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RESEARCH ARTICLE

Documentation and perceived rationale of Indigenous Technical Knowledge (ITK) utilized in *Boro* rice cultivation by farmers of Kamrup District of Assam

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Abstract

The study was conducted in Kamrup district of Assam in order to document the utilization of Indigenous knowledge System by farmers in the production of rice. Indigenous Technical Knowledges **(**ITKs) are the knowledge of local people developed during close interactions with nature and natural resources for their livelihood to mitigate immediate crop environmental situation with the objective of maintaining productivity and sustainability. A multi-stage purposive-cum-random sampling design was followed in the study. A total of 120 *Boro* rice growing farmers were selected randomly as respondents from six selected VLEW circles of three agricultural sub divisions of the district. All in about 57 ITKs under nine selected cultivation practices of *Boro* rice were explored in the study. The maximum number (33) of ITKs were identified and documented under 'plant protection' and least number (only one) recorded in 'fertility management'. Majority of the identified ITKs (43.86%) were found to be moderately effective as per respondent's view. The rationale behind the use of ITKs identified in the investigation was purely based on the free opinion of the respondents as they have observed the results in their own situation. The average extent of use of ITKs for the entire district was found to be 6.68%. The majority of the respondents (57.5%) were included in 'low user' category and least number of respondents (2.5%) in 'high user' category. In the present day agriculture, it is now realized that in all sphere of society systematic documentation, refinement and technology development by blending modern knowledge with ITks helps to combat with impact of climate change and reduce environmental degradation. Involvement of farmer's organization, KVK, Zonal Research stations and SAUs in different strata are important for proper documentation, validation and development of environment friendly, location specific technology. The establishment of National level ITK validation and regulatory board will help to restrain the uniqueness of ITKs in one hand and provide data base for research and development in agriculture for future use.

Keywords: Kamrup, purposive-cum-random sampling, *Boro* rice, fertility management, plant protection.

Introduction

Through the long path from primitive agriculture to the modern farming people have developed a number of farming techniques through their own age old experiments by trial and error in their attempt to overcome numerous problems faced during the farming operations. This knowledge is based on many generations of insight gained through close interaction within the natural and physical micro-environments (Rajsekharan *et al*., 1991; Kolawole, 2001). This form of knowledge in today's parlance is popularly known as Indigenous Technical knowledge (ITK) or Indigenous Knowledge System (IKS).

Indigenous knowledge is the knowledge of indigenous people inhabiting different geographical region of the world with their own language, culture, tradition, belief, folklore, rites and rituals (Wareren and Cashman, 1988; Chhetry and Belbahri, 2009). In course of close interaction with nature and natural resources for their livelihood, farmers have developed some knowledge to mitigate immediate environment with maintaining sustainability.

Therefore indigenous knowledge so developed is based on necessities, experimentation, curiosity and observation of ethnic groups to mitigate the immediate situational problems. Location and culture specific, cost effective locally manageable and sustainable, judicious application of plant and animals products either in raw or simple processed forms are important components of indigenous knowledge system (Tarat *et al*., 2002; Chhetry and Belbahri, 2009). Kumar *et al*. (2005) have rightly mentioned that sustainable agriculture strives to integrate modern sciences with traditional farming wisdom. Thus, it consists of technologies developed by farmers over decades of adjusting farming systems to local agro climatic and social conditions (Venkata Ramaiah and Rama Raju, 2004). Prior to the advent of Green Revolution, Indian farming was largely based on indigenous technical knowledge of the farmers. The methods of controlling pests and diseases and building soil fertility and structure were indigenous in nature since farming did not include the use of chemical pesticides or fertilizers.

Rather, soil health and pest control were achieved through the use of practices such as shifting cultivation, conservation, use of manures and farm wastes, introduction of legumes into crop rotation and use of locally available plants and plant parts as botanical pesticides that ensured ecological balance. But the launching of Green Revolution in India during 1960s with excessive irrigation, higher level of chemical fertilizers, pesticides, herbicides and plant growth regulators lead to severe environmental degradation and health hazards. The world-wide deaths and chronic diseases due to pesticide poisoning number about 1 million per year (Environews Forum, 1999). His Highness, Prince Charles opined "What I do believe, passionately, is that we should learn from the past, accept that there are such things as timeless principles, operate on a human scale, look firmly to the long term, respect local conditions and traditions, and be profoundly skeptical who suggest that everything new is automatically better- invariably it turns out to be a short lived, fashionable approach anyway" (Resurgence No. 15, Soil Association). The ITK can form a knowledge base for researchers and development professionals in planning their research strategy and experimental procedure in order to generate more eco-friendly, viable and socially acceptable technologies for the farmers blending them with modern technologies.

Rice is the major crop grown over 70% of total cultivable area of Assam. Among the four categories of rice viz. *Ahu, Sali, Boro* and *Bao*, *Boro* rice has assumed more importance and popularity during last decade because of its high yield potential and area expansion due to irrigation facilities through massive installation of shallow tube well in flood plains of Brahmaputra river. Keeping the importance and expansion of area under *boro* rice, this study was conducted to identify and document Indigenous Technical Knowledge (ITK) in *boro* rice used by the farmers, their rationale behind use and extent of adoption.

Materials and methods

Sample population and design: The study was conducted with a sample of 120 farmers of Kamrup district of Assam. A multistage purposive cum random sampling design was followed for selection of the respondents. The data were collected by personal interview method with the help of pre-tested structured research schedule (Annexure-I). The variable 'Extent of use of ITK' was calculated as the ratio of the area of the crop or quantity of seeds/grains etc. where ITK was used to the area of the crop or quantity of seeds/grains etc. where ITK could have been used and was expressed in percentage, The relevant component of socio economic status scale developed by Trivedi and Pareek (1963) was used with slight modification. The data on scientific orientation were collected by using the scale developed by Supe and Singh (1969). Frequency, percentage, means and SD are the statistical tool used for the study.

Results and discussion

Identification and documentation of ITK: All total 57 numbers of ITKs were identified under 9 selected cultivation practices of *Boro* rice in the study and they were documented in Table1. The highest number of ITKs were identified under plant protection (33 numbers) followed by post harvest practices (8 numbers). The least number of ITKs (only one) was identified under fertility management. Cultivation practice wise each ITK and rationale behind the use of the ITK as perceived by the users, frequency of the respondents using the ITK and its effectiveness based on respondents' opinion has been presented in Table 1. It was found that some locally available plants and plants parts such as leaves, twigs, seeds, rhizomes etc. were used in traditional plant protection measures. These are– 'bogori' or ber (*Ziziphus* spp.), 'kola kachu' or black colocasia (*Colocasia esculenta*), bihlongini (*Polygonum hydropiper*), bihdhekia (*Sphaerostiphnose unitus)* posotia (*Vitex negunde*), banh or bamboo (*Bambusa indica)*, citrus (*Citrus* spp*.)*, sojina (*Moringa olifera),* son borial(*Sida rhombifolia),* mahaneem (*Azadirachta indica*), keturi haldhi or wild turmeric (*Curcuma* spp.), ekora (*Sclerostachya susca*), chai tamol or momai tamol (*Caryota urens)*, Bhung (*Cannabis sativa*). In addition to the use of plants and plant parts, some other ITKs involved the use of other materials such as dead frogs/toads/crabs, wood ash, goat excreta, fresh cow dung, kerosene etc. for controlling pests and diseases. Burning tyres and lighting fire at night with straw or wood were also in practice for this purpose. For storage of grains, some traditional storage structures, viz. 'bhakheri' or 'bhoral', 'Duli', 'ber' 'Koloh', 'Topa' etc were used by the farmers. They also apply leaves of Narasingha (*Murraya koenigii*), Mahaneem (*Azadirachta indica*) and Ghora neem (*Melia azadirachta)* during storage for controlling stored grain pests.

Rationale behind the use of ITKs by the respondents: The rationale behind the use of ITKs gathered during investigation was purely based on the respondent's opinion and no attempt was made to taint it with scientific view points. The rationale so collected is presented in Table 1. Therefore, some rationale may be devoid of any scientific background and explanation while some others may be strongly backed by scientific view points and principle. For example the rationale recorded that had no scientific rationale of 'the beating of the rice plants at milking stage with 'Ekora' plants (*Sclerostachya susca*) treated with 'mantras' and putting them in the four corners of the rice field to control Gandhi bugs'. Because the belief of reduction of Gandhi bug attack due to the influence of 'mantras' was against scientific view point. On the other hand, some the ITKs and the rationale behind their use were backed by strong scientific evidence and research finding. For example, cut pieces of vines of son burial or sida hemp when applied in soil act as repellant of insect like rice hispa due to its bitter taste.

Table 1. Distribution of farmers (nos.) using different ITKs.

S. No.	Description of identified ITKs	Rational behind the use of ITKs	Farmers using ITK	Effectiveness score
	Seed selection, treatment and germination			
1.	Hot water is sprinkled over seeds of *boro* rice after soaking them overnight	Hot water increases temperature and enhances germination of seeds as seeds are germinated in winter.	2	1.50 (L)
2.	After soaking the seeds overnight seeds are cured from water, colocasia (*Colocasia esculenta*) leaves are put at the bottom of a basket made of bamboo (locally called *Pasi*); soaked seeds are put on colocasia leaves until they reach the top of the basket and again covered with colocasia leaves. Seeds are left as such in room or shade until germination.	When seeds are covered with colocasia leaves it produces heat inside the soaked seeds enhancing germination of the seeds.	11	1.80 (M)
	Raising of seedlings			
1.	During seed bed preparation land is pulverized along with stubbles and weeds and they are removed as less as possible and sprouted *boro* paddy seeds are broadcasted on nursery bed with the remaining stubbles and weeds.	Seedling growing in this way facilitates easy uprooting as seeds do not penetrate deep into the soil and uprooted seedlings contain very less amount of soil with their roots.	5	1.80 (M)
2.	Wood ash sprayed over the nursery bed before broadcasting of germinated paddy seeds.	It facilitates quick germination and easy uprooting of seedlings as uprooting as seeds do not penetrate deep into the soil	1	1.00 (L)
3.	*Boro* rice seedlings are grown on nursery bed in wet land	Growing seedlings in wet lands facilitates quick and vigorous growth because seedling do not suffer water stress due to draught	10	1.30 (L)
	Main field preparation			
1.	Ploughing with an initial irrigation in case of uplands or without irrigation in case of low land, well ahead of final puddling and keeping as such for 15 to 20 d after leveling until some excreta of locally called *Habrang* are seen on the soil surface. The practice is locally termed as “borapara”.	This practice allows earthworms to grow facilitating decomposition of stubbles, thereby making soil more fertile both with decomposed materials as well as the earthworm excreta.	12	2.25 (M)
2.	Cutting edges of border of the plots with local hoes.	It lessens weed growth around the borders and reduces pest population at later stages by killing the pest hibernating in the border edges.	16	1.56 (M)
3.	In rice field during land preparation, bunds are prepared with weeds and stubbles collected from the fields and bunds are plastered with mud.	Weed growth of weeds are suppressed and run off of rain water as well as irrigation water is reduced.	9	1.44 (L)
	Fertility management			
1.	Burning of stubbles before ploughing (usually practiced in uplands).	The ashes produced as result of burning of stubbles add to soil fertility. Besides pests and their eggs get burnt and therefore pest population in the subsequent crop becomes less.	5	1.60 (M)
	Transplanting method			
1.	Top portion of *boro* rice seedlings are cut and buried/fed to the cattle before transplanting. This is usually practiced in case of tall seedlings of traditional *boro* rice varieties.	The cutting of top portion of the seedlings removes the eggs of stem borers and thereby reduces the stem borer attack during initial stage in the main field.	20	1.55 (M)
2.	Transplanting the seedlings in muddy place other than the main field for about 15-20 d and then uprooting and transplanting in the main field. This practice is known as *Kathiajowowa* in local language, meaning somewhat like hardening of seedlings.	This practice allows the seedlings to attain a height to suit the depth of water in the main field (usually practiced in a beel areas/depressions)	2	2.00 (M)
3.	Transplanting the left over seedlings very closely or in a cluster in one of the corners of the main field.	It supplies seedling for gape filling in an event of death of seedlings subsequent to the transplanting.	7	1.85 (M)
	Water management			
1.	In nursery bed watering is done manually with *lahoti* or *lahoni* made of bamboo/tin with a handle made of bamboo.	This equipment is suitable for irrigating small areas with manual labour from natural water sources such as ditches/ trench, *khals* etc. at one corner pf the field.	3	3.6 (H)
2.	Irrigation with bamboo pipes is practiced for irrigating the crops from tube wells by splitting the bamboo in two equal halves vertically and removing the nods which act as a pipe for carrying water.	Bamboo pipes so prepared reduce loss of irrigation water during transit and they are less costly as compared to purchased pipes. (e.g. Plastic pipes) and their availability is also high.	2	3.5 (M)

Table 1. Continued….

S. No.	Description of identified ITKs	Rational behind the use of ITKs	Farmers using ITK	Effectiveness score
		Interculture		
1.	Trampling between rows and/or hills of the rice plants	It facilitates aeration and suppression of weeds and thereby increases tillering.	3	2.3 (M)
2.	Broadcasting of rice grains over the standing crop of *Boro* rice and then pulverizing the soil by opening up of ducks in the rice field.	While eating the rice grains, ducks pulverize the soil with their beaks and thereby loosen the soil facilitating more aeration.	1	2.0 (M)
		Plant protection		
1.	Bamboo sticks and highly branched top of *banh* (*Bambusa indica:* Bamboo) are erected in the nursery as well as in the main field.	Birds perch on the branches and sticks and act as predators of insects present in the crop (stem borer and leaf hopper).	13	2.15 (M)
2.	Two ends of long rope, dipped in kerosene oil, is held by two men and blown over the rice crop and available standing water is drained out.	The smear of kerosene oil on the leaves makes the insects like hispa and caseworm to fall down from the crop on standing water and then drained out from the field.	3	3.33 (H)
3.	Chopped *Kola kachu* (*Colocasia esculenta,* Black colocasia) and fresh cow dung are distributed in water in the field.	An anaerobic or poisonous condition is developed in rice microclimate, which kills the caseworm (*Nymphula depunctalis*) floating on the water surface.	1	2.00 (M)
4.	Leaves of 'Bihlongini' (*Polygonum hydropiper*) or 'Bihdhekia' (*Sphaerostiphnos unitus*; wild fern) are incorporated into the soil of the growing crop.	Highly pungent leaves of wild fern act as repellant to the insects like stem borer.	7	1.42 (L)
5.	Throwing branches of posotia (*Vitex negunde*) on standing water.	The plant acts as repellent as it produces smell intolerable to the pests like hispa and caseworm and pests go away from the field.	3	1.33 (L)
6.	Sweeping over growing crop is done with branches of thorny plants viz. 'Bogori' (*Ziziphus* spp.)	Controls insects like hispa that feed on epidermis as they get injured and disturbed they fly away from the field.	3	1.33 (L)
7.	Peeled rinds of citrus (*Citrus* spp.) or lemon (Citrus lemon) are placed sporadically in the field after transplanting.	Attracts insects like stem borer which are killed in contact with the citrus rinds	4	1.50 (L)
8.	Bark of 'Sojina' (*Moringa oleifera*; Drumstick) is removed from the trunk and branches, crushed and spread in the crop field.	Checks the infestation of stem borer because drumstick has high pesticidal properties.	1	2.00 (M)
9.	Vines of 'Sonborial' or sida hemp (*Sida rhombifolia*) are cut into pieces and incorporated into the muddy paddy field.	Acts as repellant to insects like stem borer and rice hispa due to its bitter taste.	1	1.00 (L)
10.	Chopped tobacco (*Nicotiana* spp.) leaves as well as oter parts are soaked in water overnight and the tobacco mixed water so obtained is sprayed over the standing crop.	Since tobacco mixed water is alkaline/ poisonous in nature, this controls the attacks of hispa.	5	1.4 (L)
11.	Using raw cow dung approximately @ 3 q/ha on standing water in low land condition.	Raw cow dung disturbs the crabs in movement and produces unbearable odor to them.	2	3.00 (M)
12.	Broadcasting goat's excreta on the standing crop of paddy.	It controls hispa because pests fly away due to disagreeable odor of goat excreta.	2	1.00 (L)
13.	Spraying boiled neem leaves and grinded seed solution on the standing crop.	It acts as anti feedant to many pests like leaf folder, stem borer etc. due to its bitter taste. Further, the bad odor of the solution acts as repellant which drives away the pests from the field.	3	3.00 (M)
14.	'*Postia*' leaves are dried, grinded and dusted in the field.	Hispa flies away due to disagreeable odder of posotia dust.	2	1.50 (L)
15.	Spraying of solution on the standing crop or application of crashed rhizome of '*Keturi Haldhi*' or wild turmeric (*Curcum* spp.) in different places of the crop field.	It acts as a repellant against hispa and/or stem borer. It produces bad smell making the pests to fly away from the field.	5	1.20 (L)
16.	Spraying fresh cow dung solution (1 kg raw cow dung in 10-12 L of water).	Cow dung solution controls Bacterial Leave Blight(BLB) to some extent. Further the crop is protected from catthe as because the cattle do not like to graze on cow dung treated crop.	1	2.00 (M)
17.	Planting Banana trees in the centre of the nursery and the main field.	Predatory birds rest on the pseudo stem and leave and eat up many insects.	10	2.20 (M)
18.	Erecting the long and complex leaves of *Chi-tamol or Momai tamol (Caryota urens*) in the paddy field at different places.	Birds resting on the erected leaves acts as predators against many insects including rice hispa.	2	1.50 (L)
19.	Pouring of kerosene oil directly on standing water in *boro* paddy field.	Hispa flies away from the field due to intolerable odor of kerosene oil	2	1.50 (L)

Table 1. Continued….

S. No.	Description of identified ITKs	Rational behind the use of ITKs	Farmers using ITK	Effectiveness score
20.	Application of solution of neem leaves and grinded seeds mixing with soap and/or surf (detergent powder) and raw turmeric	The solution so prepared produces disagreeable odor and reduces the chances of diseases (fungal and bacterial) occurrence and thus acts as a precautionary measure.	2	2.50 (M)
21.	Dusting of wood ashes on the standing crop.	Ashes check the spreading of infection of brown spot disease.	3	1.33 (L)
22.	Crabs, frogs or toads are killed and hung from bamboo sticks erected in the crop fields in different places.	The pest especially Gandhi bug crowd over the dead crabs/frogs/toads instead of sucking soft grains and thus the crop is saved.	9	3.22 (H)
23.	Burning of tyres in and around the rice field.	It acts as a repellent to Gandhi bug due to disagreeable odor emitted on burning of tyres.	4	3.75 (H)
24.	Burning of firewood, straw etc in and around rice field at night.	It plays its role as attractant. Various pests, particularly Gandhi bug jump down on the fire and get destroyed.	6	3.50 (H)
25.	Beating the crop plants with 'Ekora' plants (*Sclerostachya susca*) (4-5 numbers in a bundle) treated with 'mantras' and putting them in the four corners of the rice field. The practice is locally termed as Gandhi bolowa'.	Attack of Gandhi bug is reduced because of 'mantras' and beating action.	2	1.50 (L)
26.	Chewing 2-3 numbers of Gandhi bugs followed by spitting over the rice plants.	Gandhi bug attack is reduced because bad odor produced after chewing and spitting of Gandhi bugs frightens the Gandhi bug themselves.	4	2.25 (M)
27.	Planting branches of '*Bhung'* (*Cannabis sativa)* in different places of the rice field.	The offensive odor of *bhung* acts as repellant against Gandhi bug.	1	1.00 (L)
28.	Hanging of damaged video and audio tapes over the nursery bed of rice just after broad casting of sprouted seeds and/or in the main field on maturity of crop.	Shining property of tapes drives away the birds and prevents the birds from feeding the grains.	3	3.33 (H)
29.	Keeping human status model (scare crow) made of thatch in the nursery as well as the main field.	It frightens birds and thus prevents the birds from eating up the grains in the nursery as well as the main field.	4	1.50 (L)
30.	Carcass of crow is tied to a long pole in the centre of the rice field.	Birds that may eat up the matured grains are frightened and driven away and thus the crop is saved from their attack.	5	2.20 (M)
31.	Beating empty tin or drum in the main field.	Due to sound produced, birds are frightened and driven away from the field and thereby matured grains are saved from being eaten up by birds.	9	3.44 (H)
32.	A piece of black or red cloth is tied to a long pole and placed in the centre of the field.	Black or red cloth frightens birds and their attack is reduced.	3	2.60 (M)
33.	Using bell in the field which is operated from a long distance with a long rope.	Birds demanding the matured grains are scared due to sound produced by bell.	2	2.50 (M)
	Post harvest practices			
1.	Keeping the stubbles of *Boro* rice undisturbed avoiding ploughing and grazing by the cattle for 1-11/2 months. The practices is known as '*Nami*" in local terms and usually practiced with respect to traditional varieties grown in low lying (beel) areas.	This practice allows the development of ratoon of *boro* rice which provides an additional income to the farmers with zero investment.	7	3.10 (H)
2.	Leaves of Narasingha (*Murraya koenigii;* curry leave tree) are placed on the heaps of rice grains in the storage.	Prevents storage insect pests from causing damage to the stored grains because curry leaves have high pesticidal properties	10	2.20 (M)
3.	Dried leaves of 'Mahaneem' (*Azadirachta indica)* or 'Ghoraneem (*Melia azadirachta)'* are kept with rice grains in granaries or other storage structures.	The disagreeable odor as well as insecticidal properties of the leaves keeps away most of the stored grain pest including weevil and grain moth.	10	2.20 (M)
4.	Storing grains in a locally made structure called '*Bhakeri*' or '*bhoral*' meaning granary. The structure is made of bamboo on wooden post or bolder of 2-3 ft. height. The inner side of the '*bhoral*' is plastered with mixture of fresh cow dung and mud. The length and breadth varies in accordance with the amount of seeds to be stored. A roof made thatch or tin save the structure from rain.	Grain stored in '*Bhoral'* is not easily damaged because of good aeration. Attack of rats is also less since they are placed above the ground level.	32	1.115 (L)

Table 1. Continued….

S. No.	Description of identified ITKs	Rational behind the use of ITKs	Farmers using ITK	Effectiveness score
5.	Storing grains in bamboo made structure called *'Ber'* plastered with fresh cow dung and mud. After storing the seeds the top of the '*Ber'* is covered or plastered with 1-2 inches cow dung and mud mixture. It is usually used to store medium amount of grains.	The structure protects most of pests to reach grain from outside.	18	1.80 (M)
6.	Keeping grains almost in round bamboo structure called '*Duli*' in local terms. The inner side of the structure is plastered with mixture of cow dung and mud. The grains are stored in the structure followed by covering the grains with a layer of paddy husk of 2-3 inches thickness.	The pests like weevil and grain moth get difficulty to enter and reach the grains due to plaster and layer of paddy husk and thereby grains are stored safely.	20	2.15 (M)
7.	Grains for seed purposes are stored in a structure called *'Topa'*. This is an oval shaped bamboo made structure, inner side lined with paddy straw. The seeds are kept inside the structure and the mouth is covered with straw and closed very tightly. Some time outer side is plastered with fresh cow dung.	Moisture as well as stored grain pest can enter the structure and thereby seeds are stored without damage with viability.	8	3.25 (H)
8.	Grains for seed purpose are stored in '*koloh'* or earthen pitcher with a lid made of earth	The stored grain pests cannot enter the structure, thereby protects the seeds. The earthen pot also saves the grains from outside moisture.	2	3.50 (H)

L=Low, M=Moderate, H= High.

Table 2. Frequency and percentage distribution of respondents according to extent of use (%) of ITKs.

Category	Range	Frequency and percentage			Total (N=120)
		Boko agricultural sub-division	Rangia agricultural sub-division	Guwahati agricultural sub-division	
No user	0%	13 (32.50)	7(17.50)	10 (25.00)	30(25.00)
Low user	>0-15%	21 (52.50)	24 (60.00)	24 (60.00)	69 (57.50)
Medium user	15-30 %	5 (12.50)	9(22.50)	4 (10.00)	18 (15.00)
High user	> 30%	1 (2.50)	0(0.00)	2 (5.00)	3 (2.50)
Total		40(100.00)	40(100.00)	40(100.00)	120(100.00)
Mean		5.69	6.60	7.76	6.68
SD		8.30	8.29	10.33	8.99

Figures in the parentheses indicate percentages.

Spreading of peeled rinds of citrus to control stem borer attack was practiced as peeled rinds citrus killed the insect when come into contact. Spreading of crashed bark of *sojina* or drum stick was used against stem borer due to its insecticidal property. The rationale behind the use of these ITKs was supported by Deb (1981), Vaidyaratnam (1995) and Vaidyaratnam (1996).

Effectiveness of identified ITKs: As to the effectiveness of the identified ITKs, out of 57 ITKs explored during the investigation, 11(19.30%) were found to be highly effective, 25(43.86%) were moderately effective and 21(36.84%) less effective.

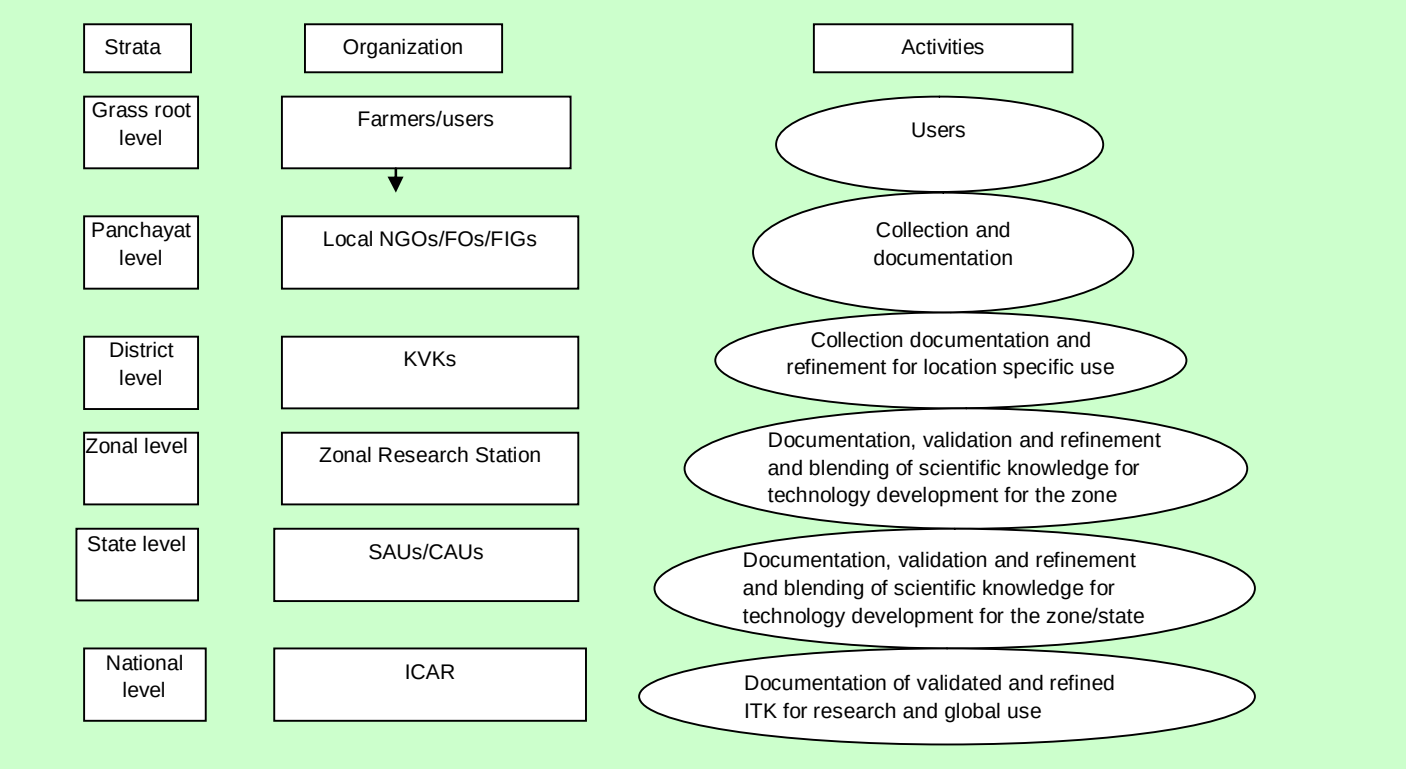
Extent of use of Indigenous Technical Knowledge (ITK): Table 2 reveals that the mean extent of use of ITK was 6.68% with standard deviation 8.99. Majority of the respondents (57.5%) were low user category while 'no user' category accounted 25% respondents.

A considerable portion (15%) of the respondents belonged to 'medium user' category. Only few portions of respondent (2.5%) could be included in the category of 'high user' of ITK. This finding has a compliance with that of Seetharam and Veluswamy (2001), who found that farmers had low awareness and adoption of ITKs. The low extent use of ITKs in the present study might be due to more inclination of the respondents towards modern scientific and high yielding technologies, low production obtained by using ITKs and scarcity or non availability of some plant species and other materials.

Conclusion

The documented ITKs serve as a ready reference for the agricultural scientists for further study to determine their scientific rationality and effectiveness (Fig. 1). This will also be helpful in technology blending programme to generate eco-friendly, location specific, economically viable and socially acceptable technology. Some locally available plants and plant parts were used by the farmers in traditional plant protection measures.

Fig. 1. Model- ITK documentation and validation.



This will lead to production of new bio-pesticides in near future. Since ITKs are organic in nature the documented ITKs may be useful for extension personnel in planning and executing various IPM and INM programmes through their judicious integration to these systems. Proper documentation, validation and refinement of ITKs at different stage will help mankind for easy access of ITKs or ITK based blended technology for their farming. In this context a model for strategic documentation, validation and refinement from grass root level to global level as suggested below may be considered.

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