مشروع الأبحاث التطبيقية لتطوير
قطاع الاستزراع المائي الداخلي
Applied Research for Inland Aquaculture Development

Applied research for Inland Aquaculture Development

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Project Director

رؤية VISION 2030 المملكة العربية السعودية KINGDOM OF SAUDI ARABIA
البرنامج الوطني لتطوير قطاع الثروة السمكية National Fisheries Development Program
وزارة البيئة والمياه والزراعة Ministry of Environment Water & Agriculture Kingdom of Saudi Arabia المملكة العربية السعودية
جامعة الملك عبد العزيز King Abdulaziz University
مركز أبحاث جامعة الملك عبد العزيز دراسات - استشارات - تدريب

The project focus on carrying out applied research in a scientific manner, with a commercial perspective for the development of the Freshwater Inland Aquaculture sector.

General aims to assist the sector to

- Maximise national production
- Cut down production costs
- Rationalize water use
- Qualifying the projects for quality certificates
- Building Capacity

Project Participants

45 Members

28 PhD

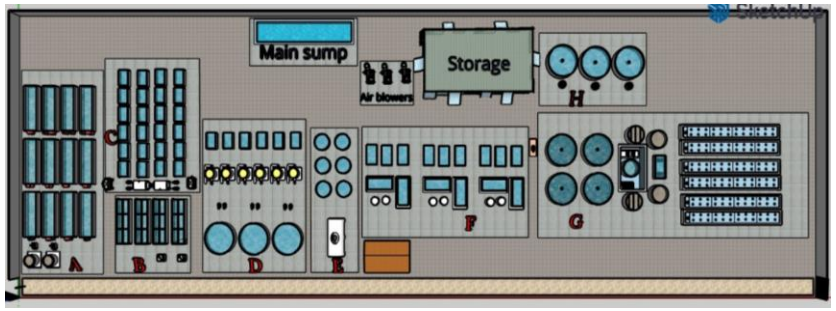
* 11 Countries

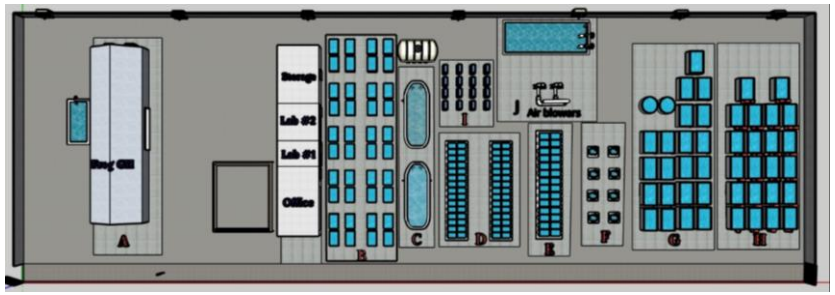
Project Partners

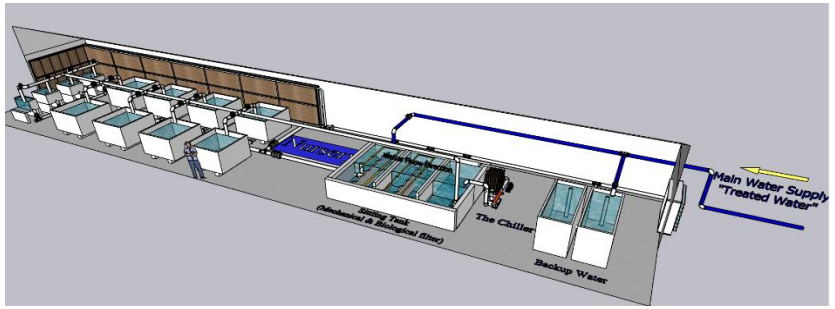
* Saudi Arabia, United States of America, United Kingdom, Scotland, Denmark, Australia, France, Egypt, Mexico, Columbia, China

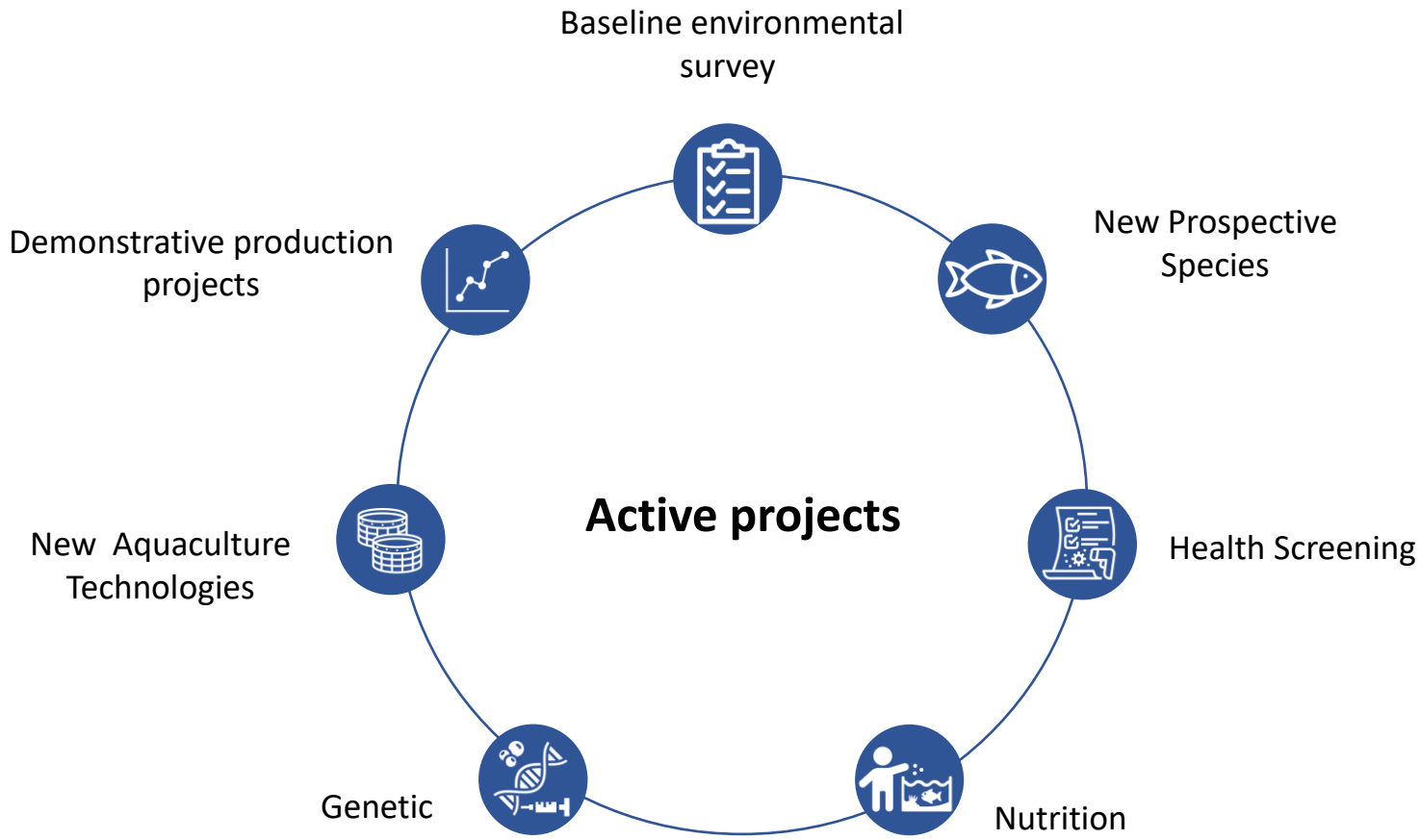
Research Unit at KACST

- Five years MOU signed between KAU and KACST
- Allocate two Aquaculture Research units of 500 sqm each for project execution
- Re-designed the facility to accommodate both warmwater and coldwater species








Baseline environmental survey
New Prospective Species
Health Screening
Nutrition
Genetic
New Aquaculture Technologies
Demonstrative production projects
Active projects

Environmental baseline survey

Environmental standards of inland freshwater projects

Evaluating the productive efficiency of the local cultured species and projects

Field visits to 81 aquaculture project

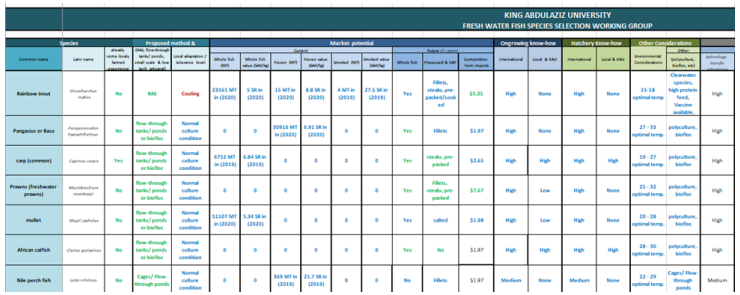
Environmental Assessment

- Water parameter assessment
- Topographic maps
- Thermal and weather maps Temp, Humidity, Wind direction and speed
- Water distribution

Production efficiency Assessment

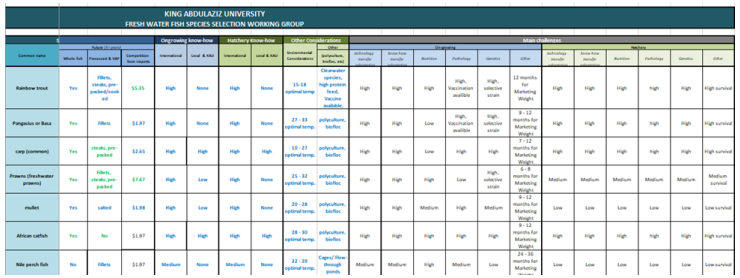
- Cultivated species (Quantitative assessment)
- Projects (Qualitative assessment)

- A wide range of assessment criteria is employed by matrix for rating.
- Annual trends and recent import statistics are utilized.



KING ABDULAZIZ UNIVERSITY
FRESH WATER FISH SPECIES SELECTION WORKING GROUP

Species			Proposed method &		Market potential										Ongrowing know-how		Hatchery know-how		Other Considerations	
Common name	Latin name	already some locals farmed practices	RAS, flow-through tanks/ ponds, small scale & low tech. ponds	Local adaptation / tolerance level	Whole fish (MT)	Whole fish value (SR/Kg)	Frozen (MT)	Frozen value (SR/Kg)	Smoked (MT)	Smoked value (SR/Kg)	Whole fish	Processed & VAP	Competition from imports	International	Local & KAU	International	Local & KAU	Environmental Considerations	Other (biotechnics, biofloc, etc)
Rainbow trout	Oncorhynchus mykiss	No	RAS	Cooling	23161 MT in (2020)	5 SR in (2020)	15 MT in (2020)	8.0 SR in (2020)	4 MT in (2019)	27.5 SR in (2019)	Yes	Fillets, steaks, pre packed/crushed	$5.35	High	None	High	None	15-18 optimal temp.	Clearwater species, high protein feed, Vaccine available.
Pangasius or Basa	Pangasianodon hypophthalmus	No	flow-through tanks/ ponds or biofloc	Normal culture condition	0	0	30916 MT in (2020)	4.91 SR in (2020)	0	0	Yes	Fillets	$1.97	High	None	High	None	27 - 33 optimal temp.	polyculture, biofloc
carp (common)	Cyprinus carpio	Yes	flow-through tanks/ ponds or biofloc	Normal culture condition	6752 MT in (2019)	6.84 SR in (2019)	0	0	0	0	Yes	steaks, pre packed	$2.65	High	High	High	High	10 - 27 optimal temp.	polyculture, biofloc
Prawns (freshwater prawns)	Macrobrachium rosenbergii	No	flow-through tanks/ ponds or biofloc	Normal culture condition	0	0	0	0	0	0	Yes	Fillets, steaks, pre packed	$7.67	High	Low	High	None	25 - 32 optimal temp.	polyculture, biofloc
mullet	Mugil cephalus	No	flow-through tanks/ ponds or biofloc	Normal culture condition	51107 MT in (2020)	5.34 SR in (2020)	0	0	0	0	Yes	salted	$1.98	High	Low	High	None	20 - 28 optimal temp.	polyculture, biofloc
African catfish	Clarias gariepinus	No	flow-through tanks/ ponds or biofloc	Normal culture condition	0	0	0	0	0	0	Yes	No	$1.97	High	High	High	High	28 - 30 optimal temp.	polyculture, biofloc
Nile perch fish	Lates niloticus	No	Cages/ Flow-through ponds	Normal culture condition	0	0	369 MT in (2019)	21.7 SR in (2019)	0	0	No	Fillets	$1.97	Medium	None	Medium	None	22 - 29 optimal temp.	Cages/ Flow-through ponds



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FRESH WATER FISH SPECIES SELECTION WORKING GROUP

S				Ongrowing know-how		Hatchery know-how		Other Considerations		Main Challenges											
										Ongrowing						Hatchery					
Common name	Whole fish	Processed & VAP	Competition from imports	International	Local & KAU	International	Local & KAU	Environmental Considerations	Other (biotechnics, biofloc, etc)	Technology transfer	Know-how transfer	Nutrition	Pathology	Genetics	Other	Technology transfer	Know-how transfer	Nutrition	Pathology	Genetics	Other
Rainbow trout	Yes	Fillets, steaks, pre packed/crushed	$5.35	High	None	High	None	15-18 optimal temp.	Clearwater species, high protein feed, Vaccine available	High	High	High	High, Vaccination available	High, selective strain	12 months for Marketing Weight	High	High	High	high	High	High survival
Pangasius or Basa	Yes	Fillets	$1.97	High	None	High	None	27 - 33 optimal temp.	polyculture, biofloc	High	High	Low	High, Vaccination available	High, selective strain	9 - 12 months for Marketing Weight	High	High	High	high	High	High survival
carp (common)	Yes	steaks, pre packed	$2.65	High	High	High	High	10 - 27 optimal temp.	polyculture, biofloc	High	High	Low	High	High	9 - 12 months for Marketing Weight	High	High	High	high	High	High survival
Prawns (freshwater prawns)	Yes	Fillets, steaks, pre packed	$7.67	High	Low	High	None	25 - 32 optimal temp.	polyculture, biofloc	High	High	High	Low	High, selective strain	4 - 6 months for Marketing Weight	Medium	Medium	Medium	Medium	Medium	Medium survival
mullet	Yes	salted	$1.98	High	Low	High	None	20 - 28 optimal temp.	polyculture, biofloc	High	High	Medium	High	Medium	9 - 12 months for Marketing Weight	Low	Low	Low	Low	Low	Low survival
African catfish	Yes	No	$1.97	High	High	High	High	28 - 30 optimal temp.	polyculture, biofloc	High	High	High	High	High	9 - 12 months for Marketing Weight	High	High	High	high	High	High survival
Nile perch fish	No	Fillets	$1.97	Medium	None	Medium	None	22 - 29 optimal temp.	Cages/ Flow-through ponds	Medium	Medium	High	Medium	Low	24 - 36 months for Marketing Weight	Low	Low	Low	Low	Low	Low survival

New Prospective Species

Biological data
- age at sexual maturity
- size at sexual maturity
- sex - spawning season
- egg characteristics
- life cycle

Optimal Condition
- water temperature
- feeding habits
- rearing systems
- growth rate

Biological Feasibility
- critical stages
- rearing systems
- growth rate
- survival rate
- FCR

Annual Import Data
- Aquaculture production
- Annual Import into KSA
- Global production
- Capture fisheries

Potential Profitability
(double weighted)
- culture systems and methods
- local acceptance
- international acceptance
- disease resistance
- production cost

Market Value
- Add value products
- Marketing price

New Prospective Species

- 5 imported and 2 local species
- A Likert scale approach was used on 6 of the criteria (1 being worst and 5 being best)

Candidate Fish Species Evaluated

1. Rainbow Trout
Oncorhynchus mykiss

2. Pangasius or Basa
Pangasianodon hypophthalmus

3. Carp (common)
Cyprinus carpio

4. Prawns (Freshwater shrimp)
Macrobrachium rosenbergii

5. Mullet
Mugil cephalus

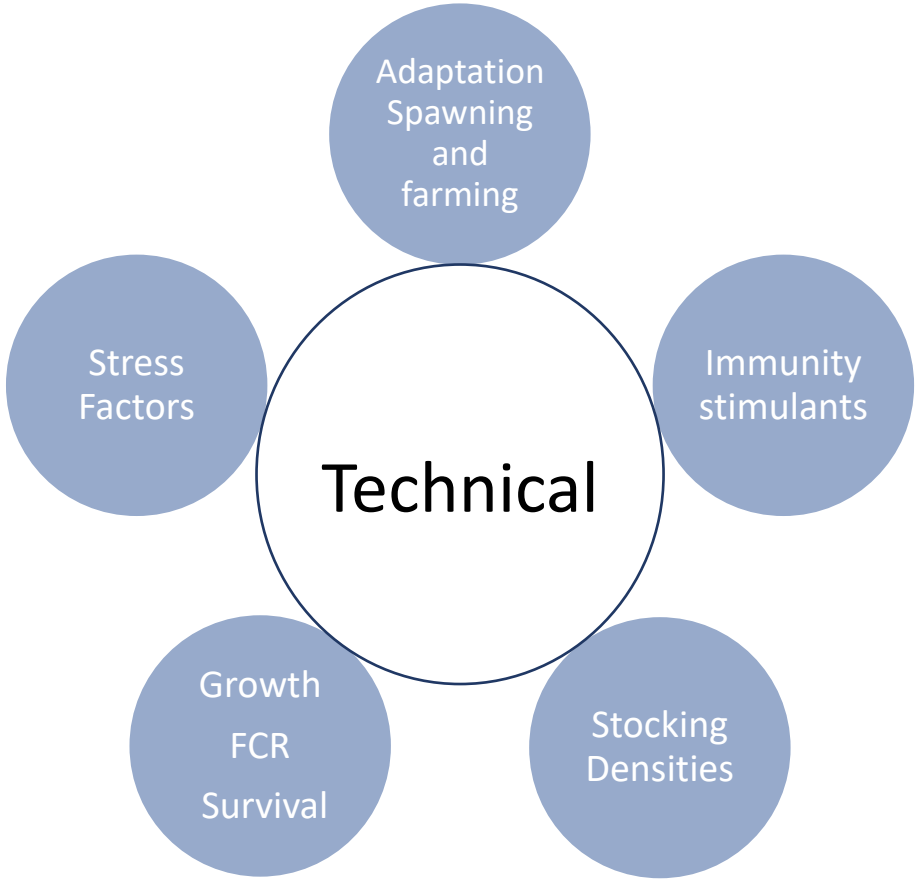
6. African Catfish
Clarias gariepinus

7. Nile Perch
Lates niloticus

Scoring Summary for 7 Species identified for consideration

	Species	*Latin name*	Biological Data	Optimal Condition Data	Biological Feasibility	Annual Import Data*	Potential Profitability (double weighted)	Market Value	Sum**
1	Pangasius or Basa	*Pangasianodon hypophthalmus*	5	4	5	3.1	4	4	29.1
2	Rainbow Trout	*Oncorhynchus mykiss*	5	2	5	0.8	5	5	27.8
3	Carp (common)	*Cyprinus carpio*	5	5	5	0.4	3	3	24.4
4	Prawns (Freshwater shrimp)	*Macrobrachium rosenbergii*	5	2	5	0	2	5	21.0
5	Mullet	*Mugil cephalus*	5	3	4	2.1	3	3	23.1
6	African Catfish	*Clarias gariepinus*	5	3	5	0	3	3	22.0
7	Nile Perch	*Lates niloticus*	3	4	2	0.1	2	4	17.1

Technical and economic experiments for the new prospective species



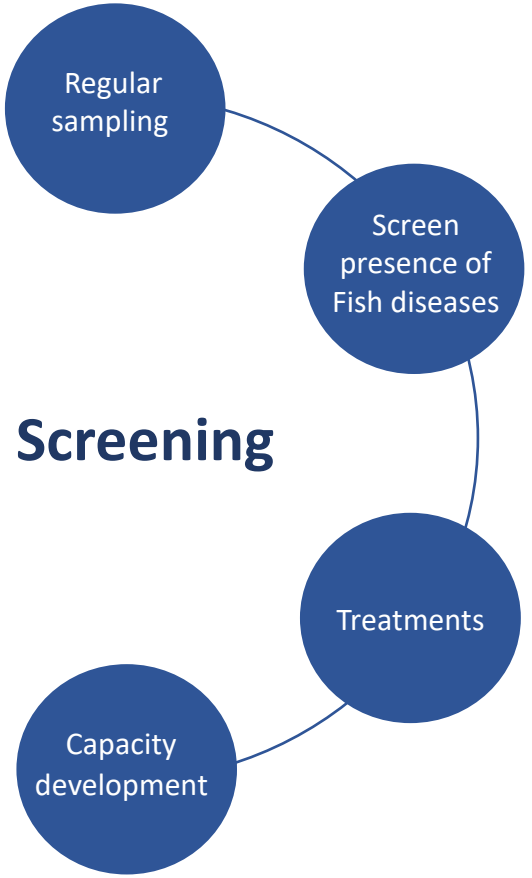
- 25 farms reflects 5 geographic locations across KSA
- visits every 6 months.
- 30 fish from each farm.
- 1500 fish is the total sample size

Samples collected on-site:

1. Blood – stress evaluation/cortisol
2. Visceral organs (liver, spleen, kidney, gills) – histology, bacteriology, virology
3. Skin – mycology
4. Wet smear of the gills, and whole fish - parasitology

Health Screening

- Testing water/fish condition in aquaculture projects
- Identify stress indicators



- Viral diseases (5)
- Bacterial diseases (15)
- Mycotic diseases (8)
- Parasitic diseases (28)

- Treatment protocols
- Contingency plans
- Disinfection

- Protocols for inspecting fish disease
- Training on disease inspection

Nutrition

Introduction of non-conventional ingredients to diets formulate on accurate digestible nutrient basis

- Offal meal
- Feather meal
- Insect meal

Digestibility study
using indigestible markers

Conc: **Low – Medium – High**
to assess the potential nutritive value based on digestibility of energy and nutrient components

Three formulated feeds
(Best digest. performance)

Two local commercial feeds

Two International commercial feeds

Trials in Controlled condition
- Production efficiency
- Financial efficiency
- Feed quality control analysis

Meat (product) analysis
- Nutrient components
- Sensory test and taste acceptance

Carry out the trials in the field at a commercial project

Genetic

Project 1: Population genetics assessment of farmed Nile tilapia in Saudi Arabia

Survey of candidate farms across KSA was performed and 15 out of 81 farms were selected based on

- Lowest risk of hybridisation
- Probability of higher numbers of parents contributing to the potential founders.
- Broad genetic origin

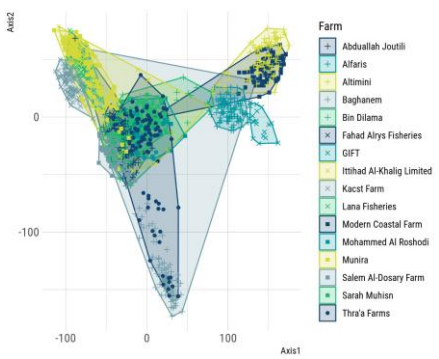
status of the population(s) was evaluated with respect to genetic diversity, value and inbreeding levels. Analysis considered:

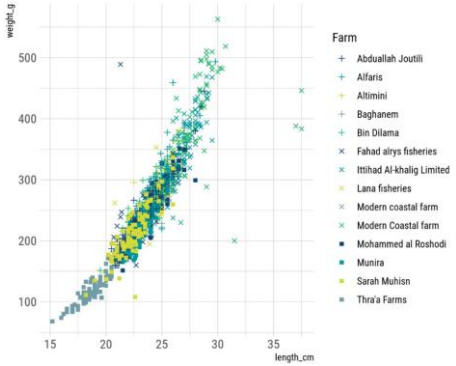
- Principal Component Analysis
- Heterozygosity and inbreeding coefficients
- Fixation index (Fst)
- Effective population size
- Pairwise relatedness
- Sibship analysis
- GWAS

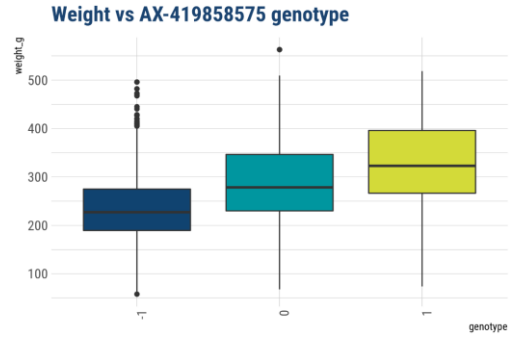
1,500 fish were tagged to identify a suitable pool of founders for future advanced genetic selection breeding program.

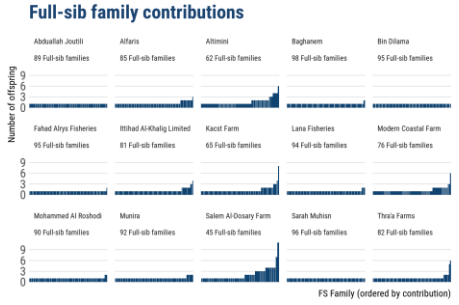
Conclusion

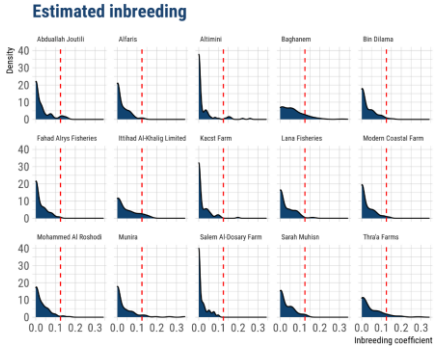
Taken all the results together, the genetic analysis indicates that the overall collections represent a genetically diverse with a high level of genetic variation and a differentiated population that is highly suitable to establishing a world-class selection breeding program.

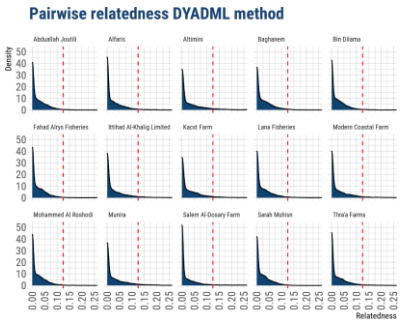








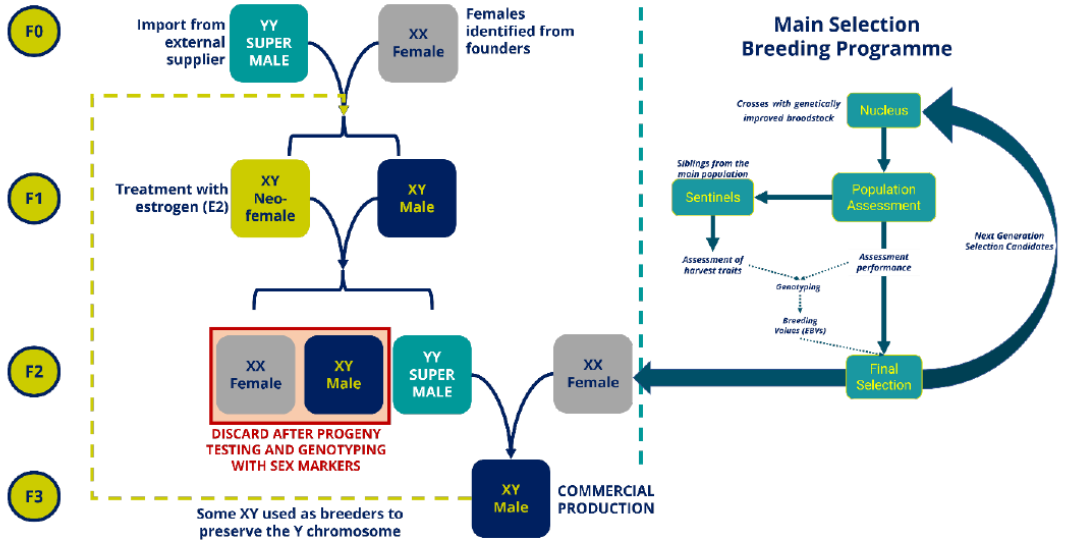




Project 2: Tilapia YY program

Objective: Production of all male tilapia (YY can be obtained by crossing sex-reversed XY neo-females obtained by hormone treatment with normal XY males, with the supermales identified by progeny testing.

- Using a shortcut of mating YY supermales with XX natural females from the available founders.
- Marker-assisted sex determination to reduce the time and effort required for progeny testing.
- Only families with a strong association to the sex markers will be retained for future generations, aiming to reduce the number of progeny-test families required per generation.
- Genotyping YY supermale to determine the genetic distance and control Inbreeding.



Demonstrative Production Projects

Considerations:

- High Capex efficiency
- Comply with biosecurity measures
- Qualified for BAP and SAMAQ Certificates
- Many life support systems to minimise risk
- Strong Concept production plan
- Business modelling and feasibility study

RAS hatchery Rainbow trout

- 5 million fry annual production
- Cold water species 16-degree temp
- 1.2M of 1gm fingerlings/ 4 months
- Ability to run 4 broodstock individual units

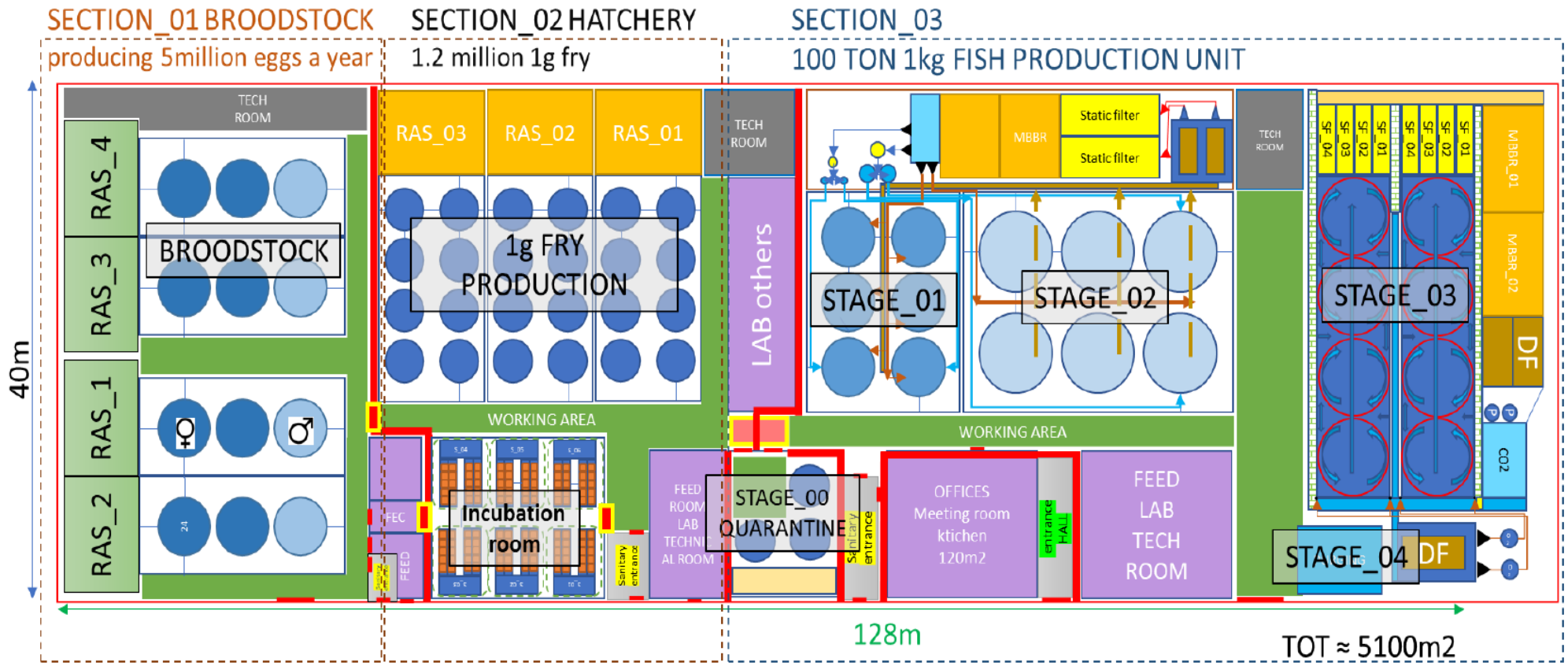
RAS farm Rainbow trout

- 100 tons annual production
- Cold water species 18-degree temp
- 17 tons of 1Kg harvest / 2 months
- Support different size harvest 500-1000g

Integrated Aquaponic

- 100 tons annual production of leafy plants and vegetables
- Rely fully on waters from fish farm

Rainbow trout RAS farm



New Aquaculture Technologies

Advanced Symbiotic as modern technology for Freshwater aquaculture

- Improve farming systems by introducing modern technologies
- Rationalizing water use by reducing operating costs
- Evaluate possibilities of introducing it at a commercial scale

Symbiotic Applications:

- **Anaerobic Fermentation**

  organic carbon (Molasses and Wheat bran)

- **Application of Nitrifying bacteria**

  Inorganic carbon source

- **Application Probiotic**