Training on Rice-fish Farming in High Schools in Madagascar's Highlands: One way to boost fish production and improve food security
Training on Rice-fish Farming in High Schools in Madagascar’s Highlands: One way to boost fish production and improve food security

GCP/RAF/466/EC SmartFish Project

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Acknowledgments

Acknowledgments from APDRA to the IOC-SmartFish Programme and the FAO

The project team would like to thank the FAO component of the IOC-SmartFish programme for proposing and supporting the school training project and making it possible to extend Phase 2 for an additional school year, known as Phase 3. This extension reflects the programme's desire to develop rice-fish farming in Madagascar’s Highlands and its confidence in the APDRA team. Special thanks go to Michel de San for his follow-up, exchanges and recommendations that contributed to the success of this school training project.

Acknowledgments to the project’s partners

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We would also like to thank the teachers for their willingness to be amongst those spreading the knowledge of rice-fish farming to their students. Their interest in rice-fish farming through the training and transfer of knowledge to the students was a guarantee for the project’s success.

We would also like to thank our operational partners, - the Regional Directorates of National Education, the Regional Departments of Marine Resources and Fisheries, and the School Districts (CISCO) - for their support.

We would also like to acknowledge the parents, fry producers and all the local actors, near or far, who have been involved in the project’s success. Their involvement demonstrates the relevance of our activities and the interest that rice-fish farming has aroused in rural areas.

We must not forget to mention APDRA’s operational and administrative teams who worked hard for the success of the school training project in the four regions of intervention.

Thanks also go to the Agence Française de Développement (AFD), who co-financed the three phases of the project and whose financing enabled Phase 3 to be extended until mid-2017, the end of both the school and agricultural year, after the closure of IOC-SmartFish funding in December 2016.
Executive summary

This pilot training project on rice-fish farming in the Highlands of Madagascar grew thanks to the voluntary cooperation of the rural lower secondary schools that wanted to offer the children of agricultural farmers a credible training that would benefit them in the long-term.


In this context the partnership between the NGO APDRA and the FAO IOC-SmartFish programme was born, initiated by the latter and financed by the EU. The pilot phase began with 20 volunteer high schools, selected in 3 regions, targeting those areas where fry producers and rural APDRA-supported hatcheries\(^1\) were already operating.

Various teaching materials were developed: a comic book, a poster and a technical manual for the teachers.

The training took place during periods set aside for extracurricular activities, and its organisation was left to the initiative of the individual schools.

Phase 2 (2015-2016): Extension phase

An internal evaluation of Phase 1 highlighted the teachers’ and students’ interest in the project, but it was apparent that more specific practical training was necessary. Hence, in Phase 2, the idea to create demonstration rice fields at high school sites was born. Eighty-eight establishments were involved in Phase 2, 60 pilot rice paddies were developed and some 10,800 children were trained.

It was also during this phase that two complementary notions were adopted as a credo at the end of Phase 3. The first is the notion of the ‘ripple effect’ and this is linked to the second notion, which is the need for a credible demonstration effect hereby showing that the pilot rice fields can produce the expected quantities, namely 200-300 kg of fish per hectare and a 20-30 per cent increase in the rice yield.

Phase 3 (2016-2017): APDRA withdrawal and handover phase; to national education partners and parents

After evaluation of Phase 2, Phase 3 focused on 65 of the 88 high schools. This downsizing was based on technical environmental criteria that were not conducive for rice-fish farming. The project also responded to a training request from the FRAM (an umbrella organisation for parents). Six hundred parents were thus trained and set up 30 pilot rice fields.

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\(^1\)Rural hatcheries are small fry (mostly Carp) production units, usually located in very remote areas. Using agricultural resources available on their farms, they are one of the solutions for the supply of fry in remote areas.
Phase 3 was an additional step to anchor the rice-fish farming training in schools, and more widely at the national level. In particular, this phase was characterised by the establishment of 109 teacher trainers (TT) at the institutional level, whose main mission will be to ensure the training of rice-fish farming in high schools, even after the end of the project. With the project’s support, the teacher trainers trained 329 adults in the 65 schools involved. The TTs were also responsible for the smooth running of the 60 pilot rice paddies set up over the course of Phase 2.

It should be noted that the question of the economic profitability of rice-fish farming was reinforced in the teaching material, and a component on nutritional aspects was also added.

**An emerging fish-farming dynamic around the institutions supported by the project**

Stakeholders are now faced with the emergence of a dynamic sector that was not initially foreseen by the project. This has been supported by rice-fish farming exchange visits, which brought about both positive and unexpected interactions, which can be summarised as follows:

- Synergies between the APDRA-supported fingerling producers and the buyers that are the schools and parents. In the long term, this could become a high value-added economic activity (€2-3 per kg of fish), on the basis of existing irrigated rice fields and professional rural farmers who have successfully mastered the business.

- Parents of students in rural areas are satisfied that their children, 50 per cent of whom drop out of school in the 3rd grade, learn a profession that is of value for the family farm and potentially useful for their future.

- Principals and teachers are more highly valued in their community as well as with FRAM parents' associations, who are, in part, their donors.

- In the long term, increased production on family farms in rural areas will have positive effects on latent malnutrition.

- Nutritional aspects are addressed in the teaching materials to attract the attention of the new generation to this problem, which is exacerbated in the Highlands.

**APDRA opens two locks with one key**

This approach to a rice-fish farming network through high schools will certainly remain one of APDRA's and its donors’ methods of action in the Highlands. Indeed, thanks to this type of intervention, the operator capitalizes and strengthens (1) its network of rural hatcheries, (2) trains children for the future and (3) reaches parents who own rice fields through the parents’ associations.
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### Acronyms and abbreviations

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<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFD</td>
<td>French Development Agency (Agence Française de Développement)</td>
</tr>
<tr>
<td>APDRA</td>
<td>APDRA Pisciculture Paysanne</td>
</tr>
<tr>
<td>CISCO</td>
<td>Circonscription Scolaire</td>
</tr>
<tr>
<td>DREN</td>
<td>Regional Directorate of National Education (Direction Régionale de l'Éducation Nationale)</td>
</tr>
<tr>
<td>EDF</td>
<td>European Development Fund</td>
</tr>
<tr>
<td>FAO</td>
<td>United Nations Food and Agriculture Organisation</td>
</tr>
<tr>
<td>FOFIFA</td>
<td>National Centre for Applied Research in Rural Development (Centre National de la Recherche Appliquée au Développement Rural)</td>
</tr>
<tr>
<td>FRAM</td>
<td>Organisation of parent’s associations (Organisation faitière des associations de parents)</td>
</tr>
<tr>
<td>INRA</td>
<td>National Institute of Agricultural Research (Institut National de Recherche Agronomique, France)</td>
</tr>
<tr>
<td>IOC</td>
<td>Indian Ocean Commission</td>
</tr>
<tr>
<td>MEN</td>
<td>Ministry of National Education (Ministère de l'Éducation Nationale)</td>
</tr>
<tr>
<td>PFP</td>
<td>Private Fry Producer</td>
</tr>
<tr>
<td>RH</td>
<td>Rural Hatchery</td>
</tr>
<tr>
<td>TT</td>
<td>Teacher Trainer</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
</tbody>
</table>
1. Introduction

1.1 An brief overview of aquaculture in Madagascar

1.1.1. The farming of consumable fish for the Malagasy population

Madagascar is a country with strong agricultural ties, with almost 75 per cent of its population living in rural areas; paradoxically, it is this population that is currently living below the poverty line, with nearly 94 per cent living on less than US $2 a day.

Nowadays, the country is faced with significant demographic growth, reaching almost 3 per cent in 2015, which in turn increases human pressure on natural resources, land, etc. Thus, the supply of fish to the population in general, and the Highlands in particular, is always in deficit: inland waters are over-exploited and marine areas around coastal urban centres are overfished, and this is coupled with administrative difficulties in enforcing measures for the good management of inland waters.

In the 2000s, freshwater aquaculture production, from rice-fish farming, was an estimated 2,500 - 3,000 MT per year. Production was more than 3,600 MT in 2015: this production is low when compared to the 25,000 MT/year produced by inland fisheries (FAO FishStat). Potential irrigated rice fields that are highly favourable for rice-fish farming represent an estimated 34,000 ha, not including the least favourable, all of which would represent several tens of thousands of tonnes of Carp. The development of the fish farming sector also benefits from attractive selling prices, around €2 to €3 per kg.

1.1.2 Aquaculture for exportation

Shrimp farming (Technical assistance from FAO and Japan; France and EU funding)

Industrial shrimp farming began in the early 1990s and reached a production of more than 6,000 MT/year in 2006-2008 (FAO FishStat). Thereafter production declined as a result of: (1) an increase in global production, linked to the industry's control of White spot Syndrome, resulting in a fall in global prices, (2) the appearance of this virus in Madagascar.

Seaweed farming (EDF promotion)

Seaweed farming involves the cultivation of two seaweeds: Cottonii (Kappaphycus alvarezii) and Spinosum (Eucheuma denticulatum), which produce carrageenans - thickening agents that are widely used in the food and cosmetics industries worldwide.
In 2016, there were three producers whose cumulative dry production was more than 1,000 MT/year. The goal for the next decade is to match Zanzibar's production of 5 to 10,000 MT/year.

**Aquaculture of sea cucumbers (supported by the Belgian universities of Brussels Mons and EFD-IOC)**

This type of aquaculture is still in its infancy and there is only one species of sea cucumber (*Scabra nobilis*) that is highly valued in Asian markets. There is only one operator in Madagascar, who produced 4.2 MT in 2016.

### 1.2 Background and history of rice-fish farming in Madagascar

#### 1.2.1 A Malagasy tradition of stocking the rice fields

"In Madagascar, if sources cite the study of the integration of fish farming in agriculture during the reign of Andrianampoinimerina (1794-1810) (FAO, 2004), the fish farming of introduced species goes back to the early twentieth century. The first introductions are dated 1861 for the Crucian Carp (*Carassius auratus*) and 1914 for the Mirror Carp (*Cyprinus carpio*) (Kiener, 1963). In the 1950s, fish farming experienced a boom with the introduction of Tilapia (*Oreochromis niloticus*), the growth of family fish farms for rural consumption and the construction of state fish farms, but in most areas it rapidly declined in the mid-1960s." according to Bentz and Oswald (2010).

According to these authors, in the 1950s, rice-fish farming was carried out as follows:

- "**When the rice was being transplanted, fish (Carp, Tilapias) were put in the paddy fields. In most cases, these fish came from natural fisheries and a market already existed for these fry [...].**

- **The fish grew in the rice fields until harvest time (March-April), or even beyond. Indeed, when the water supply to the rice fields allowed it, water was kept in the plots after the harvest, until July [...].**

- **Once the rice field was dry, any fish that had not been eaten were placed in small ponds owned by the farmers. This storage lasted several months, until the start of the next rice crop.**"
1.2.2 Recent developments of the system

Still according to Bentz and Oswald (2010): "During the 1960s and 1970s, major research efforts were made to revitalize it through the development of rice-fish farming [...], financed notably by FAO with a certain amount of success. However, in the mid-1980s, fish farming and rice-fish farming were declining and most fish farms had stopped operating (Kiriloff, 1989)." With an objective of food self-sufficiency and increased availability of protein, the Malagasy government decided to revive the sector with the support of the United Nations Development Programme (UNDP) and the United Nations Food and Agriculture Organisation (FAO). Several development projects followed aimed at encouraging farmers to raise carp in rice fields from fry provided by a network of specialized fish producers.

In the 1980s, in the Highlands, the rice-fish farming of carp set up by the FAO and the National Administration was based on two types of fish farmers: Private Fry Producers (PFP), those who supplied fingerlings and Carp producers, who grew these fry in their rice fields. Fish stations, the central pivot of the production system inherited from colonization, were now only used to supply the PFPs with quality Carp brood stock. The Private Fry Producers were approved by the Administration and supported by its services. The PFP were the only ones allowed to supply fry to Carp producers. As a result, technical services and support programmes maintained a strong hold on the sector, and very few new PFPs were accredited. For more than a decade, this commercial oligopoly resulted in a relative increase in the cost of fry compared to other consumer goods, reflecting an overall optimization of profits for the PFPs.

From the 2000s, APDRA's work with the technical services gradually resulted in the restructuring of Rural Hatcheries (RH, producers of fry in rice fields, not part of the PFP network), whose existence was not recognized - or moreover opposed - by the Administration. RHs have now become the cornerstone of APDRA's interventions in the field of rice-fish farming in Madagascar.

1.2.3 Socio-economics constraints and facilities

In Madagascar, there is a real difference in terms of the socio-economic opportunity for rice-fish farming between the Highlands and the coastal areas. Indeed, compared with the country's average population density of around 40 inhabitants/km² (World Bank, 2015), the Highlands have a high population density, with more than 350 inhabitants per km² in some rural areas.
Added to this is a serious phenomenon of deforestation in the Highlands, an overexploitation of the continental waters and an unlikely possibility of extending the surface area of the irrigated rice fields. The latter are, for the most part, limited to one annual cycle of production due to a lack of water.

Due to the demographics and the limited surface area of the rice fields in the Highlands, the area of family rice fields inherited from grandparents and parents is constantly decreasing, meaning that rice-fish farming and off-season crops enforce productivity gains.

### 1.2.4 The potential of rice-fish farming in the Highlands of Madagascar

In Madagascar, the current production of farmed fish is an estimated 3,600 MT/year (FAO FishStat), the majority of which come from rice-fish farming.

The Highlands have 200,000 ha of irrigated rice fields, of which 34,000 ha are considered to be highly favourable for rice-fish farming according to the Directorate of Marine Resources and Fisheries. These observations show the importance of rice-fish farming in the Malagasy fish farming landscape and its enormous potential for development.

However, according to the 2007 United Nations Monitoring Report, the Malagasy population consumes an average of 7 kg of fish per person per year, whilst the world average is an estimated 16.4 kg per person per year. Thus the current challenge lies in upgrading those rice fields that are favourable for the introduction of fish, in order to increase fish production and the consumption of fresh fish in rural households whilst generating an additional source of income for the latter.

In fact, rice-fish farming is a short-cycle farm (between 4 and 10 months), which makes it possible to enhance the rice ecosystem and its natural productivity; the use of inputs (food) is thus limited, and consequently investments for family farms to undertake this activity are also minimal. Investments mainly consist of (1) the purchase of fry, which must be available in quality, quantity and at reasonable cost, (2) the collection or purchase of organic fertilizer, and (3) additional labour to organise the rice fields. With fish yields of between 200 and 300 kg/ha/cycle and a 10 to 30 per cent increase in rice production, rice-fish farming is a real lever for development in rural areas that are most affected by poverty and malnutrition.
2. APDRA’s rice-fish farming activities

2.1 APDRA’s background in Madagascar

APDRA’s first intervention in Madagascar in 2004

APDRA began its work in Madagascar in the early 2000s (2002 and 2003), through feasibility studies on rural farming; it was not until 2004 - 2005 that the first activity to support fish farmers in Betafo (Vakinankaratra region) was initiated. In 2006, this project led to a project to structure Betafo’s informal rural rice-farming dynamics. This project, which was implemented over a 3-year period, enabled APDRA to understand the Highland fish farming dynamics and propose a number of solutions to the difficulties encountered by fingerling producers (Carp breeding, genetic diversity, marketing).

Development of a technical reference system

The technical reference system promoted by APDRA draws mainly on the practices of producers of fry in rice fields in the Betafo area (Vakinankaratra). In this area, the production of fry in rice fields began in the 1960s, with the support of a few technical agents. It then spread widely in the 1980s with the help of an FAO project however the FAO ended its support when a fish farming system based on private fry producers was established (see 1.2.2). Fingerling production units by small-scale farmers, known as rural hatcheries, have nevertheless continued to develop based on an autonomous, extensive model, which is an alternative to the private fry producers.

On the basis of this model, APDRA worked with the Betafo fish farmers to resolve several difficulties that they faced. A technical reference system for the production of fry in rice fields was thus developed. Similarly, a technical frame of reference for raising Carp in the rice paddies was established, by adapting the technical proposals of the FAO model to the rural farm context (limited cash flow, availability of agricultural by-products, etc.).

Initially focused on Vakinankaratra region, APDRA's intervention gradually spread to other regions of the Highlands:

- Itasy: from 2011.
- Amoron’i Mania: from 2009 to 2012, and then from 2014 to date.
**Advocacy for rural hatcheries: conflict and/or complementarity with private fry producers**

The creation of new rural hatcheries and the ‘liberalisation’ of access to fingerlings was initially poorly received by the PFPs, who were recognised by the Ministry of Marine Resources and Fisheries. The latter saw these small production units as unfair competitors and questioned the quality of the fry produced by the RHs.

However, the rural hatcheries were designed to make fingerlings available in very remote rural areas that are difficult to access by private fry producers who are usually found on the main roads. Moreover, the small quantities requested by the rural Carp producers are often not compatible with the objectives of the PFPs. Rural hatcheries can meet these demands and therefore do not position themselves on the same market as PFPs. They only target the demand for fry in the area in which they produce it.

Through consultation meetings and advocacy, APDRA and supported small-scale producers gradually managed to get the Ministry of Marine Resources and Fisheries to recognize the existence and the aim of the rural hatcheries.

At the same time, research activities on Carp genetics conducted by a consortium of INRA, FOFIFA and APDRA demonstrated that fry from rural hatcheries had genetic qualities similar to those produced by private fry producers, thereby invalidating any suspicions of poor quality.

Today, there is a well-developed network of rural hatcheries in the Highlands, with almost 300 producers spread over four regions with an estimated annual production of between 1,500,000 and 2,000,000 Carp fry.

**Advice and support for producers of Carp in rice fields**

In addition to supporting fingerling producers, APDRA offered technical support to Carp producers in rice fields so that they gradually reached expected production levels: the equivalent of 200 to 300 kg of fish per hectare and 20-30 per cent more rice.

**3. An innovative and evolving partnership between APDRA and the FAO under the framework of the IOC-SmartFish programme**

This partnership came about through the implementation of a training project for rice-fish farming in the rural high schools of the Highlands that was carried out as an extracurricular activity.
Based on the training of teachers by APDRA and thereafter the training of the students by the teachers, the project took place in three successive phases, distinguished by their scale of intervention and their approach, each phase being the subject of a participatory evaluation by the stakeholders involved.

Thus, whilst the pilot phase was focused on the implementation of the educational approach and tools, Phase 2 consisted of expanding the activities and strengthening the practical aspects of rice-fish farming through demonstration plots.

Phase 3 focused on the development of a withdrawal strategy by strengthening the capacity of institutions to integrate training modules in their curriculums on the one hand and training parents on rice-fish farming on the other.

![Figure 1: The various phases of the rice-fish training project](image)
3.1 Phase 1: Pilot phase and implementation

Phase 1 was a pilot phase to develop and test the implementation of the approach in a limited number of high schools in 3 regions of the Highlands.

Objectives

The initial objective of this phase was to increase the spread of Carp raising in rice fields of rural areas by training young people. The goal was twofold: to improve food security for children and their parents and to equip rural youth with agricultural knowledge and skills in a context of high educational dropouts.

Main activities

The aim was to train teachers from rural high schools so that they could in turn train their students, using innovative and adapted pedagogical tools (comic strip and poster for students, technical manual for teachers). The teachers trained their students during the school’s extracurricular periods. The training was divided into two main modules: (1) a theoretical part, which is subdivided into ten modules based on the comic strip and the poster, and (2) a practical part during which the students set up a rice field (raising the walls, digging the refuge channel, etc.) with the teachers and help of APDRA technicians.

It is important to note that rice-fish farming was not a completely foreign activity for the students: all of the families of rural school children had a rice field and at least 20 per cent of the families questioned were already farming Carp in a less efficient manner. The training of students was thus undertaken in a context favourable to the transmission of knowledge, given a large proportion of the students were already aware of the basic notions of rice-fish farming.

Criteria for high school selection

The success of the operation was based in particular on the careful selection of the high schools. Three selection criteria were used:

- **Voluntary participation:**
  The willingness of the Principal and his staff to participate in the project without compensation.

- **Technical and economic aspects:**
  - The availability of water in the rice fields in the area for a sufficient amount of time;
  - No risk of flooding, to prevent fish from escaping;
  - The availability of fry in the vicinity of the establishments, sold at a reasonable price by rural hatcheries supported by APDRA.
Main quantitative results and recommendations of the pilot phase

At the end of this first phase, in the three regions of intervention:

- 52 teachers were trained and 4,900 students were trained, in turn, by their teacher;
- Educational tools were developed: an educational comic strip, telling the story of two children who will discover rice-fish farming to pay for their schooling; a poster, which highlights the key elements of the training;
- An approach was built around knowledge transfer, with self-assessments and the involvement of actors from various horizons: the National Education Department through Head Teachers, Teachers and the Regional Directorates of National Education (DREN), the Regional Directorates of Fisheries and Aquaculture and of course, the students.

Pilot phase evaluation

Continuous evaluation with students and teachers enabled APDRA to build on and correct its actions as they were being implemented.

At the end of this pilot phase, despite positive assessments of competence acquisition by pupils and teachers, their knowledge/skills remained largely theoretical since, apart from the practical training sessions, no real practice had been carried out with the students. The creation of demonstration plots in each school was thus proposed to overcome this lack of practical experience.

3.2 Phase 2: Project extension phase

Phase two started at the beginning of the 2015-2016 school year, allowing for the extension of activities initiated in the pilot phase. The principles of the teacher and student training remained essentially the same, apart from the creation and use of demonstration rice fields in each establishment.

The pilot rice fields

La création de ces rizières pilotes visait à ce que les élèves et les enseignants puissent pratiquer la conduite d’un cycle d’élevage dans son intégralité, de l’aménagement des rizières à la manipulation du poisson au moment de l’empoissonnement et de la récolte, et surtout, la mise en pratique des cours théoriques sur les densités d’empoissonnement, la fertilisation, l’alimentation, l’analyse des résultats de la pêche et de la production de riz.
Table 1: Demonstration rice fields

<table>
<thead>
<tr>
<th>Regions</th>
<th>Number of demonstration rice fields</th>
<th>Surface area (are)</th>
<th>Fingerlings (1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Itasy</td>
<td>10</td>
<td>58.2</td>
<td>1,815</td>
</tr>
<tr>
<td>Vakinankaratra</td>
<td>17</td>
<td>112.8</td>
<td>3,807</td>
</tr>
<tr>
<td>Amoron’i Mania</td>
<td>21</td>
<td>48.3</td>
<td>2,072</td>
</tr>
<tr>
<td>Haute Matsiatra</td>
<td>17</td>
<td>122.9</td>
<td>2,329</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>65</strong></td>
<td><strong>342.2</strong></td>
<td><strong>10,023</strong></td>
</tr>
</tbody>
</table>

Source: APDRA PADPP, 2016

Table 2: Overview of Phase 2 results

<table>
<thead>
<tr>
<th>Regions</th>
<th>Schools trained</th>
<th>Teachers trained</th>
<th>Students trained</th>
<th>Demonstration rice fields</th>
<th>Surface area (are)</th>
<th>Total production (kg)</th>
<th>Average yield (kg/ha/cycle)</th>
<th>Average yield (kg/ha/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Itasy</td>
<td>16</td>
<td>50</td>
<td>2,139</td>
<td>10</td>
<td>76.8</td>
<td>80.6</td>
<td>140</td>
<td>366</td>
</tr>
<tr>
<td>Vakinankaratra</td>
<td>31</td>
<td>74</td>
<td>4,208</td>
<td>17</td>
<td>122.9</td>
<td>146.3</td>
<td>91</td>
<td>240</td>
</tr>
<tr>
<td>Amoron’i Mania</td>
<td>21</td>
<td>52</td>
<td>2,408</td>
<td>21</td>
<td>58.2</td>
<td>177.9</td>
<td>285</td>
<td>875</td>
</tr>
<tr>
<td>Haute Matsiatra</td>
<td>17</td>
<td>53</td>
<td>2,055</td>
<td>17</td>
<td>167</td>
<td>169</td>
<td>120</td>
<td>388</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>85</strong></td>
<td><strong>229</strong></td>
<td><strong>10,810</strong></td>
<td><strong>65</strong></td>
<td><strong>424,9</strong></td>
<td><strong>574</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: APDRA PADPP, 2016

The added value of this phase was clearly the knowledge transfer of the practical aspects of rice-fish farming through the use of demonstration rice fields, which in addition to attracting strong interest from the teachers and students also attracted the attention of the students’ parents. The latter, through the parents’ association, FRAM, repeatedly expressed their desire to be trained. The idea to integrate students’ parents in the training in a following phase arose from these multiple demands, thus improving the nascent local dynamics of rice-fish farming.

However, despite the teachers’, pupils’ and their parents’ enthusiasm, initial data from the demonstration rice fields showed that the rice fields did not reach their full potential, probably due to a lack of close technical support.
Thus a third phase was proposed for the project, aimed at:

- Consolidating the knowledge rice-fish farming at the school level, strengthening the sustainability of the system and of the training methodology for the students;
- Strengthening technical support for teachers and students for the more practical operations;
- Training and providing technical support for groups of parents.

**It was at the end of Phase 2, mid-2016, that the birth and adoption of the concept of the positive ripple effect was crystallized. At the same time it was necessary to have and ‘control’ a yield of 200-300 kg/ha of fish and an increase in the rice yield of 20 to 30 per cent in the demonstration rice fields.**

An internal APDRA impact assessment of the school training was carried out at the household level of those students who were beneficiaries of the pilot phase (2014-2015) in May and June 2016. The assessment focused on the households’ adoption of rice-fish farming a fairly long time after the students’ training. Fifty-five households from 12 of the pilot high schools were interviewed. The results showed that (1) the adoption of rice-fish farming by households with students who received the training was very low, and (2) those households adopting the practice did not really take on the technical standards taught to the students. Five recommendations were thus made:

1) Carry out a preliminary diagnosis of the rice fields in the area of intervention to judge their predisposition for rice-fish farming;
2) Strengthen the parents' awareness of adoption possibilities during student training;
3) Set up demonstration rice paddies to prove the performance proposed technical specifications and ensure support for farming by APDRA’s teams;
4) Improve the availability and accessibility of fry to meet the parents’ demands;
5) Support a handful of parents in their rice-fish farming activities.

These recommendations were addressed in Phase 3 and organisational aspects were also improved, notably consideration for the integration and harmonization of different timeframes (agricultural, school and project).
3.3 Phase 3: APDRA withdrawal phase and the sustainability of activities in high schools and parents’ associations

Following the results of Phase 2, an additional phase aimed at ensuring the sustainability of the system was launched at the start of the 2016 – 2017 school year, with new volunteers from areas near establishments from Phase 2, i.e. a total of 65 high schools.

3.3.1 Description du nombre et des zones d’implantation des collèges en phase 3

Phase 3 was an additional step to anchor the rice-fish farming training in schools, and more widely at the national level.

In particular, this phase was characterised by the establishment of one teacher trainer in each school, whose main mission will be to ensure the training of rice-fish farming in high schools, even after the end of the project.

The four regions involved in Phase 2 also participated in Phase 3. However, the number of partner schools was decreased, mainly due to:

- The withdrawal of some schools that no longer wished to participate in the project, probably due to the extra work involved in organising the training sessions;
- The abandonment of some schools located in areas less conducive to the development of rice-fish farming, or the distance to the pilot rice fields was too far from the school.

This last point was noted during an internal evaluation mission carried out in the first quarter of 2016. Most of the schools that dropped out of the project were in the region of Itasy where there are constraints regarding water access, risks of flooding and/or water shortages.

3.3.2 Phase 3 activities

Teacher Trainers (TT)

With a view to maintaining and anchoring fish farming knowledge in high schools for future generations of students and teachers, APDRA proposed voluntary institutions to choose, from amongst those teachers who already took part in the previous phases, teacher trainers (TT), teachers with the capacity to train future colleagues. These trainers were chosen according to personal experience criteria in rice-fish farming techniques, to guarantee the operationalization of the system.

A total of 109 people were thus empowered and trained in how to organise and conduct teacher training, supervise student training, as well as how to assist newly trained teachers and the practical aspects of Carp raising in the demonstration rice fields.
An innovative and evolving partnership between APDRA and the FAO IOC-SmartFish programme

Table 3: Number of teacher trainers trained and training duration

<table>
<thead>
<tr>
<th>Region</th>
<th>Itasy</th>
<th>Vakinankaratra</th>
<th>Amoron'i Mania</th>
<th>Haute Matsiatra</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of sessions</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>30</td>
</tr>
<tr>
<td>Number of hours</td>
<td>12</td>
<td>64</td>
<td>28</td>
<td>47</td>
<td>151</td>
</tr>
<tr>
<td>Number of TTs trained</td>
<td>9</td>
<td>45</td>
<td>29</td>
<td>26</td>
<td>109</td>
</tr>
</tbody>
</table>

Source: APDRA PADPP, 2017

Table 4: Number of high school teachers trained by teacher trainers

<table>
<thead>
<tr>
<th>Region</th>
<th>Itasy</th>
<th>Vakinankaratra</th>
<th>Amoron'i Mania</th>
<th>Haute Matsiatra</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of sessions</td>
<td>16</td>
<td>30</td>
<td>101</td>
<td>25</td>
<td>172</td>
</tr>
<tr>
<td>Number of hours</td>
<td>64</td>
<td>152</td>
<td>301</td>
<td>113.5</td>
<td>630.5</td>
</tr>
<tr>
<td>Number of people trained</td>
<td>19</td>
<td>124</td>
<td>130</td>
<td>56</td>
<td>329</td>
</tr>
</tbody>
</table>

Source: APDRA PADPP, 2017

Educational tools

The final phase of the project was also an opportunity to improve the educational tools that were developed in Phase 1, notably the comic strip, the poster and the trainer's manual, in response to recommendations from SmartFish. The nutritional and profitability aspects of Carp farming were reinforced.

The comic strip and the poster are available on the FAO website:
http://www.fao.org/3/a-az082e.pdf

A video, that collates all the training modules provided by APDRA, was developed and distributed on DVD to the teacher trainers, as a pedagogical tool and training support. For a wider dissemination, the video will be uploaded to YouTube and a downloadable version will be available for Smartphones (see Annex 1 for video content).

Production in the pilot rice fields and a positive ripple effect

As a reminder, the donor, FAO IOC-SmartFish stressed the need to demonstrate the feasibility of profitable rice-fish farming in the high school demonstration rice fields, to initiate the dissemination of this practice on a geographical basis through a positive ripple effect, including an area of farmers who met production expectations, i.e. 200-300 kg of fish per hectare and an increased rice yield of 20-30 per cent.
Alongside the schools, the student’s parents were trained by APDRA technicians to undertake rice-fish farming, and Phase 3 of the project was solely focused on supporting and managing production. Management of the schools’ 60 pilot rice fields, as well as the 30 pilot rice fields set up by the student’s parents, were closely monitored by the project’s technicians.

**Table 5: Status of the demonstration rice fields in the four regions**

<table>
<thead>
<tr>
<th>Region</th>
<th>Demonstration rice fields</th>
<th>Surface area</th>
<th>Fingerlings (Provisional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Itasy</td>
<td>9</td>
<td>26.5</td>
<td>610</td>
</tr>
<tr>
<td>Vakinankaratra</td>
<td>27</td>
<td>138</td>
<td>1,495</td>
</tr>
<tr>
<td>Amoron'i Mania</td>
<td>31</td>
<td>134</td>
<td>3,120</td>
</tr>
<tr>
<td>Haute Matsiatra</td>
<td>23</td>
<td>136.9</td>
<td>2,958</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>90</strong></td>
<td><strong>435.4</strong></td>
<td><strong>8,183</strong></td>
</tr>
</tbody>
</table>

Source: APDRA PADPP, 2017

Table 5 summarises information related to the stocking of the demonstration rice fields. Production results will not be known or analysed until mid-2017, at the end of the growing season. However, it should be noted that there was a significant drought in December 2016 and January 2017, which is likely to have a strong impact on rice and fish production in the Highlands.

**Networking partnerships**

The project also focused on the networking of all the stakeholders involved, through exchange visits for groups of parents, and study visits for groups of teachers to meet with experienced fish farmers, who have been supported by the APDRA for many years.

The high schools are proving to be true vectors for the diffusion of rice-fish farming, through the many actors involved (teachers, parents, students) and the exchanges that exist between them.
An innovative and evolving partnership between APDRA and the FAO IOC-SmartFish programme

Figure 2: Map showing high school locations and rural hatcheries
4 Conclusions of the high school rice-fish farming training project

4.1 Partners’ conclusions from the 4 regional workshops at the close of the APDRA/IOC-SmartFish project

(Source APDRA final report for SmartFish)

Project closure workshops were held in the four regions of intervention and brought together all the stakeholders involved in school education: National Education Officers (Principals, Teacher Trainers, CISCO, DREN), Officers from the Directorate of Marine Resources and Fisheries and parents’ association, FRAM.

The objectives of these workshops were:

- To share the results of the project with the various stakeholders;
- To discuss the successes and failures of the project and any difficulties encountered;
- To identify post-project avenues of action with or without support from APDRA.
Key elements discussed during the four workshops

All the actors involved in the project underlined the fact that rice-fish farming is an innovative activity, economically beneficial, and that the Highlands have a great potential for rice-fish farming that students’ parents can exploit. The project has led to the training and emergence of voluntary resource personnel in schools, who are motivated by a real interest in fish farming and its promotion. Thanks to this serious group people, the knowledge and skills transfer is effective at the institutional level.

All the actors agreed that the training for students at school is necessary and that it should continue without being dependent on the project. The provision of educational tools and the skill strengthening should enable activities to continue without the project’s assistance.

Involving the parents in the project helped to improve the spread of improved techniques for raising Carp in rice fields and to promote the local development of this activity. These parents can develop high value-added production, earning additional income for the family. The need to involve these players was reinforced by their requests for technical support.

Cette volonté de parvenir à la « démonstration » de la rizipisciculture a bien été affichée par les chefs d’établissements durant les ateliers, et les DREN ont fortement insité sur la nécessité d’avoir une « tâche d’huile positive ».

In contrast, the number of parents adopting these techniques relative to the number of students trained remained low. This appeared to be related to the need to see the successful results of an activity before embarking on it. This situation demonstrates the need for successful rice-fish farming activities amongst the adoptive parents as well as in the schools’ demonstration rice fields. School Principals expressed this desire for demonstration rice fields during workshops, and the DRENs strongly insisted on the need for a positive ‘ripple effect’.

Participants also discussed the possibility of organising themselves to facilitate technical exchanges between schools and parents, but also to gain access to an expanded fish market. The issue of fry supply was raised by proposing a training course for parents or teachers on the techniques of Carp reproduction.
The main lines of action proposed by participants in workshops for after the project are summarised below:

- **At the high school level:**
  - *With support from APDRA:*
    - Continue the training of students in the coming years; Sensitize new students and teachers and disseminate this activity to the neighbouring communities;
    - Continue raising Carp in the demonstration rice fields; if possible increase the surface area to obtain extra income for the school, to purchase equipment, a school canteen, etc.
  - *With support from APDRA:*
    - Enable the schools to become autonomous by training some of the teachers to breed fingerlings;
    - Encourage the exchange of experiences between FRAM, students and teachers, through the renewal of exchange visits.

- **At the parents’ level:**
  - *Without support from APDRA:*
    - Start raising Carp once training has been completed;
    - Group together to promote marketing of the grown fish and improve market access;
    - Set up a ‘model’ parents’ association to convince other parents of the benefits of rice-fish farming and encourage them to extend their children’s schooling thanks to the additional income generated.
  - *With support from APDRA:*
    - Renew exchange visits and continue training and support for Carp raising;
    - Receive training on the production on fry and receive support for the search for quality fry.
4.2 Conclusion from the IOC-SmartFish perspective

4.2.1 Value of APDRA’s participative approach and its self-assessment principle

As part of this innovative approach to rice-fish farming training through lower secondary school education, APDRA’s evolutionary intervention and its regular concern for participatory self-evaluation made it possible to move from the training of young adolescents via their teachers in Phase 1, to a technical and practical transfer of knowledge through means of demonstration rice fields in Phase 2, finishing with the integration of students’ parents and sustainable teaching measures through the establishment of teacher trainers in each school in Phase 3.

The positive ripple effect and small steps are imperative for success, together with emphasizing the feasibility and the benefits of rice-fish farming with stakeholders.

The progressivity of the activities and the notion of the ripple effect (optimised production) are based on an analysis of experiences of relatively unsuccessful rice-fish farming initiatives in recent decades in Madagascar.

These two notions, as well as issues affecting each rice-fish network of each school were well understood by partners and effective actions were put into practice in the management of the demonstration rice fields.

It is clear that this type of approach should be replicated, in whole or in part, to support the development of certain sectors. It should be recalled here the need to analyse the agro-economic context before starting this type of activity on a large scale so that it is compatible with the conditions under which the sector could develop. In the case of rice-fish farming, several prerequisites were present at the beginning of the initiative: availability of fingerlings, an attractive fish price, the need for family farms to increase the productivity of their rice fields due to increased pressure on land resources, etc.

Funding by two donors for a pooling of resources and complementarity of actions.

The training on rice-fish farming project in high schools in Madagascar was financed by the IOC-SmartFish programme together with the Agence Française de Développement.
This co-financing enabled:

- The pooling of human and material resources for the implementation of activities; since the latter were already in place at the start of the project in 2014, their efficiency was enhanced;

- The establishment of a real complementarity between activities financed solely by the IOC-SmartFish programme and those funded by the AFD, an example being the installation of the rural hatcheries with AFD funding that were necessary for the implementation of the school training project.

- Finally, this co-financing will have enabled Phase 3 to continue until June 2017, whereas the IOC-SmartFish programme is only financed until December 2016. June coincides with the agricultural calendar of the rice and fish harvest: this will make it possible to monitor the 90 rice fields for an optimum demonstration effect.

Figure 4: Financial and operational plan
4.2.2 Autonomy of the voluntary high schools through extracurricular activities: the right solution

After 23 of the 88 high schools dropped out of the project at the end of Phase 2, it was clear that the training should be:

- On a voluntary basis on the part of the high schools;
- Carried out during extracurricular periods: it cannot be incorporated in the national curriculum. Such a change to the national curriculum would take years to happen and would no doubt be inconclusive.
- Based on locations favourable for rice-fish farming, i.e. the presence of fry producers, good access to water, no danger of flooding and outside areas where the risk of fish theft is high.

The Department of Education was involved in and was supportive of the project. It was also clear to the Department that it was not conceivable to modify the general curriculum to include rice-fish farming, and that extracurricular activities vary according to region and that the choice of extracurricular activities rests with the institutions.

4.2.3 The creation and animation of an enabling network

An emerging fish-farming dynamic and socio-economic achievements

Stakeholders are now faced with the emergence of a dynamic sector that was not initially foreseen by the project. This has been supported by rice-fish farming exchange visits, which brought about both positive and unexpected interactions, which can be summarised as follows:

- Synergies between the APDRA-supported fingerling producers and the buyers that are the schools and parents. In the long term, this could become a high value-added economic activity (€ 2-3 per kg of fish), on the basis of existing irrigated rice fields and professional rural farmers who have successfully mastered the business.
- Parents of students in rural areas are satisfied that their children, 50 per cent of whom drop out of school in the 3rd grade, learn a profession that is of value on the family farm and potentially useful for their future.
- Principals and teachers are more highly valued in their community as well as with FRAM parents’ associations, who are, in part, their donors.
- In the long term, increased production on family farms in rural areas will have positive effects on latent malnutrition.
- Nutritional aspects are addressed in the teaching materials to attract the attention of the new generation to this problem, which is exacerbated in the Highlands.
**APDRA opens two locks with one key**

This approach to a rice-fish farming network through high schools will certainly remain one of APDRA’s and its donors’ modes of action in the Highlands.

Indeed, thanks to this type of intervention, the operator capitalizes and strengthens (1) its network of rural hatcheries, (2) trains children for the future and (3) reaches parents who own rice fields through the parents’ associations.


**Internet sites**


Annex A. The 11 modules of the DVD

The video is made up of 11 chapters, 9 of which are devoted to the knowledge required for the rice-fish farming of carp; the chapters are an average of 7.5 minutes long.

The video comes with an illustrated educational module for teachers.

The eleven modules covered in the film include the following:

1. Overview of the video, partner logos, acknowledgements, etc. (1 minute)
2. Theme 1: The school training project (5 minutes)
3. Technical information
   a. Definition of rice-fish farming
   b. Rice-carp association
4. Site selection and development
5. Fertilisation
6. Stocking density
7. Transportation and stocking
8. Food
9. Nutrition
10. Environment
11. Economic calculations