Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS) project

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

care

CGIAR

RESEARCH PROGRAM ON Livestock and Fish

WorldFish

IMPROVING EMPLOYMENT AND INCOME THROUGH DEVELOPMENT OF EGYPT'S AQUACULTURE SECTOR (IEIDEAS) PROJECT

Authors

Malcolm Dickson, Ahmed Nasr-Allah, Diaa Kenawy, Mohamed Fathi, Gamal El-Naggar and Nabil Ibrahim

Citation

This publication should be cited as: Dickson M, Nasr-Allah AM, Kenawy D, Fathi M, El-Naggar G and Ibrahim N. Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS) project. Penang, Malaysia: WorldFish. Program Report: 2016-14.

CONTENTS

LIST OF ACRONYMS

BMP	best management practice
CLAR	Central Laboratory for Aquaculture Research
EGP	Egyptian pound(s)*
FCR	feed conversion ratio (amount of food fed divided by fish weight gain)
FTE	full-time equivalent (jobs)
g	gram(s)
G9	Generation 9 of the Abbassa improved strain of Nile tilapia
GAFRD	General Authority for Fisheries Resource Development
ha	hectare(s); 1 feddan = 0.42 ha
IEIDEAS	Improving Employment and Income through Development of Egypt's Aquaculture Sector
L&F	CGIAR Research Program on Livestock and Fish
M4P	"making markets work for the poor"
SDC	Swiss Agency for Development and Cooperation
t	metric ton(s)
USD	United States dollar(s)*

* Exchange rates:
USD 1 = EGP 6.03 (January 2012) to EGP 7.15 (December 2014)

EXECUTIVE SUMMARY

The Swiss Agency for Development and Cooperation (SDC)-funded Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS) project was implemented by WorldFish in partnership with CARE Egypt and the Egyptian Ministry of Agriculture and Land Reclamation from 2011 to 2014 and later extended to November 2015.

The project focused on four governorates with significant aquaculture production—Kafr El Sheikh, Behera, Sharkia and Fayoum—and one governorate, El Mineya, where aquaculture was a new activity. The main objective was to increase aquaculture production by 10% and create 10,000 jobs. Other objectives included improving profitability for existing producers, securing employment for women fish retailers, expanding aquaculture in El Mineya and improving the policy environment for aquaculture.

The project provided best management practice training to around 2400 fish farmers and released a faster-growing strain of Nile tilapia, the Abbassa improved strain, to the sector through broodstock multiplication centers and hatcheries, reaching around 500 fish farms in 2014. Six women fish retailer organizations were formed under existing community development associations and were supported through training, small grants for equipment such as iceboxes, and self-help loan schemes (through village savings and loan associations), while in Fayoum a dedicated market space was established.

The project also provided support to existing and prospective fish farmers in El-Mineya and facilitated the establishment of an aquaculture innovation platform, resulting in six working groups focused on the main policy issues affecting the aquaculture industry, while the main aquaculture producer organization was given capacity-building support.

In 2015, the project team focused on assessing the quantitative impacts of the IEIDEAS project through three field-based surveys: a best management practice adoption survey to determine whether fish farmers had applied the recommended practices, a fish farm and farmer impact assessment survey, and a retailer survey to assess the degree to which project-assisted retailers had benefitted.

The project resulted in greatly increased profitability for fish farms (equivalent to around USD 16,000 in extra profit generated per farm, USD 27 million total value added by the project). Increased profitability was mainly achieved by cost savings through more efficient feed management rather than increased production. This will result in reduced environmental impacts (greenhouse gas emissions and nutrient discharges). However, the directly attributable increase in fish production was only 200 metric tons (t) per year. Earlier studies had established that 14 full-time equivalent (FTE) jobs are created along the aquaculture value chain for each 100 t per year of production, suggesting that only 28 FTE had been added by the project by the end of 2014. Clearly, this fell well short of the target of 10,000 jobs. However, this target is likely to be met as a result of project interventions as the use of the Abbassa strain expands and farmers invest their profits from improved practices in intensification of production.

The work with women retailers has increased understanding of this vulnerable group and led to the development of a toolkit of approaches that could be scaled out to other communities. The main benefit achieved appears to have been the empowerment that they gained from being able to work together in a group and advocate for their rights with local authorities and other value chain actors, such as wholesalers.

Different types of fish farms were tested in El Mineya and could serve as models for other non-aquaculture governorates and for integrated aquaculture-agriculture systems, while the innovation platform was an effective vehicle for policy progress in a difficult political environment.

The IEIDEAS project has resulted in a follow-up project, also supported by SDC and managed by WorldFish in collaboration with CARE and the Ministry of Agriculture and Land Reclamation. The 3-year Sustainable Transformation of Egypt's Aquaculture Market System (STREAMS) started in December 2015 and has three main activity areas:

- continued support for best management practice training and dissemination of the Abbassa strain, with more responsibility taken by strengthened regulatory authorities and producer organizations
- the creation of opportunities for small-scale aquaculture and integrated aquaculture-agriculture through pilot-testing and policy change
- improved market prospects for aquaculture products through support of retailers and provision of market information.

INTRODUCTION

Egypt has a significant aquaculture sector that produces over 1 million metric tons of fish per year and provides around 65% of the fish eaten by Egyptians (GAFRD 2014).

The SDC-funded project Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS) was implemented from 2011 to 2014. The project was managed by WorldFish in partnership with CARE Egypt.

The project was based on a value chain analysis conducted by WorldFish in September 2011 that identified the aquaculture value chain as a significant employer, particularly in rural areas. The analysis suggested that there was scope to increase employment of youth and women in the aquaculture sector (Macfadyen et al. 2011; Macfadyen et al. 2012).

While the value chain analysis indicated that the industry was sustainable and generated considerable profits and employment, estimated at 14 jobs per 100 t per year of fish production, equivalent to 100,000 FTE, it also suggested that the sector was under increasing financial pressure. Feed prices had risen by 200%–250% in the previous 7 years, while fish selling prices were declining in real terms. The study suggested a series of issues that could be addressed to improve profitability along the value chain and that could result in sustained growth of employment.

The main activity area for the project was to improve productivity and increase employment in existing fish farms, mainly through best management practice training of fish farmers, but also through releasing a faster-growing strain of Nile tilapia (the Abbassa strain developed by WorldFish) to the sector.

The value chain analysis identified that a substantial number of women were employed in fish retailing. However, they faced a wide range of challenges. Testing approaches to reduce their vulnerability and improve their incomes was selected as a second activity area for the project.

Almost all Egyptian aquaculture takes place in designated aquaculture zones on the southern margins of lakes, including Burullus, Manzala, Edko and Quaron. The third activity area for the project was to test approaches to development of aquaculture in the Upper Egyptian governorate of El Mineya, outside of these designated zones, but in an area with relatively high poverty rates and high demand for fish.

The fourth activity area was to improve the policy and institutional environment for sustainable development of the aquaculture sector.

The project had the following objectives (see Annex 1 for logframe):

Project goal: To create 10,000 jobs in the Egyptian aquaculture value chain through support for the sector in five governorates, benefitting 50,000 household members; to build a more secure future for the sector; and to contribute to the nutritional health of low-income consumers.

End of project indicators:
- 10,000 jobs created, including 900 decent jobs for women retailers
- net income in target enterprises increased by USD 8.8 million
- project benefits extended to 2000 fish farms, 100 wholesalers and 900 retailers by end of project
- access to quality fish maintained or enhanced for low-income consumers.

Project outcomes:
- productivity and sustainability of existing fish farms in Sharkia, Kafr El Sheikh, Behera and Fayoum improved
- livelihoods and working conditions of women fish retailers improved through pilot-scale interventions in Sharkia, Kafr El Sheikh, Behera, Fayoum and El Mineya
- farmed fish production increased in El Mineya, including pro-poor aquaculture and reduced environmental impact systems
- efficient and sustainable value chains in the aquaculture sector and optimal institutional, policy and regulatory frameworks facilitated.

Outcome indicators are detailed in Annex 1. Overall project management was by WorldFish, with management of outcomes 2 and 3 subcontracted to CARE Egypt. A project management committee with representatives from WorldFish and CARE met on a monthly basis to discuss project progress and to agree on upcoming work plans. The management committee reported to a project steering committee, co-chaired by the Director of the Agriculture Research Center of the Ministry of Agriculture and Land Reclamation and a representative from SDC.

Woman retailer selling fish at a fish market in Kafr El-Sheikh.

Background

This outcome focused on providing high-quality seed (the Abbassa improved strain of Nile tilapia) and technical best management practice training to fish farmers in Kafr El Sheikh, Behera, Sharkia and Fayoum.

Dissemination of the Abbassa improved strain

WorldFish staff, assisted by staff from the Central Laboratory for Aquaculture Research (CLAR), conducted a value chain analysis study of the Egyptian fish seed sector in March and April 2012. This study involved focus group discussions and individual interviews with hatchery operators and fry and fingerling traders in Sharkia, Kafr El Sheikh, Behera and Fayoum. The complete dataset covered responses from 50 individual interviews and 4 focus group discussions with hatchery operators, as well as interviews with 8 fry and fingerling traders. Results from the study were published (Nasr-Allah et al. 2014a; Nasr-Allah et al. 2014b).

Mapping of the fish seed value chain revealed that expansion of Egypt's aquaculture industry has been matched by the development of a large number of tilapia hatcheries, nearly all producing sex-reversed, all-male fry and fingerlings. Hatcheries use a range of technologies, from simple *hapa*-based systems (small net enclosures installed in ponds) to greenhouse-covered tanks and systems incorporating water heating to advance and lengthen the spawning season. Most of the hatcheries' production (95%) is sold as fry (soon after sex reversal) rather than fingerlings and is sold directly to production farms, rather than through fry and fingerling traders. Some of the hatcheries are part of an integrated fish farm including both hatchery and production systems.

An average Egyptian tilapia hatchery produces around 10 million seed and employs five or six FTE, with 59% of the employees under 30 years old. If overall tilapia seed production is estimated at 3.5 billion, there may be over 400 hatcheries, employing 2000 FTE. Despite low seed prices, hatcheries appear to be highly profitable, with average net profits of 44% of sales and average total value added of EGP 24,430 (USD 3500) per million fry.

While fry and fingerling traders play a limited role in linking tilapia hatcheries with producers, they play a major role in the mullet fry and fingerling trade, where seed are wild-caught from the Mediterranean shoreline (Azazy et al. 2012). Fry caught through the official General Authority for Fisheries Resource Development (GAFRD) system are distributed to licensed fish farms according to a quota system. However, an unknown and much larger number of mullet fry are now caught by unlicensed fishers and supplied to fish farms, often through fry and fingerling traders. Fry and fingerling traders generate relatively few jobs (0.55 FTE per million fry sales) but generate reasonable profit levels (29% net profit).

According to the value chain analysis, the main issues facing tilapia hatchery operators were access to capital, broodstock quality, hormone quality, water quality and availability, labor and management skills, power costs and availability, land availability and tenure, fish health management, declining prices, fluctuating prices, and getting permission to transport fry. The study also made it more apparent that the production benefits, and hence the directly attributable employment from dissemination of the improved strain, would take time to materialize, as it takes time to disseminate a new strain to several thousand small fish farms.

The results of the study helped to develop an IEIDEAS project seed dissemination strategy (Figure 1) in which mixed-sex broodstock were distributed to strategically located multiplication centers, which then sold broodstock to hatcheries with the aim that the hatcheries would supply all-male improved strain fry to fish farms.

The broodstock multiplication centers were supplied with mixed-sex ninth generation (G9) Abbassa strain fry in July 2012. These fish were on-grown for the remainder of 2012 and transferred to breeding systems in the broodstock multiplication centers at the start of

IMPROVING PRODUCTIVITY AND SUSTAINABILITY OF EXISTING FISH FARMS

the 2013 season. The broodstock multiplication centers also produced 4.7 million mono-sex fry that were sold to 45 fish farms in 2013 and 6.1 million mono-sex fry that were sold to 48 farms in 2014 (Table 1). WorldFish also supplied additional broodstock to the broodstock multiplication centers to compensate for any losses or additional requirements for them to achieve targets.

By the end of 2014, there were 11 broodstock multiplication centers and 159 hatcheries with the improved strain (Table 1). This makes up a significant proportion of the hatchery industry, which was estimated to comprise around 400 hatcheries in 2012.

While early estimates suggested that the hatcheries had stocked 1200 fish farms in 2014, direct follow-up with the hatcheries and broodstock multiplication centers in 2015 showed that only around 459 fish farms were stocked with the improved strain in 2014 and that the total number of improved strain stocked into fish farms was 109 million. It emerged that most hatcheries supplied multiple batches of fry to the same fish farms or to their own ponds in integrated hatchery-fish farms, rather than to many different fish farms. Many hatcheries complained that their broodstock were too small to breed at the start of the 2014 season, when demand was at its highest. Hatcheries did not face this constraint in 2015, as their broodstock were larger at the start of the season.

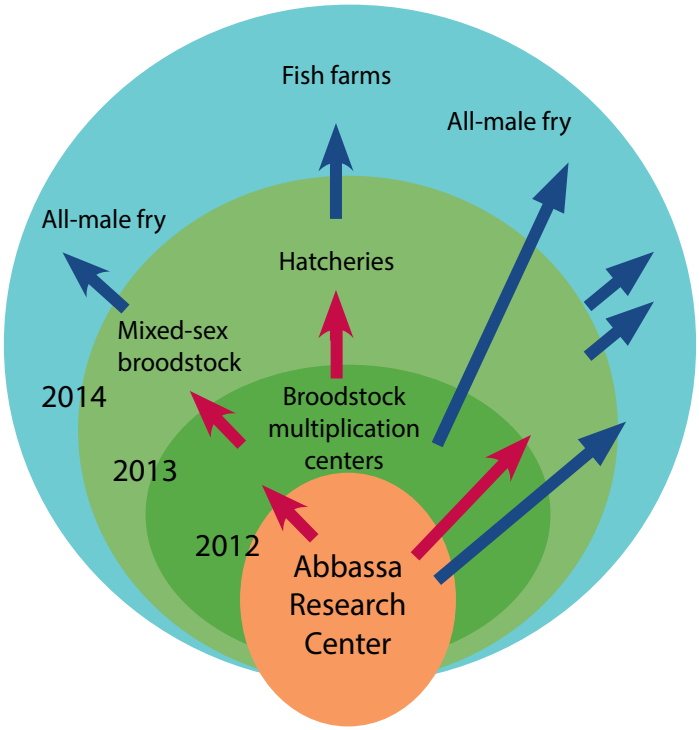


Figure 1. Abbassa improved strain dissemination strategy.

	Kafr El Sheikh	Behera	Sharkia	Fayoum	El Mineya	Other	Total
Broodstock multiplication centers	4	2	1	2	1	1	11
Hatcheries	89	13	50	1		6	159
Farms	255	30	90	31	26	27	459
Number of seed stocked (million)	78.1*	12.5	3.6*	3.9	1	10	109.1

* Estimated, as it was not possible to collect information from all the hatcheries.

Table 1. Broodstock multiplication centers, hatcheries and fish farms with the Abbassa improved strain in 2014.

The revised logframe target that 2000 fish farms would be stocked with the improved strain by the end of project was not achieved in 2014, but current estimates suggest that it has been achieved in 2015, as more improved-strain seed was available and there was strong demand from fish farms.

Meanwhile, WorldFish has continued to develop the Abbassa improved strain of Nile tilapia. The 13th generation was produced in 2014–2015, which should perform significantly better than the G9 released to fish farms under the IEIDEAS project. It has not yet been decided when the next release will be made to the broodstock multiplication centers, but it would be logical to wait until the impacts of G9 have been fully evaluated before releasing the next generation.

Best management practice training

The development of aquaculture best management practice guidelines started in late March 2012 with a field survey of existing practices, followed by a best management practice drafting workshop and review of best management practices in governorate-level workshops.

During the field survey, data on existing practices in target governorates was collected through a combination of focus group discussions (5) and individual interviews (65) using a standard questionnaire. These were compiled and used to inform discussions during the best management practice drafting workshop, which was held in Abbassa during 14–15 May 2012 and brought together WorldFish staff and a group of nine experienced aquaculture producers to produce a first draft of the best management practices.

Examples of existing aquaculture best management practices were presented to the participants: GLOBAL Good Agriculture Practices (GLOBALGAP) Smallholder Aquaculture Standards and Aquaculture Stewardship Council (ASC) Tilapia Aquaculture Standards. Results from the field survey were presented and a list was drawn up of the 10 main topics that should be covered by IEIDEAS: site selection and pond design, pond preparation, stocking rates and species, fertilization and feeding, water management, fish health management, harvest and postharvest treatment, marketing, record keeping, and social responsibilities. Draft best management practices were developed by the group and refined at governorate-level workshops (Kenawy et al. 2013).

A group of potential farmer trainers attended a 2-week training of trainers course in Abbassa in September 2012. The aim was to develop a cadre of trainers to deliver field training to fish farmers, based on best management practices. The training focused on developing the technical knowledge of trainers while also improving their training skills and developing the materials that they would use during farmer training. Field training by farmer trainers started in mid-October 2012. A further training of trainers course was held in March 2013 for 15 more trainers.

By the end of December 2014, more than 3000 training sessions had been delivered across the five project governorates. The highest number was in Kafr El Sheikh (1340 sessions), followed by Sharkia (886 sessions), Fayoum (635 sessions), Behera (382 sessions) and El Mineya (44 sessions).

Table 2 shows the number of training sessions and trainees attending the training. Two of the trainers developed very active programs, delivering over 750 training sessions each, while another 12 trainers delivered between 44 and 312 training sessions. By December 2014, a total of 5813 training sessions had been delivered, with an average of 9.7 trainees at each session.

While original training session plans covered only 10 subjects, some of these were subdivided so that trainers reported against delivery of 15 subjects. The most frequently delivered training session was on pond preparation (271 sessions), followed by water management (258 sessions) and site selection (250 sessions), while postharvest treatment (162 sessions), fish sampling (170 sessions) and record keeping (174 sessions) were delivered less often. Figure 2 shows the number of trainees in each subject. The average number of trainees trained in each subject was 2027, while the total number of trainees attending at least 80% of the training sessions, and counted as graduates of the training program, was 2400.

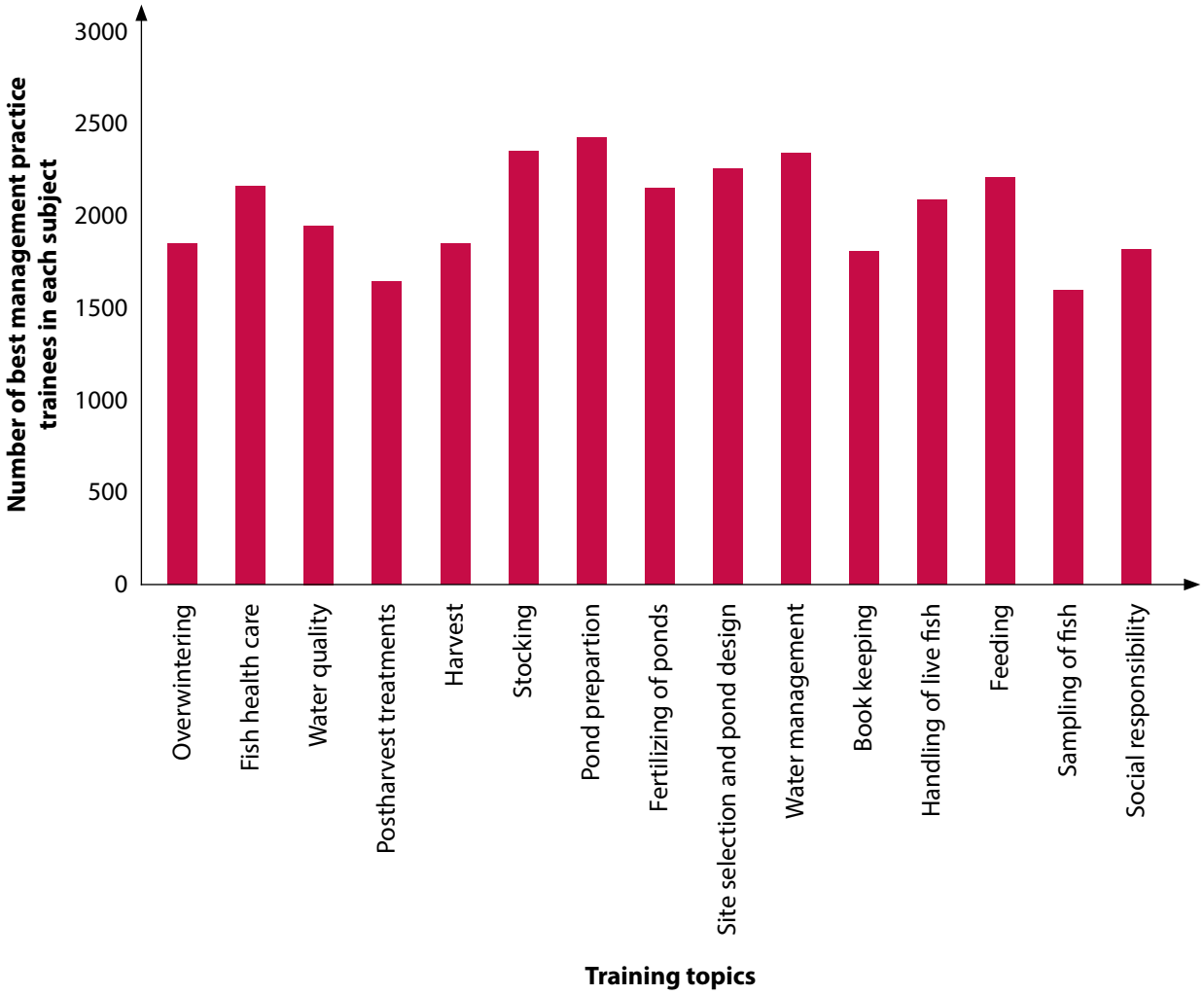


Figure 2. Number of best management practice trainees in each subject (October 2012–December 2014).

Best management practice trainer	Governorate	Number of trainees*	Number of training sessions
Sayed Desouky	Sharkia	6,387	804
Ahmed Sany	Kafr El Sheikh	8,350	771
Hassan Ali	Fayoum	3,276	321
Hesham Zaghloul	Fayoum	2,324	267
Salah Ibrahim	Kafr El Sheikh	2,626	248
Hossam Ezz El Den	Kafr El Sheikh	2,432	246
Ameer Sany	Behera	1,631	196
Mohamed A. Mohsen	Sharkia	1,430	89
Mohamed Kord	Kafr El Sheikh	810	76
Khalid Kammoun	Behera	794	74
Youssif Garana	Kafr El Sheikh	486	49
Mohamed Qader	Multiple	528	48
Mahmoud Saleh	Fayoum	536	47
Gamal El Azazy	El Mineya	193	44
Attef Abdel Gawad	Behera	74	5
Mohamed Abou El Dahab	Kafr El Sheikh	34	1
Yaser Emam	Kafr El Sheikh	34	1
Total		**31,945**	**3,287**

* Number of trainees = trainees at each session multiplied by the number of sessions.

Table 2. Training sessions and trainees trained by the best management practice trainers (October 2012–December 2014).

The best management practice training has been complemented by the production of 10 short films on the main training topics (WorldFish 2013) and best management practice training for hatcheries (Nasr-Allah et al. 2014c).

While the original plan was for training to be managed by aquaculture producer organizations, in practice they were too weak—or in some cases, nonexistent—which made it necessary to organize and deliver through farmer trainers, supported directly by the project. After the end of the IEIDEAS project, private sector actors such as feed companies can take responsibility for some aspects of the best management practice training, while still engaging strengthened aquaculture producer organizations that have received capacity-building support under the project.

Through collating information from the best management practice training and adding information from GAFRD and the governorate-level fish farmer associations, IEIDEAS project staff have been able to develop a farmer and fish farm database. By December 2014, the database included 3715 fish farms and fish farm owner records (out of an estimated total of 6000–10,000 fish farms in the country) and was used as the main source for random selection of fish farms during the impact assessment.

Best management practice adoption study

Study methodology and approach

The first step in impact assessment was to carry out a study to estimate the rate of adoption of the best management practices by fish farmers who had received training organized by the IEIDEAS project. This study was intended as a preparatory activity for the more detailed impact assessment. Farmers that received best management practice training could have chosen to adopt none, some or all of the recommended practices. It is clearly futile to attempt to assess impacts of best management practice training unless the principles of the training have been adopted and applied.

Project staff and farmer trainers selected a stratified random sample of best management practice trainees from the project database. Table 3 shows the sample sizes surveyed in each governorate.

Table 4 outlines all 15 of the best management practice training topics, the main indicators for the recommended practices, and the threshold level that indicates whether a farmer has adopted this practice or not.

Results

Figure 3 displays the degree of importance attached to the various best management practice training topics by the respondents. The topics rated as most important were pond preparation and feed management, followed by pond fertilization, pond stocking and water quality management.

Table 5 provides a detailed breakdown of the degree of adoption of the best management practices related to pond design and pond preparation and maintenance, as well as a selection of other best management practice topics. The adoption of changes in pond design was not very high due to the considerable capital investment required. Most of those who had adopted these best management practices modified the pond area, the water inlet and outlet, the pond ditch, and the catch pond. The topics related to pond preparation showed higher adoption rates, with the majority drying their ponds after harvest and maintaining dikes and pond bottoms.

More than half (61%) of best management practice-trained farmers adopted a change in stocking rate. Most fish farmers (77%) applied pond fertilization techniques during the grow-out phase for an average period of 13 weeks. In addition, a majority of respondents changed their feeding practices (93%) and most achieved lower feed conversion ratios (FCRs; average of 1.48), which is very much in line with the recommended indicator for the adoption of this best management practice. Adoption of the best management practices related to fish health was quite high (91% and 69%). This is likely due to the importance placed on this topic by farmers who have either experienced or heard about disease outbreaks and are eager to avoid financial loss. Changes in fish sampling and in overwintering practices were also highly adopted.

The farmers who reported high adoption rates (70% of the total) were selected as the main population for the impact assessment study (Table 6).

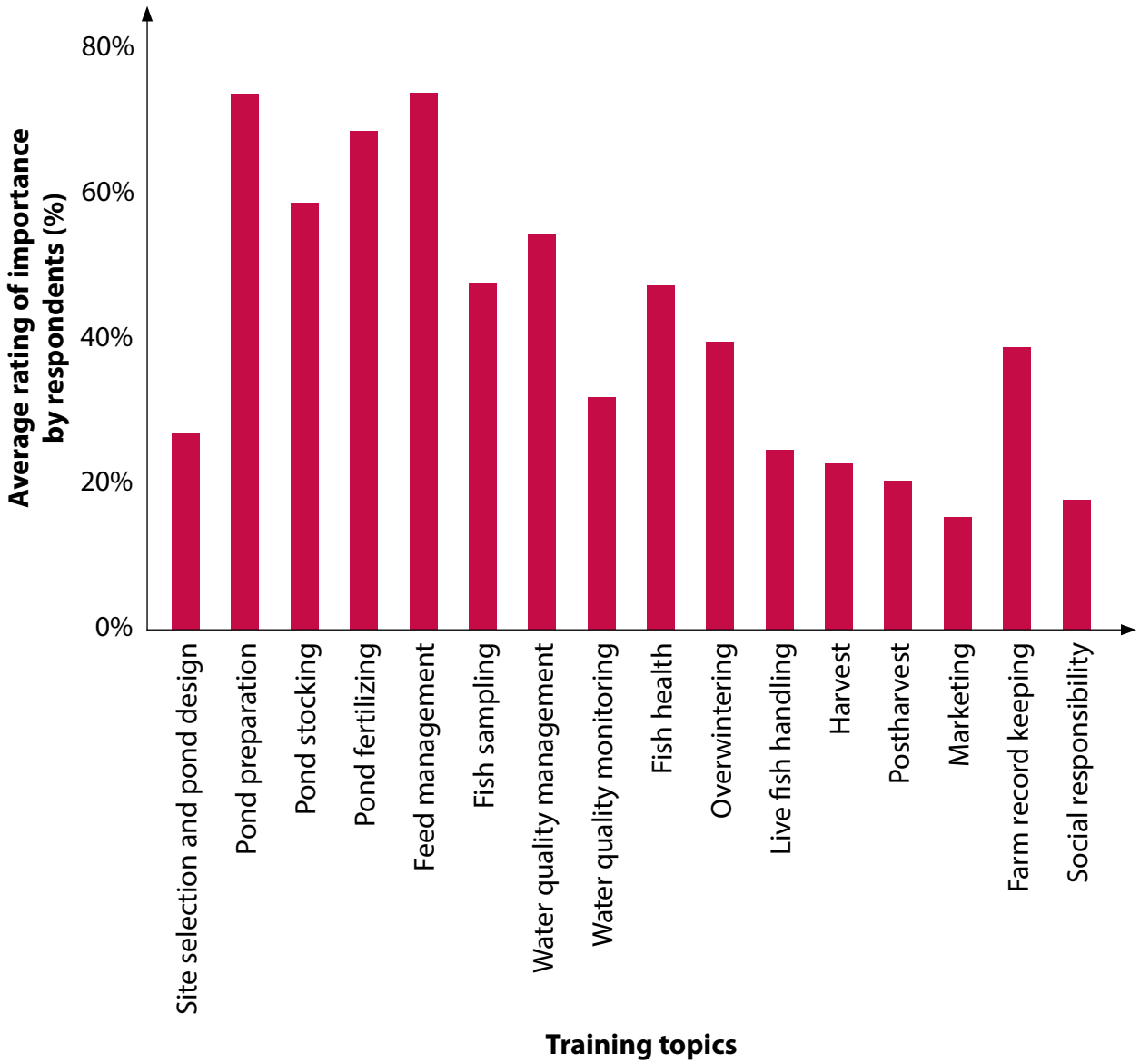


Figure 3. Respondents' average rating of importance for each best management practice training topic.

Governorate	Total number of best management practice trainees	Number of trainees interviewed
Behera	299	35
Fayoum	427	92
Kafr El Sheikh	818	136
Sharkia	666	112
Total	**2,210**	**375**

Table 3. Sample size for best management practice adoption survey.

Training topic	Indicator associated with recommendation	Threshold for adoption
Feed management	Has a proper feed conversion ratio	1.3–1.7
	Has made a partial shift to good-quality feed	Yes
Pond fertilization	Uses fertilizer (for small stocked fish)	3–6 weeks of fertilization
Fish sampling	Uses fish sampling for adjusting feeding rate	Yes
Water quality management	Has adapted water exchange rate	Reduction in number of hours spent pumping water
Water quality monitoring	Conducts water measurement (oxygen, ammonia)	Yes
Pond preparation	Dries ponds after harvest	Yes
	Uses screens for water inlet and outlet	Yes
Pond stocking	Has changed the stocking rate	15–25 thousand seed/ feddan
Fish health care	Uses disinfection during pond preparation	Yes
	Practices proper handling of dead fish (burying them using lime)	Yes
Overwintering	Ponds have sufficient water depth	> 150 cm
	Has shelter in ponds	Yes
Site selection and pond design	Has modified pond design (e.g. added water inlet and outlet)	Yes
Social responsibility	Medical check-up of farm workers and their families	Yes
	Provides workers with safety equipment and protective clothing	Yes
Record keeping	Keeps records on seed (source, stocking rate per pond)	Yes
	Keeps records on feed (source, type, application per pond)	Yes
	Keeps records on fish sampling (size, dates)	Yes
	Keeps records on water quality measurements	Yes
	Keeps records on harvest (volume, grades)	Yes
Marketing	Keeps records on prices of fish per pond, grade and buyer	Yes
Live fish handling (from nursery to pond)	Practices proper preparation of equipment before harvest	Yes
	Acclimatizes fish before stocking	Yes
Harvest and postharvest	Packs fish in crates in a proper way (changed method of packing, includes ice and packs fish that are clean)	Yes

Table 4. Full list of best management practice training topics with associated indicators for the recommended practices and threshold level for adoption by farmers.

Best management practice topic	Adoption criteria	Behera	Fayoum	Kafr El Sheikh	Sharkia	Average
Pond design	Modified pond design in last 2 years	20%	27%	31%	31%	29%
	Modified pond area	86%	68%	81%	51%	69%
	Modified water inlet and outlet	57%	60%	57%	63%	60%
	Modified ditch and catch pond	57%	80%	60%	77%	70%
Pond preparation and maintenance	Changed pond preparation	71%	88%	82%	81%	82%
	Drying pond after harvest	100%	95%	95%	88%	94%
	Fixed screens on water inlets	88%	56%	50%	60%	57%
	Maintaining dikes and pond bottom	100%	67%	82%	97%	84%
Pond stocking	Changed stocking rate	60%	58%	66%	59%	61%
	Average stocking rate (1000s of seed per feddan)	19.9	13.8	16.6	14.1	14.71
Pond fertilization	% fertilized ponds	86%	65%	96%	62%	77%
	Fertilization period (weeks)	17.05	7.12	16.51	7.81	13.20
Feed management	Change in feeding practice	91%	36%	57%	92%	93%
	Feed conversion ratio	1.77	1.61	1.53	1.67	1.48
	Change in fish sampling in last 2 years	83%	64%	70%	61%	67%
	Intervals between fish samples (days)	16.83	21.57	16.47	16.37	16.76
Fish health	Disinfecting pond bottom	89%	91%	96%	87%	91%
	Disposing of dead fish	91%	63%	79%	56%	69%
Overwintering	Changed overwintering practices	80%	57%	57%	58%	60%
Abbassa strain	Stocking Abbassa strain	9%	26%	17%	17%	18%

Table 5. Degree of adoption of best management practice training topics.

Governorate	Number	High adoption > 50%	Medium adoption 30%–50%	Low adoption < 30%
Behera	34	31	2	1
Fayoum	92	57	30	5
Kafr El Sheikh	136	108	25	3
Sharkia	113	68	32	13
Total	**375**	**264**	**89**	**22**

Table 6. Numbers of respondents that adopted best management practices divided into three categories (low, medium and high adoption).

Farm impact assessment

Study methodology and approach

This study covered four governorates in which the IEIDEAS project carried out activities and in which there were established fish farming zones: Behera, Fayoum, Kafr El Sheikh and Sharkia.

A stratified random sampling framework based on the IEIDEAS project farm and fish farmer database was established with the aim of comparing results from the main project interventions. The groups used for comparison were as follows: (1) farms where the fish farm operator had received best management practice training (BMP); (2) farms that had been stocked with the Abbassa improved strain of Nile tilapia (Abbassa); (3) farms where both interventions were applied (BMP + Abbassa); and (4) a control group of fish farms that had no previous involvement with the IEIDEAS project (control). The sampling framework was designed in consultation with staff from the Policies, Economics and Social Sciences departments of WorldFish and an impact assessment scientist at the International Livestock Research Institute (ILRI).

The IEIDEAS project farm and fish farm database was compiled using data collected during the best management practice training, as well as using sales records from hatcheries disseminating seed of the Abbassa improved strain. Additional data came from databases held by GAFRD on licensed fish farms and farms that have been fined for operating without a license. The total number in the database stood at 3715 farms in December 2014. The total number of fish farms in Egypt is unknown but has been estimated at between 6000 and 10,000.

Farmers in the BMP group were pre-qualified for selection through the best management practice adoption survey. Only farmers classified as high adopters (using identified thresholds; 70% of the total number of farmers interviewed for the best management practice adoption survey) were included in the list to be used for randomly selecting impact assessment survey participants. The rationale behind this approach was that it did not make much sense to assess impacts if the farmers in question were not applying the recommended practices. Fish farms in the Abbassa group were randomly selected from the list of farms supplied with the Abbassa strain by hatcheries and broodstock multiplication centers. Farms that had received the combination of the Abbassa strain and best management practice training (BMP + Abbassa) were selected by merging and manually cross-checking the two lists. The primary sources for identifying control group fish farms were the GAFRD databases.

Questionnaire design and fieldwork

The study used a structured questionnaire that focused on measuring project impact in terms of farm production, productivity and financial performance. The questionnaire was drafted in English for discussion, then translated from English into Arabic and field tested at the WorldFish Research Center in Abbassa, Sharkia, before being finalized for use in the field. The final version of the questionnaire was incorporated into the open data kit KoBoCollect 1.4.3 (1039) to enable the digital execution of data collection using tablets and smartphones. KoBoCollect allows users to carry out surveys or to collect data (in a synchronous fashion) that are compiled into a database for future downloading and aggregation as necessary. Where tablets or smartphones were unavailable during the survey, hard copies of the questionnaire were used.

The fieldwork could not commence until almost all the farms had harvested fish that were stocked in 2014. Consequently, the start was delayed until May 2015. The study team consisted of four staff from WorldFish plus two IEIDEAS farmer trainers (the trainers varied between governorates). The trainers provided support in identifying the selected farmers and inviting them for interview. In order to maximize the number of interviews and increase the efficiency of fieldwork, the general approach used was to invite selected farmers in groups to meet the study team at a central location.

Each meeting started with introductory comments, followed by individual interviews that lasted for approximately 1 hour. Two meetings per day were arranged to give time for side discussion with invited farmers before and after each interview. This approach worked well with farmers who had received best management practice training, but for other farmer groups (Abbassa and control), individual farm visits were more effective.

Randomized selection of interviewees meant more time was taken in data collection than was anticipated, and the start of Ramadan in June 2015 caused further delays. Although the original sampling framework anticipated a

total of 372 interviews (93 for each group), only around half this number had been completed by early November when field data collection was terminated. Table 7 shows the distribution of interviews between groups and across the four project governorates.

At the end of each interview, the combined data was downloaded from the KoBoCollect website as a Microsoft Excel file and aggregated by governorate and by group. Data was checked for validity with the interviewer responsible for completing the interview. The data was then analyzed to generate the outputs presented in this report.

Results

Table 8 displays descriptive information about the respondents. The mean number of years of experience as a fish farmer was 16, mean age was 41.7 years and mean family size was 5.5 persons. There were no significant differences (at 5% confidence level) between the governorates or among groups.

Table 9 describes the farms managed or owned by the respondents. While the overall mean farm area was almost 8.35 hectares (ha), with 7.72 ha of that area used for aquaculture ponds, there were marked differences in farm areas between governorates. The mean whole farm area was

Governorate	BMP	Abbassa	BMP + Abbassa	Control	Total
Behera	15	5	2	12	34
Fayoum	14	0	6	14	34
Kafr El Sheikh	31	6	8	20	65
Sharkia	22	12	6	10	50
Total	**82**	**23**	**22**	**56**	**183**

Table 7. Number of fish farm impact assessment interviews, May–November 2015.

Governorate	Category	Number	Mean number of years experience as a fish farmer	Mean age (years)	Mean family size	Number who received best management practice training	Number who received Abbassa strain
Behera	Control	12	19.5	42.3	7.3	1	1
	BMP	15	13.2	37.8	5.5	15	4
	Abbassa	5	17.0	45.8	8.0	2	5
	BMP + Abbassa	2	16.5	47.5	8.0	2	2
Fayoum	Control	14	14.8	43.6	5.5		
	BMP	14	9.3	37.8	4.6	14	2
	Abbassa	0					
	BMP + Abbassa	6	9.3	43.2	5.7	6	6
Kafr El Sheikh	Control	20	16.1	43.5	6.1		
	BMP	31	17.5	38.6	4.5	31	11
	Abbassa	6	24.2	44.7	4.0	3	6
	BMP + Abbassa	8	14.9	40.8	4.0	8	8
Sharkia	Control	10	15.3	44.6	6.0	9	9
	BMP	22	17.5	41.2	5.7	22	2
	Abbassa	12	20.2	45.7	5.8	5	12
	BMP + Abbassa	6	12.5	44.2	5.3	6	6
Overall mean		183	16.0	41.7	5.5	124	74

Table 8. Descriptive information on respondents.

10 ha in Sharkia compared to 8.9 ha in Kafr El Sheikh, 7.5 ha in Behera and only 3.9 ha in Fayoum. This reflects the relative availability of land and the leasing or land ownership patterns in each governorate (Hebicha et al. 2013). The differences in farm size between governorates were also seen in grow-out pond numbers and pond sizes. Farms in Sharkia had the largest ponds (mean 1.83 ha), followed by Behera and Kafr El Sheikh (where there tend to be more, smaller ponds) and Fayoum (mean pond size only 0.79 ha). There were also differences in the average farm areas when divided by project group: the mean farm area used in the control group was 7.2 ha, compared to 8.0 ha in the BMP group, 10.1 ha in the Abbassa group and 5.6 ha for BMP + Abbassa farms.

Table 10 shows information on stocking and growth patterns for each of the main species, averaged across all governorates and types of farm. Tilapia comprise around 85% of the fish

Governorate	Project status	Number	Mean farm area (ha)	Mean farm area used (ha)	Mean number of nursery ponds	Mean number of grow-out ponds	Mean size of grow-out ponds (ha)
Behera	Average		8.26	7.49	1.59	6.38	1.33
	Control	12	6.5	5.8	1	5	1.3
	BMP	15	8.3	7.4	2	5	1.4
	Abbassa	5	12.2	11.7	2	14	1.3
	BMP + Abbassa	2	8.4	7.6	3	7	1.3
Fayoum	Average		4.35	3.90	1	4.53	0.79
	Control	14	3.7	3.5	1	4	0.7
	BMP	14	4.5	3.9	1	4	0.8
	Abbassa	0					
	BMP + Abbassa	6	5.4	4.8	1	6	1.1
Kafr El Sheikh	Average		8.89	8.08	1	6.49	1.33
	Control	20	11.3	10.0	1	9	1.2
	BMP	31	8.1	7.4	1	5	1.4
	Abbassa	6	10.2	9.3	0	7	1.4
	BMP + Abbassa	8	5.3	4.9	1	6	1.2
Sharkia	Average		10.42	10.02	1	5.78	1.83
	Control	10	8.9	8.6	0	5	2.0
	BMP	22	12.2	11.7	1	6	2.1
	Abbassa	12	10.2	9.8	1	7	1.3
	BMP + Abbassa	6	6.8	6.8	1	4	1.7
Overall mean		183	8.35	7.72	1	6	1.37

Table 9. Farm size, number of ponds and pond areas.

Species	Tilapia	Grey mullet	Thin-lipped mullet
Mean stocking density (number/ha)	35,677	1,128	2,506
Mean seed size (g)	7.5	23.9	19.0
Mean losses (%)	12	11	8
Mean harvest size (g)	298	421	225

Table 10. Average stocking densities, seed size, losses and harvest sizes for each fish species.

stocked at the start of the growing cycle, grey mullet around 5% and thin-lipped mullet 10%. Mullet (which are sourced from wild stocks in the Mediterranean) tend to be stocked as fingerlings of around 20 grams (g) average weight, whereas tilapia are bred in hatcheries and stocked at only 7.5 g average weight. The larger size of mullet seed at stocking means there are fewer mortalities than for tilapia. Significant tilapia mortalities have also occurred in recent years during the summer, whereas mullet appear to be more resistant to the as yet unidentified problem. The mean harvest size for tilapia was just under 300 g compared to a mean harvest size of 420 g for grey mullet and 225 g for thin-lipped mullet.

Figure 4 illustrates one aspect of how farmer behavior changed as a result of project interventions, and particularly the best management practice training. Farmers in the BMP and Abbassa groups tended to stock fewer fish than the control group. The rationale behind reducing stocking rates is that it is better to stock fewer fish per unit area and practice efficient feed management that will result in larger average fish sizes at harvest, as wholesalers pay more (EGP per kilogram [kg]) for larger fish grades than smaller grades. However, stocking rates in the BMP + Abbassa farms (n=22) were almost as high as in the control group. This may be because the mean farm area in BMP + Abbassa farms was smaller than in the other groups, which leads farmers to pursue more intensive practices, including stocking at higher densities.

Figure 5 shows that BMP farmers also tended to use lower feeding rates (in terms of the amount of food fed per day as a percentage of total estimated biomass) at the grow-out stage compared to control and Abbassa farmers. Improved control over feeding was emphasized as a key message during the best management practice training.

Figure 6 compares average yields (t/ha) between the four groups. While there were no statistically significant differences (at 5% confidence level) between the mean yields, the highest mean was for farms with both interventions, BMP + Abbassa (8.77 t/ha), followed by farms with the Abbassa strain only (8.46 t/ha), the control group (8.16 t/ha) and the BMP group (8.00). It might be concluded from the fish yield data that stocking the Abbassa improved strain had little impact, as there were only slight (nonsignificant) increases in production from farms stocked with the improved strain (3.7% for Abbassa only and 7.5% for BMP + Abbassa) compared to control farms. These are well below the predicted growth improvement of 28% when the eighth generation of the Abbassa strain was compared to existing commercial strains (Ibrahim et al. 2013). However, total yield is a crude figure that depends on a wide range of factors, including stocking rates, feeding rates, growth rates, the growing period and market preferences in terms of optimal fish size at harvest. It would have been useful to derive growth rates for the different groups. As will be seen in the following analyses, BMP farmers tended to prioritize production efficiency, producing the same amount of fish with fewer inputs and at lower cost, rather than increasing the quantity of production, which accounts for the slight drop in mean yields compared to the control group.

Figure 7 shows the distribution of mean operating costs for all farms. Clearly, feed is the major cost item at 80.8% of operating costs, followed by seed (8.2%), labor (6.7%) and power (2.5%). Other items, such as chemicals, sales costs, transport and ice, each made up less than 1% of operating costs. There were no discernable differences in the distribution of operating costs between project groups.

Figure 8 shows how FCRs varied between the groups and illustrates that the project interventions had major impacts on farm efficiency. FCR (the amount of food fed divided by fish weight gain) is commonly used to assess the efficiency of aquaculture production systems. Feed costs make up a major proportion of total costs, so any efficiency gains will contribute towards improved profits. The mean FCR for control farms was 1.82, while on farms where farmers had been trained on best management practices it was 1.53 (a significant difference). Mean FCRs for farms stocked with the Abbassa strain and farms where both interventions were applied were 1.48 and 1.42, respectively.

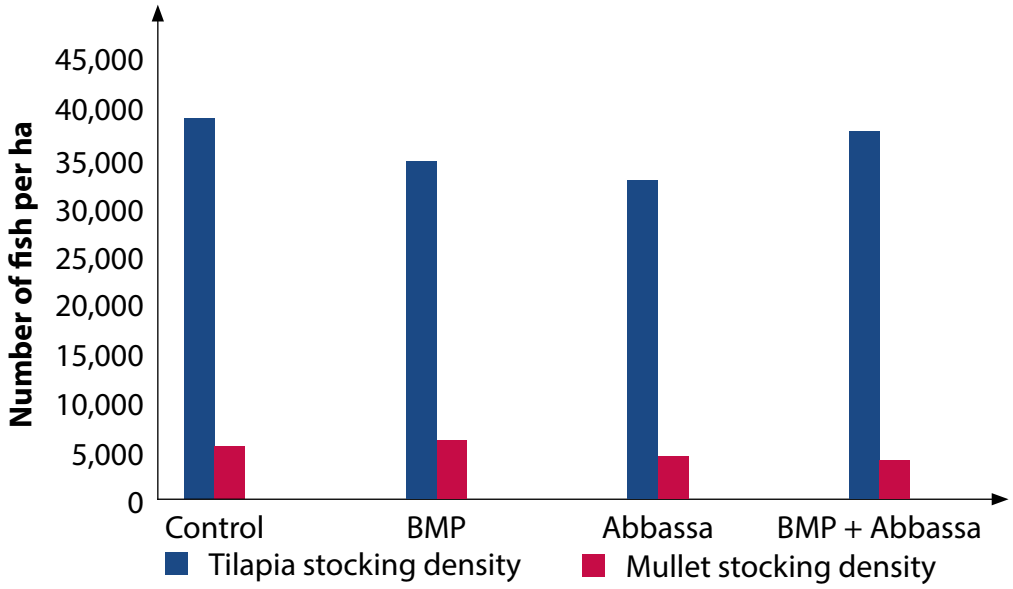


Figure 4. Average tilapia and mullet stocking densities by group.

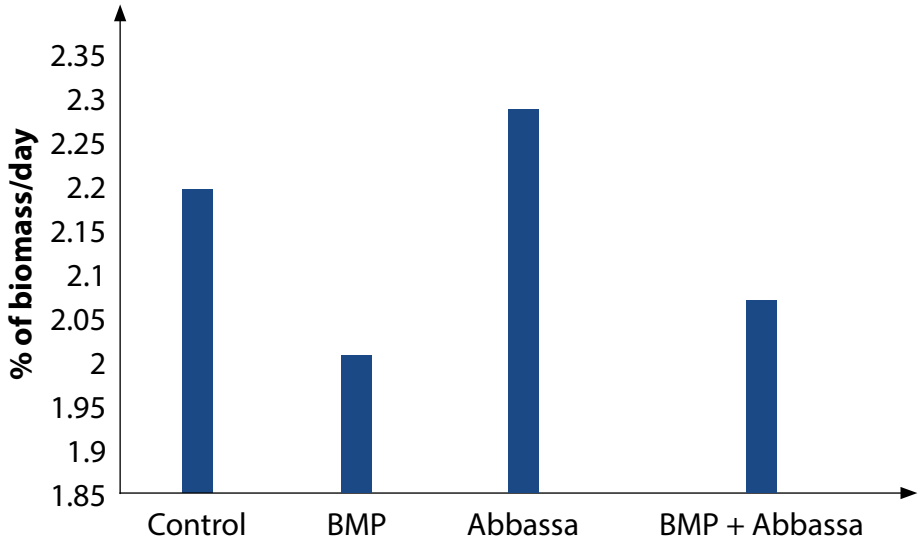


Figure 5. Average feeding rates at the grow-out stage by group.

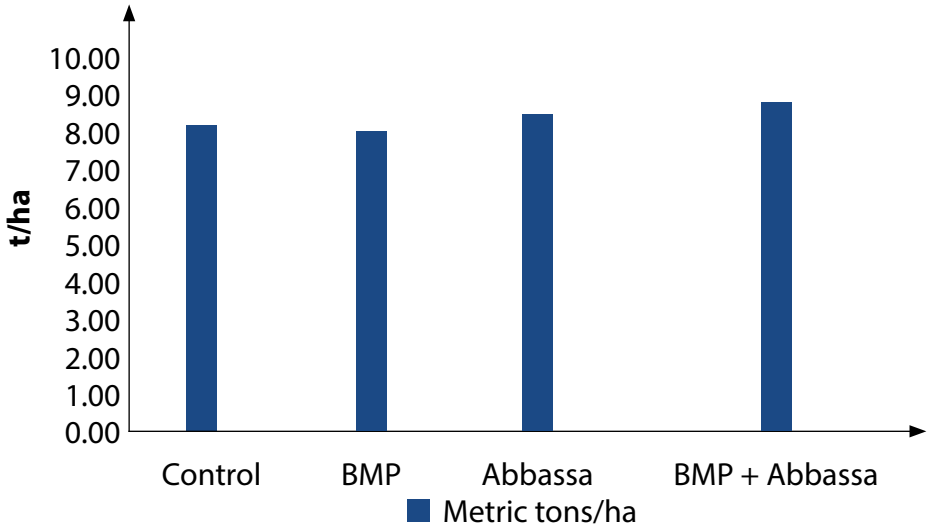


Figure 6. Mean yields for the four groups: control, BMP, Abbassa and BMP + Abbassa.

The reduced FCRs for the best management practice-trained farmers was a direct indication that the farmers applied the improved, more efficient feeding practices recommended in the best management practices. Relatively low FCRs on farms stocked with the Abbassa strain are more difficult to explain. As yet, there is no indication that the feed efficiency of the Abbassa strain is better than that of existing strains. However, it may indicate that farmers were underfeeding the Abbassa strain because they had not fully adjusted their feeding rates to cope with the faster growth potential of the fish.

Figure 9 shows how sales, operating costs and fixed costs varied between groups. Mean total sales per hectare were highest in the BMP + Abbassa strain group (EGP 115,268), followed by the BMP (EGP 107,264), Abbassa (EGP 104,530) and control (EGP 100,941) groups. Total sales is a function of yield and unit value. Average unit values were EGP 13.4/kg for BMP farms, EGP 13.1/kg for BMP + Abbassa farms and EGP 12.4/kg for non-best management practice-trained farms (control and Abbassa), which might indicate that best management practice-trained farmers were able to produce more fish in the higher size grades. Operating costs varied from an average of EGP 77,315/ha for control farms to EGP 67,849/ha for BMP farms, while average fixed costs made up a minor proportion of total costs.

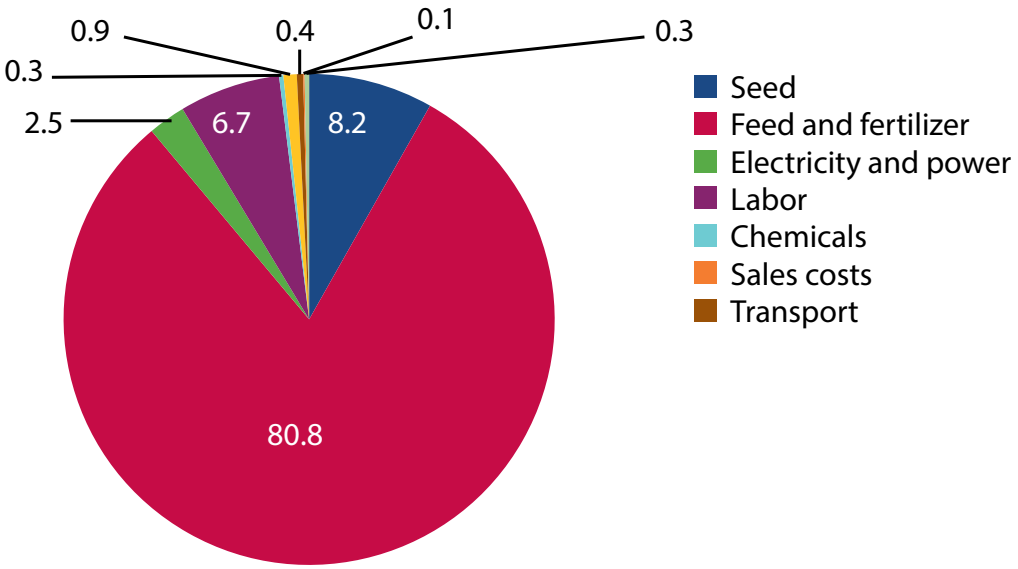


Figure 7. Mean operating costs for all the farms (percentage of total operating costs).

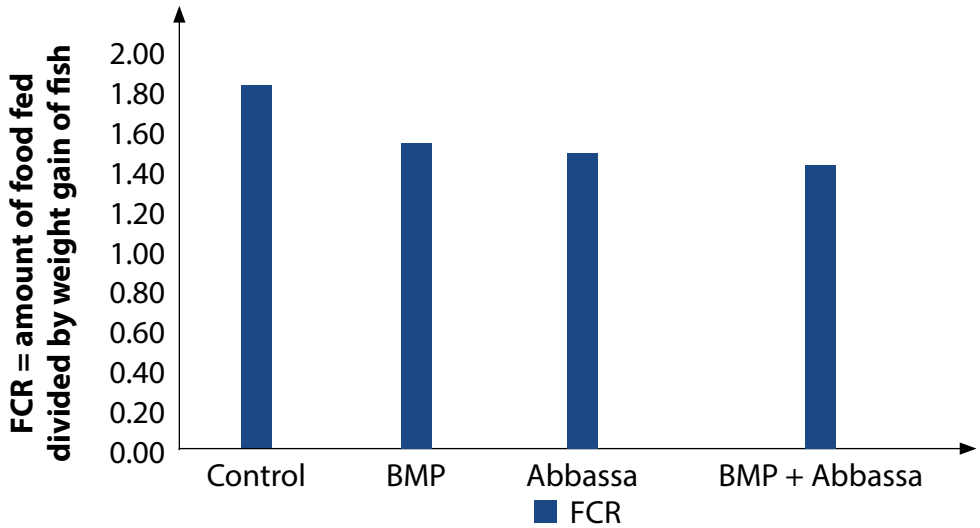


Figure 8. Mean FCR by group.

Table 11 compares average total sales, total costs (operating costs + fixed costs), net profits (total sales minus total costs) and profitability (net profits as a percentage of total sales). The relatively high costs and low sales achieved by control farms meant that these farms had low net profits (averaging EGP 19,281/ha = USD 2570/ha) and low profitability (averaging 13% of sales). The highest average net profit and profitability were achieved by BMP + Abbassa farms (EGP 36,245/ha, 34%), followed by BMP farms (EGP 34,713/ha, 27%) and Abbassa farms (EGP 32,457/ha, 31%). The differences between profits and profitability on the control farms and on farms assisted by project interventions were highly significant. There were no significant differences between the BMP, Abbassa and BMP + Abbassa groups.

Multiplying the average profits per hectare for each group by the average farm area used (7.72 ha) suggests that farms applying best management practices made USD 15,894 more profit than control farms, while the additional profit made by farms who stocked the Abbassa strain was USD 13,571 and BMP + Abbassa farms made additional profits of USD 17,472 compared to control farms.

Discussion and conclusions

Both the best management practice training and the dissemination of the Abbassa strain of Nile tilapia were intended to improve incomes and increase employment in the aquaculture value chain.

There is no doubt that incomes have improved for over 2000 fish farmers trained in best management practices and/or stocking the Abbassa strain. Profitability has increased from an average of 13% to 27%–34% depending on the intervention, which equates to extra income per farm per year of between USD 13,500 and USD 17,500. If it is assumed that these results have been repeated on 2000 farms (500 farms stocked with the Abbassa strain and 1500 more farms receiving and applying best management practice training), the total added value in 2014 was over USD 27 million from a 4-year project investment by SDC of USD 4.6 million and compares favorably with the end of project indicator in the project logframe of a projected increase in net income (profits) of USD 8.8 million from all project activities.

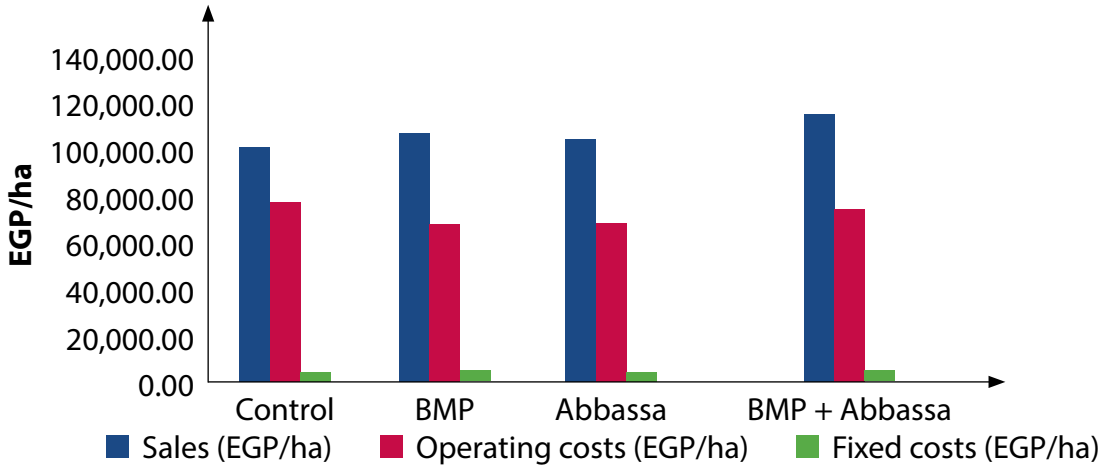


Figure 9. Mean sales, operating costs and fixed costs by group.

	Sales (EGP/ha)	Total costs (EGP/ha)	Net profits (EGP/ha)	Profitability (% of total sales)
Control	100,941	81,659	19,281[a]	13[a]
BMP	107,264	72,551	34,713[b]	27[b]
Abbassa	104,530	72,073	32,457[b]	31[b]
BMP + Abbassa	115,268	79,023	36,245[b]	34[b]

Note: Means with different superscripts are significantly different (P=0.001).

Table 11. Average total sales, total costs, net profits and profitability by group (EGP/ha and % of total costs).

These profits will almost certainly grow in the coming years as more farmers adopt the more efficient production practices either through an expansion of the best management practice training program or just from farmer-to-farmer learning. The total number of fish farms in Egypt is between 6000 and 10,000, which suggests a total value added through the best management practice training of around USD 100 million per year within 5 to 10 years. Furthermore, the improved profitability will have secured existing employment in fish farms (because profitable fish farms will stay in business) and along the value chain. It will also encourage fish farmers to upgrade their production systems through installing aeration, automatic feeding and improved fish handling systems, leading to even greater efficiencies and sustainable intensification. This is important, as the area under culture is unlikely to expand, so increased production will have to come from producing more fish per hectare of pond area. Improved efficiency of feeding also has direct results on the environmental performance of the sector, greatly reducing its potential for pollution of surrounding water bodies through nutrient-enriched discharges and its greenhouse gas emissions, which come mostly from feeds.

Increased employment was expected to come about through an overall increase in the amount of fish produced. The 2011 value chain analysis that preceded the IEIDEAS project estimated that around 14 jobs (FTE) were created in the value chain (fish farms, wholesale and retail) for each 100 t/year of fish production. Total 2009 Egyptian fish production was estimated at 700,000 t/year, suggesting that total employment was around 100,000; therefore a 10% increase in production would lead to 10,000 new jobs in the value chain.

However, the best management practice training resulted in farmers improving the efficiency of their farms, reducing feed costs rather than increasing production, and predicted increases in production from dissemination of the Abbassa strain have taken longer to accrue than was anticipated in the original project proposal. According to the impact assessment, the 2000 best management practice-trained farmers produced around the same amount of fish as control farms and the 500 fish farms stocked with the Abbassa strain in 2014 each produced only 5% more fish (t/ha) than control farms. Therefore, in 2014, project interventions only resulted in around 200 t/year additional production (equivalent to only 28 FTE) compared to the 70,000 t/year needed to generate 10,000 jobs.

Although this is disappointing, the process set in motion by dissemination of the Abbassa strain will have much greater impact in the immediate future when availability improves and experience of fish farmers with the new strain increases. Farmers should be able to see a 20% increase in production as a result of stocking the improved strain, and the project has shown that demand is there for the Abbassa strain (Ibrahim et al. 2013). In 2015, at least 2000 fish farms will be stocked with the improved strain, and its use will most likely spread to almost all Egyptian fish farms within 5 years, as it is the only genetically improved Nile tilapia available to Egyptian fish farmers.

The fish that was made available to the industry by the IEIDEAS project was G9 of the Abbassa strain. Generation 12 or 13 will shortly be released using the same dissemination process. The fish has demonstrated even faster growth, perhaps 40% faster than other commercial strains, and has demonstrated average response to selection for live weight at harvest of 11.9% per generation (Hamzah et al. 2014). A conservative estimate would be that within 5 years, 5000 fish farms will be using the Abbassa strain and achieving 30% faster growth, which could result in extra productivity of 2.4 t/ha/year. At an average farm size of 7.72 hectares, this would result in 90,000 extra tons of fish, equivalent to the creation of over 12,000 jobs at an employment rate across the value chain of 14 FTE per 100 t/year of production.

Project support for women fish retailers

In 2012, CARE organized a scoping study to identify the main issues facing informal women fish retailers in the project governorates. The study identified them as being among the poorest of the poor, usually either wives of fishers or without land to farm, or widowed, divorced or having a husband who is unable to hold full-time employment.

Most work informally, either buying their fish from wholesalers in the market or from traders who deliver to the retailers. They work between 2 and 7 days per week, with 80% working more than 5 days in a week.

The retailers use metal trays to display and carry fish to the market, which makes storing and transportation of fish from the wholesaler to the market very difficult. They generally have some fish left over at the end of the day. Around 50% of women retailers drop their prices later in the day and pay the wholesaler before purchasing the next batch, as they do not have the means to store their fish in good condition to the following day.

Therefore, the initial project interventions focused on issues related to the quality, storage and transport of fish, and on market infrastructure and policies and organizations that affect women fish retailers, particularly as these relate to market and other fees.

The work was undertaken with women retailer organizations under the umbrella of community development associations already operating in the villages and towns around which retailers were concentrated, rather than launching a process of forming and registering new retailer organizations with the Ministry of Social Solidarity, which would have taken several months.

Based on the survey and subsequent meetings with women retailers in the five governorates, interventions were prioritized by location. In the first location—Shakshouk, Fayoum—the focus was on preserving and transporting fish, developing a formal fish marketplace, and improving access to affordable fish throughout the year. After some initial training on proposal writing and resource mobilization involving the Shakshouk Community Development Association, a proposal was developed and finalized that included the distribution of iceboxes, provision of a motor tricycle, developing the community development association as a fish redistribution center, setting up a marketplace in Shakshouk, awareness and hygiene training for the women fish retailers, and capacity-building training for the community development association.

In El Mineya, work with women retailer groups took place under the local fishers' organization in the village of Diyaba. As the wives and relatives of fishers in this village, women retailers were selling river-caught fish during the fishing season, as well as lower-quality and frozen fish from Lake Nasser in Aswan. The main interventions related to consistent access to good-quality, affordable fish.

Activities in other community development associations and retailer groups progressed more slowly due to political turmoil in Egypt, but they focused on the same interventions: providing subsidized equipment to improve quality and marketability of fish, including iceboxes, motor tricycles, deep freezes and fish grills, along with capacity building and technical training for the community development associations and retailer committees. Community development associations received training in grant management, financial management, strategic planning, monitoring and evaluation, proposal writing, communication skills, effective management, negotiation skills, and planning skills. Women retailer committees were established comprising 10–15 women in each community development association. The committee members received training in teamwork, marketing skills, gender principles, meeting management, hygiene skills, and roles and responsibilities of committees.

IMPROVING THE LIVELIHOODS AND WORKING CONDITIONS OF WOMEN FISH RETAILERS

By mid-2013, six women retailer committees were operating in the five project governorates, all with approval from the Ministry of Social Solidarity: Shakshouk Community Development Association in Fayoum, Al Amal Community Development Association and Deir Abu Henes Community Development Association in El Mineya, Abu Hammad Community Development Association in Sharkia, Sabeel Community Development Association in Behera, and Riyadh Community Development Association in Kafr El Sheikh.

The Shakshouk women retailer committee established a market area in April 2013. This provided the women with a clean, shaded area to sell their fish and resulted in dialogue between the women retailers and local government officials so that other facilities, such as a water supply, were supplied by the council. The women said that their situation had improved, as they could sell their fish more quickly so they had more time for other activities. Customers knew where to go to buy fish and the fish was fresher. The market was also popular with local residents because there was less waste and with drivers because the retailers and their customers do not block the road.

A total of eight motor tricycles were provided to groups (each comprising six women retailers) to transport fish from wholesalers to community development association redistribution centers or to marketplaces. Each group of women contributed 20% of the cost of the tricycle.

Fish distribution centers that provided deep freeze storage space for fish in the community development association office, fish boxes, and capital to buy and sell fish were established in five of the community development associations with the aim of storing fish and reducing the control over fish supply by wholesalers. Results from this intervention varied. In some governorates, the women retailers preferred to source their fish through the community development association, whereas others felt they got better service through existing wholesalers, possibly reflecting the degree to which retailers are already linked to wholesalers. For example, most of the retailers in Behera were new to fish marketing and many bought fish from the community development association, whereas in Fayoum and Kafr El Sheikh they had already been in business for many years before the project started and tended to stay loyal to the wholesalers.

Four fish grills were distributed (a proportion of the costs was borne by the future operator of the grill) with the aim of allowing the women to diversify their services by providing cooked fish in addition to fresh fish. Again, the results were mixed. This perhaps reflects whether there was a genuine need for fish grills, or if there was competition from other fish grills in a particular village. Women retailers were also provided with cleaning tools so that they can prepare fish (gutting, scaling) for customers. In Fayoum, some of the women were supplied with ducklings, an alternative income generation approach that had already been used in a project supported by the nongovernmental organization Drosos.

It appears that new entrants were attracted to fish retailing in some of the project areas. In Behera, 35 women started working as fish retailers, while 4 women in Fayoum returned to fish retailing.

In 2014, capacity building of the community development associations and women retailer committees included empowerment training through interactive theater and the development of some of the women as trainers.

Twenty-one village savings and loan association groups, led by female retailer committee members, were established in Kafr El Sheikh and El Mineya in 2014. The village savings and loan association groups operated independently of the retailer committees and included male group members. They hold regular meetings at which they pay a fee, and the capital is then disbursed as loans to members. In most cases this has been used to provide capital for fish purchases. These groups have been popular, especially in Kafr El Sheikh.

An external study in 2014 (Kjaersig, personal communication, 2014) suggested that the retailer committees need further support to become sustainable and representative. The review also called for more resources to be allocated to carry out research and documentation of the work with the women retailers.

Documentation study on fish retailing

A study was carried out by a CARE consultant in late 2014 to capture the lessons learned and recommendations for future work in this area (D'Allessandro, personal communication, 2015). The study found that the creation and strengthening of women retailer committees was at the heart of the project. However, other more tangible interventions had to be implemented in parallel to committee formation in order to gain the trust of the women retailers and demonstrate a commitment to their needs. While women retailer committee responsibilities were taken over by the community development association in many instances during the project, the study recommended that more responsibility should be passed to the women retailer committees.

Positive outcomes noted by the study included the fish market in Shakshouk; the inclusion of the retailers as members in the Fayoum Fish Farmers Association; the creation of identification cards for women retailers in Diyaba, El Mineya; the creation of village savings and loan association groups in three communities; and reports of improvements in working conditions and incomes of women retailers.

However, the study also outlined the challenges, including the fact that CARE was working in new governorates in the Delta region and partnering with newly formed community development associations, a target group which required building trust and common understanding. Also, the unstable political context and security problems caused delays, particularly in mid-2013, and the time taken for the Ministry of Social Solidarity to approve community development association activities resulted in further delays.

The main lesson learned from the study was that formalization of the status of retailers and their ability to stand up for their rights was more important to them than the provision of material benefits such as iceboxes or tricycles. However, getting women retailers to work together and cooperate requires changing competitive behaviors that they have been practicing for years. Although the retailers cited very similar problems across the six target communities, the solutions may be different. The study suggested that community development associations need greater technical and business management support, that joint ownership models (for tricycles and grills) need more guarantees and technical support, and that there needs to be more attention and focus on raising the awareness of consumers about the types and safety of fish.

The study made several recommendations, including the following:

- Male retailers should be included in the target group for project support.
- There should be more emphasis on strengthening the women retailer committees, the preferred organization for implementation, rather than community development associations.
- Retailers should be involved in all phases of the project.
- A stronger monitoring and evaluation system is needed that traces project outputs, processes and outcomes across the different actor groups.
- Distribution centers need to operate with the same business and economic principles as regular private sector enterprises.
- Village savings and loan association groups could be continued and replicated in other communities as a way of strengthening solidarity among women retailers.

Retailer impact assessment

Methods

A quantitative impact survey of retailers was carried out to measure outcomes such as sales, incomes, profits and working conditions. The structured questionnaire used in the study focused primarily on individual fish retailers and included issues such as background data on the retailers, species and quantities of fish bought and sold, fish prices, losses through wastage, relationships with traders and wholesalers, main problems faced, and questions related to empowerment and decision-making.

The most frequently traded farmed fish species in the market—tilapia and mullet—are graded by wholesalers according to size. The size grades used in this study were as follows: tilapia premium (over 500 g), tilapia super (300–500 g), tilapia grade 1 (200–300 g), tilapia grade 2 (125–200 g), tilapia grade 3 (50–125 g), tilapia grade 4 (less than 50 g), mullet grade 1 (250–400 g) and mullet grade 2 (150–250 g).

The survey questionnaire was translated from English into Arabic and field-tested in two governorates before being finalized for field implementation. The final version of the questionnaire was incorporated into open data kit KoBoCollect 1.4.3 (1039) to allow for a digitized data collection process using tablets and smartphones. The use of KoBoCollect enabled the synchronized compilation of the results from the surveys into a database for later download and aggregation of the collected data.

Women fish retailers, including project beneficiaries and nonbeneficiaries (control groups), were identified through CARE staff and the community development associations. A stratified sample was selected in each governorate focusing—where possible—on women retailers only. Project beneficiaries were randomly selected from an existing list. Nonbeneficiaries were selected randomly in marketplaces. The sample sizes are shown in Table 12.

The fieldwork took place in March 2015. The study team consisted of four staff from WorldFish plus a consultant to WorldFish and four staff members from CARE who arranged to bring retailers selected for interview to a central meeting point at each location.

At the end of each set of interviews, the combined data was downloaded from the KoBoCollect website as a Microsoft Excel file and the data was then aggregated by governorate and by project beneficiary or nonbeneficiary.

Results

Table 13 and Figure 10 provide a description of the project beneficiaries and nonbeneficiaries surveyed in each governorate. The survey team found it difficult to identify sufficient female informal retailers to interview as nonbeneficiaries, particularly in Sharkia, but also in El Mineya and in Kafr El Sheikh. Consequently, they interviewed more male retailers than in other governorates, as well as several fish shop owners.

On average, fish retailers had 9.3 years of experience. The average for project beneficiaries was 7.6 years compared to 10.9 years for nonbeneficiaries. As can be seen in Figure 10, project beneficiaries in Behera and Sharkia were relatively inexperienced. In Behera, most of the participant retailers had not been involved in fish retailing before the project started. The community development association in Behera identified needy women who might benefit from becoming fish retailers rather than the approach used in other

Governorate	Project beneficiaries	Nonbeneficiaries
Kafr El Sheikh	29	29
Behera	15	20
Sharkia	15	19
Fayoum	15	21
El Mineya	15	14
Total	**89**	**103**
Grand total	**192**	

Table 12. Sample sizes for retailer impact study.

	Behera	Fayoum	Sharkia	El Mineya	Kafr El Sheikh	Total
Project beneficiary	15	15	15	15	29	89
Nonbeneficiary	20	21	19	14	29	103
Female	35	35	24	22	52	168
Male	0	1	10	7	6	24
Informal retailer	31	36	24	29	54	174
Fish shop owner	4	0	10	0	4	18

Table 13. Description of respondents by location, gender and nature of their business (n = 192).

locations, where the community development association and project staff identified existing retailers as potential project beneficiaries.

The respondents were asked whether there were peak and off-seasons for fish retailing in their area. Nearly all responded that there were peak seasons, and in most communities these were in winter and spring (coinciding with lower ambient temperatures, making it easier to keep fish fresh). However, in El Mineya the peak was in winter only (because there are restrictions on catching fish in spring), and in Fayoum, sales are spread evenly throughout the year.

The respondents were asked how many working days per week and hours per day they worked during the peak and off-seasons in the last year (Table 14). It appears that retailers work slightly fewer days per week but more hours per day during the off-season, indicating that the core issue is a lack of customers.

Interviewees were also asked whether they work more or less now compared to 3 years ago. Of these, 53% reported the same level of work, 17% responded that they worked fewer hours now and 29% (35% of project beneficiaries compared to 23% of the control group) claimed to work more hours now. This is in line with expectations, since many of the respondents were new to fish retailing, particularly in Behera and Sharkia.

The retailers were asked about the number of people they employed. In addition to the 192 respondents, a total of 51 people were employed by the retailers during the peak season and 35 during the off-season (Table 15), indicating that most of the fish retailers interviewed act as sole traders. Comparing the situation across governorates, retailers in Sharkia (where several of the respondents were actually owners of fish shops) were more likely to employ additional personnel during both the peak and off-seasons, followed by Fayoum

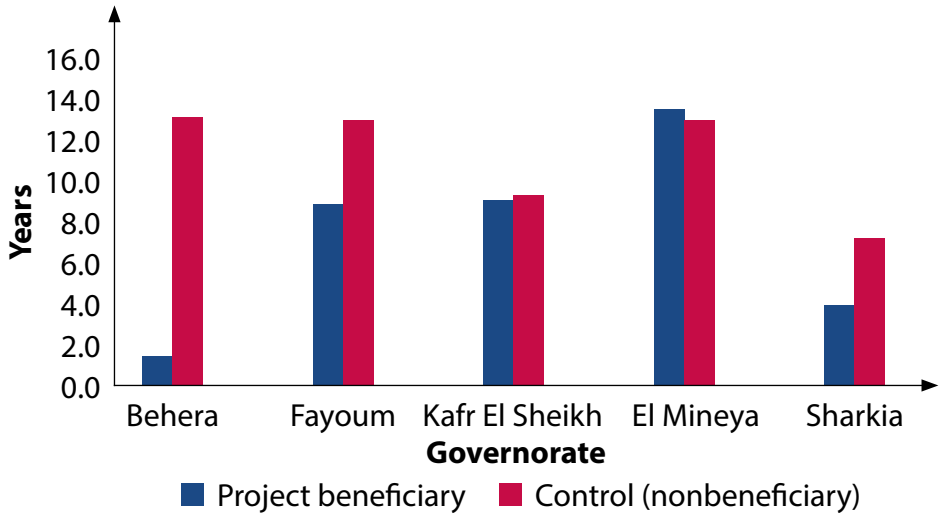


Figure 10. Respondents' experience in fish retailing by governorate and project beneficiary status.

	Average number of days worked per week		Average number of hours worked per day	
Governorate	In peak season	In off-season	In peak season	In off-season
Behera	5.2	4.8	6.1	7.7
Fayoum	5.6	4.4	6.2	8.3
Kafr El Sheikh	5.8	5.3	7.0	9.2
El Mineya	6.3	4.9	5.8	7.3
Sharkia	5.5	4.2	6.1	7.2
Total	**5.7**	**4.8**	**6.3**	**8.1**

Table 14. Number of days worked per week and hours worked per day by retailers.

during the peak season. Table 15 displays the breakdown of employees by age, gender and whether they were working full or part time. The most frequently employed group was older women (over 30 years old) working full time, followed by older men also working full time.

The retailers were asked about the source of their fish obtained the previous day and during the peak season. Table 16 presents the responses for fish bought the previous day.

Overall, 59% of the retailers sourced their fish from wholesalers in markets, while 21% sourced their fish from a wholesaler who delivered to their selling place. However, the data illustrates wide variation between the different retailer groups. In Behera, nearly all the nonbeneficiary retailers obtained their fish from wholesalers in a market, whereas project-supported retailers obtained their fish from a wider range of sources, including from the distribution center of the retailer committee or community development association. In Fayoum, the main source of fish for both beneficiary and nonbeneficiary retailers was wholesalers that deliver to the retailer. For Sharkia-based respondents, most fish came from market-based wholesalers, while some was also delivered by wholesalers. For El Mineya-based respondents, the largest proportion of fish came directly from fishers; however, some was also sourced from markets. In Kafr El Sheikh, respondents reported that nearly all the fish came from market-based wholesalers.

Total number	> 30 full time	> 30 part time	< 30 full time	< 30 part time
Men	12	4	9	3
Women	15	1	4	4

Table 15. Additional employment by retailers broken down by age, gender and full time or part time (number of workers).

Governorate	Project beneficiary status	Number	Direct from a fisher	Direct from a fish farm	From a wholesaler in a market	From a wholesaler that delivers to the retailer	From a community development association distribution center
Behera	Average	35	0.00	3.57	73.29	5.57	17.57
	Beneficiary	15	0.00	8.33	37.67	13.00	41.00
	Control	20	0.00	0.00	100.00	0.00	0.00
Fayoum	Average	36	12.64	7.50	7.92	71.94	0.00
	Beneficiary	15	19.00	0.00	8.33	72.67	0.00
	Control	21	8.10	12.86	7.62	71.43	0.00
Sharkia	Average	34	7.50	7.21	61.76	19.85	3.68
	Beneficiary	15	2.00	11.67	51.33	26.67	8.33
	Control	19	11.84	3.68	70.00	14.47	0.00
El Mineya	Average	29	32.41	3.45	35.34	13.62	15.17
	Beneficiary	15	31.00	0.00	25.33	14.33	29.33
	Control	14	33.93	7.14	46.07	12.86	0.00
Kafr El Sheikh	Average	58	1.03	0.34	93.62	5.00	0.00
	Beneficiary	29	1.72	0.00	91.38	6.90	0.00
	Control	29	0.34	0.69	95.86	3.10	0.00
Total	**Average**	**192**	**8.91**	**3.96**	**59.40**	**21.59**	**6.15**

Table 16. Source of fish obtained the previous day, as reported by retailers (%).

This pattern was repeated for data from the peak sales period.

The retailers were asked about the storage methods they used to keep their fish in the market during the day (Table 17) and at night (Table 18). The main difference between project beneficiaries and nonbeneficiaries during the day was in the use of ice and iceboxes. A higher proportion of nonbeneficiaries either kept their fish alive or without ice during the day, particularly in Fayoum and El Mineya. In contrast, project beneficiaries tended to use iceboxes (provided by the project) to store their fish.

Project beneficiaries were more likely to store their fish overnight in an icebox or freezer, as opposed to nonbeneficiaries, who were more likely to not store fish overnight or to keep the fish on ice or in a fridge.

Table 19 presents information on the quantity of fish purchased by retailers each day, for the previous day and for a typical day during the peak season.

While the overall average amounts of fish purchased the previous day by retailers was 55.2 kg compared to 81.3 kg in peak season, there were large differences between governorates and between project beneficiaries and nonbeneficiaries. In Behera, Sharkia and El Mineya, nonbeneficiaries purchased more fish per day than project beneficiaries, whereas in Fayoum and Kafr El Sheikh project beneficiaries tended to buy slightly more fish than nonbeneficiaries. This may be related to the retailing experience, since most project beneficiaries in Behera were new to fish retailing and those in Sharkia were relatively less experienced than their counterparts in other governorates. It is not clear why project beneficiaries in El Mineya purchased less fish than nonbeneficiaries. Table 19 also compares fish purchases the previous day to those during the peak season. On average, the retailers reported buying 47% more fish during the peak season than they did the previous day; however, this ranged from only 19% more fish purchases for nonbeneficiaries in Fayoum to over 80% more fish purchases for project beneficiaries in Sharkia and nonbeneficiaries in El Mineya.

	Live	On ice	No ice	Icebox	Fridge	Freezer
Project beneficiary	20.1	29.1	10.4	34.3	0.7	5.2
Nonbeneficiary	26.7	37.9	32.9	0.6	0.6	1.2

Table 17. Fish storage methods during the day (%).

	Never keep overnight	On ice	No ice	Icebox	Fridge	Freezer
Project beneficiary	11.7	12.6	1.0	39.8	12.6	22.3
Nonbeneficiary	22.1	36.3	4.4	0.9	22.1	14.2

Table 18. Fish storage methods overnight (%).

Governorate	Category	Previous day	Peak season
Behera	Project beneficiary	33.0	51.7
	Nonbeneficiary	61.8	77.8
Fayoum	Project beneficiary	32.0	41.9
	Nonbeneficiary	28.4	33.9
Sharkia	Project beneficiary	52.1	97.3
	Nonbeneficiary	102.6	153.4
El Mineya	Project beneficiary	24.0	35.0
	Nonbeneficiary	38.2	69.6
Kafr El Sheikh	Project beneficiary	78.6	117.7
	Nonbeneficiary	64.7	91.6
	Overall average	**55.2**	**81.3**

Table 19. Average quantity of fish purchased per retailer per day (kg).

As illustrated in Figure 11, the most frequently traded type and species of fish during the peak period was grade 1 tilapia (average of 27.8 kg/retailer/day), followed by grade 2 tilapia (average of 14.5 kg/retailer/day), tilapia super (average of 10.5 kg/retailer/day), grade 4 tilapia (average of 5.4 kg/retailer/day), grade 3 tilapia (average of 4.7 kg/retailer/day), grade 2 mullet (average of 4.1 kg/retailer/day), other (average of 4 kg/retailer/day), grade 1 mullet (average of 3.6 kg/retailer/day), live catfish (average of 2.8 kg/retailer/day) and frozen mackerel (average of 2.3 kg/retailer/day). Notable variations to this pattern were observed among project beneficiary retailers in Fayoum, where sales of grade 2 tilapia were slightly higher than grade 1 tilapia, and project beneficiaries in Sharkia, who had exceptionally high sales of frozen fish (other, average of 35.7 kg/retailer/day; and mackerel, average of 14.3 kg/retailer/day). Frozen fish were also sold by project beneficiaries in Behera and both types of retailers in Kafr El Sheikh. Mullet sales were concentrated among retailers in Kafr El Sheikh, project beneficiaries in Fayoum, and nonbeneficiaries in Behera and Sharkia.

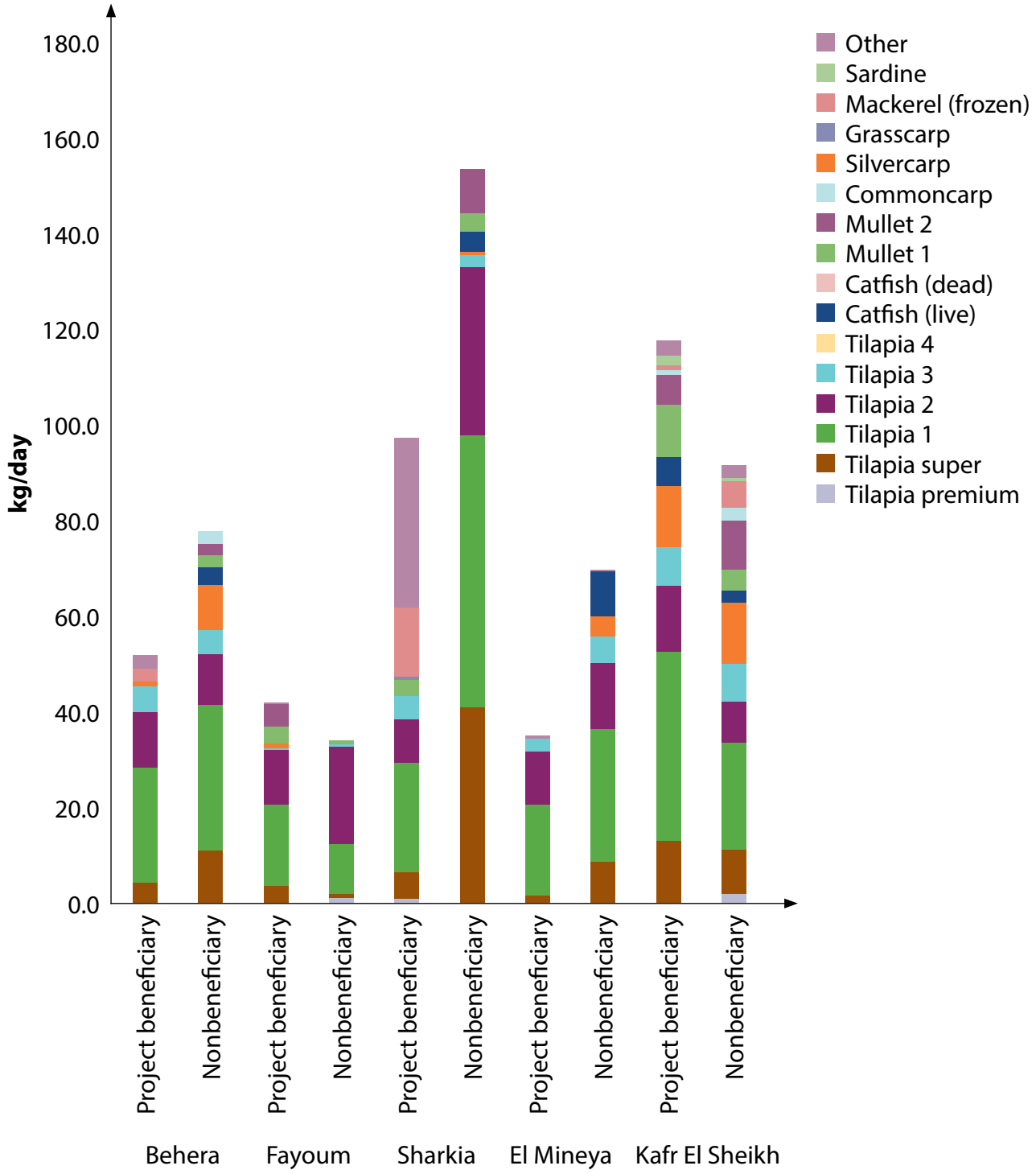


Figure 11. Average quantity of each fish product (species and grade) purchased by project beneficiaries and nonbeneficiaries during the peak sales period.

Tables 20 and 21 display data on average buying and selling prices for the previous day and for peak season across all the governorates for the most frequently sold species. Both tables illustrate the difference in gross profitability (selling price minus buying price) between fish sales in the morning and in the afternoon, when the quality of the fish product may have deteriorated and retailers are obliged to lower their prices. Continuing to sell in the afternoon clearly takes more time, which is representative of reduced earnings per unit of labor (in this case, time). These tables also outline differences in profitability between fish products (species and grades). The highest profitability for the previous day's sales (Table 20) appears to be for very small tilapia (grade 4), which had an average gross profit of 53% in the morning and 25% in the afternoon. Sales of grade 3 tilapia were also very profitable, with an average gross profit of 29% in the morning, which dropped to 18% in the afternoon. Meanwhile, the average gross profit for frozen mackerel was 28% in the morning and 26% in the afternoon. Clearly, actual profitability will vary from site to site and from retailer to retailer.

The data from the peak sales period appears to be very similar to the average buying and selling prices from the previous day for most fish products. However, selling prices for tilapia grades 1 and 2 and mullet appear to be slightly higher in the peak season than on the previous day.

The quantity of fish bought (average 81.3 kg/day for peak season) seemed to correlate well with the quantity of fish sold (average 78.2 kg/day during peak season) by retailers in each governorate.

	Average buying price	Average selling price in the morning	Gross profit in the morning	Average selling price in the afternoon	Gross profit in the afternoon
Tilapia super	12.3	14.2	15.7	13.2	7.0
Tilapia grade 1	11.3	12.8	13.1	11.8	3.9
Tilapia grade 2	10.0	11.8	17.8	10.5	4.6
Tilapia grade 3	7.6	9.8	29.3	9.0	18.3
Tilapia grade 4	4.4	6.7	52.7	5.5	25.5
Mullet grade 1	24.7	27.1	9.8	25.7	4.2
Mullet grade 2	21.9	24.0	9.5	21.6	-1.2
Live catfish	10.2	11.8	16.3	10.8	6.5
Frozen mackerel	12.8	16.4	27.7	16.1	25.5

Table 20. Fish buying and selling prices (EGP/kg) and % gross profit for the previous day.

	Average buying price	Average selling price in the morning	Gross profit in the morning	Average selling price in the afternoon	Gross profit in the afternoon
Tilapia super	12.6	14.3	14.3	13.6	8.1
Tilapia grade 1	11.4	13.5	18.0	12.4	8.4
Tilapia grade 2	10.0	13.2	31.8	10.4	3.9
Tilapia grade 3	7.1	8.7	22.9	7.7	8.3
Tilapia grade 4	4.6	6.3	36.5	5.3	16.6
Mullet grade 1	26.0	29.3	12.9	28.3	9.2
Mullet grade 2	22.2	24.5	10.6	22.9	3.3
Live catfish	10.4	12.1	15.7	11.0	5.5
Frozen mackerel	12.5	16.2	29.9	15.9	27.6

Table 21. Fish buying and selling prices (EGP/kg) and % gross profit during peak season.

Retailers were asked about what happens to any unsold fish at the end of the day, how much is stored to sell the next day, how much is taken home and eaten by the family, and how much is thrown away (Table 22). In line with expectations, fewer fish remain unsold and are stored overnight to sell the following day during the peak season (average 1.8 kg) compared to the previous day (average 3.9 kg). The total quantities represent the equivalent of 7% by weight of the fish purchases the previous day and 2.2% of the fish bought in peak season.

When the same data was analyzed by governorate and by project beneficiary or nonbeneficiary, it was evident that large quantities of fish (likely to be primarily frozen fish) were being stored overnight in Sharkia and in Kafr El Sheikh. In Sharkia, this was only from the time of the survey (fish purchased the previous day), whereas in Kafr El Sheikh it was for both fish purchased the previous day and fish purchased during the peak season (Table 22).

Smaller quantities of fish were either eaten by the household or thrown away because they were unfit for sale during the peak season compared to fish purchased the previous day.

The retailers were asked to estimate their non-fish purchase operating costs for both the previous day and during peak season. The total average operating costs per day for retailers were EGP 31.9 the previous day and EGP 33.9 during the peak season. Figure 12 displays the relative distribution of operating costs for the previous day. For both scenarios, transportation constituted the primary operating cost (58% for the previous day, 54% for peak season). The next highest reported operating costs are for floor fees (paid for space to sell fish) and for ice.

When the data for operating costs was broken down by governorate and project beneficiary status (Table 23), the highest costs appear to be for nonbeneficiaries in Sharkia and both project beneficiaries and nonbeneficiaries in Kafr El Sheikh. Most of the retailers in these governorates must travel to collect fish from market wholesalers, and this adds to their costs. The Sharkia nonbeneficiaries also included a number of fish shop owners who would be expected to have inherently higher operating costs than informal retailers.

The retailers were asked whether they owned key pieces of equipment as an indication of

Governorate	Category	Fish purchased the previous day	Fish purchased during peak season
Behera	Average	3.5	0.7
	Beneficiary	2.1	0.6
	Control	4.6	0.8
Fayoum	Average	2.4	1.2
	Beneficiary	3.8	2.0
	Control	1.4	0.6
Sharkia	Average	5.5	1.1
	Beneficiary	7.1	0.8
	Control	4.3	1.3
El Mineya	Average	1.4	1.4
	Beneficiary	0.6	0.6
	Control	2.3	2.3
Kafr El Sheikh	Average	5.4	3.6
	Beneficiary	4.2	2.9
	Control	6.6	4.3
Total average		**3.9**	**1.8**

Table 22. Quantity of all fish products left over and stored, by governorate and project beneficiary or nonbeneficiary (kg).

how much they have invested in retailing and to estimate the associated depreciation costs for the owned equipment. As can be seen from Figure 13, around 60% of retailers owned weighing scales and just over 70% of project beneficiaries owned an icebox (these were supplied by the project). The next most frequently owned item was crates used for storing fish (38%). Other tools included knives and plastic basins for cleaning and degutting fish.

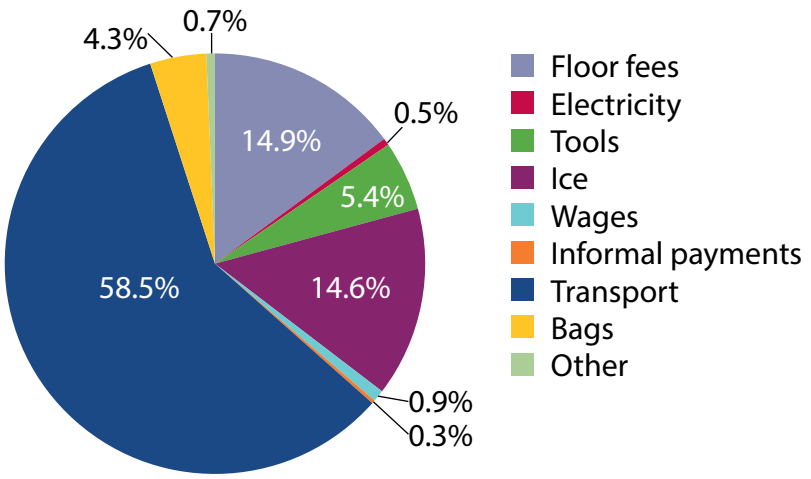


Figure 12. Average operating costs for all retailers the previous day (% of total costs).

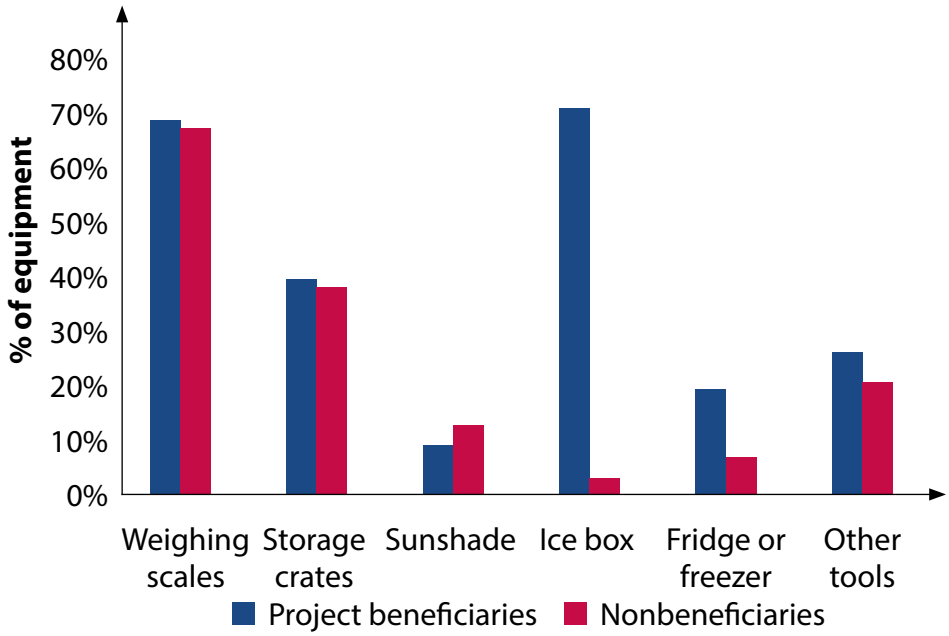


Figure 13. Retailer ownership of various pieces of equipment.

Governorate	Status	Previous day	Peak season
Behera	Project beneficiary	18.6	25.9
	Nonbeneficiary	26.9	21.7
Fayoum	Project beneficiary	15.8	25.8
	Nonbeneficiary	15.7	16.1
Sharkia	Project beneficiary	22.1	26.5
	Nonbeneficiary	70.8	63.5
El Mineya	Project beneficiary	8.3	8.9
	Nonbeneficiary	18.6	17.0
Kafr El Sheikh	Project beneficiary	51.6	58.5
	Nonbeneficiary	40.6	44.7
	Average total	**31.9**	**33.9**

Table 23. Operating costs by governorate and by project status (EGP/day).

The fish retailers were asked about the main issues that they faced on a day-to-day basis.

Overall, the most commonly reported problem was a lack of funds (55% of respondents), followed by harassment by people (47%), unsteady fish supply (40%), transport (40%), a lack of physical space in which to sell (35%) and low demand for fish (35%).

In Behera, the most frequently cited issue was lack of funds, followed by unsteady fish supply, harassment by people and transport. In Fayoum, the main issue was harassment by people, followed by lack of funds, no selling place, unsteady fish supply and no umbrella. In Sharkia, it was lack of funds, followed by unsteady fish supply, transport and harassment by people. In El Mineya, the overall response was lower, indicating that fewer retailers identified issues or concerns. The main issues were transport, unsteady fish supply, no selling place and harassment by people. In Kafr El Sheikh, the main issue reported was lack of funds, followed by transport, no selling place, harassment by people and no umbrella. Other problems reported across the various governorates included no health insurance or pension, tiredness from walking on the streets selling fish (El Mineya), and unfair practices in the wholesale market.

The retailers were also asked about the organizations that support their work. As expected, project beneficiaries felt that they had received support, while nonbeneficiaries did not. The most frequently cited form of support was providing iceboxes, followed by providing training and support from the village savings and loan association.

Retailers were also asked if they were aware of a fish retailer committee in their area. There appeared to be a very high level of awareness of the women retailer committees, with 96% of all the retailers responding that they were aware of a fish retailer committee. However, only 47% of project beneficiaries (23% of total number surveyed) said they had received help from the retailer committee. The most common type of help received was fish price negotiation (31% of project beneficiaries), help with officials (21% of beneficiaries) and buying fish (15% of project beneficiaries).

The retailers were asked a series of questions related to their attitudes towards savings, household expenditure, work and the role of women. The results have been separated into Figures 14 and 15 for beneficiaries and nonbeneficiaries.

Slightly fewer beneficiaries (44%) than nonbeneficiaries (54%) claimed it is unacceptable for a wife to have her own savings. More beneficiaries (76%) than nonbeneficiaries (51%) agreed that the couple should decide together how to spend money. There was little difference in attitudes between beneficiaries and nonbeneficiaries when asked

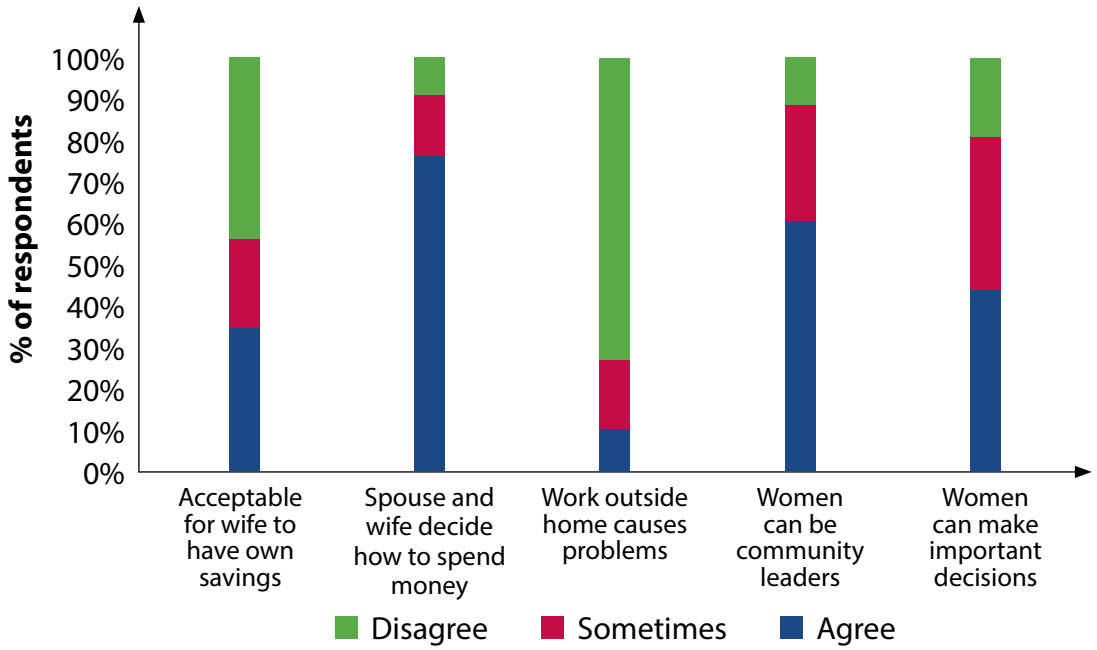


Figure 14. Project beneficiaries' responses to questions about savings, household expenditure, work and the role of women.

whether work outside the home causes family problems; both groups disagreed with this statement. However, there was a divergence between attitudes in response to the statement "women can be community leaders," with 60% of beneficiaries agreeing, while only 30% of nonbeneficiaries agreed with this statement. Similarly, more beneficiaries (44%) agreed with the statement that women can make important decisions alone than nonbeneficiaries (23%).

Fish retailers were also asked about decisions on spending (Figure 16). More project beneficiaries than nonbeneficiaries agreed that they are consulted in decisions on spending income and that they participate in the final decision on spending.

A follow-up question investigated who made the final decision on spending in the case of disagreement (Table 24). For project beneficiaries, this was usually the spouse (64%) followed by self (26%) and other men at home (9%). For nonbeneficiaries, the main decision maker was still the spouse, although at a lower frequency (50%), followed by self (36%) and other men at home (13%).

In summary, project beneficiaries appeared to show more liberal attitudes toward these issues than nonbeneficiaries, suggesting that involvement in the project and the empowerment training delivered by the project may have influenced their beliefs and opinions.

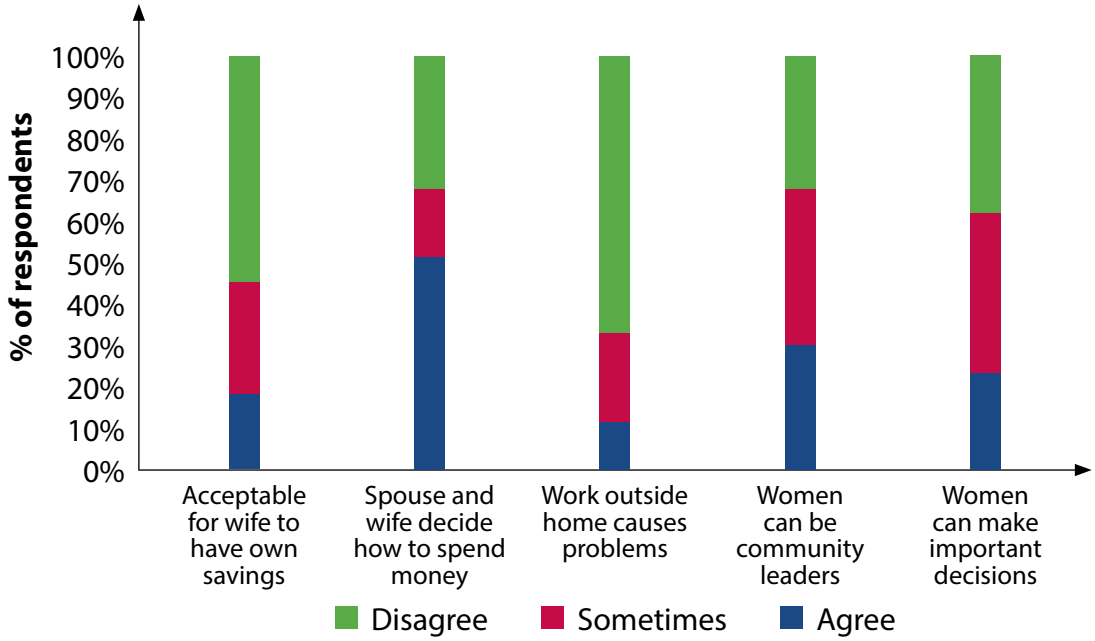


Figure 15. Nonbeneficiaries' responses to questions about savings, household expenditure, work and the role of women.

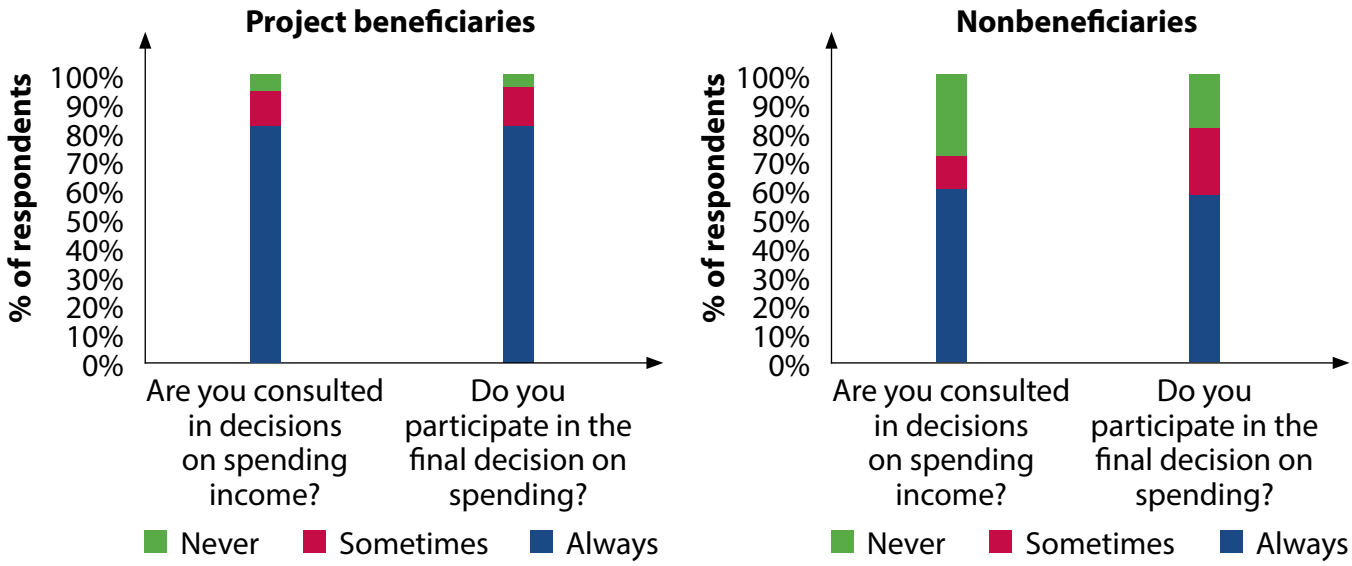


Figure 16. Retailers' responses on decisions about spending.

Retailer profitability

The data on quantity of fish purchased and sold, the buying and selling prices for fish (morning and afternoon), and operating costs was used to generate estimates of profitability on an individual retailer basis for the peak season. These were grouped into average profitability overall for project beneficiaries and nonbeneficiaries, and whether the fish were sold in the morning or in the afternoon (Table 25). Afternoon prices are usually lower than morning prices, so they would be expected to generate less profit.

Using an average of afternoon and morning prices, project beneficiaries made significantly higher profits than nonbeneficiaries, equivalent to around USD 10/day for beneficiaries compared to less than USD 1/day for nonbeneficiaries.

When morning sales prices were used in the analysis, the difference between beneficiaries and nonbeneficiaries was significant at the same level. When afternoon sales prices were used, the difference between profitability of project beneficiaries and nonbeneficiaries was highly significant, suggesting that project beneficiaries are less likely to drop their prices over the course of the day than nonbeneficiaries.

However, as can be seen in Figure 17, the profitability varied markedly from governorate to governorate. In Kafr El Sheikh and Sharkia, project beneficiaries achieved significantly higher profit levels compared to nonbeneficiaries. In Behera, El Mineya and Fayoum, the mean profit levels were not significantly different between beneficiaries and nonbeneficiaries.

The apparent losses encountered by all retailers in Fayoum and nonbeneficiaries in Kafr El Sheikh and Sharkia are difficult to explain, particularly as the data was from the peak season. This underlines the narrow margins that the retailers work under and their vulnerability. In Fayoum, retailers also offer to clean (gut and scale) the fish and are paid an extra sum for this.

Discussion

As previously noted, there was a high degree of variability between retailer groups and between interventions, which made it difficult to compare the socioeconomic performance of beneficiaries and nonbeneficiaries and also to compare the results achieved in different locations.

	Project beneficiary	Nonbeneficiary
I make the decision	25.8	35.9
Spouse makes the decision	64.0	49.5
Other women at home make the decision	1.1	1.9
Other men at home make the decision	9.0	12.6

Table 24. Retailer responses to the question "In case of disagreement on spending income, which one makes the decision?" (% of respondents).

	Beneficiaries			Nonbeneficiaries			Significance
All governorates and all respondents	Number	Mean	Standard error	Number	Mean	Standard error	
Net profit (using average price)	87	81.5	19.01	101	6.2	17.7	*
Net profit (fish sold in the morning)	87	118.1	19.47	101	57.0	18.18	*
Net profit (fish sold in the afternoon)	87	44.9	20.31	101	-44.7	18.98	***

Note: Significance levels are ***, **, * for 0.001 (highly significant), 0.01 and 0.05 (least significant) confidence levels respectively.

Table 25. Profitability of fish retailers during peak season (EGP/day).

Nevertheless, the profitability analysis indicated that overall, project beneficiaries achieved significantly higher profits than nonbeneficiaries. However, it should be noted that these profits were calculated for the peak season (peak sales period—reflective of best case scenario) and that even then, they were modest or in some cases negative, even for project beneficiaries.

Disaggregation of the data makes it more difficult to discern significant differences because the sample sizes are lower. However, the two groups where positive results might be expected were Kafr El Sheikh and Fayoum, as they had strong retailer committees and community development associations, as well as consistent supplies of and markets for fish.

In Kafr El Sheikh, the profitability of beneficiaries, who were making reasonable profits, was significantly higher than nonbeneficiaries, who were only barely profitable.

In Fayoum, both beneficiaries and nonbeneficiaries appear to be losing money, and although the mean losses for nonbeneficiaries were higher, the difference was not significant. Fish retailers in Fayoum face a complicated situation in which competitive demand for live tilapia shipped to Cairo markets means prices for purchasing fish are higher than in the other governorates. It appears that the retailers make profits by adding a fish cleaning (scaling, degutting) surcharge to the selling price.

In Behera, the community development association encouraged women who had little or no experience in fish retailing to participate in the project and appeared to be more focused on operating as an income-generating distribution center than on supporting the retailers. Unsurprisingly, the mean profitability of experienced nonbeneficiaries was higher than for the project beneficiaries; however, it was not significantly higher.

In Abu Hammad, Sharkia, the retailer committee never really became established and has since dissolved. The retailers and fish shops in Abu Hammad sell large quantities of frozen fish (a relatively profitable activity) rather than fresh farmed fish, making their situation slightly different than those in the other project locations. However, this may be an accurate representation of the situation in many other parts of the Nile Delta and Upper Egypt, where access to farmed fish is restricted. The significantly higher profitability of project beneficiaries in Sharkia is likely to be due to differences in the scale and nature of their businesses compared to nonbeneficiaries rather than project interventions.

In El Mineya, the retailers have a fish supply problem, as there is little farmed fish available. They depend mainly on intermittent supplies of locally caught wild fish from the Nile and fish from Lake Nasser. Both project beneficiaries and nonbeneficiaries appear to be making modest profits.

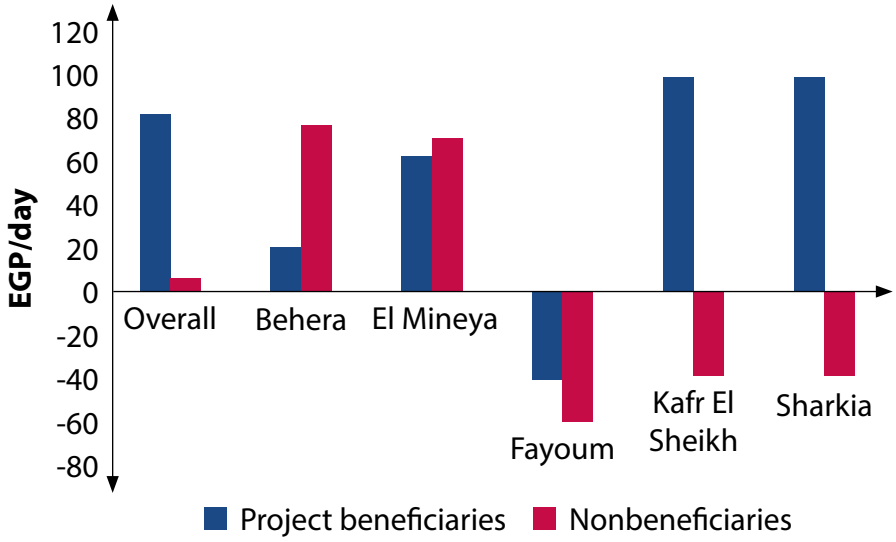


Figure 17. Average retailer profitability during the peak season assuming that fish are sold at an average of morning and afternoon prices.

Although the project appears to have achieved slight improvements in the livelihoods of participating women retailers, they still face very significant challenges. The study highlighted the importance that many of the retailers attach to being able to operate as a group rather than as individuals. As a group, they can advocate for their rights in a way that they cannot when operating alone. This has resulted in notable achievements such as the creation of a dedicated market space in Shakshouk, Fayoum; better linkage with fish farmer producer organizations; and official identification cards being issued to retailers in El Mineya.

Along with informal retailers from other sectors, women fish retailers are in a vulnerable position in which they face financial risks and exploitation on a daily basis. Their fish is either delivered to them by wholesalers who are in control of price-setting because they offer credit, or they have to pay to visit and transport fish from local wholesale markets where they have little control over prices because they must buy the fish on credit. In both cases, they are buying fish with a very short shelf life that needs to be sold the same day because it is handled and transported at ambient temperatures by the wholesalers. As indicated by this analysis, retailers reduce their prices in the afternoon because of the pressure to sell their fish within the day, but this in turn has a significant impact on their profitability. They are also exploited because many have to pay arbitrary charges for selling space. Ice is another significant cost; some of the project beneficiaries mentioned that they use their iceboxes more to extend the life of the ice than for storing fish, which has to remain on display to customers.

The creation of retailer groups is the first step in a process of converting an informal activity into a formal profession. Perhaps in the future retailers will be able to operate formal businesses where they have the infrastructure to sell fish in good condition and with a longer shelf life to consumers. This would be easier to achieve if there were an effective cold chain from the fish farms to the retailers. It is interesting to compare what is happening in Abu Hammad, Sharkia—where the retailers sell large amounts of frozen mackerel, which has a longer shelf life and higher profitability than farmed fish—to other governorates. If retailers were supplied with chilled and iced farmed fish in insulated containers (such as expanded polystyrene fish boxes), instead of rapidly deteriorating fish in open plastic crates, they would be exposed to less risk and would therefore be less vulnerable. This would then grant these retailers more time to sell their fish in good condition, and they could transport the fish to new or currently underserved markets.

The profitability of different types of fish should also be noted. The profitability of frozen mackerel is high. However, the profitability of selling the smallest grade of tilapia is also much higher than for the larger grades. Clearly, there is strong consumer demand for smaller fish, which have a lower price per kilogram, whereas fish farmers are incentivized by wholesalers to produce larger fish. This suggests that fish farmers have a poor understanding of consumer preferences, particularly for poor consumers, which could be improved by closer linkages between fish farms and retailers (Kantor and Kruijssen 2014).

INCREASING FARMED FISH PRODUCTION IN EL MINEYA

El Mineya was selected as a typical non-aquaculture governorate for the project that could act as a model for aquaculture development in similar areas in the future.

An initial scoping study was conducted in April and May 2012, with the aim of identifying existing fish farms and evaluating their potential, assessing locations in El Mineya with high potential for aquaculture development, identifying barriers to the development of aquaculture in El Mineya, and beginning to identify and prioritize potential producers to work with.

The study team was able to identify three main geographical locations where aquaculture was already taking place and with high potential for improvement: Beni Mazar (the northernmost site in the governorate), Samalut and Mallawi (the southernmost site in the governorate).

Three main types of fish farms or fisheries are found in the governorate:

- fisheries in Nile enclaves leased from GAFRD
- earth ponds in land designated for agriculture
- concrete, brick or plastic-lined ponds established for storage of irrigation water on reclaimed desert land.

The main barriers identified were the following:

- geographical restrictions in the areas available for aquaculture development (At present, it is illegal to develop fish farms in agricultural zones; they are only allowed in areas deemed unsuitable for agriculture and zoned for aquaculture development, while cage farming is not allowed in the Nile or in irrigation canals.)
- very limited technical expertise
- shortage of quality inputs (feeds, fish seed).

Based on the research carried out by the study team, it was concluded that project interventions would focus on stocking irrigation ponds or tanks in the reclaimed desert land areas, as well as developing the full production potential of existing pond farms on agricultural land.

In the first year, direct technical assistance was offered to producers and potential producers. WorldFish recommended Dr. Gamal El Azazy, a scientist with CLAR, to provide technical backstopping to CARE's field supervisor in El Mineya, Mr. Bahaa Gerges.

Bahaa and Gamal were able to provide support to 30 producers owning desert farm tanks and 5 pond farms on agricultural land in 2012. The team carried out water quality testing, tested fish samples, and introduced improved feeding programs and training in best management practices for established farms.

In addition, two cross-visits for El Mineya producers were organized. The first visit, held in May 2012, took a group of producers to Fayoum, where they met local farmers and GAFRD representatives and learned about the potential and challenges for fish farming. The second visit, to the WorldFish Research Center in Abbassa, occurred in early October 2012. This visit included a visit to a fish feed factory in Obour City and 2 days of basic aquaculture training at Abbassa. A workshop was also held in El Mineya in mid-September 2012 with the local GAFRD head to introduce various producers to one another and identify potential new farms. Dr. Gamal El Azazy delivered best management practice training to a total of 195 trainees in 44 training sessions.

In 2013, 9 farms with 18 existing ponds and 54 desert fish farms (plastic-lined ponds or tanks) were stocked with tilapia fry, and a newly established hatchery in El Mineya was stocked with Abbassa strain broodstock. Figure 18 compares production levels achieved in 2013 with those achieved in 2012 in nine farms (eight existing, one desert), indicating that there was good progress.

In 2014, the El Mineya hatchery produced 0.38 million fry and the total number of fish farms being supported under the project was 120. This included 18 farms with existing ponds, the remainder being desert fish farms.

Harvest data was collected from 46 of the farms covering 68 feddans (28 ha) that were stocked in 2014. This indicated that aquaculture production in El Mineya had risen to 295 t. However, around half of this was contributed by just 3 large farms, while 35 farms produced 5 tons or less and many others reported no production at all.

An aquaculture association has been established in El Mineya, although its registration under the Aquatic Union of Cooperatives has not yet been officially approved. The project has provided capacity-building training to the association.

A group of 18 young people (14 male, 4 female) was identified for development as aquaculture resource persons for the governorate. A training of trainers program was conducted, including residential training at Abbassa.

Few farmers are successfully farming in El Mineya. There should be a longer growing season, better water quality and higher fish selling prices (by around EGP 2/kg) in Upper Egypt than in the Delta. Few fish farmers have been able to develop significant pond areas and therefore do not have the potential to achieve higher revenues. However, most of the "fish farms" developed under the project have been small ponds or tanks set up to hold water for crop irrigation. For these farmers, fish farming is a very minor activity compared to their main crops, and some are interested in managing their ponds while others are not.

Also, the El Mineya work took place in an area and using methods that are, strictly speaking, illegal. Act No. 124 of 1983 states, "It is forbidden to construct fish farms except on infertile lands which are not suitable for agriculture, and where the water supply comes from drains and lakes, and not from irrigation water." There are no designated aquaculture zones in El Mineya, and the farms were not using water from irrigation canals or groundwater. Although these regulations were not enforced during the project, they could be, in which case aquaculture in El Mineya and similar governorates would have to stop. This calls for urgent action to revise the policies controlling where and how fish farms can be developed. The experience from El Mineya demonstrates that there is interest in developing small-scale fish farms and that integrated fish farms can be productive, suggesting at the very least that aquaculture should be allowed on land not suited for agriculture and in integrated agriculture-aquaculture systems using groundwater.

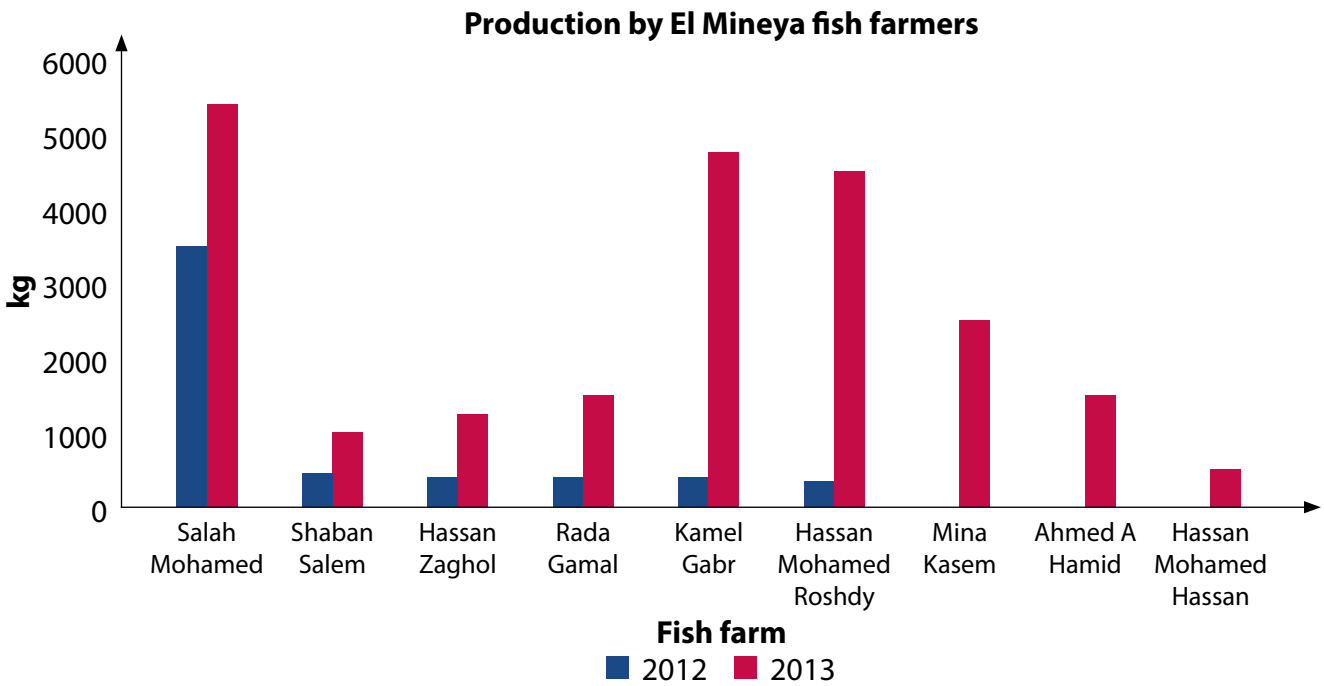


Figure 18. Production from fish farms in El Mineya.

Policy and institutions study

A consultancy was organized in 2013 to provide background information and recommendations on aquaculture policies and institutions (Goulding and Kamel 2013). It concluded that while there is a clear legal and policy framework, there are a number of important gaps that do not reflect the growing importance of the sector for food security and economic development. Other points included the following:

- Uncontrolled harvesting of marine fry, such as mullet for aquaculture, increases the risk of wild stock collapse.
- The seasonal nature of tilapia production and the limited range of market options make market development a priority for the sustainability of the sector.
- Egypt is unable to export aquaculture products to the European Union, as it does not have the necessary residue-monitoring or health control systems in place.

This study should have provided a firm platform for aquaculture policy engagement with key stakeholders such as the Minister of Agriculture, GAFRD, the General Organisation for Veterinary Services, the Ministry of Water Resources and aquaculture producer organizations. However, the overthrow of the Morsi Government in early July, the lack of an effective parliament and frequent changes in public service heads made it impossible to move forward. It was decided in late 2013 that the best way forward would be to use a "bottom up" policy process by establishing an aquaculture innovation platform.

Aquaculture innovation platform

An Egyptian aquaculture innovation platform was launched in January 2014 with the aim of bringing together industry stakeholders and regulators to work on the main issues constraining the aquaculture industry so that clear policy recommendations could be made to the new government.

The process started with governorate-level workshops, where issues and representatives were identified. At the national workshop in February 2014, the main issues were discussed and prioritized. Ten working groups were established during the meeting (Mur, personal communication, 2014). At the first meeting following the national workshop, the 10 groups were reorganized into 6 working groups as follows:

- access to water
- land ownership and leasing policies
- development of markets
- fish health
- reducing farm operating costs (mainly feed costs)
- improving fish farmer representation (through the producer organization).

Each working group was assisted by a WorldFish facilitator and held a series of meetings. Most documented their conclusions by writing reports. The most comprehensive is a report defining operating standards and practices for farmed fish markets. A particularly urgent issue was fish health, as many fish farms experienced significant mortalities during the summer. The fish health group helped to carry out a mapping exercise to establish which diseases are impacting fish farms in different locations and at what times of the year. Support was offered by the CGIAR Research Program on Livestock and Fish (L&F) in collaboration with the international veterinary pharmaceutical company, Merck Animal Health, and Skretting, the feed company. The innovation platform group succeeded in highlighting a problem that led to new sources of support and coordinated action for the sector.

Reports from the working groups were to be used to advocate for policy changes when the new parliament was elected and was sitting in mid-2014. Unfortunately, the political process was delayed and the frequent changes in key stakeholders continued (there have been six Ministers of Agriculture over the course of the project). While the security situation has improved greatly, parliamentary elections were only taking place at the end of 2015.

Meanwhile, the innovation platform groups held a plenary meeting in September 2015 to discuss progress and prioritize next steps. The main recommendation was that a high-

IMPROVING INSTITUTIONAL, POLICY AND REGULATORY FRAMEWORKS

level authority for aquaculture needs to be established, headed by a public figure, in order to coordinate between the relevant ministries and agencies.

The actions proposed by the different innovation platform groups were as follows:

Water quality and quantity:

- Consider aquaculture as part of cultivation (agricultural) activities with an equivalent share of water.
- Create various models of integrated aquaculture systems in order to use water resources in a more effective way and make the findings accessible to all.
- Establish a map of land and groundwater available for aquaculture to encourage investment.

Fish health:

- Establish veterinary centers close to fish farms to make regular check-ups on water quality and diagnose fish diseases; provide training and guidance to fish farms and hatcheries.
- Tighten control on wastewater treatment stations (industrial and sewage) to decrease pollution levels in the water used in aquaculture.

High cost of production:

- Expand the cultivation of feeds.
- Use new technology to manufacture floating feeds to enhance fish growth rates while improving the economic performance of fish farms and protecting the environment.
- Apply quality control standards for both feed raw materials and final products.

Land tenure for aquaculture:

- Exempt the renewal of aquaculture land rental contracts from Law No. 89 (1998) that defines EGP 50,000 as the value above which public land must go to tender.
- Provide equal property taxation rules for land used for aquaculture and agriculture.

Farmers' representation:

- Enhance the role of aquaculture associations to provide services to members by providing inputs, marketing services, and social and health insurance and helping to reduce land rentals and renew licenses for members. This will encourage farmers to become members of these associations.
- Establish an insurance fund against risks for fish farmers while ensuring a funding mechanism to maintain its sustainability.
- Establish a fund to support cooperative associations to be affiliated with the Cooperation Union Fund.

Improving fish handling in markets:

- Develop fish markets and provide basic services (potable water supply, toilets) for the public.
- Provide training on best fish-handling methods using related guidelines developed by WorldFish and the innovation platform group members.
- Approve legislation to control the procedures and processes used in fish production and handling, from fish farms to consumers.

At the end of the September meeting, the participants agreed that the next step was to decide upon the right channels to communicate these messages to key policymakers in the regulatory authorities and government (local and national).

Most of the recommendations from the working groups include changes to policies and laws or interpretation of these by the regulatory authorities. This process needs to be taken up by aquaculture producer organizations in the future with the assistance of projects such as IEIDEAS or STREAMS.

In 2013, CARE carried out an assessment of aquaculture producer organizations, which highlighted the important role that the Aquatic Union of Cooperatives, the apex body for governorate-level fish farmer associations, should be playing for the sector. Until recently, the Aquatic Union represented only the fish-catching sector cooperatives. The CARE assessment led to a proposal from the Aquatic Union for capacity-building support from CARE under the IEIDEAS project. This took the form of training for the board members of the Aquatic Union and the establishment of a training unit to provide capacity-building support to governorate-level fish farming associations.

Market studies

Detailed market studies were carried out in 2012 and 2013 in preparation for a project to be funded by Danida (Macfadyen et al. 2012). The results of these studies identified opportunities for economic development and job creation through added-value processing and improving postharvest handling practices for traditional markets. A paper on the results was presented at the World Aquaculture Society conference in Australia in mid-2014.

Unfortunately, Danida decided to cut its aid program to Egypt in August 2013. Recent discussions suggest that it will not be able to consider support for new projects until 2017.

Pro-poor aquaculture

Pro-poor aquaculture production was a pilot-scale activity introduced into the project design in response to a review of project activities using the "making markets work for the poor" (M4P) approach.

Aquaculture production in Egypt is dominated by medium-scale enterprises rather than poor producers because of the policy framework under which the sector operates. Aquaculture can only be conducted in designated areas where most of the land is government-owned and leased to farmers. No other forms of development, such as agriculture or construction of permanent buildings, are allowed in these aquaculture zones. The relatively large size of leased land blocks (around 10 ha) means they are operated as businesses employing staff rather than as household-operated units. Also, under current regulations, aquaculture is technically illegal in non-aquaculture zones, such as traditionally irrigated land (where there are many very poor farmers) or in small cages in the Nile. This places a major constraint on opportunities for poor people to directly engage in aquaculture.

A Malawian fisheries officer, Jacqueline Kazembe, joined the project for 4.5 months through an AWARD scholarship (www.awardfellowships.org). She concentrated on setting up experimental, pro-poor aquaculture systems for women based on farming African catfish in small homestead tanks. The concept was to grow fish in simple tanks, where water is exchanged on an occasional basis and effluent water is used to irrigate vegetables.

The systems included demonstration tanks at Abbassa, growth trial tanks at Abbassa and tanks at the homesteads of women in the Abbassa area. The growth trial results were disappointing, both on-station and at the homesteads. The catfish used in the trial failed to thrive, which raises questions about their origin and suitability for this type of system, or possibly the strains of catfish used. Further research is needed to determine whether the problem is related to the strain used (their behavior seemed very different from the same species in West Africa), feeds or the system itself.

The other pro-poor technology tested by the project was growing and selling small tilapia (100–150 g average weight) to meet demand for small fish by poor consumers. This was based on the finding that IEIDEAS project women retailers say they cannot get enough small fish to meet market demand, as fish farmers concentrate on producing larger fish (>350 g), which command 30%–40% higher prices (EGP/kg) from wholesalers. From the fish farmers' point of view, growing larger fish should intuitively be more profitable because of the higher wholesale price. However, high feed costs mean that if they fertilized rather than fed for more of the growing period and harvested more frequently, they should be able to reduce their operating costs, improve their cash flow, reduce their need for credit from wholesalers and feed mills, and meet market demand from poor consumers, who are the main buyers of farmed fish in Egypt.

In fact, the trend towards producing ever-larger fish could be seen as targeting limited, higher-value markets and fish farmers moving away from their traditional "bottom of the pyramid" markets. Tests were set up at the Abbassa Research Center in 2014 to compare high and low stocking densities harvested either

once or twice during the growing season. The preliminary results indicated that it should be possible for farmers to maintain profitability if they harvest their fish at smaller sizes and grow two crops a year instead of one. This could offer a new pro-poor production option for existing fish farmers.

The greatest potential for pro-poor aquaculture in Egypt would be integrated aquaculture-agriculture in traditionally irrigated areas. If small farmers were allowed to develop small-scale fish-rearing systems as part of their farming system, they could generate significant household-level benefits in terms of improved incomes (by selling fish) and nutrition (from eating fish), as well as improving the sustainability of their farming system through nutrient recycling. However, integrated aquaculture-agriculture is not allowed at present in Egypt, as anything that reduces the area of irrigated crops is seen as a threat to national food security. The restrictions on where fish farms can be operated (only in defined aquaculture zones) and what water can be used (water from irrigation drainage canals or lakes) are codified in the Law on Fisheries No. 124 (1983). It seems unlikely that this policy will change; however, it could be taken up by strengthened producer organizations in the future.

Another opportunity that is more likely to be officially supported is the integration of aquaculture and agriculture in "new" or "reclaimed" land where the main water source is groundwater. This has been tested by the project in El Mineya, where over 100 groundwater irrigation ponds have been stocked with fish. The next step will be to develop dedicated fish-rearing systems to improve productivity and benefits for the operators.

Food safety research

ILRI carried out collaborative research in two projects focusing on food safety and the aquaculture value chain in Egypt. The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)-supported project, Safe Food Fair Food, and the Australian Centre for International Agricultural Research (ACIAR)-supported project, Rapid Integrated Assessment, carried out fieldwork in late 2012 and the first half of 2013 (El Tholth et al. 2015). This research concluded that the main food safety issue facing the value chain is poor postharvest handling.

Analysis of farmed tilapia samples for chemical pollutants (heavy metals and pesticide residues) revealed that all were either nondetectable or within the maximum permissible limits defined by national and international organizations. However, bacteriology indicated that there was potential postharvest contamination and spoilage of farmed tilapia.

The report concluded that tilapia is perceived as a highly nutritious animal-source food and is frequently consumed by a high proportion of the household members in the study area. Potential investment by providing cold chains, supervising fish markets and implementing hazard analysis critical control points would improve the safety and quality of tilapia and reduce human health hazards. Also, one of the important and urgent requirements is the development of a reliable database for fish farms in Egypt. (There was none available at the time this work was carried out—the IEIDEAS training database now goes some way toward filling the gap.)

SDC-commissioned project progress review

A project review was carried out in February 2014 at the request of SDC (Kjaersig, personal communication, 2014) with the aim of assessing project progress against end of project targets, to plan activities for the remainder of the project period and to plan toward a new phase of the project.

The review concluded that implementation progress was higher than what could be expected. It recommended that the final (revised) project framework needed to be formally endorsed by the project steering committee and SDC. Comparing end of project targets to project progress, the review concluded that most targets were likely to be met, except the employment target of 10,000 FTE and improved nutritional health of low-income consumers, which were unlikely to be met during the project period.

Regarding the work with women fish retailers, the review suggested that the project needed to identify mechanisms to establish representative retailer committees and consider the sustainability implications of some of the interventions, such as iceboxes, freezers and tricycles. The review also recommended a project approach with a gender lens rather than just working with women only, as well as a need for more resources to be dedicated to gender research and documentation over the remainder of the project period. These recommendations were acted upon by the project through the retailer and fish consumption studies.

The review suggested that the environmental impacts of the project should be given more consideration and that the innovation platform process should be maintained. (An environmental impact study of Egyptian fish farming based on lifecycle analysis was carried out by the project in late 2014 and is still in draft form). It also indicated that more resources should be committed to communications, as long as this did not conflict with the national security situation.

The review recommended that the final impact assessment should not take place until early or mid-2015 to allow for results from fish harvests of fish stocked in 2014. Rather than using an elaborate monitoring and evaluation framework, the review suggested that a limited number of "golden" indicators should be used, with data disaggregated by gender and youth where appropriate. These principles were incorporated into the design of the project impact assessment framework.

The review recommended that SDC should continue support for the sector through a new project focused on employment creation and economic development in the Egyptian aquaculture value chain. Due consideration should be given to issues of environmental sustainability and inclusion, gender and youth. The new program should have a clearer value chain approach, including M4P ("making markets work for the poor") and gender-transformative approaches. Further piloting should be limited and centered around recommendations from the innovation platform.

Feed value chain analysis

Dr. A.F.M. El-Sayed, an Egyptian, carried out a value chain analysis study of the Egyptian aquaculture feed industry in late 2013 (El Sayed 2014; El-Sayed et al. 2015). The report concluded that the commercial aquaculture feed industry in Egypt is growing at a rapid rate. As a result, the number of fish feed mills has increased from 5, producing about 20,000 t per year in 1999, to over 60 mills with a current production estimate of 800,000–1,000,000 t/year.

The study summarized the major constraints facing the fish feed industry in Egypt and proposed the following recommendations for better management and development of the sector:

- Reduce dependency on expensive feed ingredients.
- Improve capacity for production of high-quality feeds.
- Increase employment opportunities in the aquaculture feed sector.
- Improve access to credit.
- Improve access to training.
- Strengthen the legal and policy environment for feed production, quality control, handling, storage and trading.

Human nutrition study

A study commissioned by the project sought to understand the role of fish and other animal-source foods in Egyptian households, resulting in the report *The Role of Farmed Fish in the Diets of the Poor in Egypt*. Field surveys were carried out by the Environment and Development Group in May–June 2014 and focused on the following issues:

- the place of animal-source foods, particularly fish, in the diets of the poor
- factors affecting consumer demand for different types and qualities of animal-source foods among the poor
- how equitably animal-source food consumption is distributed within households.

The results were published as a WorldFish report (El Mahdi et al. 2015). Household spending on fish ranged from 5.4% to 6.7% of total food expenditures. The frequency of fish consumption increased with level

of resources, but even in households in the highest expenditure quintile, fish was eaten as a main dish just 2.9 times per month. An increase in the level of education completed by the household head predicted a significant increase in the frequency of fish consumption by the household head.

The survey identified several factors that shape preferences for fish, red meat and poultry and further areas for future research, while making the following recommendations:

- Reduce the price of fish. A full 87% of survey respondents said that they would buy more fish if it were less expensive.
- Improve the quality and freshness of marketed fish. Nearly all survey respondents believed that fish safety, an aspect of quality, can be judged by sight and taste. Improving provision of transport and cold storage services to small-scale fish retailers could serve to improve its quality and freshness as it reaches the marketplace.
- Educate consumers about aquaculture and nutrients in fish. Consumer education campaigns could help to allay concerns about the safety of farmed fish and convince consumers that the health benefits of fish are comparable to red meat and poultry.

The report concluded that the results and those of future research efforts will empower value chain actors to more successfully market their products and enable organizations like WorldFish to improve the design and targeting of programmatic efforts to boost sustainable fish production and consumption.

Farmer learning about feeding fish, Abbassa, Sharkia.

Performance against project objectives

The IEIDEAS project goals were to create 10,000 jobs in the Egyptian aquaculture value chain through support for the sector in five governorates, benefitting 50,000 household members; to build a more secure future for the sector; and to contribute to the nutritional health of low-income consumers.

The end of project indicators for the project goal were the following:

- 10,000 jobs created, including 900 decent jobs for women retailers
- net income in target enterprises increased by USD 8.8 million
- project benefits extended to 2000 fish farms, 100 wholesalers and 900 retailers by end of project
- access to quality fish maintained or enhanced for low-income consumers.

Results:

- Best management practice training of fish farmers resulted in significantly improved profits, from 13% for control farms to 27%–34% (depending on the intervention), yielding around USD 27 million extra profit (net incomes) for project-supported fish farmers. The increased profitability has been achieved through more efficient feeding (FCR 1.8 for control farms compared to 1.53–1.42 for project-supported farmers) and management practices rather than increased production.
- Only around 28 jobs (FTE) are likely to have been created as a result of increased fish production directly from project interventions. Best management practice training resulted in more efficient fish production, including less feed used, but there was no apparent production increase. Productivity (t/ha) appears to have increased by around 5% from stocking the Abbassa strain of Nile tilapia. However, only around 500 farms were stocked with the Abbassa strain in 2014, so this would only represent around 200 t of extra production. Approximately 70,000 t/yr would have been required to hit the 10,000 FTE jobs target. Production and employment will increase in future years with increased availability of the Abbassa strain and as farmers become more familiar with the new strain. It is expected that more profitable, best management practice-trained farmers will also invest in extra production. Even without further project support, employment resulting directly from IEIDEAS project interventions should rise to over 10,000 jobs in the next 5 years.
- Project benefits have been extended to over 2000 fish farms and more than 1000 retailers.
- There has been a 56% increase in aquaculture production, from 0.7 million tons in 2009 (baseline year for the project) to 1.1 million tons in 2013, and total per capita fish consumption (farmed, wild and traded) rose marginally from 19.70 kg in 2010 to 19.73 kg in 2013. Aquaculture-produced fish represented an increasing proportion of this: 65% of total fish consumed in 2013 compared to 59% in 2010.
- The project nutrition study indicated that 58% of poor households consumed farmed fish regularly and that farmed fish is cheaper than other animal-source foods.

The project outcomes were the following:

Productivity and sustainability of existing fish farms in Sharkia, Kafr El Sheikh, Behera and Fayoum improved.

Indicators:

- 30% production increase among 2000 target producers
- 10% increase in national aquaculture production
- 10,000 jobs (FTE) created:
  - 8000 on fish farms (4000 for youth)
  - 800 with traders and retailers (300 for youth)
  - 1200 for retailers (600 for women, 600 for youth).

Results:

- Production increases (nonsignificant) have only been seen on the 500 farms stocked with the Abbassa strain (around 5% higher production than nonbeneficiary farmers).

- GAFRD production statistics indicate continued growth in aquaculture production (3% increase in 2012 and 7% increase to 1.1 million tons in 2013). However, little of this can be directly attributed to the project, as the main activities only started in 2012.
- Job creation across the value chain has been limited so far because best management practice-trained farmers prioritized profitability rather than production and the Abbassa strain was stocked in only 500 farms in 2014. However, it is anticipated that more profitable fish farms will expand production by investing in new technology and the Abbassa strain will spread rapidly as the seed becomes more available. The employment target of 10,000 FTE is likely to be reached within a few years when larger production increases result from widespread adoption of improved practices and use of the improved strain.

Livelihoods and working conditions of women fish retailers improved through pilot-scale interventions in Sharkia, Kafr El Sheikh, Behera, Fayoum and El Mineya.

Indicators:
- 5 sustainable fish retailer organizations established
- working conditions improved for 900 fish retailers
- approaches developed for scaling out to other markets and governorates.

Results:
- Six women retailer groups were established and operating in El Mineya (two groups), Fayoum, Kafr El Sheikh, Sharkia and Behera, involving 1125 women. Participants say they have benefitted from the process and have been able to advocate for recognition and support that they would not have been able to access on an individual basis.
- The impact survey showed that on average, project beneficiary retailers made significantly higher profits than nonbeneficiaries.
- 21 village savings and loan association groups were also established, helping to free the women from exploitative credit and price-fixing.
- Different approaches (market infrastructure, improved transport, distribution centers, empowerment training) were tested in the groups. These have resulted in a toolkit of approaches that could be used for scaling out.

Farmed fish production increased in El Mineya, including pro-poor aquaculture and reduced environmental impact systems.

Indicators:
- El Mineya fish farm production reaches 150 t/year by end of project (100 t/year from desert aquaculture integrated fish farms and 50 t/year from existing farms)
- 100 new fish farms developed (150 jobs)
- pro-poor aquaculture systems tested.

Results:
- In 2014, 120 farms were stocked with high-quality seed and provided with technical assistance. Variable production increases were shown in 2013–2014 harvests. The total amount harvested from fish stocked in 2014 was 295 t from 46 farms (compared with 5.5 t in 2012).
- Tonnage from existing ponds has reached the end of project target. Production from desert aquaculture has been less because most comes from small irrigation ponds or tanks, many of which have been unproductive or poorly managed. The 18 existing farms and 102 new farms stocked in 2014 are likely to have generated 41 FTE. Widespread adoption of aquaculture in El Mineya will require policy change to loosen zoning and encourage agriculture-aquaculture integration.
- Work on pro-poor aquaculture systems in El Mineya was terminated because of poor results with catfish in small tanks.
- While reduced environmental impacts are important, this objective never really fitted into this outcome, which was more about starting new farms in an area where there was nothing before the project started. Lifecycle analysis has been used to estimate environmental impacts of fish farms in the Nile Delta and will help to set the benchmark for reduced impacts in the future.

Efficient and sustainable value chains in the aquaculture sector and optimal institutional, policy and regulatory frameworks facilitated.

Indicators:
- strengthened capacity of existing aquaculture producer and industry organizations to represent their members' interests

- private and public sector policy platform established to develop approaches for key aquaculture sector challenges (resource planning, licensing, land and water tenure, quality management systems, market development).

Results:

- Capacity building support has been given to the Aquatic Union of Cooperatives as the representative body for governorate-level aquaculture producer organizations.
- The policy and institutional environment was analyzed in 2013.
- An aquaculture innovation platform was established in 2014 with six working groups who focused on key policy issues affecting aquaculture development.

Recommendations and next steps

The IEIDEAS project was an ambitious intervention designed to address some of the challenges and opportunities offered by the 2011 Arab Spring. The main concept was to improve incomes and create employment in the aquaculture value chain through providing technical assistance to fish farmers and other value chain actors.

Egypt has a successful and productive aquaculture sector. This has resulted from commitments made by the government in the early 1980s to set aside large areas of land that could be leased to prospective fish farmers. The farms could reuse agricultural drainage water so they would not have to depend on scarce Nile water. Key staff were trained, GAFRD was established and legislation was passed that has allowed the sector to grow. The other main driver behind growth of the sector has been its inherent profitability, which has allowed the private sector to invest in hatcheries, feed mills, farms, wholesale businesses and retailing. Egyptian aquaculture is now a sector driven by the private sector, which has become the country's main source of fish. Aquaculture-produced fish has resulted in per capita fish supply rising from around 15 kg to 20 kg over the last decade. According to the consumer study carried out under the IEIDEAS project, 58% of poor Egyptians regularly eat farmed tilapia and it is the least expensive animal-source protein.

The value chain analysis at the start of the IEIDEAS project indicated that the sector employed 14 people (FTE) for each 100 t/year of production, leading to an overall estimate of 100,000 jobs. However, the study also recognized that the sector needed stronger support if it was to continue expanding, as profitability was in sharp decline due to increased feed prices and static or declining selling prices. Thus, the central focus for existing fish farmers was to reverse the decline in profitability through best management practice training and by releasing the Abbassa improved strain to fish farmers. The project also aimed to investigate how to improve the livelihoods of informal female fish vendors, who are responsible for selling a large proportion of Egyptian farmed fish, and to see whether aquaculture could be introduced as a new activity in Upper Egypt (El Mineya Governorate).

IEIDEAS project startup also coincided with the start of L&F, and Egypt was identified as one of the main value chains in the program. The L&F program rationale was based on carrying out rapid value chain analysis to identify best bets, which would then be tested on-station or on-farm before being scaled up through partners to achieve development-level impacts.

The IEIDEAS project value chain analysis took place before L&F started, and it could be argued that best management practice training and dissemination of the Abbassa strain were implemented at scale from the start rather than as best-bet pilots. On the other hand, the work with women retailers and in El Mineya were best bets, as was some preliminary work on pro-poor fish production systems.

Best management practice training was very successful at changing fish farm management practices on around 2000 fish farms, resulting in major gains in efficiency and profitability but not yet increased production. The use of the Abbassa strain appears to result in slight production gains. However, the dissemination process took longer than anticipated in the project design, so directly attributable gains in production (and employment) have been very limited so far.

Meanwhile, the pilot-scale work with retailers has shown that informal women vendors benefit both in terms of empowerment and financially

from a group-based approach. This approach could be scaled up to other communities, to other parts of Egypt and even to other countries where informal retailing is prevalent.

The first steps have been taken to start integrated agriculture-aquaculture development in El Mineya. Again, this could be scaled up to other parts of the country in a future program.

Perhaps the most difficult aspect of the project was to achieve progress on aquaculture policies and institutions during a period of continued political instability. This was addressed, at least to some extent, by the innovation platform. However, the recommendations generated by the platform still need to be taken forward by representative organizations (who are currently weak and, it could be argued, unrepresentative) to policymakers (a new parliament was elected in late 2015) who are likely to have many important priorities to face in the months to come.

The IEIDEAS project results suggest that while good progress has been made in the first 3–4 years, the sector could benefit from sustained support to consolidate the work with existing fish farmers, to improve the institutional and regulatory environment, and to scale up some of the pilot-scale approaches. SDC is supporting a follow-up intervention for the sector, the Sustainable Transformation of Egypt's Aquaculture Market System (STREAMS) project.

The new project is based on three main activity areas:

- continued support for existing fish farmers through best management practice training and dissemination of the Abbassa strain but with improved management and increased responsibility by strengthened regulatory authorities and producer organizations
- creating opportunities for the development of small-scale and integrated aquaculture-agriculture approaches through pilot testing and facilitating the necessary policy changes
- improving markets for farmed fish through continued support for informal retailers, increased access to market information, carrying out market studies and facilitating market promotion.

The STREAMS project links with other projects being implemented by WorldFish, including the Sustainable Trade Initiative project under which a certification system will be developed for Egyptian farmed tilapia, the SDC Youth Employment in Aswan Governorate Project (managed by CARE), and the AquaLINC project supported by the German Federal Ministry for Economic Cooperation and Development on pro-poor market systems for farmed fish in Egypt and Bangladesh, while funding is being sought for major scaling up of IEIDEAS project retailer approaches.

REFERENCES

Azazy GE, Hebicha HA and Nasr-Allah AM. 2012. Estimated costs and returns for commercial cage production of fingerlings and table-size mullet (*Mugil cephalus*) in Dakhlia Governorate, Egypt. *Egyptian Journal for Aquaculture* 2(4):1–14.

El Mahdi A, Krstic J, Abdallah A, Abdullah H, Kantor P and Valpiani N. 2015. The role of farmed fish in the diets of the resource-poor in Egypt. Penang, Malaysia: WorldFish. Program Report: 2015-05.

El-Sayed AFM. 2014. Value chain analysis of the Egyptian aquaculture feed industry. Penang, Malaysia: WorldFish. Project Report: 2014-22.

El-Sayed AFM, Dickson MW and El-Naggar GO. 2015. Value chain analysis of the aquaculture feed sector in Egypt. *Aquaculture* 437:92–101.

El Tholth M, Fornance K, Grace D, Rushton J and Hasler B. 2015. Characterisation of production, marketing and consumption patterns of farmed tilapia in the Nile Delta of Egypt. *Food Policy* 51:131–43.

[GAFRD] General Authority for Fish Resources Development. 2014. Fish statistics yearbook for 2013. General Authority for Fish Resources Development, Ministry of Agriculture and Land Reclamation, Egypt.

Goulding I and Kamel M. 2013. Institutional, policy and regulatory framework for sustainable development of the Egyptian aquaculture sector. WorldFish. Project Report: 2013-39.

Hamzah A, Ponzoni RW, Nguyen NH, Khaw HL, Yee HY and Nor SAM. 2014. Performance of the Genetically Improved Farmed Tilapia (GIFT) strain over ten generations of selection in Malaysia. *Pertanika J. Trop. Agric. Sci.* 37(4):411–29.

Hebicha HA, El Naggar GO and Nasr-Allah AM. 2013. Production economics of Nile tilapia (*Oreochromis niloticus*) pond culture in El-Fayum Governorate, Egypt. *Journal of Applied Aquaculture* 25:227–38.

Ibrahim AN, Abou Zaid MY, Khaw HL, El-Naggar GO and Ponzoni RW. 2013. Relative performance of two Nile tilapia (*Oreochromis niloticus* Linnaeus) strains in Egypt: The Abbassa selection line and the Kafr El Sheikh commercial strain. *Aquaculture Research* 44(3):508–17.

Kantor P and Kruijssen F. 2014. Informal fish retailing in rural Egypt: Opportunities to enhance income and work conditions for women and men. Penang, Malaysia: WorldFish. Project Report 2014-51.

Kenawy DAR, Nasr-Allah AM and Ahmed MFM. 2013. *Egyptian Aquaculture Best Management Practice Guidelines.* In Arabic. WorldFish.

Macfadyen G, Nasr-Allah AM, Kenawy DA, Fathi M, Hebicha H, Diab AM, Hussein SM, Abou-Zeid RM and El-Naggar G. 2012. Value chain analysis: An assessment methodology to estimate Egyptian aquaculture sector performance. *Aquaculture* 362–363:18–27.

Macfadyen G, Nasr-Allah AM, Kenawy DAR, Fathi M, Ahmed M, Hebicha H, Diab A, Hussein SM, Abouzied RM and El Naggar G. 2011. Value-chain analysis of Egyptian aquaculture. Penang, Malaysia: The WorldFish Center. Project Report: 2011-54.

Nasr-Allah AM, Dickson M, Kenawy DAR, El Naggar G, Ahmed MFM, Azazy G, Garana Y and Diab AM. 2014a. Value chain analysis of Egyptian fish seed production. 4th Scientific Conference in Aquaculture between Science and Application, organized by CLAR, 11–12 March 2014. *Egyptian Journal for Aquaculture and Abbassa International Journal* 351–72.

Nasr-Allah AM, Dickson MW, Kenawy DA, Ahmed MFM and El-Naggar GO. 2014b. Technical characteristics and economic performance of commercial tilapia hatcheries applying different management systems in Egypt. *Aquaculture* 426–427:220–30.

Nasr-Allah AM, Kenawy DAR, Ahmed MFM and Zakey A. 2014c. *Best Management Practices for Tilapia Hatcheries in Egypt*. Manual in Arabic. Egypt: WorldFish.

WorldFish. 2013. Egyptian aquaculture best management practices. Video series (Arabic and English subtitles). On Worldfishcenter YouTube channel: http://www.youtube.com/playlist?list=PL_5s5CPGqCKQtv15flpx4UKDltm3JyEIM

ANNEX 1 PROJECT LOGFRAME

Revised project logframe

Logframe: Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS)		Ph. 01	1 December 11 – 31 December 14
Hierarchy of objectives	**Key performance indicators**	**Means of verification**	**Assumptions and risks**
Impact (goal)	**Impact indicators**		
To create 10,000 jobs in the Egyptian aquaculture value chain through support for the sector in five governorates, benefitting 50,000 household members; to build a more secure future for the sector; and to contribute to the nutritional health of low-income consumers.	• 10,000 jobs created, including 900 decent jobs for women retailers • Net income in target enterprises increased by USD 8.8 million • Project benefits extended to 2000 fish farms, 100 wholesalers and 900 retailers by end of project • Access to quality fish maintained or enhanced for low-income consumers	• Value chain analysis • GAFRD statistics • Central Agency for Public Mobilization and Statistics (CAPMAS) data • Project reports and databases	
Outcomes	**Final outcome indicators**		
Productivity and sustainability of existing fish farms in Sharkia, Kafr El Sheikh, Behera and Fayoum improved.	• 30% production increase among 2000 target producers • 10% increase in national aquaculture production • 10,000 jobs (FTE) created: - 8000 on fish farms (4000 for youth) - 800 with traders and retailers (300 for youth) - 1200 for retailers (600 for women, 600 for youth)	• Value chain analysis • Best management practice surveys • GAFRD production statistics • Other independent external evaluations	**See section on risk in main proposal**
Livelihoods and working conditions of women fish retailers improved through pilot-scale interventions in Sharkia, Kafr El Sheikh, Behera, Fayoum and El Mineya.	• Five sustainable fish retailer organizations established • Working conditions improved for 900 fish retailers • Approaches developed for scaling out to other markets and governorates	• Organizational assessments • Value chain analysis and retailer survey and interviews • Project reports and databases	
Farmed fish production increased in El Mineya, including pro-poor aquaculture and reduced environmental impact systems.	• El Mineya fish farm production reaches 150 t/year by end of project (100 t/year from desert aquaculture integrated fish farms and 50 t/year from existing farms) • 100 new fish farms developed (150 jobs) • Pro-poor aquaculture systems tested	• Project reports and databases	
Efficient and sustainable value chains in the aquaculture sector and optimal institutional, policy and regulatory frameworks facilitated.	• Strengthened capacity of existing aquaculture producer and industry organizations to represent their members' interests • Private and public sector policy platform established to develop approaches for key aquaculture sector challenges (resource planning, licensing, land and water tenure, quality management systems, market development)	• Policy and institutions reports • Project reports	

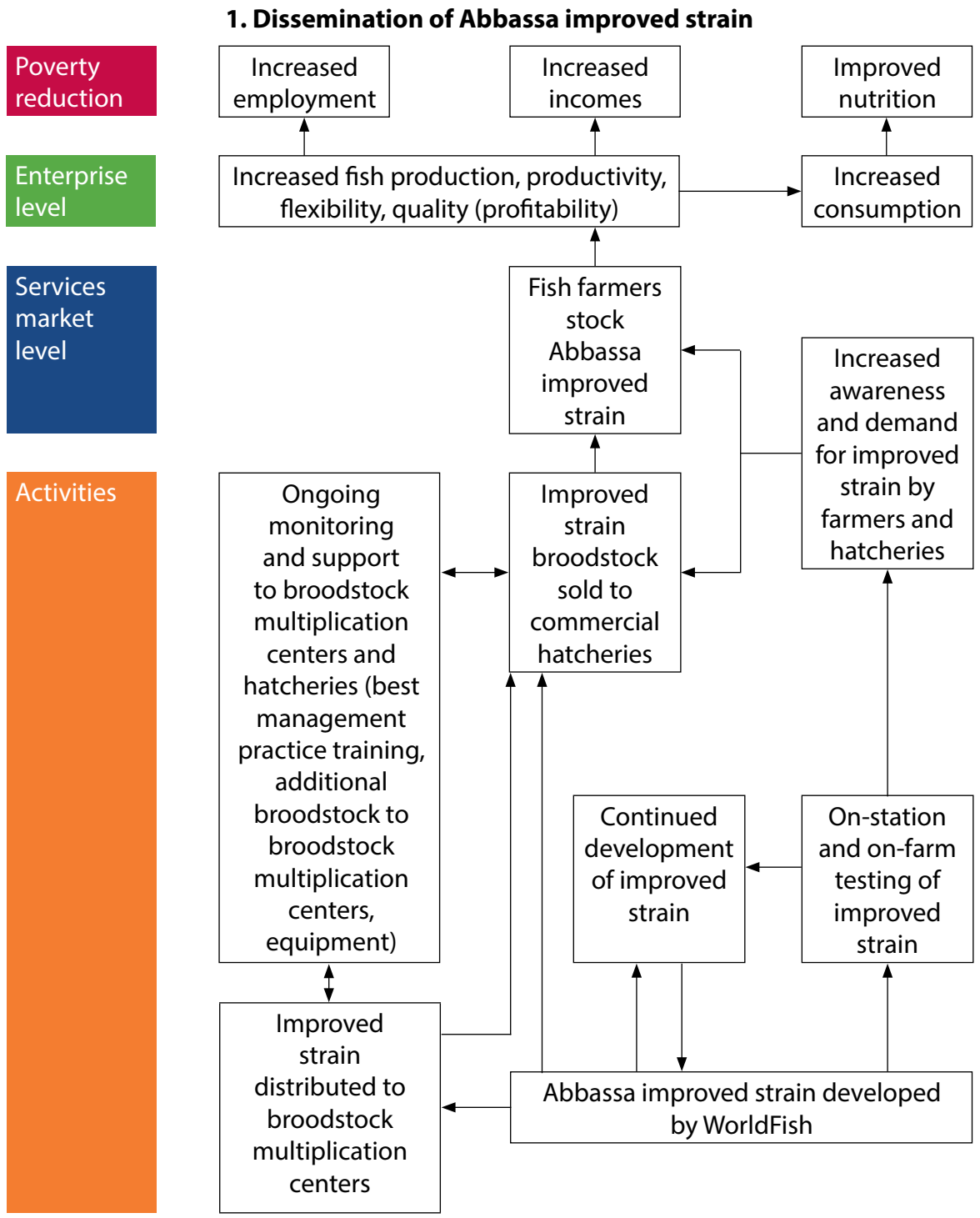
Revised project logframe

Logframe: Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS)		Ph. 01	1 December 11 – 31 December 14
Hierarchy of objectives	**Key performance indicators**	**Means of verification**	**Assumptions and risks**
Outputs (results)	**Output indicators**		
Fish farms, hatcheries and other value chain actors in the four main aquaculture production governorates received best management practice training, other technical support and access to Abbassa improved strain seed.	**Seed** • 2000 fish farms using Abbassa improved strain by end of project • 20% improvement in fish growth rates among farmers using Abbassa strain **Best management practices** • 2000 fish farmers trained in complete set of best management practices by end of project • Significant improvements in productivity, production, quality, efficiency of production and FCR among trained farmers	• Best management practice surveys • Project reports and databases	
Fish retailing organizations established and functioning in five governorates.	• Retailer committees formed and members trained • Retailer committees supported to deliver interventions and services • Results from pilot-scale trials assessed and communicated	• Organizational assessments • Committee meeting minutes • Training documents • Documentation of interventions and services delivered • Project reports and databases	
New aquaculture value chains in El Mineya established.	• 100 new fish farms established • Hatchery established in El Mineya • Producer organization established • Market linkages and systems established • Pro-poor aquaculture production systems tested	• Project reports and databases • Producer organization assessment	
Improved institutional and policy environment, fostering efficient and sustainable value chains.	• Sector development strategy and quality management plan developed by producer organizations • New licensing arrangements proposed	• Project reports	

Revised project logframe

Logframe: Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS)	Ph. 01	1 December 11 – 31 December 14
Activities + results chains		

Outcome 1. Productivity and sustainability of existing fish farms improved

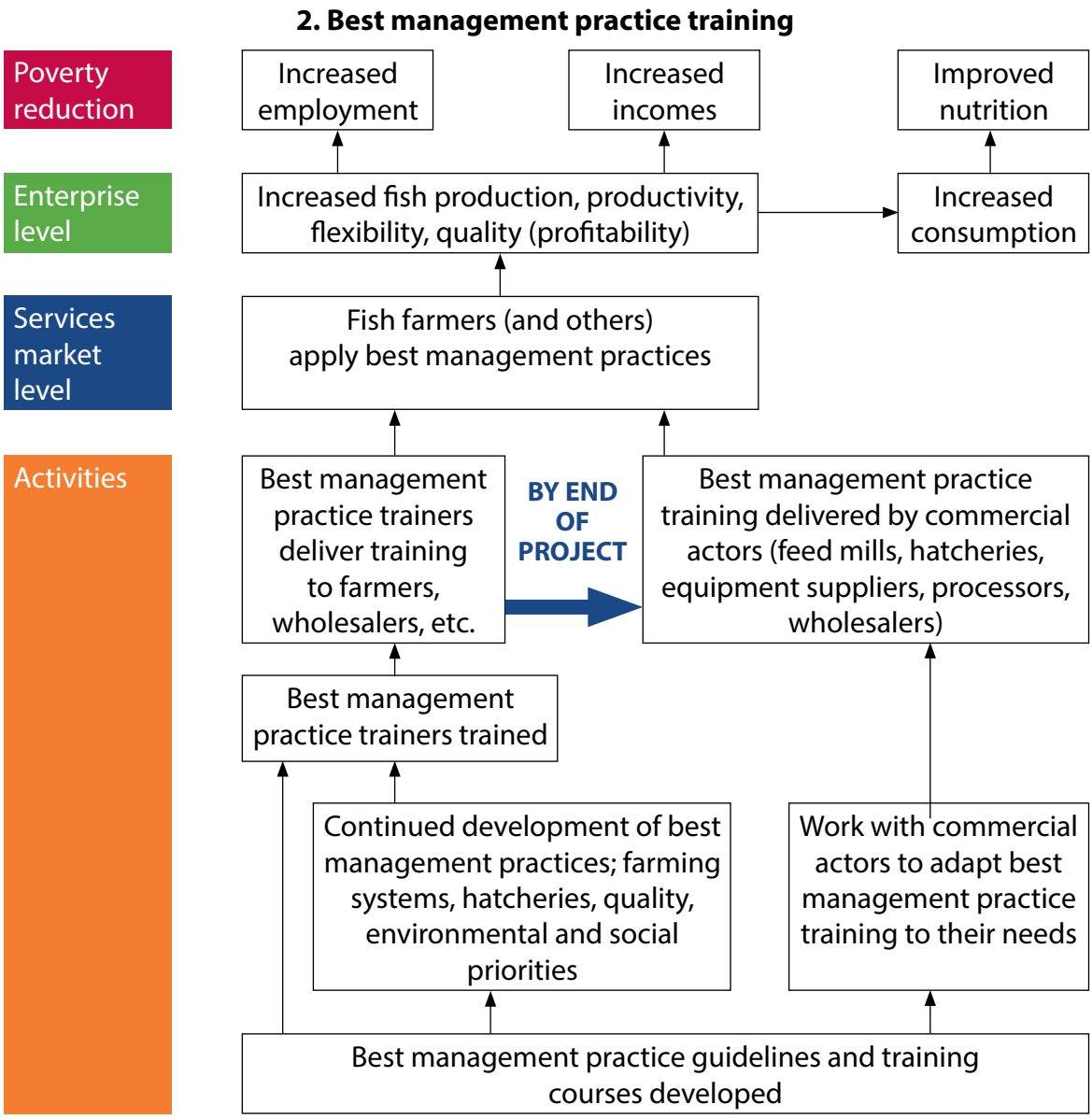


ANNEX 1

Revised project logframe

Logframe: Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS)	Ph. 01	1 December 11 – 31 December 14
Activities + results chains		

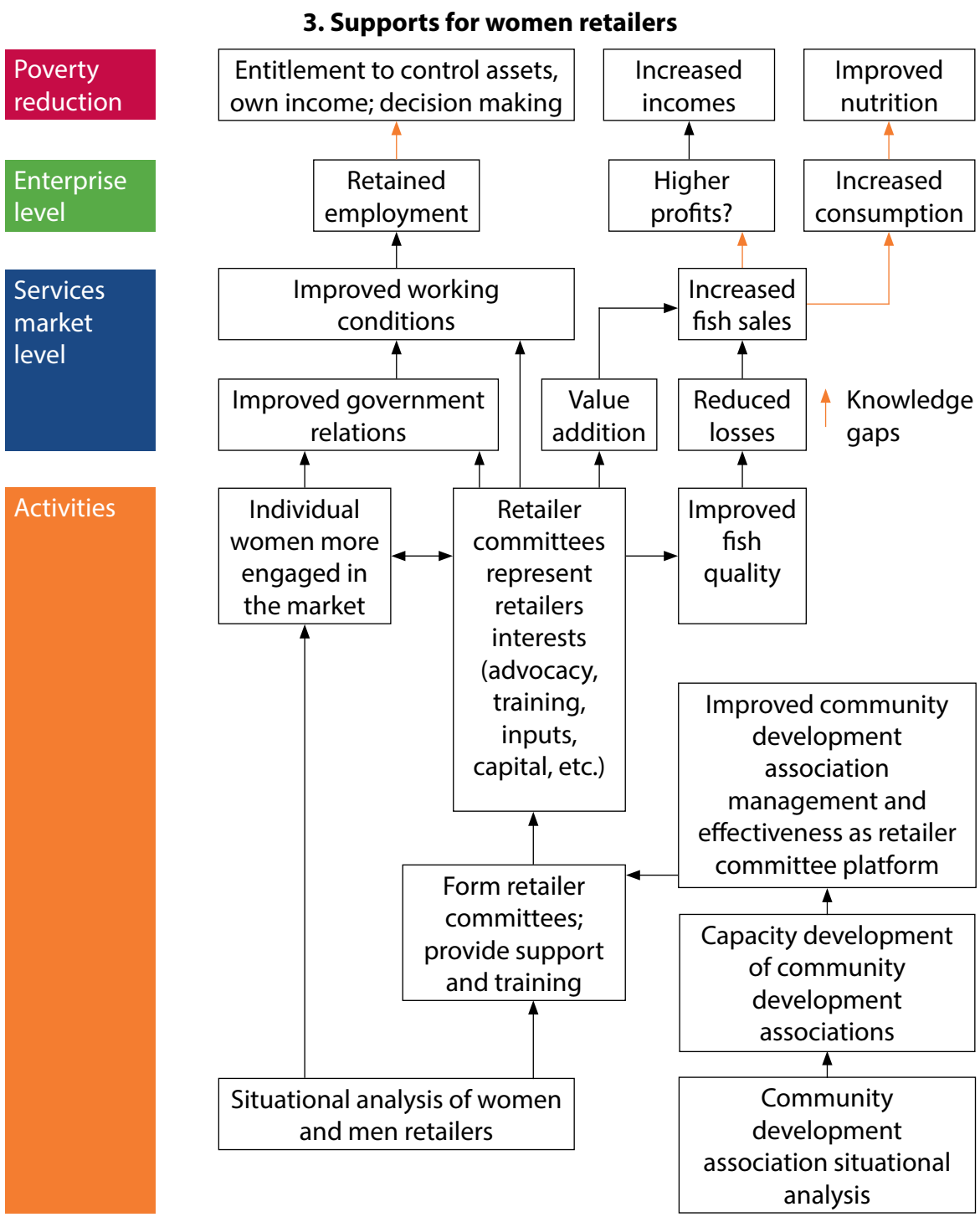
Outcome 1. Productivity and sustainability of existing fish farms improved



Revised project logframe

Logframe: Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS)	Ph. 01	1 December 11 – 31 December 14
Activities + results chains		

Outcome 2. Livelihoods and working conditions of women fish retailers improved

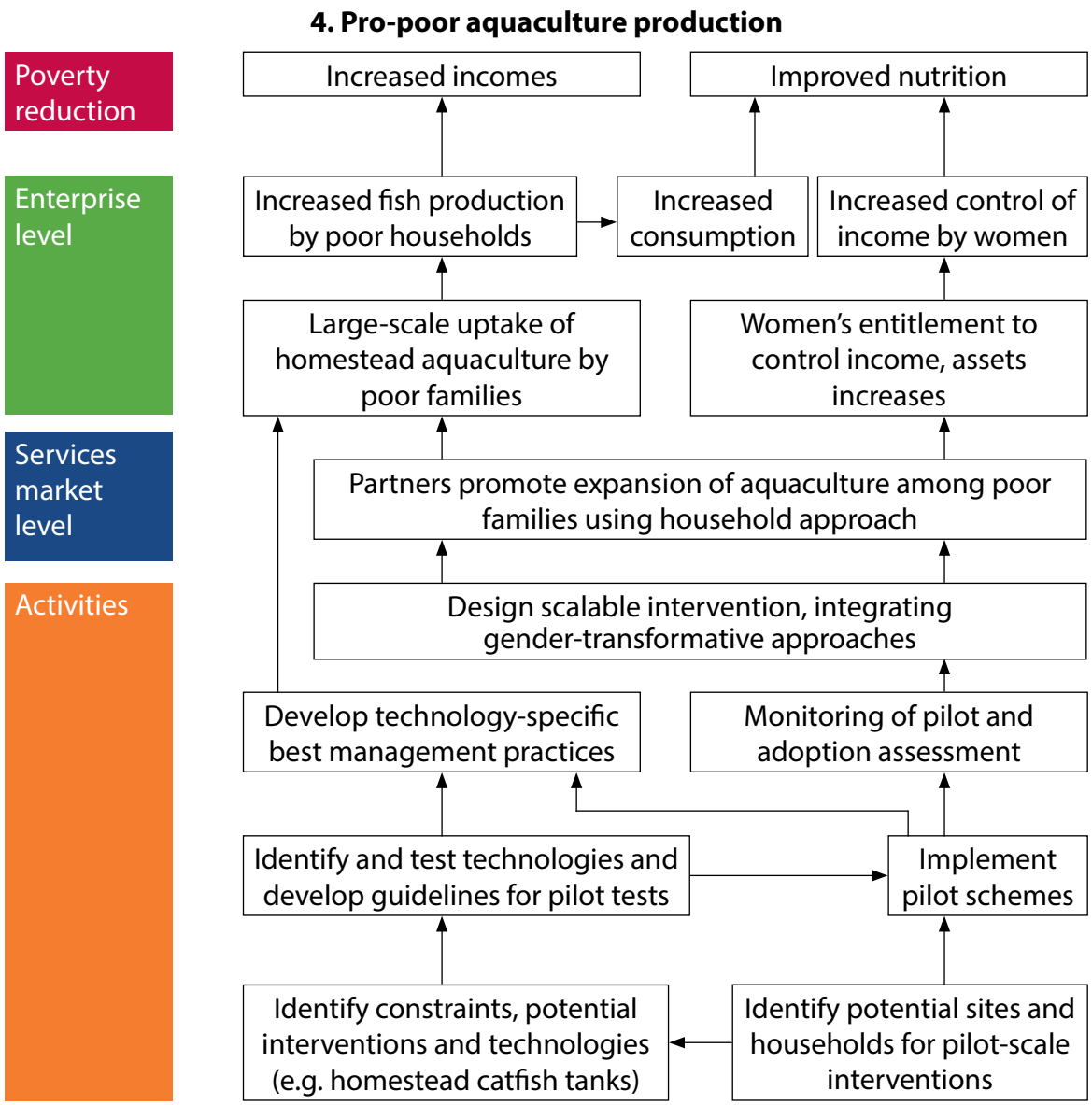


ANNEX 1

Revised project logframe

Logframe: Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS)	Ph. 01	1 December 11 – 31 December 14
Activities + results chains		

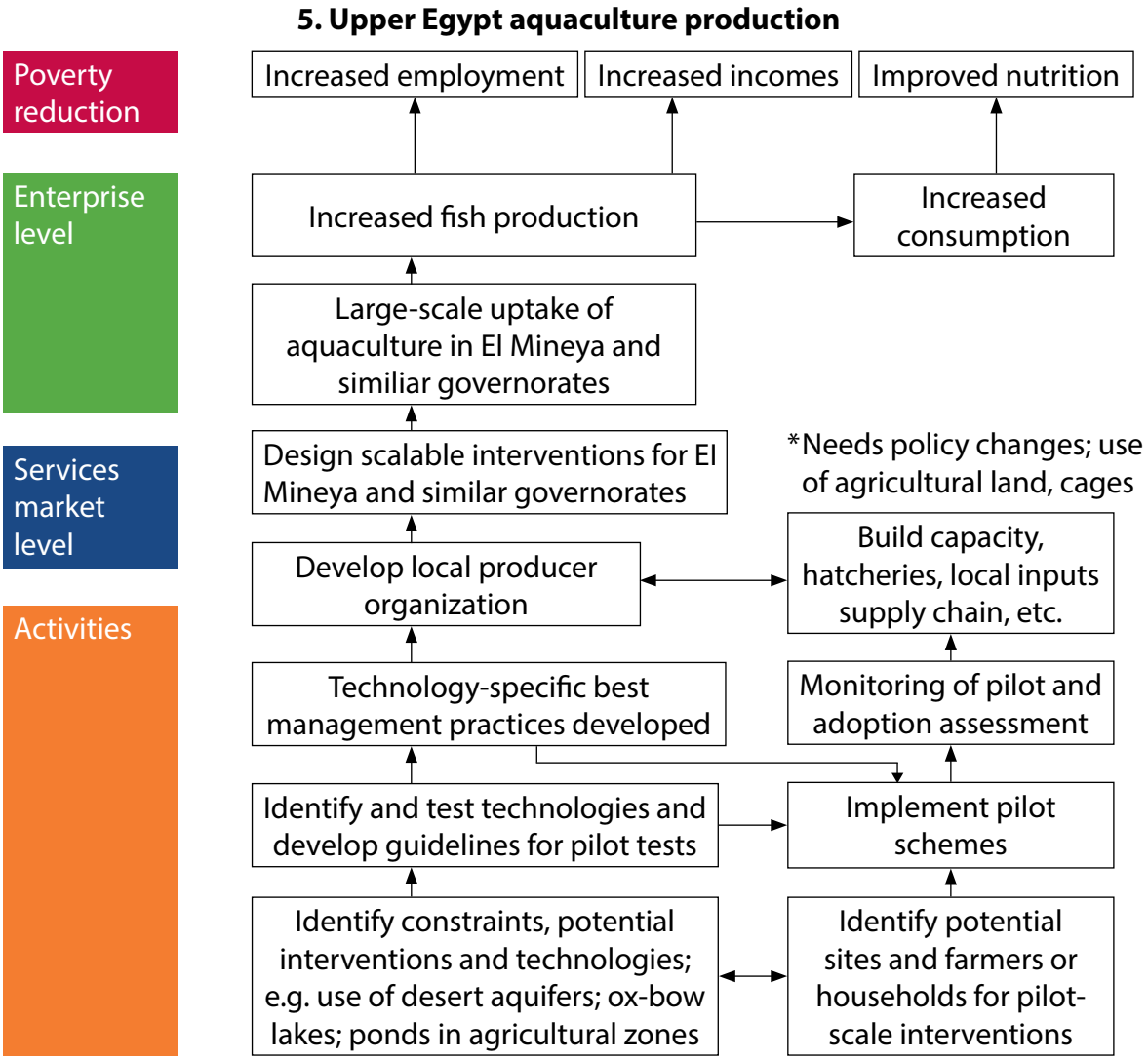
Outcome 3. Farmed fish production increased in El Mineya



Revised project logframe

Logframe: Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS)		Ph. 01	1 December 11 – 31 December 14
Activities + results chains			

Outcome 3. Farmed fish production increased in El Mineya

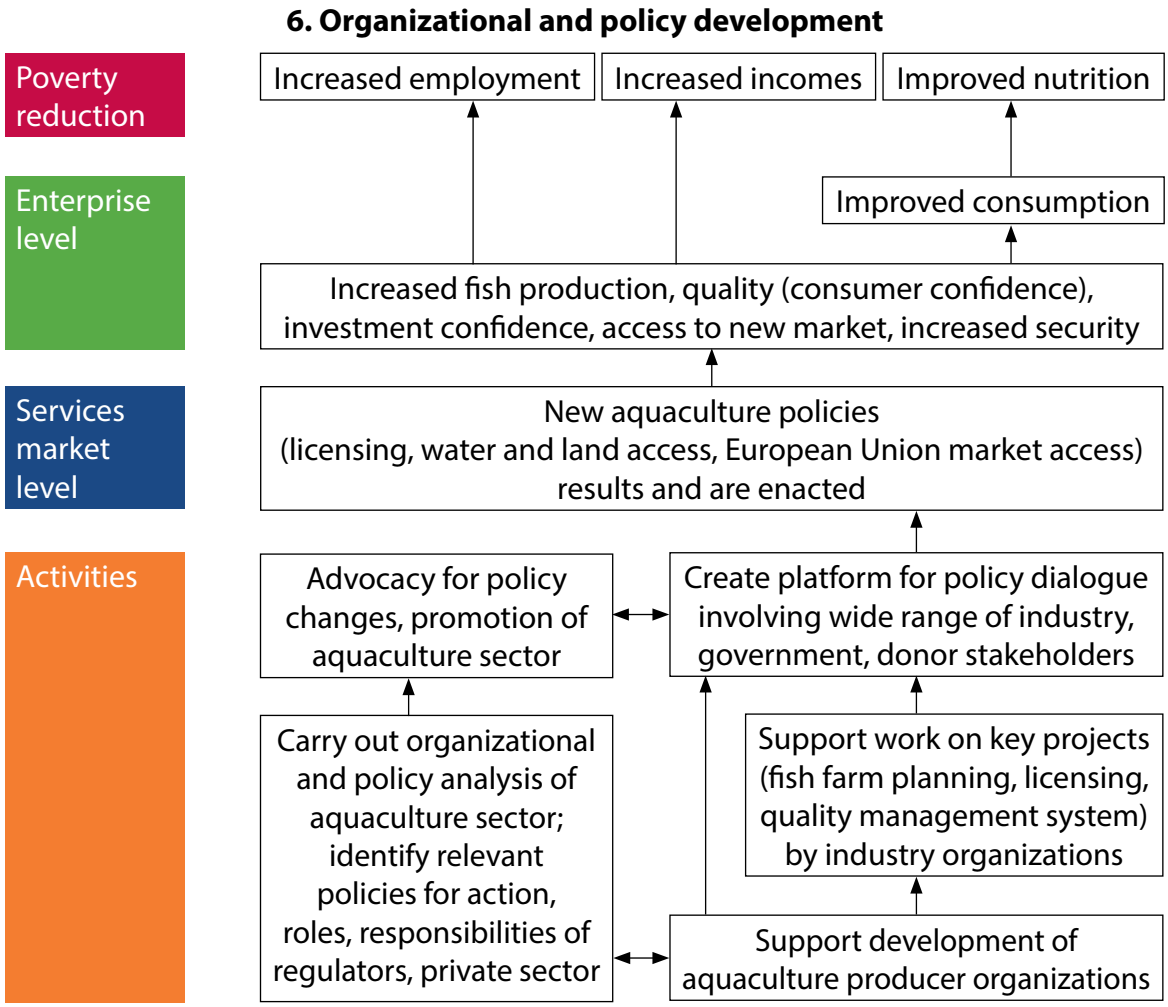


ANNEX 1

Revised project logframe

Logframe: Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS)		Ph. 01	1 December 11 – 31 December 14
Activities + results chains			

Outcome 4. Improved value chains, policy and institutional frameworks



ANNEX 2 UNPUBLISHED REPORTS AND NEWS ARTICLES

Unpublished project reports

D'Alessandro Y. 2013. Aquaculture associations in Egypt: A situational analysis. IEIDEAS project report (unpublished). May 2013.

D'Allessandro Y. 2015. Documentation report: Livelihoods and working conditions of women fish retailers improved. IEIDEAS project report (unpublished). January 2015.

IEIDEAS Project. 2012. Year 1 operational report (1/12/2011–30/9/2012). IEIDEAS project report (unpublished). November 2012.

IEIDEAS Project. 2013. Second operational report (1/10/2012–30/6/2013). IEIDEAS project report (unpublished). August 2013.

IEIDEAS Project. 2014. Third operational report (1/7/2013–30/6/2014). IEIDEAS project report (unpublished). August 2014.

Kjaersig H. 2014. IEIDEAS Project. External review: Final report. Copenhagen: PEM Consult. (unpublished).

Macfadyen G, Nasr-Allah AM and Dickson MW. 2012. The market for Egyptian farmed fish. IEIDEAS project report (unpublished). June 2012.

Mur R. 2014. Development of the aquaculture value chain in Egypt: Report of the National Innovation Platform Workshop, February 2014. Amsterdam: Royal Tropical Institute (KIT). (unpublished).

WorldFish. 2011. Improving employment and income through development of Egypt's aquaculture sector: A proposal for consideration by SDC (unpublished).

Press releases and news articles

http://www.worldfishcenter.org/news-events/egyptian-aquaculture-sector-plans-further-growth

http://www.worldfishcenter.org/content/community-theatre-inspires-women-fish-retailers-egypt

http://www.worldfishcenter.org/content/theatre-workshops-help-egyptian-women-fish-retailers-lobby-their-rights

http://www.worldfishcenter.org/content/aquaculture-training-helps-egyptian-farmers-increase-profits

http://www.worldfishcenter.org/news-events/online-aquaculture-training-videos-now-available-egyptian-fish-farmers

http://www.worldfishcenter.org/news-events/sheltered-marketplaces-offer-security-and-profits-women-fish-retailers

http://www.worldfishcenter.org/news-events/how-fish-can-feed-africa

http://www.worldfishcenter.org/news-events/iceboxes-help-women-fish-retailers-find-profits

This publication should be cited as:
Dickson M, Nasr-Allah AM, Kenawy D, Fathi M, El-Naggar G and Ibrahim N. Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS) project. Penang, Malaysia: WorldFish. Program Report: 2016-14.

Contact Details:
WorldFish, PO Box 500 GPO,
10670 Penang, MALAYSIA
www.worldfishcenter.org

Photo credits: Front and back cover, Heba El Begawi/WorldFish

Harnessing research that makes a difference

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Swiss Agency for Development and Cooperation SDC
care
CGIAR
RESEARCH PROGRAM ON Livestock and Fish
WorldFish