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Exploratory study on ITK practices prevailing in Pudukkottai district, Tamil Nadu

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India, being a tropical country with fifteen agro ecological zones, is confronted with climate change influences through droughts, floods, cyclones, heat waves, hailstorms, and coastal salinity. The climate change remains a potential challenge to farm sustainability. It also evolved as an impending threat to socio-economic status of rural population. For sustainable farming and climate change resilience, Indigenous Technical Knowledge (ITK) could help growers in broad spectrum. The ITK system though derived out of informal experimentation, it has been developed by the community based on their experiences and incessant improvement over generations. Therefore, identifying and documenting of ITK practices is very much imperative. In this context, an exploratory research study was conducted to document the extent of awareness and community's perceived benefits of using ITK practices along with the prevailing ITK practices in Pudukkottai district of Tamil Nadu. It was revealed that majority of the respondents' of about 73% and 74% were aware of crop management practices and crop protection measures respectively. Only one third of the respondents (38%) were familiarised with indigenous poultry management practices. A vast majority of the respondents (75%) perceived considerable reduction in farm expenditures by following ITK practices.

Keywords: Climate change, Farm sustainability, Indigenous Technical Knowledge (ITK), Validation

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Over the decades, the climate change marked considerable productivity loss in the potential crop cultivation zones and economic losses among the rural community of developing countries. In India though the varieties evolved out of Green revolution, rendered quantitative yields, the cost of cultivation escalated over the years. From the past experience, it was evident that during the unexpected seasonal variations, traditional varieties and wild races fought back against climate resilience in various climatic zones of our country. The vital elements of affordability and pro eco technologies fasten the thirst for sustainable farming practices which enhances productivity as well as conservation of resources.

The indigenous knowledge practices in farming in climate change mitigation have been documented earlier in many parts of India. The local rural communities depend on ITK for their livelihood and to manage local ecosystem in a sustainable manner[1]. The communities are the real time respondents to any agro climate variations[2]. The traditional farming practices followed for generations helped farmers to tackle climate change as well as farm problems in a cost-effective way by using locally available resources. The storage needs of small farmers have always been fulfilled by indigenous structures crafted and designed by farmers with easily and cheaply available materials[3]. The pest and disease management of agricultural and horticultural crops were carried efficiently using locally available inputs[4]. Not only in agriculture, also in animal husbandry domain, various ethnoveterinary practices helped the cattle growers to cure the animal diseases using homemade medicines in cheaper costs. It was revealed that the farmers opined low cost as prime factor for selecting Indigenous Technical Knowledge (ITK) practices in animal husbandry[5]. As far as economic returns, the ITK practices involve lesser costs since they are available locally and the farmer need not source out the inputs externally. For instance, the traditional varieties may give relatively lesser yield as compare to the high yielding varieties, due to the climate resilience nature. But due to the lower input requirement and lower cultivation costs, it

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is highly remunerative to the farmers. The non - exploitative methods of traditional practices especially in the areas of pest management, nutrient management leads to conservation of natural resources and sustainability of farming in the long run. The ITK practices are to be considered for adoption based on the criteria of efficacy, intricacy, environment and cultural flawlessness. For validation, the experience of rural community and ITK practices should be documented first. With this background, an exploratory study was conducted to document and explore the prevailing ITK practices in and around Pudukkottai district of Tamil Nadu. Nevertheless to mention, the involvement of various institutions and farmers' involvement leads to protection of the traditional varieties and practices.

Methodology

Study area

Pudukkottai district lies between 78.25' and 79.15' of the Eastern Longitude and between 9.50' and 10.40' of the Northern Latitude. The administrative units of this district consist of 3 Revenue Divisions comprising with 12 taluks, 13 blocks and 763 villages, besides Village/Town Panchayats and Municipalities. Out of total geographical area of 4,66,329 ha., with a coast line of 39 Kms, about 29.4% of land is not available for cultivation. About 22% of the soil is reported to be suffering from salinity/alkalinity. The nature of the Pudukkottai district is purely agrarian with paddy, banana, sugarcane, groundnut and cashew nut as major crops. Since the livelihoods majority rely on Agriculture, every petite change in farming, results in dire consequences.

Methodology

Ex-post facto research design was used in the present study. Multistage stratified random sampling technique was implied and the survey was conducted in 3 blocks of Pudukkottai district *viz.,* Annavasal, Arimalam, Kunnandarkovil blocks during April-August 2019 by utilizing a semi-structured interview schedule with 120 respondents. Participatory Rural Appraisal (PRA) tools were conducted in pilot visits. Key informants belonging to all categories of farmers (small, medium and large categories) were interviewed. Direct interviews and Focussed Group discussion (FGD) were used for the study. During the data collection process mainly open-ended, semi-structured questionnaire, as well as free-flowing talk, personal interviews and focused group discussions methods were conducted to get precise information on varietal selection, traditional farming practices, traditional pest and disease management and ethno veterinary practices prevailing in their respective villages. During visits to their home, personal observation method was followed to confirm the indigenous farm practices. During the field survey, photographs and specimens of ITKs were documented. More than 10 visits were made to the study locations for interacting with the key informants. During the survey, triangulation exercise was also done to enhance the reliability of information gathered during data collection. Prior informed consent was obtained from all informants.

Results and Discussion

Indigenous Technical Knowledge (ITK) practices

It was evident from the study that, still farmers in few pockets of Pudukkottai district, are following traditional knowledge practices for rainfall forecasting, agricultural implements, soil fertility management, sowing, weeding, inter cropping, harvesting, winnowing, grain storage structures, safe storage of grains using traditional pest repellent measures. The resource poor farmers could cope up climate change and free from clutches of poor yields, frequent pest and disease occurrence and poor returns by using ITKs and traditional crop varieties. Thus ITKs are still playing a key role in promoting the low-input agriculture and sustainable farming. At the same time, due to lack of interest by the younger generation, the traditional knowledge practices are diminishing with time. The ITKs possessed by them is of immense importance and must be documented and conserved for future use unless it gets lost or endangered with time 6.

Changes in farming situation as perceived by farmers

The crop yield not only affects the producers but also the food basket of developing countries including India[7]. The present study revealed that the changes in farming situation are apparent and even perceived by the farmers over a period of time. From the results of the Table 1, it is inferred that nearly three-fourth

Table 1 — Changes in farming situation as perceived by farmers (n = 120)

Sl. No.	Farm situations	User respondents	
		Garrett's Score	Rank
1.	Erratic yield	73.02	I
2.	Unpredictable weather	64.15	II
3.	Severity of pest & diseases	58.10	III
4.	Change in cropping pattern	57.32	IV
5.	Monkey and birds menace	44.17	V
6.	Fodder demand	36.04	VI
7.	Demand for labour	14.20	VII

(73.02%) of the respondents ranked erratic yield in primary place. The profitability out of farming could be realized only through sustainable crop yields. Globally, crop yields are unpredictable in nature due to various factors like climate change, market forces, escalating input costs and demand for labour. The investment in the farming is from the earlier savings if any, credit facility from input dealers as well as petty loans from banks and money lenders. Even a single crop failure would lead to severe indebtedness and vicious cycle of poverty. This might be the reason for ranking erratic yield as the prime spot.

The unpredictable weather practices and severity of pest & diseases information were observed two-third (64.15%) and less than two-third (58.10%) of the respondents. A little more than half of the respondents (57.32%) perceived change in cropping pattern. The monkey and birds menace was experienced by more than two-fifth (44.17%) of the respondents. Little more than one-third (36.04%) of the respondents ranked fodder demand in the sixth rank where as only 14.20% of the respondents ranked demand for labour.

Crop husbandry ITK practices

The Pudukkottai district receives an average rainfall of 821 mm per annum. Anyhow the delayed-on set of monsoon and early with drawl of seasonal showers leads to frequent crop failures and shift to allied agro ventures.

Traditional paddy varieties

The indigenous paddy varieties are being resistant to various climatic changes like flood and drought. The communities are utilizing the climate resilient cultivars as a part of adaptation strategies. The traditional paddy varieties cultivated *viz.*, *Karudan Samba*, *Thooyamalli*, *Milagi*, *Poongar*, *Kitchdi Samba*, and *Illuppaipoo Samba* in Pudukkottai district was documented during the study (Fig. 1). These indigenous rice varieties performed well during the time of seasonal variations of temperature and precipitation. These indigenous varieties under cultivation have medicinal properties aromatic flavours also.

Local vegetable varieties

Many local varieties of vegetables such as gourds, tomato and brinjal are cultivating in and around Pudukkottai district. The varieties are not only tastier but also ruling the local market fetching remunerative price for the farmers. Some of the brinjal local varieties are *Sellukudi*, *Aalavayal*, *Thirukkattalai* and *Kudumiyanmalai* are even sent to nearby wholesale markets at Trichy and Madurai (Fig. 2).

For sustainable returns farmers are practicing indigenous farm practices as follows

1. The crop stubbles (remaining after harvest) are burned in the field for controlling pests.
2. The neem leaves and seeds are crushed and mixed with fertilizers for avoidance of pests.
3. Dry lands deep ploughing are practiced in summer for breaking hard pan in soil, and for improving water holding capacity (WHC) as well as for pest control.
4. Neem leaves and *Notchi* and *Pungam* leaves are kept along with grains to prevent storage pests in paddy and pulses.
5. The filtered extract of well crushed cloves of Garlic, Ginger and chillies are used in pest repellent in Horticultural crops and pod borer in Pigeon pea.
6. For Jaggery Sugarcane crop, during the 3rd month, broadcasting of ground nut cake 60 kgs per acre would results in enhancement of yellow colour for the Jaggery.
7. Goat excreta are applied and goat urine is sprayed to prevent fungal diseases.

Fig. 1 — Traditional Paddy varieties

Storage of grains

By the hearsay information on these botanicals from generation to generations such as insect repellence, ovipositional prevention, fumigant or contact aberration etc., the farmers are curious to use the products. At the same time, many resources-poor farmers use the naturally available products and botanicals due to the low cost or freely available nature. The usage of natural products/botanicals grains could be stored up to a year. At times, famers place the leaves of the plants believed to possess insecticidal properties as layers in between the gunny bags arranged one above other in the store room.

Storage pest management with natural products/botanicals

The wood ashes or dried leaves of plant species such as *Pongamia pinnata* (L.) *Pierre, Vitex negundo* (L.), and *Melia dubia* are mixed with the seeds to control food grain pests. The redgram (*Cajanus cajan* (L.)) seeds are mixed with red sand prohibits stored pest attack, because of abrasive action.

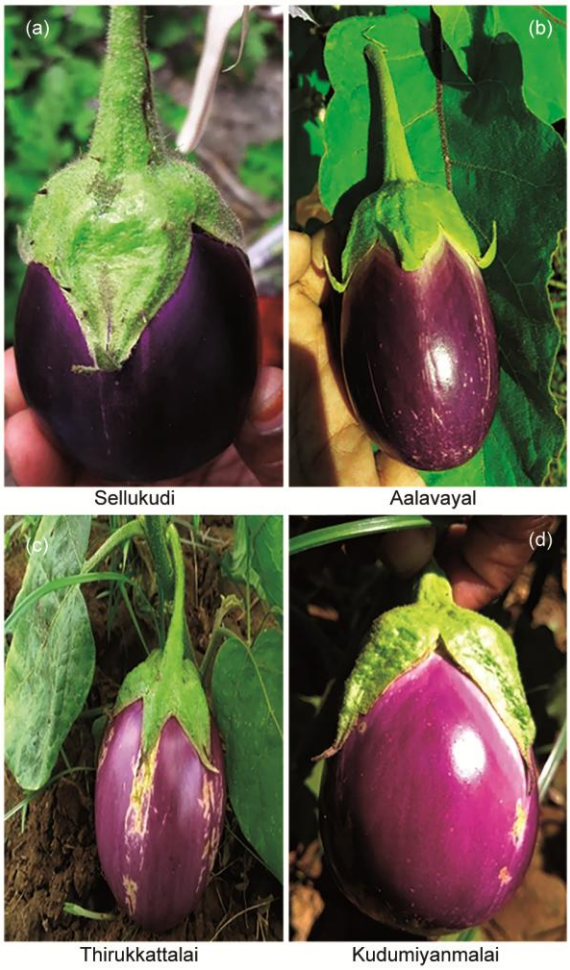

Fig. 2 — Brinjal Local varieties

Seeds stored with table salt

It is a common practise that for brief storage of *Cajanus cajan* and *Phaseolus vulgaris* for 6-8 months. About 200 g of table salt is thoroughly mixed seeds and sealed in jute bags.

Storage with cow dung

The vegetable seeds such as okra and cluster bean meant for next season sowing are sun dried along with the pods. After properly dried, the seeds are stored in gunny bags. In some areas, fresh cow dung is used for embedding the seeds while sun drying. The immunostimulant properties of cow dung reduces incidence of rice moth pest and seeds can be stored for up to a year.

Grain storage structures

The indigenous grain storage structures provide excellent moist proof environment to the stored grains thereby avoiding the occurrence of pests and diseases and these structures also prevent the damage by rats, rodents, etc. For generations, farmers were using neem and neem based products for storage of grains there by curtailing post-harvest losses due to storage pests. These traditional grain storage structures are made up of wood and red clay and in various sizes based on the requirement. The storage structures are very durable and once constructed farmers use it for storage purpose for more than 50 years[8]. Not only grains, seeds which are also input for the next season are stored in the storage bins. The vegetable seeds are mixed with wood ash to prevent the storage pests[9]. The people of Pudukkottai still use various kinds of traditional grain storage methods, without using any chemicals for storage of grains. The farmers from Annavasal, Arimalam, Kunradarkovil, are using different methods of grain storage after harvesting. The farmers are drying the seeds in hot sun and dry the moisture content and stores properly. Some mixes the seeds with red soil and some grains are salted before kept for storage. After drying, the seeds and grains are mixed with dried leaf powder extracts of neem leaf (*Azadirachta indica*), turmeric (*Curcuma longa*) and *Notchi* leaves (*Vitex negundo*). The neem and *Notchi* contains various alkaloids which have unique odour as well as insecticidal properties that keeps away most of the stored grain pests including weevil and grain moths. Finally the grains are stored in the grain storage structures such as *Pathayam* and *Mankuthir* made up of wood and red soil, respectively. The durability of wooden storage extends up to 10 to 15 years where the mud structures

if properly covered with bamboo thatched roofs and placed protectively extends up to 3 to 5 years.

Pathayam

Pathayam is a four-sided box or bin built of wood, which has a wooden lid, built inside the house, often utilizing one or more of the existing walls (Fig. 3). A small outlet is made on the lid to take out the grains. The capacity is variable and can store about 300 to 400 kg seed or grain. These are commonly used for storing rice, but they are used to store other grains as well. These structures are used for long term method of storage. It is one of the preferred methods of storage in Pudukkottai because of few advantages. The humid weather is not suitable for post–harvest storage and the *Pathayam* prevents the moisture flux into the seeds or grain from the surrounding air. It protects the seeds by maintaining moisture level. The lid, additionally, checks the invasion of rodents and insects to the storage.

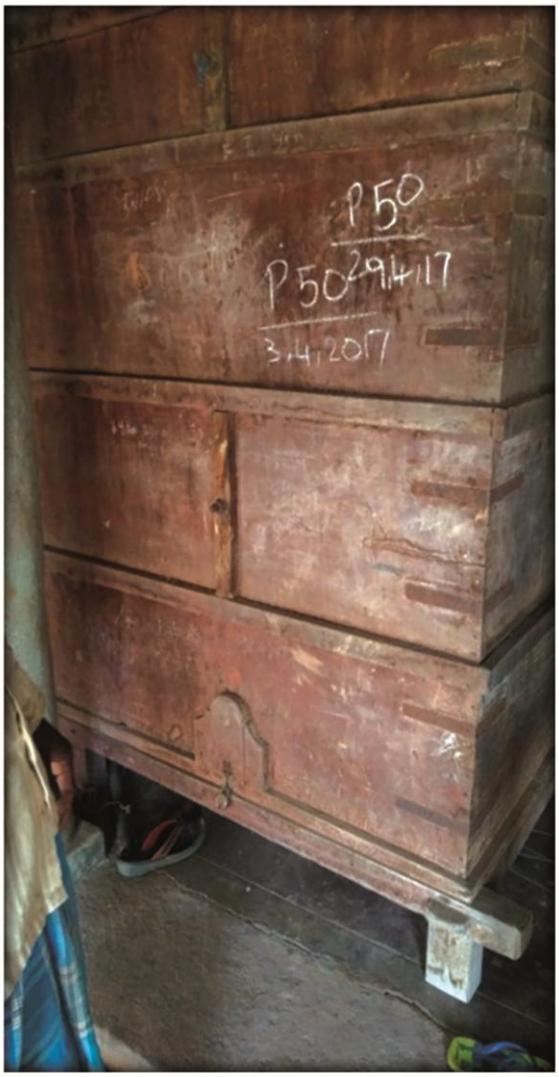

Fig. 3 — Pathayam

Kuthir and Mankuthir

Kuthir is a grain storage stricture made up of wood where as *Mankuthir* is a small conical or cylindrical shaped structure made red soil mud or clay (Fig. 4 a,b). The container ensures that grains remain airtight inside it. The *mankuthir* structure requires plastering with cow dung lining. These structures are used for storing threshed food grains such as cowpea, maize sorghum, paddy, black gram and millets. The grains stored in these structures are mostly used for planting. The majority of the farmers used earthen bins because of their low cost and easy construction through locally available materials followed by low-temperature variation that keeps the grains cool, easy to fill and discharge of grain and can be airtight to control insect. The storage structures *Kuthir* and *Mankuthir* are commonly found and used in every rural household of Pudukkottai. It has the capacity of holding about 10 to15 kg of grains and seeds.

Extent of awareness on Indigenous Technical Knowledge practices

The extent of awareness on Indigenous Technical Knowledge practices is an important and decides the extent of utilization of ITK practices to store and manage the agricultural produce for longer period (Table 2).

From the results of the Table 2, it is inferred that showed that out of the total respondents, the majority

Fig. 4 — a. Kuthir b. Mankuthir

Table 2 — Extent of Awareness on Indigenous Technical Knowledge practices (n=120)

Sl. No	Indigenous Technical Knowledge	Awareness level	
		Awareness Frequency	Awareness %
I	**Crop management practices**		
1.	Puddling of *Aeschynomene indica* L. and *Crotalaria juncea* L @flowering stage for soil fertility	85	71
2.	Panchagavya for seed treatment and yield boost	88	73
II	**Pest management practices**		
1.	Ginger, Garlic and Green chillies extracts for sucking pests	89	74
2.	*Acorus calamus* powder and *Azadirachta indica* leaves for storage pests	84	70
3.	Application of wood ash for fungal diseases in plants	76	63
III	**ITK Storage practices**		
1.	Mud and Wooden Storage structures for storing grains	78	65
2.	Neem oil coated pulses for seasonal storage	72	60
IV	**Animal husbandry ITK practices**		
1.	Aloe vera for deworming in poultry breeds	45	38
2.	Neem leaves with Jaggery to arrest blood while milking dairy animals	67	56

Table 3 — Extent of utilization of Post-Harvest ITK practices (n=120)

Sl. No	Post-harvest Indigenous Technical Knowledge	Frequency of usage			Mean score	Practise wise ranking
		ML (3)	LU (2)	UL (1)		
1.	Gunny bags are used for storage purpose	30	66	24	2.05	II
2.	Dried Neem & Notchi leaves are used for grain storage	90	24	6	2.70	I
3.	Mixing of red sand with red gram for long-time storage	12	36	72	1.50	V
4.	Mud /Wood Storage structures for storing grains	6	48	66	1.65	IV
5.	Neem Oil coating on Pulses	6	36	78	1.40	VI
6.	Vegetable seeds dried with pods	18	60	42	1.80	III

proportion of the respondents' of about 73% and 71% were aware of crop management practices such as land preparation and seed treatment respectively. The pest and disease management ITK practices were also known by majority of the respondents (74%). The post-harvest / storage ITK practices were felt aware by 65 and 60% of the respondents. The reason for non-awareness might be frequent selling decisions at farm gate and non-availability and deterioration of storage structures in the recent past. As for as animal husbandry practices are concerned, only one third (38%) and half of the respondents (56%) were aware about the techniques. The availability of village level animal husbandry hospitals and timely availability of veterinary doctors might be reasons for less awareness and usage of ITK animal husbandry practices.

Extent of utilization of Post-harvest ITK practices

The post-harvest and storage techniques decide the availability of seeds for next season and better remuneration for the farmers by selling quality grains. From the results of the Table 3 and Fig. 5, it is inferred that the respondents ranked using of Neem and *Notchi* leaves in first place. Thus the extent of utilization of post-harvest ITK technologies was primarily decided by the availability of inputs or products. Traditionally, majority of the farmers are using the low cost storage materials and structures. This might be the reason for ranking gunny bags usage as the second spot. The vegetable seeds storage and traditional storage structure usage were practiced by the respondents and thereby assigned with III and IV ranks, respectively. The practice of mixing of red sand with red gram for long-time storage was assigned with V rank and neem oil coating on pulses with VI rank, respectively. The reason of quick selling decision of pulses and less crop acreage might be reasons.

Animal husbandry ITK practices prevailing in the study area

Dairy and cattle are indispensable part of farmers. Many farmers choose dairy and goat rearing for livelihoods during the crop failures. Many landless farmers and Agri pruners resort to poultry and dairy as a good source of additional income generation and year around employment. In the recent past, there were empirical evidences of positive impact of ITKs in the crop and animal husbandry domains. The use of

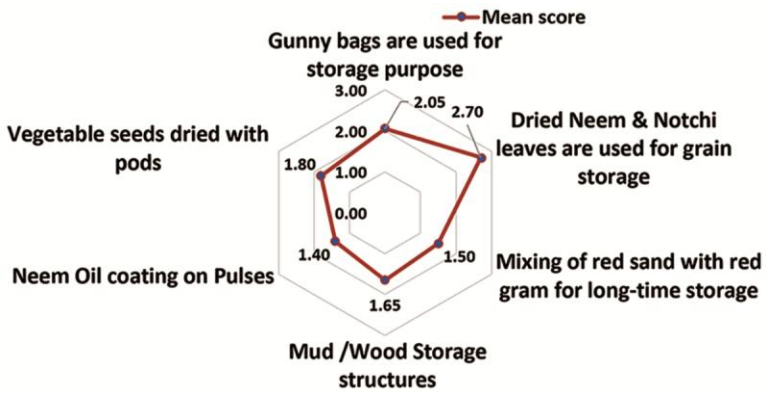

Fig. 5 — Extent of utilization of Post-Harvest ITK practices (n=120)

Fig. 6 — Animal penning sheds

garlic and other ethno vertinary practices are need to be documented and popularised[10]. Many animal husbandry ITK practices are followed among cattle growers in Pudukkottai. The ingredients needed were available in home or which incur lesser costs. Some of the practices are listed below:

1. For treating animals suffering from gastric trouble, asaphoetida powder dissolved in edible oil is in practice.
2. For all udder disease in dairy animals, grind *Aloe vera* 250 g, turmeric 50 g, calcium or lime 15 g as a paste and from that a handful of paste was mixed with 100 mL water and spread on the udder. This may be continued for 10 times a day for a period of 5 days.
3. Lemon fruits per day for a period of 3 days also help in early curing of the udder disease in dairy animals.
4. While noticing blood along with the milk when milking, feeding 2 handful of neem leaves with jaggery 100 g could arrest the problem.
5. For deworming in poultry breeds, 250 g of *Aloe vera* mixed with 2 litres of water during 45th or 90th day is done.
6. For curing viral disease in poultry, paste of neem and *Virali* turmeric (*Curcuma longa*) 1-4 drops as oral suspension.

Table 4 — Users' perceived benefits on using ITK technologies (n=120)

Sl. No.	Perceived benefits	Agree		Disagree	
		No.	%	No.	%
1.	Able to reduce farm expenditures	90	75	30	25
2.	Increase of traditional knowledge level	76	63	44	37
3.	Farm profitability could be achieved	84	70	36	30
4.	Locally available products could be utilised	103	86	17	14
5.	Enhancement of social esteem	82	68	38	32

For animal penning and stay sheds

The spiny shrubs and small trees such as *Zizyphus* species were used for construction circular shaped animal sheds. The goats and sheep were used to tie inside the penning sheds made up of bamboo and spiny shrubs (Fig. 6).

Users perceived benefits out of ITK practices

It is known from the Table 4 (Fig. 7) that among the respondents 75% felt that reduction in farm expenditures is possible by using ITK technologies whereas 25% denying the same. In the context of traditional knowledge increase, 63% of the users perceived the enhanced ITK knowledge followed by 37% perceived not so. The majority of the respondents (70%) reported that farm profitability could be achieved by using ITK practices. A vast majority of the respondents (86%) perceived that locally available products could be utilized. The social esteem was felt increased by 68% of the respondents. In reality, the crop seasonality, input availability and market forces might play in price realization and this might be reason for respondents to perceive profitability in lower scale.

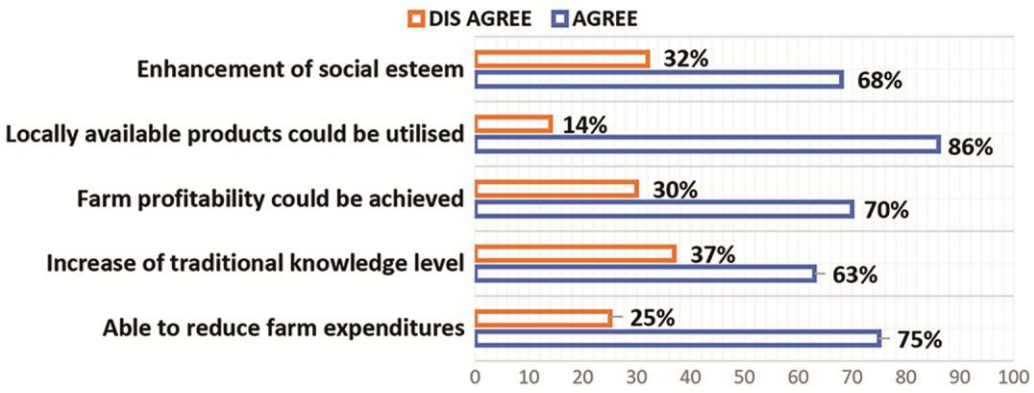

Fig. 7 — Users' perceived benefits on using ITK technologies (n=120)

Conclusion

The present study documented the significant traditional paddy and vegetable varieties, widely used storage structures, animal husbandry practices and farm practices among farmers in Pudukkottai district of Tamil Nadu. Storage of grains without pests is important and indigenous practices incur no cost and locally available. Considering the diversity of ecological, socio-economic, historical and political contexts in which agricultural systems functioning in past and present-day, it is prudent to define a set of flexible and locally adaptable principles and boundaries of sustainability and resiliency for the agro ecosystems of the immediate future[11].

The ITKs are environment-friendly and site specific and cost effective in nature. Over the years, documenting the traditional farm practices are gaining momentum due to pro community and pro environment nature[12]. Though the local community were reported to have rich traditional knowledge, the traditional knowledge practices are vulnerable due to the lack of interest by the younger generation[13]. The knowledges which are transferred from generations to generations should be documented so as to consolidate this experience into a system[14]. The traditional practice of seed storage like salting enables farmers to store seeds for the upcoming seasons[15]. This practice enables farmers not to depend upon others for seeds as well as to attain seed sovergenity. The traditional storage structures are utilized for storing food grains for longer duration[16]. The storage structures also helps farmers to make selling decisions during fluctuating prices. The ITKs practices are able to reduce the input usage and costs thereby curtailing the chemical entry in food chain and enhanced farm returns. In the recent past, IKS have been eroded due to many social, economical and environmental driving forces[17]. The negligence in promoting indigenous knowledge would lead to accelerating the triple planetary crisis *i.e.*, climate, nature, and pollution as well as loss of biodiversity. This in turn led to an unsustainable world[18]. There exists extensive requirement for understanding the scope of traditional knowledge in India. Preserving, protecting and harnessing the traditional knowledge systems is timey needed in the areas of agriculture and medicine[19]. The institutional interventions and policy support are highly needed to promote indigenous knowledge systems[20]. The collaborative research between farm scientists and stakeholders of traditional knowledge systems could lead to documentation, preservation as well as blending of traditional knowledge with the modern farming practices to enhance ecologically, and economically sustainable farming. The scientific validation of the traditional technologies and refinement with modern scientific technologies could resolve the major challenges of sustainable farming in future.

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Conflict of Interest

We hereby declare that we have no conflict of interest.

Authors' Contributions

NA: Carried out data collection, photography and prepared manuscript, Both KCS and SN Perceived concepts, review, edits and prepared draft paper of the study: Both NA and KCS prepared final manuscript.

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