible] more balanced choices combining technico-economic, so[illegible]. It should be noted th[illegible]t for the social pillar is low in both [illegible] existent or hardly represented.



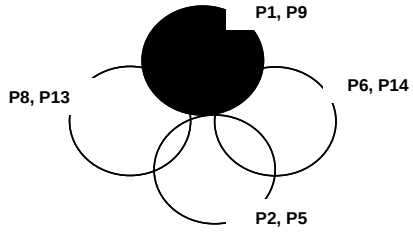
Diagr[illegible]se 1 per actor profile in the Mediterranean region



Thus, producers have given significant importance to the flexibility, adaptability and durability of firms which involves diversification as well as research and implementing innovations such as using labels or taking part in quality approaches. “Non-producers” underline the importance of the social food supply, the need for governance plans as well as the Government’s participation in the implementation of sustainable development.

The second phase consists in collectively approving the PCI list prepared by aggregating individual choices. This aggregation is carried out by weighting via scores the choice classes used for the selection. In the initial phase, the aim was to provide all actors with the results for their individual choices by showing the differences observed between the sites or actor categories. This restitution then gave rise to a debate between actors which enabled to identify converging and diverging viewpoints among the actors, particularly between both categories. Following this discussion and as long as a consensus has been reached, it is then possible to collectively re-introduce (or exclude) certain principles or criteria whose significance was revealed during the discussion. Thus, this approval phase is used for defining a compromise between two major types of actors in the aquaculture system. In the case of the Mediterranean site, it is observed that the validation phase was employed for reaching a compromise which will re-balance the representation of the four pillars (*see Diagram 2*).

Diagram 2: Results following phase 2 (approval) in the Mediterranean area



Principles globally approved by the actors

Results obtained following the implementation of this construction approach show the advantage of its collective character in terms of actor coordination and of building a compromise based on sustainable development issues on a given territory.

Criteria representing action fields have also been subject to an individual selection by actors (according to the principles to which they are connected). They have often been used, which is also the case for indicators, during the individual selection or in the discussion of the collective approval phase for illustrating the usefulness or meaning of the principles. Collective discussions have shown that actors gave much more attention to principles and indicators than to criteria. The criteria and indicators were then finally selected by researchers so as to balance criteria per principle and to account for information availability.

Lastly, as regards results over a longer term related to the learning processes enabled by this co-construction approach, we can attempt to list a few examples of situations and/or objects which have been part of a learning process characterized as individual or collective according to Agyris and Schön, (1996), i.e. according to whether they are used for modifying the practices (simple loop learning process) and objectives (double loop learning process) of actors. Table 2 lists the main fields and subjects for which learning processes have been completed (*see Table 2*).

Table2: Illustration of learning processes created by the co-construction structure

	Simple loop learning	Double loop learning
Individual learning	- Clarifying possible solutions for promoting fishfarming (Cameroon) - Increasing awareness of the need for information on production systems and pollution causes (Indonesia) - Position of fishfarmers with respect to other actors based on PCI results (Cameroon)	- Clarifying sustainable development representations (Cameroon) - Demystifying sustainable development: describing the content of sustainable development (Brittany) - Integrating a new concept such as biodiversity (Indonesia) - Extending the time scale of current reflections (Brittany) - Improving the understanding of sustainable development: this is no longer a useless concept (Brittany)
Collective learning	- Collective consideration of the position of fishfarming in the West of Cameroon - Increasing awareness of the need for providing a territorial dimension to aquaculture (Mediterranean region and Indonesia)	- Implementing an institutional organization committee (Cameroon) - Changing the dialogue existing between popularizers and institutional actors (Indonesia) - Creating a dialogue and common objectives and identifying priorities (Indonesia)

Conclusion

The co-construction method for sustainable development indicators in aquaculture is used for including actors in the definition or listing at a local scale of sustainable development principles, which can thus facilitate their appropriation by actors. It offers an operational framework which fulfils participation objectives supported by sustainable development and thus facilitates its appropriation (materialization process) as an organizational and institutional

innovation. In actual fact, sustainable development imposes major changes both individually for fishfarms, as well as collectively regarding the changed reference system and representations within a group of actors which tends to increase in size due to the emergence of new actors involved in sustainable development. Thus, the learning process must be based on a double loop principle involving appropriate and progressive support structures with respect to current actors' representations. This involves institutional changes at the level of territorial governance structures. In this innovation approach framework (in which the social character becomes central), the multiple and complex relationships existing between innovation and learning are to be examined. This domain is a main topic in the problems encountered in Management Sciences, particularly regarding the co-construction process or more generally concerning research and partnership positions and organizations determining the implementation of these processes.

Thus, this article has described how the co-construction protocol for sustainable development indicators has been constructed with actors, according to participation and association structures according to the research phases. The principle criteria and indicator system on which is based the construction of the approach represents an organizational innovation according to David (1996). We can, in actual fact, consider that we have jointly mobilized the three components identified by David for the innovation process, i.e. technical substrates (tools, models, references, representation analysis, etc.), a management philosophy (in our case, the assumption according to which the effective implementation of sustainable development requires a cooperation strategy via a co-construction approach) and lastly a simplified vision of organizational relationships (in this case, the organization of individual and collective relationships around the selection and approval of principles and criteria). This type of approach is used for connecting indicators and interacting individual, collective and scientific knowledge. The major role played by institutional conditions and innovations should however be noted for achieving this type of innovation as it can only be developed and operated if structures, which facilitate the learning process and transform knowledge into local useable know-how (Avenier and Schimth, 2005), have been implemented.

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