

**FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS
TECHNICAL COOPERATION PROGRAMME
Philippines TCP /PHI/3404**

Patrick White

**Improvement of feeding and feed
management efficiency in aquaculture
production in the Philippines**

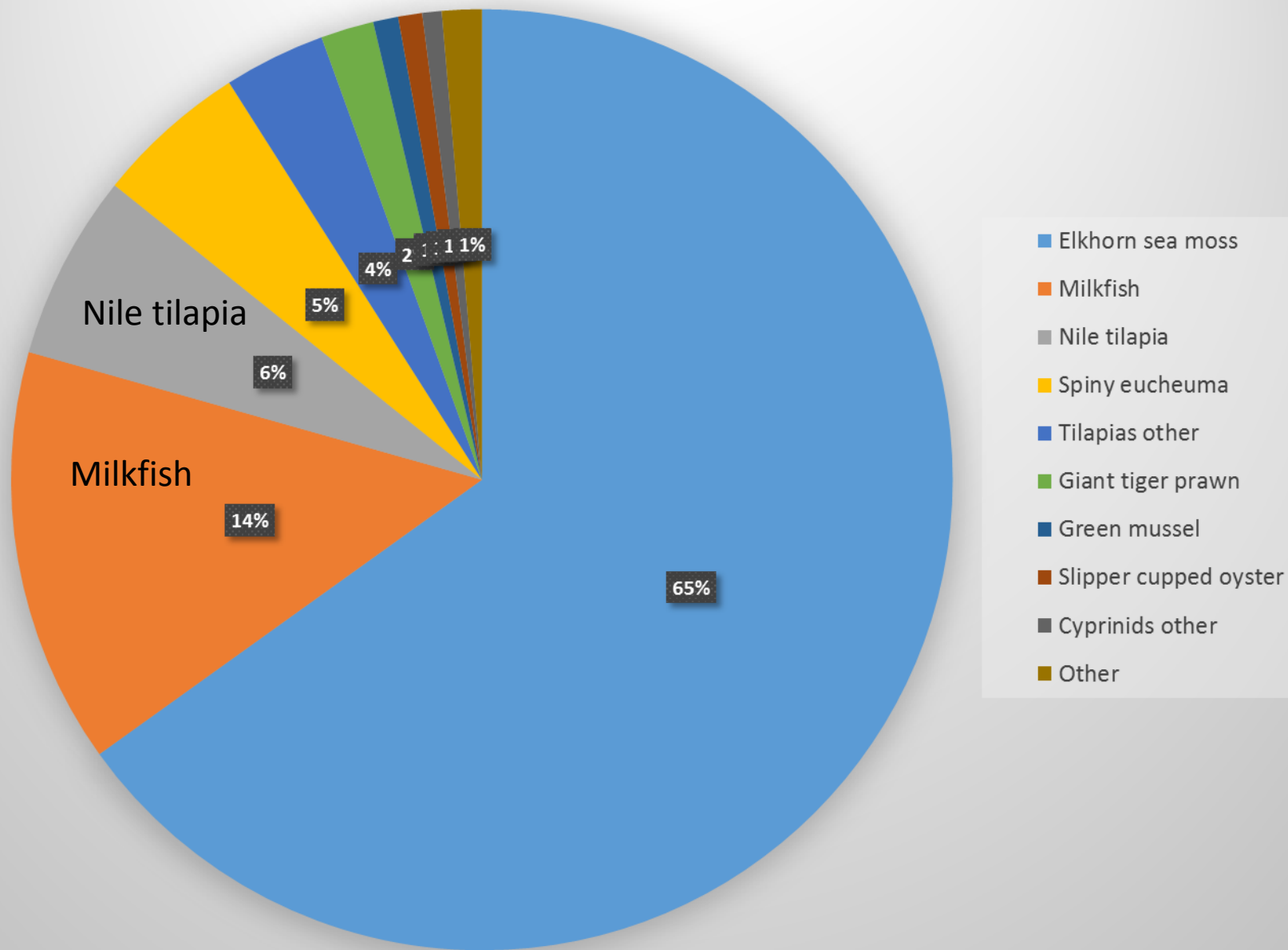


Output 3

Good on-farm feeding practices and feed management strategies are developed/optimized and government extension workers and farmers are trained

- Optimized feeding practices
- Good feed management
- Training materials and training course

Philippines top 10 species cultured (2011)



Background - Tilapia

Species and varieties

- GET Excel, Supreme, GIFT, etc
- Systems
 - Semi intensive Ponds
 - Intensive Cages (lakes)
 - Partial fed cages/pens (Laguna)

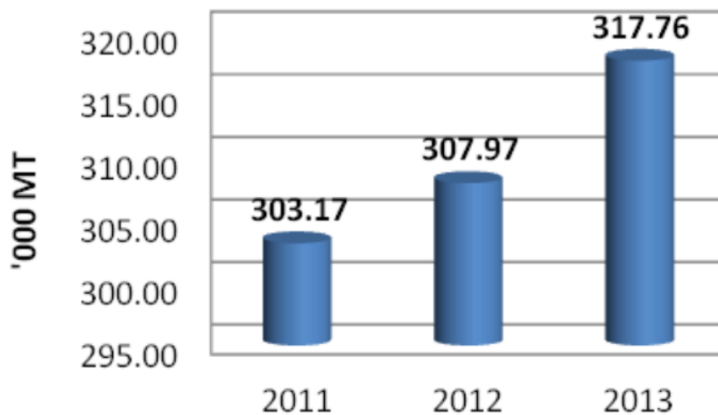


Tilapia production

Main provinces for tilapia production 2006

- Farmer trial areas
 - Zambales?
 - NCR (Taal Lake)?
 - Palawan?

Tilapia: Volume of Production, Philippines, 2011-2013



Background - Milkfish

Species

- Wild caught
- Hatchery bred
- Nursery reared



• Systems

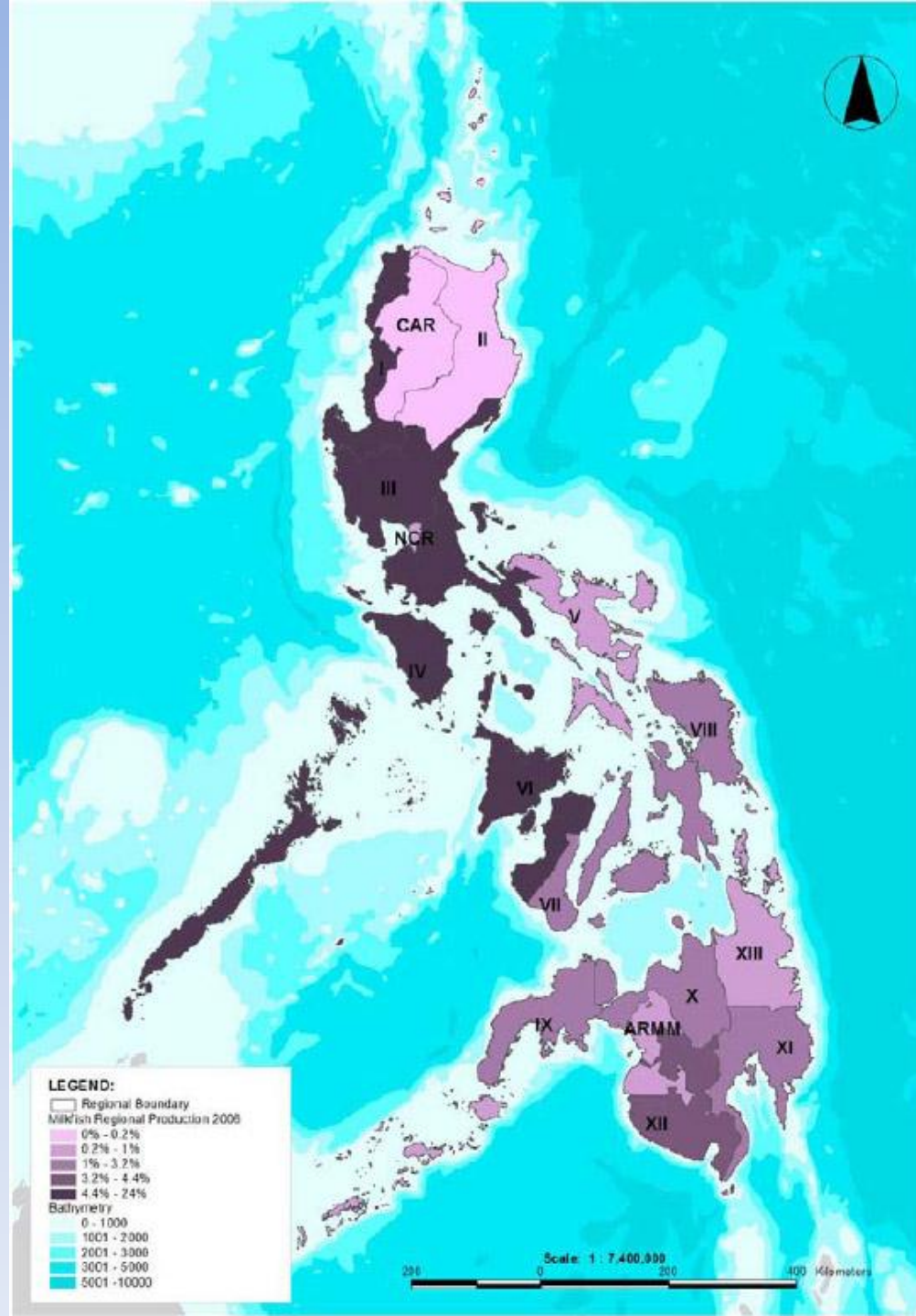
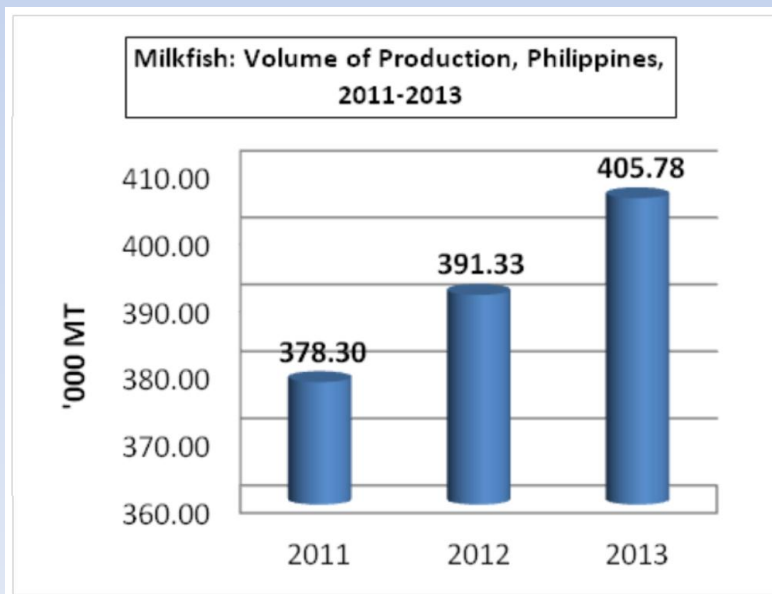
- Semi-extensive Brackish-water Ponds
- Intensive brackish and marine cages



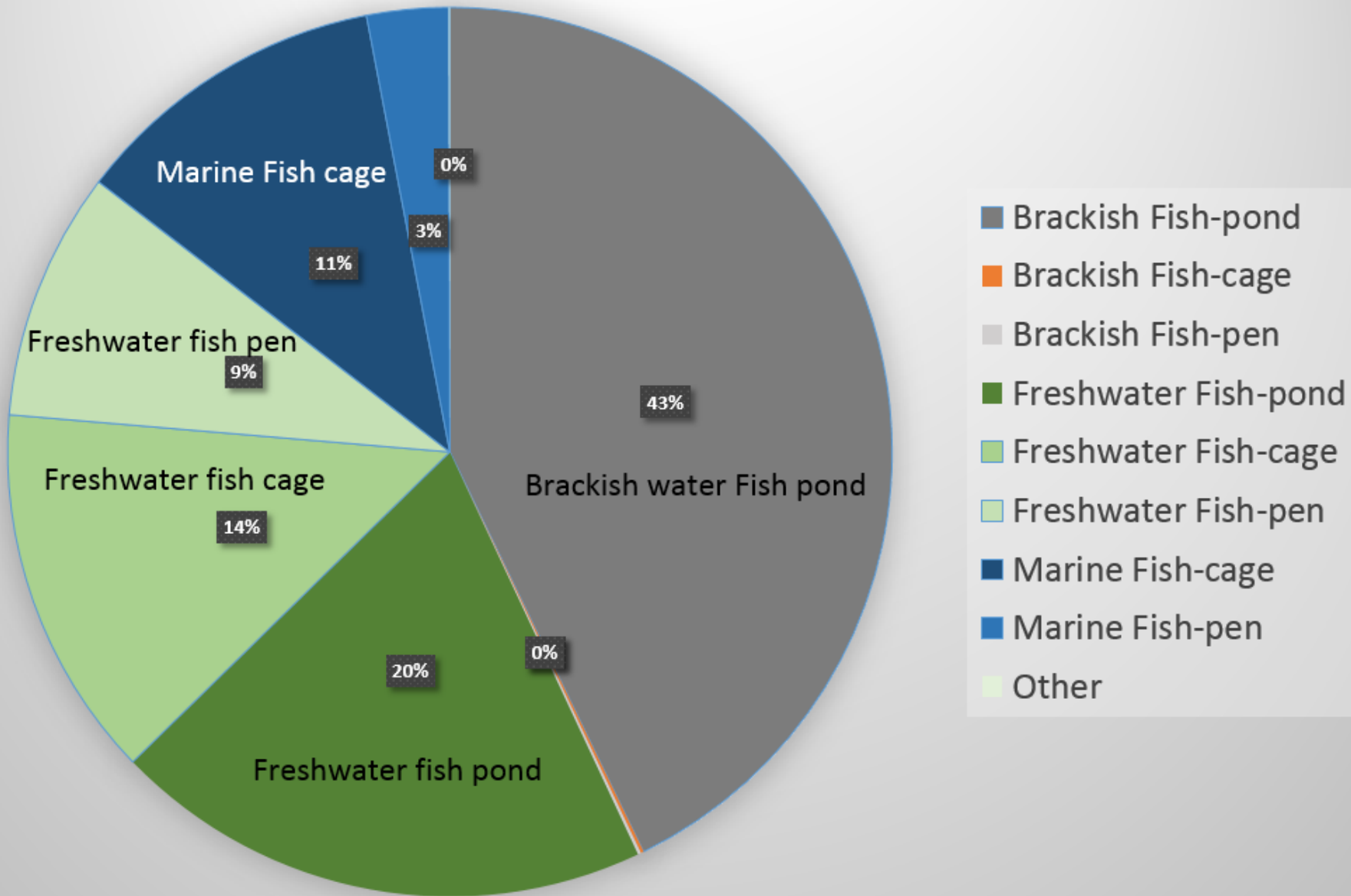
Milkfish production

Main provinces for milkfish production 2006

- Case study areas
 - Pangasinan?
 - Iloilo?
 - Palawan?



Philippines Aquaculture (2011) by environment and culture system excluding molluscs and seaweed

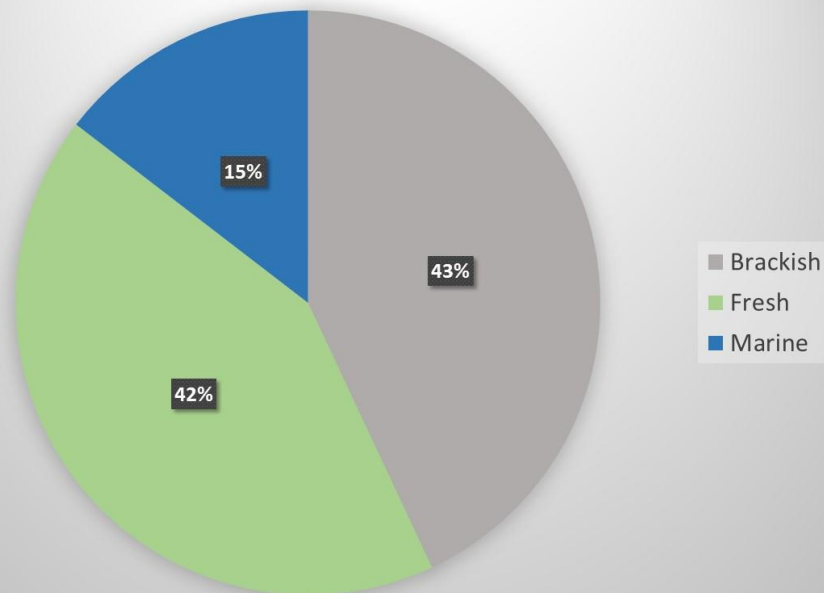


Production by environment and system

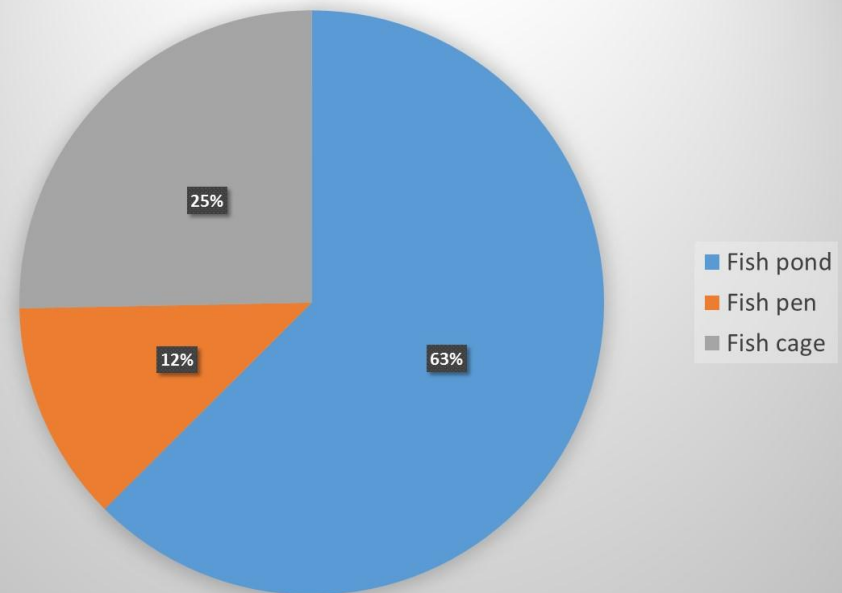
Brackish water dominant

Pond culture dominant

Philippines aquaculture production by environment



Philippine aquaculture by culture system



Possible project duplication?

- FAO TCP - optimizing feed formulation and feeding strategy 2 species (Milkfish and Tilapia)
- USAID/SEAFDEC – optimizing feed and feeding strategy – multi species and best practice analysis

Suggest one project chooses pond culture the other chooses cage culture (?) so no duplication or gaps.

Output 3

- **Activity 3.1:** Develop an understanding of on-farm feeding and feed management practices and constraints.
- **Activity 3.2:** Develop better management practices (BMP)/good aquaculture practices (GAqP) guidelines/manuals for on-farm feeding and feed management including processing, handling and storage at the farm level.
- **Activity 3.3:** Develop feed management tools such as simple feed-back systems to prevent over feeding and appropriate feeding tables.
- **Activity 3.4:** Organize workshop on BMP/GAqP guidelines/manuals with farmers and develop training materials
- **Activity 3.5:** Training in BMP/ for feeding and on-farm feed management for farmers and government extension workers.

Feed and feeding considerations

Parameter	Pond	Cage
Natural productivity	Significant pond natural productivity so some nutrient provided by pond. Feed formulation less demanding.	Less natural productivity. Feed formulation should supply all nutrients, vitamins and minerals.
Water temperature	Significant diurnal and seasonal water temperature fluctuations. Need to alter feeding tables seasonally, need to decide optimal feeding time of day	Less diurnal and seasonal water temperature changes. Feeding time not so important.
Oxygen levels	Significant diurnal dissolved oxygen levels. Need to decide optimal feeding time of day	Less dissolved oxygen level change. Feeding time not so important.

Feeding strategy considerations

- **Number of feeds per day** (changes with life stage). Will affect feeding hierarchy and range of fish size.
- **Feeding duration** – fast feeding, slow feeding. Will affect feeding hierarchy and feed wastage.
- **Feeding rate** (% body weight/day) – will change with stage of life, fry, fingerling, juvenile, adult and with temperature. Will affect FCR and growth rate.
- **Time of feed**. Feed to avoid peak temperatures and low oxygen.

Feed management trials

- **Choice of feed type**

- Compressed Pellets (sinking)
- Extruded Pellets (sinking)
- Extruded pellets (floating)



- **Choice of feed size**

- Pellet size vs fish weight



SEA-Asia Soyabean Association feeding

- Measure satiation, feed floating feeds into a feed collar
- Feed satiation level for the next two weeks



Feeding strategy trials

- Feeding strategy
 - Demand feeding (baseline)
 - Feeds per day vs size of fish
 - Feeding rate (% body wt/day)
 - Feed wastage (feeding tray)
 - Intermittent feeding
- Measure growth rate and FCR

Outputs

- Report on feed management and strategy trial results

Output 3 – 3.1

Activity 3.1: Develop an understanding of on-farm feeding and feed management practices and constraints.

- Rapid Farmer survey – 20 questions around 1 hour
 - 50 tilapia farms
 - 50 Milkfish farms
- Case study area feed availability, distribution and cost
- Laboratory and economic analysis

Data collection – present practice

50 farms in case study area

- Feed type used and cost
- Feed conversion rate
 - Fry
 - Fingerlings
 - Grow-out
- Feeding strategy
 - Feeding rate (% body weight/day) for different sizes
 - Feeds/day

Data collection – present constraints

Data collection – case study area

- Feed availability – distributors/shops, brands, feed types and cost
- Feed price compared with ex Factory price (transport and commission charges)
- Feed storage (on shore/on cage) – temperature/protection from rain
- Biological and economic FCR
- Feed wastage (feed tray analysis)

Data collection – present constraints

Laboratory and economic analysis

- Feed quality vs cost
- Feed stability in water
- Dust levels in the feed
- Feed quality variability between batches
- Availability and quality of feeding tables

Outputs

- Report on existing feeding practices and constraints

Output 3 – 3.3

Activity 3.3: Develop feed management tools such as simple feed-back systems to prevent over feeding and appropriate feeding tables.

- Appropriate and cost effective feed-back systems to avoid overfeeding
- Accurate feeding tables
- Combine with optimized feeding strategy
- Test at semi commercial scale with farmers

Types of feed wastage monitoring and control

Good control but expensive

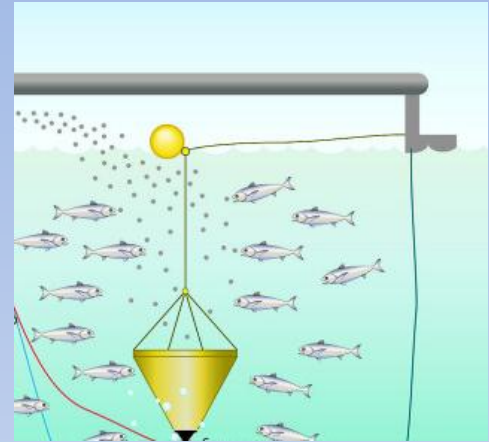
- Cameras with pellet counting software
- Cameras and analysis of feeding behavior
- Feeding tray
- Water surface feeding behavior
- Feeding table related to fish size and temperature
- Bags of feed fed to cage/pond during production cycle

Poor control but cheap

Develop feed back systems

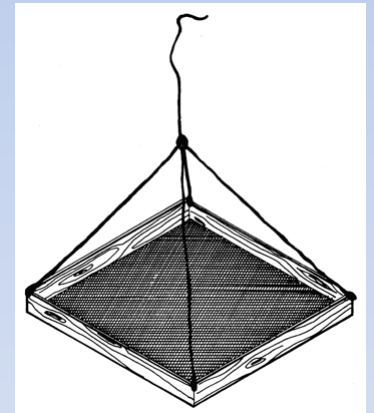
Monitoring feeding rate and wastage

- Develop simple and effective feed monitoring system



Output

- Feedback tool described on BFAR web site



Develop feeding tables

- Develop accurate feeding tables
 - Fish size
 - Water temperature

Output

- Feed tables printed on feed sacs and on BFAR web site

Example of an accurate feeding table

Mediterranean seabream

		SPECIFIC GROWTH RATE (SGR)												
Temp		mean weight (gr.)												
min		35	48	60	80	100	150	200	250	300	350	400	450	500
max		48	60	80	100	150	200	250	300	350	400	450	500	<
12	14	0.19	0.15	0.12	0.11	0.10	0.07	0.07	0.06	0.05	0.05	0.05	0.05	0.04
14	16	0.43	0.34	0.26	0.24	0.22	0.17	0.15	0.14	0.12	0.10	0.09	0.09	0.08
16	18	0.75	0.59	0.46	0.42	0.38	0.31	0.27	0.24	0.21	0.17	0.16	0.14	0.12
18	20	1.28	1.03	0.81	0.74	0.65	0.52	0.46	0.41	0.36	0.30	0.27	0.24	0.20
20	22	1.92	1.59	1.27	1.15	0.99	0.78	0.70	0.62	0.54	0.45	0.40	0.36	0.30
22	24	2.43	2.04	1.66	1.49	1.26	1.00	0.89	0.79	0.69	0.57	0.51	0.46	0.40
24	26	3.02	2.54	2.06	1.85	1.57	1.24	1.10	0.99	0.86	0.71	0.64	0.57	0.50
26	27	3.25	2.74	2.22	1.99	1.69	1.34	1.19	1.06	0.92	0.77	0.69	0.61	0.53
27	28	3.30	2.78	2.25	2.02	1.72	1.36	1.21	1.08	0.94	0.78	0.70	0.62	0.54
28	29	2.60	2.19	1.78	1.59	1.35	1.07	0.95	0.85	0.74	0.62	0.55	0.49	0.42
29	30	1.95	1.64	1.33	1.20	1.02	0.80	0.71	0.64	0.55	0.46	0.41	0.37	0.32

Specific growth rate at different temperatures and fish size

Example of an accurate feeding table

Mediterranean seabream

		DAILY FEEDING RATE (SFR)												
Temp		mean weight (gr.)												
min		35	48	60	80	100	150	200	250	300	350	400	450	500
max		48	60	80	100	150	200	250	300	350	400	450	500	<
12	14	0.8	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3
14	16	0.9	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3
16	18	1.3	1.0	0.8	0.8	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.4
18	20	1.9	1.6	1.3	1.2	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6
20	22	2.4	2.0	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7
22	24	2.9	2.4	2.1	2.0	1.8	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9
24	26	3.6	3.1	2.6	2.5	2.3	2.0	1.9	1.8	1.6	1.5	1.4	1.2	1.1
26	27	4.1	3.5	3.0	2.8	2.6	2.3	2.2	2.0	1.9	1.7	1.5	1.4	1.3
27	28	4.3	3.7	3.2	3.0	2.7	2.5	2.3	2.2	2.0	1.8	1.6	1.5	1.4
28	29	3.6	3.1	2.7	2.5	2.3	2.1	1.9	1.8	1.7	1.5	1.4	1.3	1.1
29	30	2.8	2.4	2.1	2.0	1.8	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9

Daily feeding rate at different temperatures and fish size

Example of an accurate feeding table

Mediterranean seabream

		FEED CONVERSION RATE (FCR)												
Temp	mean weight (gr.)													
min		35	48	60	80	100	150	200	250	300	350	400	450	500
max		48	60	80	100	150	200	250	300	350	400	450	500	<
12	14	4.00	4.07	4.31	4.56	4.87	5.54	5.85	6.13	6.47	6.93	7.15	7.36	7.70
14	16	2.15	2.18	2.31	2.44	2.61	2.97	3.13	3.28	3.47	3.71	3.83	3.94	4.12
16	18	1.72	1.74	1.85	1.95	2.09	2.38	2.51	2.63	2.77	2.97	3.06	3.15	3.30
18	20	1.49	1.51	1.60	1.69	1.81	2.06	2.17	2.28	2.40	2.57	2.65	2.73	2.86
20	22	1.25	1.27	1.34	1.42	1.52	1.73	1.82	1.91	2.01	2.16	2.23	2.29	2.40
22	24	1.18	1.20	1.27	1.34	1.43	1.63	1.72	1.80	1.90	2.04	2.10	2.17	2.27
24	26	1.19	1.21	1.28	1.35	1.45	1.65	1.74	1.82	1.92	2.06	2.12	2.19	2.29
26	27	1.25	1.27	1.34	1.42	1.52	1.73	1.82	1.91	2.01	2.16	2.23	2.29	2.40
27	28	1.32	1.34	1.42	1.50	1.60	1.82	1.92	2.01	2.13	2.28	2.35	2.42	2.53
28	29	1.40	1.42	1.50	1.59	1.70	1.93	2.04	2.14	2.25	2.42	2.49	2.57	2.68
29	30	1.45	1.48	1.56	1.65	1.77	2.01	2.12	2.22	2.35	2.51	2.59	2.67	2.79

Food conversion rate at different temperatures and fish size

Output 3 – 3.2, 3.4 & 3.5

- **Activity 3.2:** Develop better management practices (BMP)/good aquaculture practices (GAqP) guidelines/manuals at the farm level for;
 - on-farm feeding and feed management,
 - handling and storage.
- **Activity 3.4:** Organize workshop on BMP/GAqP guidelines/manuals with farmers
 - develop training materials
- **Activity 3.5:** Training in BMP/ for feeding and on-farm feed management for farmers and government extension workers.

Feeding strategy that has worked in other species/countries

Restricted feeding to reduce FCR (but may affect growth rate)

Slight restriction

- Feed 80% of satiation
- Feed 6 days per week then 1 day no feed
- Feed 2 days and then no feeding for 1 day – repeat
- Feed every other day
- Starve 1 week feed one week (compensatory growth gains)

Strong restriction

Feeding strategy that has worked in other species/countries

Feeds per day

- **Fewer larger feeds per day** – ensures that most fish will have a chance to feed and ensure a more homogenous size within the population
- **Many smaller feeds per day** – maximizes growth potential but feeding hierarchies may develop leading to less homogenous size within the population.

Feeding strategy that has worked in other species/countries

US Soya Bean Association feeding method

- Uses floating feeds fed to satiation and that ration maintained for 2 weeks before determining satiation again
- Feed fed once per day into a feeding ring

Develop feeding recommendations

- Develop draft Better feeding management practice/ Good Aquaculture practice
- Test recommendations at semi commercial scale
- Get feedback from farmers
- Organise stakeholder BMP/GAqP workshop
- Outputs
 - Workshop report
 - BMP/GAqP guidelines

Technology transfer and training

- Develop training materials
- Undertake farmer training to test training materials – case study areas
- Undertake training of trainers/extension workers – RFTCs?
- Finalise feeding manuals and training materials
- Get cooperation from feed manufacturers to disseminate feed tables and recommendations with feed sales

Outputs

- Report on training for feeding and feed management

Ecosystem Sustainability

- Calculate theoretical (and measure actual?) environmental impact reduction by using improved feed and feeding management
- Calculate fish-in:fish-out ratio
 - Fish meal use
 - Fish oil use
- Calculate simplified life cycle analysis
 - Energy, Greenhouse gas emission, resource use



Output

- Section in Final project report

Organisation and responsibilities – who, when, where?

- Background data collection on present practice
- Controlled small-scale trials on different feeding practices
- Up scaled farmer trials with improved feeding practice and management
- Development of Better Management Practice manuals/guidelines and testing with farmers
- Development of training materials and test training course for farmers
- Training of trainers course
- Widespread dissemination

Decisions to be made

- Culture systems – ponds or cages?
- Cast study areas – Tilapia and Milkfish
- Small scale trials – CLSU, NIFTDC, SEAFDEC?
- Training partners – Universities, RFTCs, NIFTDC?
- Project timing – data collection, small scale trials, farmer trials?
- Quantities of feed pellets required and sizes?
- Feed quality tests – proximate analysis, digestibility, feed stability?
- Commercial feed partner to make the pellets?