



# FEED THE FUTURE

The U.S. Government's Global Hunger & Food Security Initiative

## NIGERIAN AQUACULTURE: STATUS, PROSPECTS, AND FUTURE GROWTH

## TILAPIA GENETICS:

## WORLD FISH RESEARCH AND FUTURE VISION



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## ABOUT ME

- 24 years aquaculture experience
- 17 years breeding programs
- Scientist (Fish Genetics), WorldFish
- Penang, Malaysia
- Tilapia breeding programs
- Asia and Africa



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# What make a successful aquaculture production?

Seed



Feed



Management





## WORLD FISH TILAPIA PROGRAMS

- *Oreochromis niloticus*
  - Malaysia
  - India
  - Egypt
  - Ghana
- *Oreochromis andersonii*: Zambia
- *Oreochromis shiranus*: Malawi







## TILAPIAS: GOOD AQUACULTURE CANDIDATES

- Omnivorous, growing on lower quality diets
- Tolerance variable water quality
- Relatively hardy and resistant to disease
- Inexpensive to raise
- Breeding after six months
- Generation time < a year





## NILE TILAPIA

- *Oreochromis niloticus*
- 4.5 million tonnes in 2022
- 10.3% total production of major aquaculture species (FAO, 2022)





## Approaches to genetic improvement in aquaculture



- Interspecific hybridisation
- Intraspecific cross-breeding



**Selective breeding/genomics**  
gains are cumulative and permanent



Genetic (chromosome)  
manipulation



Transgenic



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## Selective breeding

Several approaches

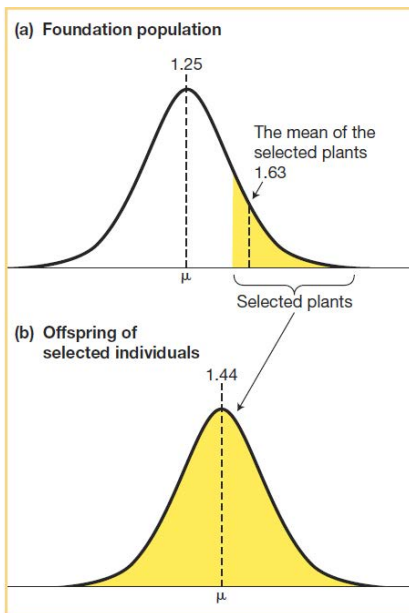
Combined family selection

Within-family selection

Cohort selection

Individual selection

Increasing complexity



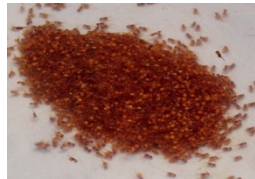




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## TECHNIQUE AND APPROACH USED



Strains from different locations

Mating, strain comparison, family production

Tagging

Grow-out (performance testing)

Harvest  
Data analysis  
Selection  
Mating

- Heritability ( $h^2$ )
- Estimated Breeding Value (EBV)
- Genetic correlation ( $r_g$ )
- Genotype by environment ( $G \times E$ ) interaction
- Genetic gain



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## A BREEDING CYCLE



Mating



Family production



Tagging



Grow-out

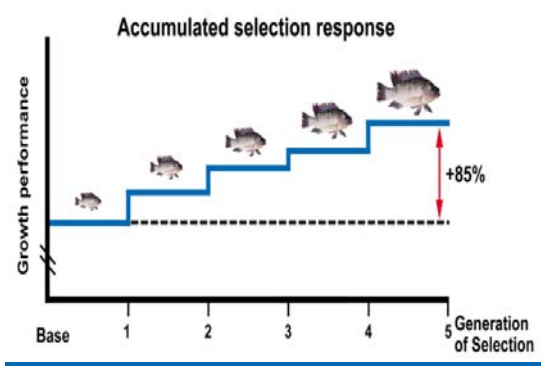


Harvest  
Data collection  
Data analysis  
Selection  
Sampling



## 1988 – 1997: GIFT PROJECT, PHILIPPINES

- ICLARM (WorldFish)
- AKVAFORSK
- Research institutions (Philippines)
- Eight founder populations
- Five generations
- 85% gain







## 2000 – TO DATE: WORLDFISH, MALAYSIA

- Pond-based system
  - 2000: 63 full-sib families
  - Jitra, Kedah, Malaysia
  - Generations **G<sub>1</sub>** to **G<sub>17</sub>**
- Tank-based system
  - Since 2019
  - WorldFish headquarter
  - Generation **G<sub>17</sub>** and **G<sub>18</sub>**



## GIFT TRAITS OF INTERESTS

Trait	Selected	Studied	Generation
Harvest weight	Yes	Yes	All
Fillet weight and yield	-	Yes	4, 5 and 6
Fatty acid composition	-	Yes	4 and 5
Feed efficiency	-	Yes	15 and 17
Resilience to (low) oxygen	-	Yes	16 and 17
Swimming performance		Yes	
Resistance to TiLV	Yes	Yes	16 and 17

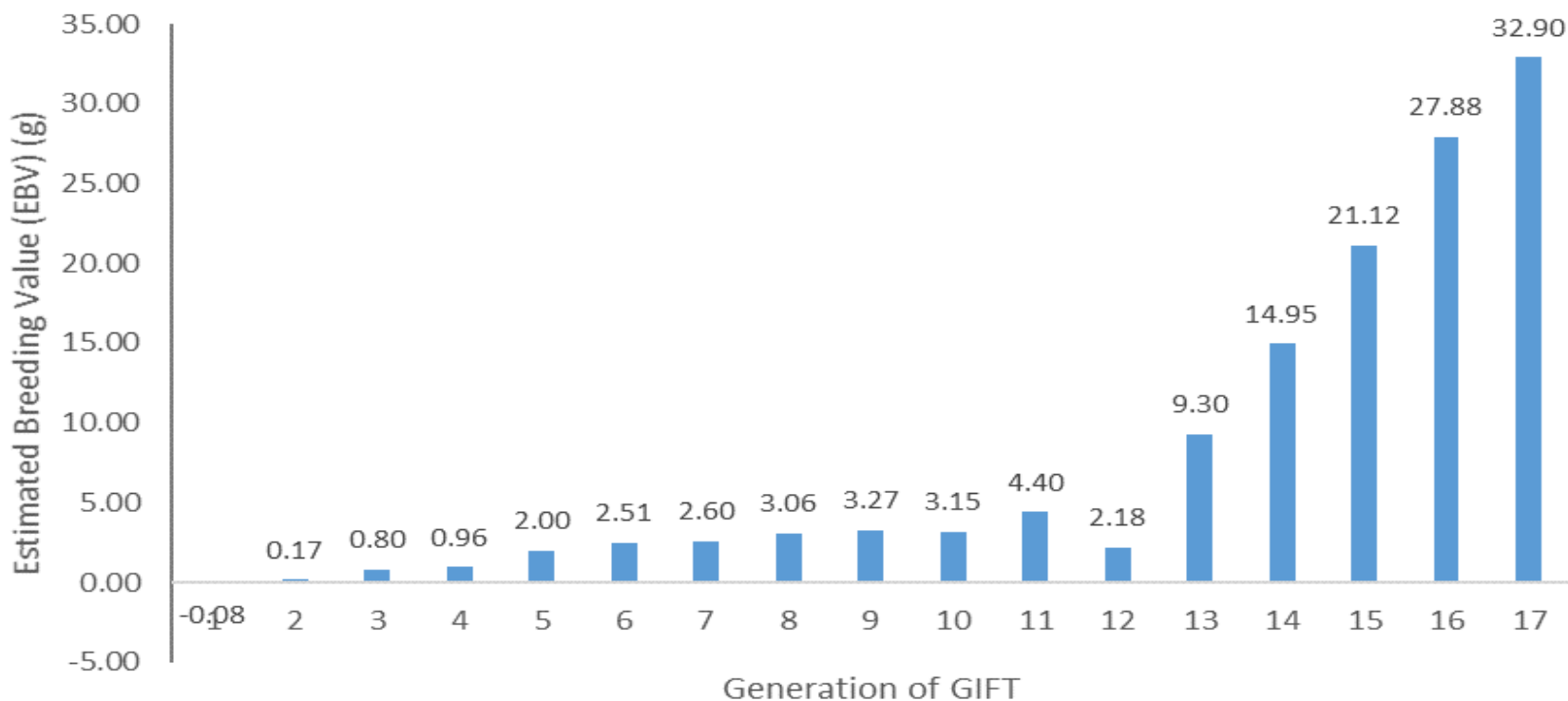




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## GIFT GENETIC TREND



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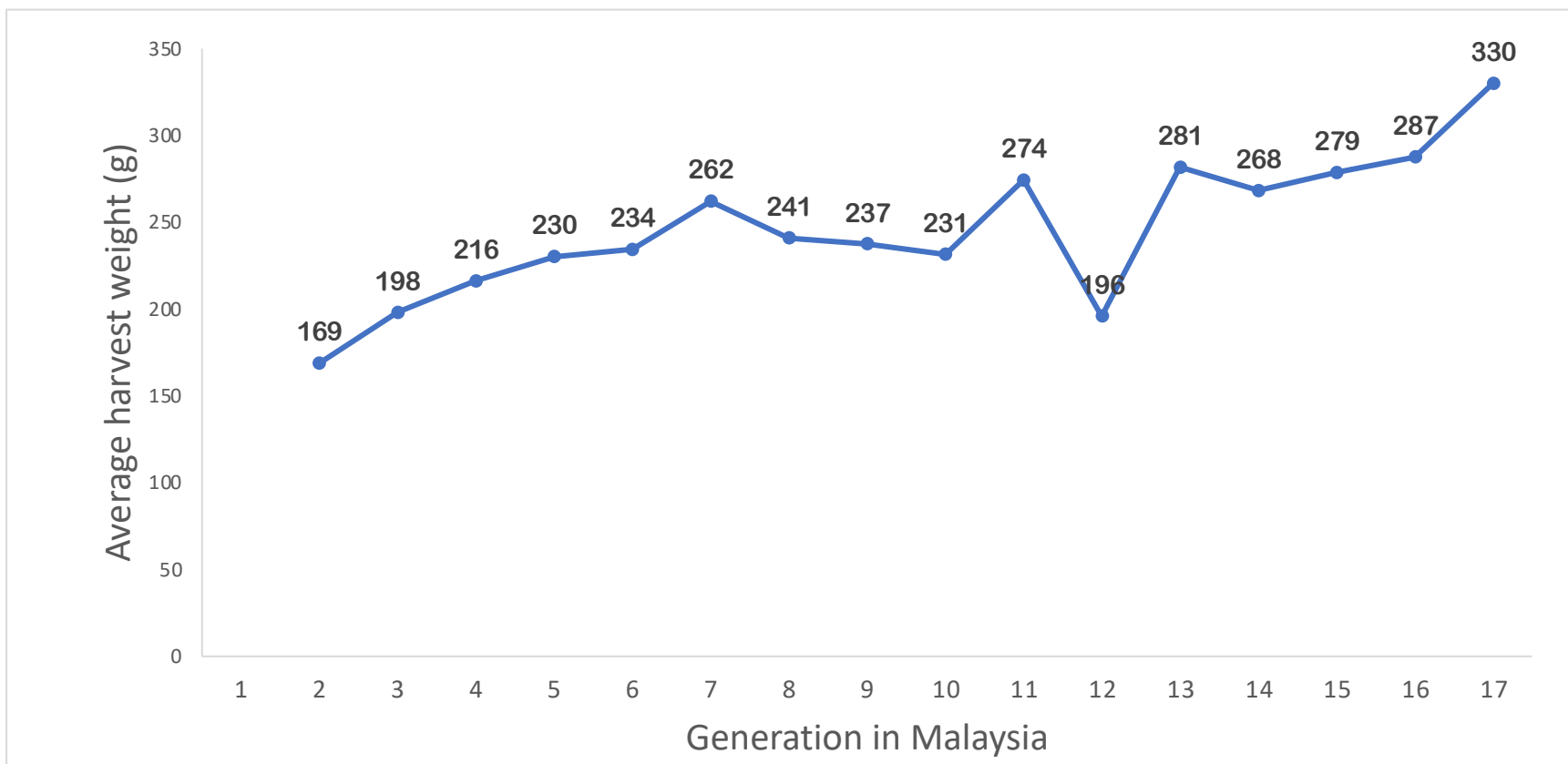




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## GIFT AVERAGE HARVEST WEIGHT



**USAID**  
FROM THE AMERICAN PEOPLE

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## GIFT DISSEMINATION





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## GIFT DISSEMINATION TO NIGERIA

- Commercial cooperation program
- Partner: PAL
- Funded by BMGF and USAID
- More than 60,000 fry



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## GIFT FUTURE DEVELOPMENT

- International research partners
- Protocols phenotyping
- Quantitative genetics and genomics
- Traits:
  - Feed efficiency
  - Resilience
  - Resistant to TiLV







## TILAPIA FUTURE DEVELOPMENT IN AFRICA?

- What is required?
- What is available?
- Chain development
- Species of choice
- Complex vs. simple programs



