Living territories to transform the world

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The *Agricultures et défis du monde* (Agriculture and Global Challenges) collection publishes a book every year that showcases Cirad’s research into the sustainable development of tropical agricultural systems. It is co-published by Éditions Quæ, AFD and Cirad. The collection is coordinated by Cirad’s Patrick Caron.

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The extension of fish farming is rarely considered at a territorial scale. This chapter focuses on a conceptual framework used to mobilize the resources of a territory for devising new fish farming innovations. Starting from an initial formulation developed in Brazil to interpret differences in territorial fish farming trajectories, this framework will be applied to fish farming realities of West Africa. The competitive advantages of a territory depend fundamentally on its ability to construct an innovative productive organization – the local innovation system – that relies on the local specificities of the biophysical, social, economic and institutional environment (Bureth and Llerena, 1992). The local innovation system is the result of interactions between four hubs of expertise: production, science, training and funding. A specific component of the innovation process is associated with each of these hubs. Production is associated with learning, which is the acquisition of knowledge and know-how by an individual or a group; science with research and development if its priority is to produce knowledge oriented towards the resolution of production system bottlenecks; and training with impartation of skills to producers. As for the funding hub, it encompasses the evaluation process which validates and orients the choices of the technologies to be developed. To be truly effective, public action must incorporate three of these four hubs of the local innovation system: science, training and funding.

The local innovation system is considered to be the nucleus of the socio-technical network of fish farming (Da Silva et al., 2009). It is constituted by individual and collective entities defined by their identities and their projects, linked to each other within a territory (Callon, 1986). The network is consolidated by expansion through translation operations (Figure 8.1) undertaken by an individual or institution. The translation aims at reconciling the statements of different groups of actors and, in particular, to resolve controversies in order to facilitate the construction of the fish farming innovation being promoted by the emerging network.
The study by Da Silva et al. (2009) found that the dynamics of fish farming in the Ribeira valley in São Paulo State are not as strong as those of the upper Itajai valley in Santa Catarina State (Table 8.1).

Fish farming was introduced in the Ribeira valley by Japanese immigrants in 1931. From 1984 to 1989, the State provided technical assistance, distributed fingerlings and made often irrelevant investments, such as a fish filleting factory that was still unused in 2013. In spite of this diffusionist approach, a local innovation system emerged in 1990 in Juquia municipality. A fish farmer, who had earlier been a technician-researcher, proposed a fish farming project which obtained the support of the mayor. A research unit was set up. The sector began acquiring structure. As early as 1991, a food factory located outside the territory began experimenting with making extruded food for use as fish food. The translator was this fish farmer at the heart of the local innovation system. From 1992 to 1997, the network lacked coordination and there was little proximity between the actors: sales took place outside the territory, the extruded food was made in distant cities, and the fingerlings produced in north-western Brazil were shipped in by air. Technical advice was provided by fish-food vendors who had no link to the network or its territory. The researchers conducted research without involving the network and, after 1996, the local research unit sputtered to a halt. From 1998 to 2003, the network gradually imploded. Leaders of the sector turned into fingerling traders, especially since the market had become increasingly less favourable. This situation persists until today.

In the upper Itajai valley, immigrants, mainly of German origin, started carp fish farming in 1920, introduced from back home, as a subsistence activity. In 1986, a technician from the government’s research and development agency proposed a model that integrated pig and fish production. In 1994, a local innovation system
Table 8.1. Comparison of the development of the dynamics of fish farming in the Ribeira valley and the upper Itajai valley.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Ribeira valley</th>
<th>Upper Itajai valley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land use and occupation</td>
<td>Indigenous population, Japanese colonization, various investors</td>
<td>German and Italian colonization, family farming</td>
</tr>
<tr>
<td>Territorial resources</td>
<td>Exogenous: extruded foods</td>
<td>Endogenous: pig droppings</td>
</tr>
<tr>
<td>Type of controversy</td>
<td>Mild: external to the territory - political</td>
<td>Strong: internal to the territory - environmental</td>
</tr>
<tr>
<td>Translator</td>
<td>Fish farmer</td>
<td>Extension agent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>World Bank mission</td>
</tr>
<tr>
<td>Training hub</td>
<td>Initial training, then technicians of food manufacturers</td>
<td>Learning and extension agents</td>
</tr>
<tr>
<td>Research hub</td>
<td>Presence of a research unit</td>
<td>Research on the farms</td>
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<tr>
<td></td>
<td>Action external to the network</td>
<td>Action within the network</td>
</tr>
<tr>
<td>Funding hub</td>
<td>Priority for infrastructure</td>
<td>Funding for training and research and development</td>
</tr>
<tr>
<td>Production hub</td>
<td>Weak organization of producers</td>
<td>Strong organization of producers</td>
</tr>
<tr>
<td></td>
<td>Relationships related only to market opportunities</td>
<td>Relationships of cooperation, trust and market</td>
</tr>
</tbody>
</table>

Based on Da Silva et al., 2009.

emerged in the city of Agrolândia around his activities. It was supported by the town’s administration. Agrolândia producers came together in the harvesting of fish and local industrialists integrated the sector in their activities (fingerling producers, fish producers, and fish processors for the local market). In 1997, this system was blamed by an NGO that claimed that the integrated pig/fish production was leading to a proliferation of mosquitoes. In response, various actors mobilized themselves (World Bank, municipal councilors, mayors, technicians, researchers, fish farmers, NGOs), initiating a translation process. Rules were formulated to regulate fish farming practices that were acceptable to the NGO. From 1993 to the present day, Agrolândia’s local innovation system is being consolidated through dissemination and replication in a large number of the region’s municipalities.

**REALITIES OF SUB-SAHARAN AFRICA: THE CASE OF GUINÉE FORESTIÈRE**

In Guinée Forestière (Forested Guinea), the technical reference framework was transferred from the lessons learnt from West-Central Côte d’Ivoire (Oswald, 2015). From 2002 to 2008, in several villages in Nzérékoré prefecture, the local innovation system took the form of a network of fish farmers’ groups who maintained close links with the project leaders and managers. The latter encouraged scientists to get involved and facilitated frequent exchanges with administrators and financial institutions (Box 8.1). Experienced farmers from these villages subsequently helped other fish farmers get started after the project ended.
The local innovation system here has been able to derive value from the territory's own resources, i.e., the numerous lowlands used for fish farming and the know-how in rice cultivation, by profitably associating fish farming with flooded rice cultivation. The recent introduction of palm kernel crushers has made palm kernel cake abundantly available as animal feed, a development that has encouraged the establishment of pig farming and its integration into fish farming (Rangé et al., 2015). Based on these dynamics, the network is being further strengthened since 2012 under the impetus of a new project, the Rice-Fish Farming Development Project in Guinée Forestière (2012-2017), and is now participating in the role of translator within this local innovation system. The project's actions are stimulating professional proximity within the network, which now includes more than 1500 agro-fish farmers, numerous local village groups and a professional organization, the regional federation, which is backed by unions in a few districts.

Recently, a controversy erupted regarding the use of exogenous but selected breeding strains, leading to a different organization of reproduction. This can be a threat or an opportunity for the network depending on how the federation, the project and government will resolve the controversy.

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**Box 8.1. Project intervention strategy in Guinea.**

The Fish Farming Project in Guinée Forestière (1999-2008) benefited from AFD's support. The National Aquaculture Directorate, the contracting authority, has a mandate to evaluate fish-farming activities.

Implemented by APDRA – Pisciculture Paysanne (www.apdra.org), the intervention strategy is based on the men and women in farmer families, who mobilize their know-how, skills and labour, and their ability to take initiatives and assume risks. In return, the programme provides the technical information and expertise necessary – easily appropriated and with low investment cost – for setting up fish farms in the lowlands. A training and support system destined for voluntary producer groups disseminates this technique.

Several elements contribute to the emergence and consolidation of the socio-technical network:

- the participation of all families since no investment subsidies are available, the management of the ponds being undertaken by the fish farmers;
- grassroots groups, which are the driving force behind a dynamic of local innovation, make training more accessible, facilitate exchanges, gradually lower the training costs of the fish farmer and structure the sector (Grosse and Oswald, 2010);
- the integration of the association of fish farming and flooded rice cultivation into local agricultural production systems does not compete with the farming calendar of other agricultural activities (Simon and Benhamou, 2009);
- access to a large local market, with fish making up the bulk of animal protein intake in this region.

The projects' actions gradually strengthen the autonomy of the local fish farming groups which provide the main functions of facilitation, coordination, training and support.
Diversity of territorial functions and approaches

Figure 8.2. Large and completely transplanted rice-fish farming pond. The monk sluice can be seen in the background and, on one side, a pigsty (Gbotoye, Prefecture of Nzérékoré, Guinée Forestière).

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Figure 8.3. Integration of flooded rice cultivation and fish farming. The fish farmer will soon begin to raise the water level in his pond – while ensuring that the top of the rice is above the water – to simulate a flood. We can see the service pond where the fish for restocking is kept (Gbotoye, Prefecture of Nzérékoré, Guinée Forestière).

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CONCLUSION

The fish farming network manages the territory’s resources in a wide-ranging manner: design of efficient fish farming facilities, appropriate choice of fish species, abundant supply of inputs, implementation of fish farming practices recognized as high-performance, identification of accessible markets, innovative ways of organizing and, more broadly, a body of specific expertise and know-how.

However, the example of Brazil shows that the sustainability of these local dynamics depends on their recognition by the State. The consolidation and expansion of the local innovation system constitute a same continuous process that draws its resources from the territory but can be weakened or threatened by an external entity (example of extruded food in the Ribeira valley) if it does not incorporate the network. In Guinea, the production hub, acting through local groups, has been able to prolong the growth of fish farming beyond the duration of projects. However public actions that rely on international funding do not seem to be able to integrate the three other hubs of competence of the local innovation system, despite the support of the national directorate of fish farming (Halftermeyer, 2009).

The agro-fish farming territory thus exists as a space for managing resources whose characteristics, including geographical boundaries, are shaped by its history, the local innovation system and its expansion supported by public action. This requires national policies that are able to take the competitive advantages of these agro-fish farming territories into consideration. An interface between the representation of a territory’s fish farming profession and State services, and a balanced dialogue between all stakeholders would facilitate this desired evolution.

References


Diversity of territorial functions and approaches
