

Management, production and utilization of small indigenous species “Zako” for nutritional improvement in rural areas and biodiversity conservation in inland Southeast Asia

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ABSTRACT

Recent commercial aquaculture development in Southeast Asia has contributed to both economic growth and improvement of national food security. On the other hand, health problems, e.g., stunting in children younger than 5 years old and prevalence of anemia in women of reproductive age (15–49 years old), still remain unsolved particularly in rural inland areas^[1]. These symptoms are considered to be attributable to deficiencies in micronutrients and vitamins^[2]. In order to reduce the above health concerns, increase in intake of small fishes with high minerals and vitamins is strongly recommended^[3].

In addition to the nutritional improvement, small indigenous fishes are important components from the point of view of biodiversity conservation. However, because of the impact of introduced alien species^[4] and the aquacultural development of hybrid/alien fishes^[5], there is increasing concern regarding the substantial risk of loss of regional biodiversity^[6]. This situation has led to the necessity for aquacultural development, stock assessment and multiplication of indigenous fish species.

With the above background, management, production and utilization of small indigenous species “Zako” are important key issues for nutritional improvement and biodiversity conservation. In recent years, biological and aquaculture-related studies of several “Zako” species have progressed^[7] and technical improvements in their efficient/value-added utilization are also ongoing^[8]. However, considering the diversity of unexploited “Zako” species as well as a large number of residents under health risks due to micronutrient/vitamin deficiencies in Southeast Asia, further investigations of their biology, aquaculture and processing techniques contributory to management, production and utilization are required.

[1] Pahlisch, T.H., Parvathi, P. & Waibel, H. (2017) TVSEP Working Paper, No. WP-005, Leibniz Universitaet Hannover, Institute of Development and Agricultural Economics, Hannover, Germany.

[2] Ernawati, F. et al. (2021) *Nutrients* **13**, 1802 (<https://doi.org/10.3390/nu13061802>)

[3] Kavarazuka, N. & Béné, C. (2011) *Public Health Nutrition* **14**, 1927–1938.

[4] Welcomme, R.L. & Vidthayanon, C. (2003) Technical Paper No. 9, Mekong River Commission, Phnom Penh, Vietnam.

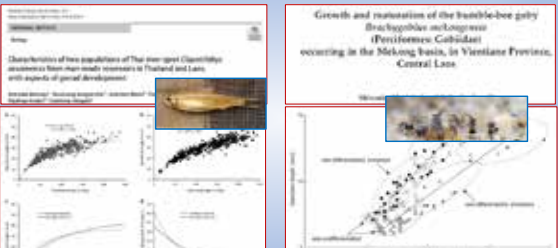
[5] Na-Nakorn, U. et al. (2004) *Aquaculture* **240**, 145–163.

[6] De Silva, S.S et al. (2009) *AMBIO A Journal of the Human Environment* **38**, 24–28.

[7] Ahamed, F. et al. (2017) *International Journal of Fisheries and Aquatic Studies* **5**, 336–339.

[8] Marui, J. et al. (2021) *Journal of Food Protection* **84**, 429–436.

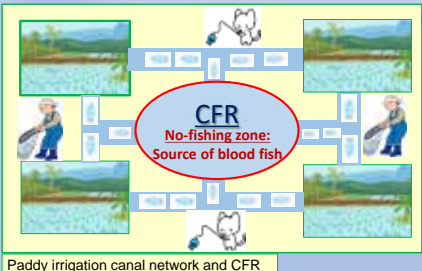
Past achievements (by JIRCAS/UBU/LARReC)
Ecological/biological aspects (resource management)



Seasonal growth, reproduction & life spans

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Past/ongoing activities (by WFC Cambodia)
Application of **Community Fish Refuge (CFR)**



CFR as a center of fish supply to fishing zone

Stabilization/enhancement of fish production

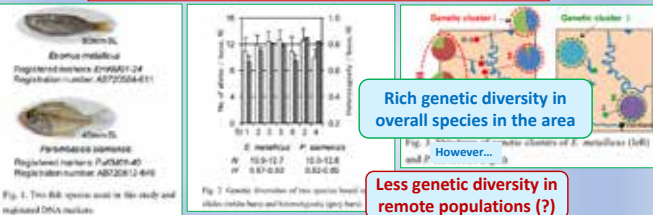
Creation of income generation

Improvement of nutritional status

Paddy irrigation canal network and CFR

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Past achievements (by NARO/LARReC)
Evaluation of genetic diversities of SIFs in Laos by microsatellite DNA marker



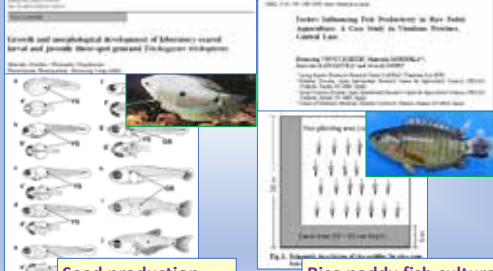
Rich genetic diversity in overall species in the area

Less genetic diversity in remote populations (?)

Useful information for resource management

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Past achievements (by JIRCAS/LARReC)
Aquacultural aspects (seed production/culture techniques)




Seed production

Rice paddy fish culture

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Past achievements (by JIRCAS/LARReC)
Utilization of insect larvae as feed protein (affordable feed acquisition for small-scale fish farmers)



Black soldier fly (BSF) adult, larvae and the climbing perch

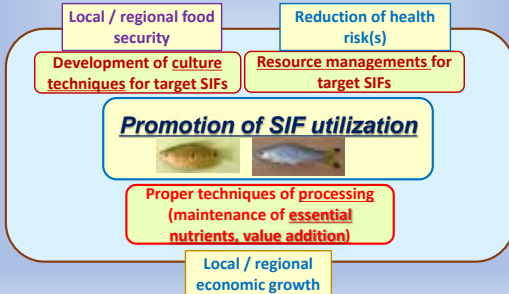
Protein assimilation index	At harvest		
	T1	T2	T3
Protein efficiency ratio	0.9 ± 0.04 ^a	1.1 ± 0.13 ^a	1.3 ± 0.05 ^b
Protein retention	16.4 ± 0.70 ^a	18.8 ± 2.32 ^{a,b}	21.9 ± 0.84 ^b

Better protein assimilation observed in BSFM than in FM

Affordable feed protein for small-scale fish farmers

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Propositions:
Technical package to be prepared



Local / regional food security

Reduction of health risk(s)

Development of culture techniques for target SIFs

Resource managements for target SIFs

Promotion of SIF utilization

Proper techniques of processing (maintenance of essential nutrients, value addition)

Local / regional economic growth

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