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Assessment of applicability of Indigenous Technical Knowledge (ITK) in aquaculture as perceived by fish farmers in Assam

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ABSTRACT

This paper examines the applicability of Indigenous Technical Knowledge (ITK) relating to aquaculture in Assam and it specifically emphasises the effectiveness as well as constraints perceived by the fish farmers in practicing the ITKs. The study was conducted in Nagoan District of Assam in the year 2012-2013 and is based on primary data collected through personal interview using semi-structured interview schedule, focus group discussion and observation methods.The ITKs studied are related to pond preparation and renovation, water quality management, stocking, feed management,disease and pest control, piscicidal plants/fish attractants used for catching fishes and post-harvest operations. Rationality and effectiveness of the ITKs were also assessed. The study identified and ranked nine constraints as perceived by the fish farmers and documented their suggestions to overcome the constraints so as to conserve the ITKs for wider application in aquaculture systems. Further, the study recommends the need for validation, refinement and popularisation of the ITKs.

Keywords: Aquaculture, Assam, Constraints, Effectiveness, ITK, Rationality, Suggestions

Introduction

Indigenous Technical Knowledges (ITKs) are treasure troves of ancient wisdom, beliefs and traditional knowledge passed on from generation to generation for preservation, effective utilisation and conservation of natural resources, soil, plant and other organisms. It is mainly passed down generations through folklore, myths, customs, folk songs, proverbs, puppetry and other traditional methods (Swathi and Dinesh Babu, 2009). According to World Bank (1998), ITKs are local, tacit knowledge, transmitted orally or through imitation and demonstration, experimental rather than theoretical, learned through repetitions, and are constantly changing.

India is home to hundreds of ITKs thanks to the ancient civilisation and the localised way of cultivating crops and rearing of fish as well as livestock. These ITKs play significant role in agricultural production, as Das *et al*. (2002) observed that 'the enhancement of the quality of life of the Indians who in great majority live in and depend on agricultural production systems would be impossible by keeping this rich tradition of ITK aside'. Das *et al*. (2003) compiled the ITKs practiced in agriculture in India. They found 1998 ITKs being practiced by the farmers in the area of veterinary and animal sciences, pest and disease management in crops, grain/seed storage, horticultural crops, and cropping systems and fisheries.

Indigenous knowledge is effective, locally available, relatively cheap and less destructive to local environments. Most of Assam's tribal people survive on local knowledge base (Kalita *et al.*, 2010). It is therefore important to identify and preserve these traditional technologies in order to sustain the productivity and protect the ecosystem. ITKs related to inland fisheries were documented mainly on fish harvesting by some researchers (Yadava and Choudhury, 1986; Bhagabati and Kalita, 1987; De and Saha, 2001; Saha and Nath, 2013). Very few systematic works have been done in recent times in bringing the indigenous knowledge on important aspect of fisheries such as pond maintenance, fish health management and fish seed preparation to light (Kalita *et al.,* 2004). Moreover, none of these studies have attempted to characterise the scientific rationale, adoption, awareness and perceived effectiveness of the traditional practices.

Assam State in north-east India is a heartland of indigenous groups of people and since hundreds of years, many indigenous groups have been living in the state, maintaining their originalities in every sphere of life. Central Assam is the highest fish production zone with

maximum fisheries resources. The indigenous knowledge accumulated through experiences of the farmers in these areas have never been documented systematically, and hence these are not easily accessible to fishery researchers, extension workers and development practitioners. The present study attempts to document the ITKs related to fish farming as perceived by farmers and to assess their rationality as well as effectiveness and also to identify the constraints faced by the traditional farmers in practicing them.

Materials and methods

The study was conducted in Nagoan District of Central Assam in the year 2012-2013. Out of the 18 blocks in this district, four blocks were selected with the help of purposive sampling method based on traditional fish farmers' populations. The selected blocks were Batadrawa, Kaliabar, Rupahi and Binakanti. Two villages from each block were selected based on the population of traditional fish farmers. From each village 10 fish farmers who had the experience of at least 10 years were selected through snow ball sampling technique. Thus a total of 80 fish farmers were selected. The ITKs were documented through interaction, observation and focus group discussions with farmers with the help of semi-structured interview schedules. Rationality scale (Hiranand, 1979) was used to judge the rationality of the indigenous practices. Rationality refers to the degree to which ITK can be explained or supported with scientific explanations, or have been established based on long term experiences (Husain and Sundaramari, 2011). After documenting the indigenous practices from the farmers, for judging the rationality of the documented ITKs, the practices were listed and send to a panel of thirty judges comprising fishery scientists (having a minimum of 4-8 years of experience in fishery science) of Raha Fishery College, Assam Agricultural University, Assam and College of Fisheries, Central Agricultural University, Lembucherra, Tripura and their response were rated on a 5 point score. The weighted mean scores of individual practices were then calculated. The practices and beliefs which were assigned a weighted mean score above 3.5 were considered to be rational. Perceived effectiveness of the ITK, *i.e.,* the degree of relative usefulness of the ITK as perceived by the practicing farmers in resolving the problems in fisheries activities, was measured using the Mean Perceived Effectiveness Index (MPEI) methodology constructed by Sundaramari (2001). The expert's opinion was also considered, along with the perception of the farmers who adopted the ITKs, to measure the MPEI. Farmers were also questioned on the constraints faced by them. Accordingly suggestions were also elicited from the perception of respondents. The data obtained were then analysed to fulfill the objective.

Results and discussion

Category of ITKs

During the course of investigations, a total of 34 items of different ITKs on aquaculture were documented and categorised into 7 areas as depicted in Table1. Majority of the ITKs documented were on post-harvest operations (23.53%); followed by feed management (17.65%), water quality management (14.71%), disease and pest control (14.71%), pond preparation and renovation (11.76%), stocking (8.82%) and piscicidal plants/fish attractants used for catching fishes (8.82%).

ITKs documented

I. Pond preparation and renovation

ITK-1 Squeeze method for soil testing.

ITK-2 Hole method of testing the water holding capacity of soil: a round hole of about 2 m depth is dug, filled with water and covered with banana leaves and the next day water level is examined.

ITK-3 Use of bamboo fencing for retention of pond dyke.

ITK-4 Traditional spillway using bamboo pipe: constructed to protect the pond from unwanted excess water during floods.

II. Water quality management

ITK-5 Use of banana stem to correct water quality.

ITK-6 Use of banana ash (kalakhar) for reducing turbidity of water.

ITK-7 Application of straw/husk (kherpelai) in pond water for reducing clay turbidity.

ITK-8 Application of cow urine in the pond surface to control algae.

ITK-9 Beating the water surface of the pond with bamboo for 15-30 min to increase the oxygen level.

Table 1. Categorisation of the documented Indigenous Technical Knowledge (ITK)

S. No.	ITK category	Practices under each category	Percentage (%)
1.	Pond preparation and renovation	4	11.76
2.	Water quality management	5	14.71
3.	Stocking	3	8.82
4.	Feed management	6	17.65
5.	Piscicidal plants/fish attractants used for catching fishes	3	8.82
6.	Post-harvest practices	8	23.53
7.	Disease and pest control	5	14.71
	Total	34	100

III. Stocking

ITK-10 Use of 'javaputi' (*Puntius sarana*) to control aquatic vegetation.
ITK-11 Rice- cum-fish culture with common carp.
ITK-12 Stocking *Labeo gonius* and *Labeo calbasu* instead of common carp to protect the dyke from erosion.
ITK-13 Use of 'dimaru'(*Ficus carica*) fruit as fish feed.

IV. Feed management

ITK-14 Substrate such as bamboo, wood, stem and branches of plants are put in the pond bottom for plankton growth.
ITK-15 After complete harvesting of previous batch of fish, farmers sow the seeds of *dhanusha* in the pond bottom.
ITK-16 Use of banana and bamboo leaves as feed of grass carp (*Ctenopharyngodon idella*).
ITK-17 Use of rafts to control aquatic weeds and to apply feed.
ITK-18 Control the spreading of weeds over the pond surface using bamboo.

V. Piscicidal plants/fish attractants used for catching fishes

ITK-19 Application of 'konibih' for killing unwanted fish.
ITK-20 Use of 'moin'(*Durantap lumieri*) seeds as fish poison
ITK-21 Branches of the 'saura' plant (*Grewia sapida*) are placed as fish attractant in suitable shallow areas of the beels and rivers

VI. Post-harvest practices

ITK-22 Moslin net hapa for keeping live fish.
ITK-23 Live fish transport in polythene lined bamboo baskets lbarrels.
ITK-24 Use of rice bran in thermocole box while transporting fish
ITK-25 Seed selling in temporary plastic trays in the market
ITK-26 Use of 'neempat' in 'hundi' for transportation of fish
ITK-27 Dry small fish using 'bihlongonii'.
ITK-28 Drying fish by keeping them over the kitchen fire on 'chalonee'.
ITK-29 Drying fish in bamboo racks

VII. Disease and pest control

ITK-30 Use of 'Pachatiya' plant to reduce *Argulus* infestation.
ITK-31 Application of turmeric with lime at 3:7 ratio to control Epizootic Ulcerative Syndrome(EUS).
ITK-32 Old gunny bags submerged in pond water are removed periodically to dry and kill eggs of *Argulus* deposited over them
ITK-33 Application of salt and neem to control EUS
ITK-34 Keeping snakes away by growing turmeric plants on pond dyke

Rationality and perceived effectiveness of the documented ITKs

Rationality analysis revealed that out of the 34 practices evaluated, 26 were rational and the remaining 8 were irrational as per the perception of the experts (Table 2). Perceived effectiveness of the ITKs, *i.e.,* the degree of relative usefulness of the ITKs as perceived by the farmers and experts in resolving problems in fisheries and related activities, is also given in Table 2. The effectiveness of ITKs for each category is described below:

ITKs on pond preparation and renovation

All four ITKs were found to be rational. ITK-1 and ITK-2 were used for selection of suitable site for pond construction. ITK-2 was perceived to be more effective (MPE I2.35) than ITK-1 (MPE I1.90). However, both the ITKs have rationality and scientific base. ITK-1 can be used to get first hand idea about the presence of clay particle in the soil. ITK-2 can be used to test the level of ground water as well as the water permeability of the soil. ITK-3 and ITK-4 were found to be highly effective. Since the district experiences heavy rainfall and frequent floods, bamboo fencing is useful to protect pond dykes

Table 2. Rationality and effectiveness of ITKs as perceived by practicing farmers and experts

ITK	Rationality	MPEI	Remarks
ITK-1	R (3.54)	1.90	R +LE
ITK-2	R (3.60)	2.35	R+ E
ITK-3	R (4.06)	2.56	R +HE
ITK-4	R (3.60)	2.60	R+ HE
ITK-5	R (3.60)	2.10	R +E
ITK-6	R (3.72)	2.06	R+ E
ITK-7	IR (2.18)	-	-
ITK-8	IR (2.45)	-	-
ITK-9	R (4.20)	2.57	R+HE
ITK-10	R (3.90)	2.40	R +E
ITK-11	R (4.37)	2.50	R+ E
ITK-12	IR (3.10)	-	-
ITK-13	IR (3.00)	-	-
ITK-14	R (4.18)	2.10	R+ E
ITK-15	R (4.23)	2.64	R+HE
ITK-16	R (4.09)	2.60	R+HE
ITK-17	R (3.57)	2.07	R+E
ITK-18	R (3.60)	2.10	R+E
ITK-19	IR (3.20)	-	-
ITK-20	IR (3.09)	-	-
ITK-21	R (3.53)	2.10	R+E
ITK-22	R (3.54)	2.17	R+ E
ITK-23	R (3.67)	2.40	R+ E
ITK-24	R (4.20)	2.67	R+HE
ITK-25	R (3.50)	2.02	R+E
ITK-26	R (3.60)	2.27	R+E
ITK-27	R (3.54)	2.10	R+E
ITK-28	R (3.63)	2.23	R+ E
ITK-29	R (3.53)	2.10	R+ E
ITK-30	IR (3.09)	-	-
ITK-31	R (3.81)	2.75	R+HE
ITK-32	R (3.72)	2.45	R+E
ITK-33	R (3.83)	2.78	R+HE
ITK-34	IR (2.54)	-	-

R = Rational; IR= Irrational; RE = Rational and effective; RLE = Rational but less effective; '-' indicates ITK not evaluated Rationality score: <3.5 = irrational, >3.5 = rational; MPEI 3 = most effective, 1 = ineffective, <2.0 = less effective, >2.0 = effective, > 2.5 = highly effective.

from erosion. The traditional spillway is a simple and cost effective method to drain out extra water from ponds. Kalita *et al.* (2004) in their study in the hill zone of Assam also documented spillway and plantation of coconut and betel nut on the dykes to prevent erosion.

ITKs on water quality management

Out of five ITKs identified on water quality management, three *i.e.,* ITK-5, 6 and 9 were found to be rational and effective as perceived by the experts and practicing farmers (MPE I 2.10, 2.06 and 2.57 respectively). Banana is available in plenty in the study area. The ash of banana plants is rich in potassium and is alkaline in nature, which helps to increase the water pH. Banana ash also binds dissolved and suspended particles in the water column and thus clears water by coagulating the particles. Water treated with banana ash is thus rendered suitable for higher phytoplankton growth which in turn supports the fish growth. ITK-7 and ITK-8 were not found to be rational. But these are age old practices in the study area. Regarding application of straw for controlling clay turbidity, some experts were of the opinion that the clay particles may get attached to the straw and when they settle at the pond bottom, the water may become clear. But deposition and decomposition of straw at the pond bottom may produce toxic gas which may create more hazards. Regarding application of cow urine, no scientific rationality could be established but the farmers reported that with this traditional technique, the algae can be controlled convincingly within one to two weeks. Therefore, more future research on this area is required. Das *et al.* (2013) in their study in Tripura also documented the application of cattle urine to control the problem of algal bloom formation in pond water. In this connection,Venkataraman (1979) reported that supplementation of cattle urine with bicarbonate supported growth of the algae up to a level of 3% urine, beyond which the urine *per se* seemed to inhibit algal growth even with the addition of bicarbonate.

ITKs on stocking

Out of the three ITKs identified on stocking management in aquaculture, two were found to be rational (ITK-10, ITK-11) and effective as perceived by the experts as well as farmers (MPEI are 2.40 and 2.50 respectively). ITK-10 may be effective as *Puntius sarana* feeds heavily on *Lemna* and *Hydrilla*. ITK-11 *i.e.,* rice-cum-fish culture by introducing common carp is an age old practice done by few farmers. The rationality of releasing common carp in paddy-cum-fish culture is that it tries to dig out and eat the insects available in the mud and hence helps in releasing nutrients from the soil, besides reducing the insect pests of paddy. Reportedly, farmers release fry or advanced fry in paddy-fish culture and after four months (as four months is necessary to complete one paddy cycle) it attains a size of nearly 15-20 cm, which is considered as table-size fish. However, ITK-12 *i.e*., stocking of *L.gonius* and *L. calbasu* instead of common carp was not found rational (MPEI 3.10) due to lack of location specific experiments, but the ITK may be important in specific locations since the practising farmers had accepted this age old practice and reported good returns, but further comparative studies are required to establish its rationale.

ITKs on feed management

Farmers in the study area were found to practice six ITKs on feed management in fish ponds. Apart from ITK-13, all the five ITKs documented were perceived as rational. ITK-15 and ITK-16 were found to be highly effective (MPEI- 2.64 and 2.60 respectively). ITK-13 (*dimaru* fruit as fish feed) was found to be irrational by the experts but the farmers believe that fish, mainly Indian major carps feed on the '*dimaru*' fruit. There is scope for proper validation of the ITK by assessing the nutritional composition of the fruit. ITK-14 was found to be a very popular practice in this category and effective (MPEI 2.10) as perceived by the fish farmers and experts. Fish farmers use substrates such as bamboo, wood, stem and branches of plants in the pond to enhance the growth of periphyton.

ITKs on piscicidal plants/fish attractants used for catching fishes

ITK-21 was found to be rational and effective (MPEI2.10) as the 'saura' plant probably contains some chemical which acts as chemo-attractant for fish. ITK -19 and ITK-20 were also very popular. As per the expert's perception 'konibih' contains chemical components such as glyceryl cretonate, cronic acid and, crotonic resin which are toxic to fish. Toxic nature of the plant needs to be ascertained through chemical analyses and laboratory experiments. After proper validation, the plants may be very useful in eradicating unwanted fish in scientifically managed fish production systems.

ITKs on post-harvest practices

All the eight ITKs documented on post-harvest practices including preservation, processing and transportation of fishes were found to be rational and effective. ITK-24 was perceived as highly effective (MPE I2.67) as rice bran acts as insulator of heat and keeps the ice inside the thermocole box intact or partially melted. These in turn reduces the excess use of ice and extends the shelf life of fish.

ITKs on disease and pest control

Out of the five ITKs documented on fish disease and pest control, 3 ITKs were perceived as effective. To

control EUS, farmers applied paste of turmeric and lime into pond water. Some farmers also used salt and neem plant to control EUS. Both the ITKs documented on EUS control (ITK-31 and ITK-33) were found to be highly effective (MPEI 2.75 and 2.78 respectively). ITK-32 to control *Argulus* was found to be effective (MPE I2.45) as experts opined that the eggs of *Argulus* may get deposited on gunny bags due to their sticky and adhesive nature. The gunny bags can be lifted out later to destroy the deposited eggs which would help to disrupt the life cycle of *Argulus*.

The ITKs which have high level of rationality and effectiveness scores should be given priority by extension agents and researchers as they will greatly reduce expenditure on aquaculture practices and benefit farmers.

Constraints faced by the fish farmers while applying the ITKs

Various constraints as reported by farmers in adopting the ITKs have been documented with frequency and rankings (Table 3). All (100%) the farmers interviewed during the study, perceived that 'ITK alone is not complete panacea for fish production practices'. Therefore, along with ITK, scientific package of practices need to be practiced by the farmers. Alternatively, the modern science of fish farming should include the right mix of ITKs in evolving package of practices.

Another constraint expressed by majority (77.5%) of the farmers was that 'Government officials and educated people give less recognition to this knowledge'. Very often the fisheries development officials ignore ITKs. Hence, farmers are also reluctant to put full confidence in applying ITKs.The officials need to be sensitised regarding the utility of ITKs.

'Low yielding nature of traditional package of practices' was a constraint to more than 70% of the farmers. ITKs evolve through experience, trial and error, and they take in to account the holistic management of natural resources. In most cases, ITKs ensure the sustainability of production. Sometimes they may provide low yield, but the yield will be sustainable. Scientific testing and refining of this knowledge can definitely help to improve the yield. Hence, research and development organizations should take up the task of refining select ITKs and popularise them among the fish farmers.

More than one-half (52.5%) of the farmers commented that they don't have the knowledge regarding application of ITKs.. It has been seen that the younger generation generally does not rely on ITKs and they do not care to learn from their forefathers about the usefulness of ITKs. Hence, there exists a gap in the propagation of ITKs. Local panchayat offices could document the ITKs in their locality and popularise them.

Another major constraint, as expressed by the farmers (42.5%) was that 'many ITKs become extinct due to non-practice by the younger generation'. Older farmers in particular stressed upon this constraint. In contrast, 12.5% of the farmers, who were comparatively young complained that, 'the older experienced farmers did not transfer the ITKs to any other person except their sons to maintain their monopoly in the field'. Less than one-fifth (18.75%) of the farmers perceived that 'traditional knowledge has no written documents; and it is only transmitted orally'. Since information on ITKs is seldom documented, it often happens that such information may be lost if it is not passed-down generations and is not preserved or practised by the local people. In the context of the present day Intellectual Property Rights (IPR) regime, it is all the more imperative to document and protect our valuable ITKs for posterity (Das *et al.,* 2002). Efforts should be made to store the information in simple files managed by villagers themselves (Ponnusamy *et al,.* 2009). The local panchayat has a big role to play in documenting the ITKs in their locality, validating and refining them with the help of researchers and popularising them.

Table 3. Constraints faced by the fish farmers regarding the use of ITKs

S. No.	Constraints	Frequency	Percentage	Rank
1.	ITK is not complete panacea for fish production practices	80	100.00	I
2.	Lack of full confidence in applying ITKs as Government officials and educated people give less recognition to this knowledge	62	77.50	II
3.	Low yielding nature of traditional package of practices	58	72.50	III
4.	Lack of knowledge in application with proper standard dosage	42	52.50	IV
5.	Many ITKs become extinct due to non-practice by the younger generation	34	42.50	V
6.	Many new problems have no traditional cures	25	31.25	VI
7.	Lack of sufficient number of required plant materials for practicing the ITKs	22	27.50	VII
8	ITK has no written documents as it is transmitted orally	15	18.75	VIII
9.	Elderly, experienced farmers do not transfer their knowledge to any other person, except their sons	10	12.50	IX

Measures suggested by the farmers to overcome the constraints

Some suggestive measures were given by the respondents which are important and indicative of the rational thinking and intent of farmers to evolve everlasting solutions for the problems. All the respondents (100%) opined that 'Government officials should look at the traditional knowledge with due consideration and be ready for its proper assessment' (Table 4). Another valuable suggestion, given by 51.25% of the respondents was that 'effective ITKs should be disseminated in the social system with effective dose and recommendation'. The result is in line with the findings of Rajput (2005) who observed that lack of knowledge for processing and development of suitable dosage forms hinder the wider use of ITKs for field applications. If ITKs were used in farming systems along with frontier technologies developed by agricultural scientists, it would be more practical and will be quickly adapted by the farmers, which will in turn increase the benefits, practicability and acceptability of the technology. More than one-third of the respondents (37.50%) recommended that 'ITKs should be preserved for future use'. In this context Karthickeyan and Gajendran (2004) also concluded that 'efforts should be made to preserve various plants, which have high economic importance in terms of preventive and curative properties'.

Table 4. Suggestions given by the farmers to overcome the constraints

S. No.	Suggestions	Respondents (n = 80 fish farmers)	
		Frequency	Percentage (%)
1.	Government officials should look at the traditional knowledge with due consideration and be ready for its proper assessment.	80	100.00
2.	Effective ITKs should be disseminated in the social system with effective dose and recommendation	41	51.25
3.	ITKs as well as plant materials should be preserved for future use	30	37.50

As most of the fish farmers of Central Assam are poor, they cannot easily adopt modern technologies. Therefore, upgradation of all the documented traditional technologies in aquaculture with modern technologies is of utmost importance. The ITKs which are most effective for aquaculture, as found in this study, need special attention by scientists and extension workers in order to recover, conserve, improve and utilise for future research and development.

Since majority of the ITKs could be justified through scientific explanation, it should be accepted that the farmers indeed have a wealth of knowledge in solving their own problems. Hence, it is suggested that scientists and scientific institutions should consider the farmers as active partners in the process of technology generation to dissemination. Documented ITKs will also help policy makers to protect products of creative and inventive endeavorus of fish farming community through intellectual property rights (IPR).

The present study identified 34 traditional practices on aquaculture in the study area. Majority of the ITKs analysed for their rationality were judged as rational by experts. Such rational and effective ITKs suited to the local situation and culture may either be suggested for adoption, or may be recommended to scientists for further examination, or blended with modern technologies, which in turn would promote sustainable farming systems. Validation of ITK is a logical step to qualify and quantify effectiveness of the practices. Suitable modifications of the local practices, through R&D will help to develop appropriate and acceptable methodologies that are more suited to our farming situations. The farmers practicing ITKs may also collaborate with research scientists in refining the knowledge for evolving appropriate technologies. Local ITK practitioners need to be honoured and recognised and publications of local innovation in regional magazines including names and photographs of the innovators can motivate traditional practitioners to disseminate their knowledge.

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