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Climate Change Related Plant Protection ITKs and their Scientific Rationality

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ABSTRACT

The study focuses on documentation and scientific rationality of Indigenous Traditional Knowledge (ITK) on plant protection which are local knowledge related to farming under climate change condition. The Indigenous Technical Knowledge is necessary for preservation, development and sustainability of local wisdom. The study is based on both secondary and primary sources. A lot of ITKs were collected from various sources including from the farmers. Sample farmers are belongs to area of Zone-1 (Krishna Godavari) and Zone-6 (Scarce Rainfall) of Andhra Pradesh. A total 40 ITKs were filtered to analyse the scientific rationality. An interview schedule was prepared to assess 40 ITKs scientific rationality and was introduced to 30 plant protection experts. Experts were asked to rate ITKs based on the extent at which they perceive ITKs as scientifically rational. The rating was based on their knowledge and academic experience in the field. Based on their ratings ITKs were categorised into three groups using mean and standard deviation. From the results 5 ITKs were highly rationalise, 15 ITKs are moderately rational and 20 are less rational ITKs. Being low in cost to adopt in filed it will also benefit farmers economic condition and sustainable agricultural development.

Keywords: *Climate change, Plant protection, ITKs and Scientific Rationality.*

After the starting of green revolution in India farmers are shown more interest and started to move towards modernization but heavy usage of chemicals and mechanization in agriculture and also rapid development of industrialization in India and as well in the world over these years causes to make many environmental changes around the globe and shown a very huge impact on global food production. i.e., Heavy rainfalls, predominant droughts, declining of soil health, genetic modification of pests, evolution of new viral and bacterial diseases, declining of milk production and its quality and so many. Impact of climate change on Indian agriculture was studied under National Innovations in Climate Resilient Agriculture (NICRA) it states that rainfed rice yields in India are projected to reduce marginally (<2.5%) in 2050 and 2080 and irrigated rice yields by 7% in 2050 and 10% in 2080 scenarios (Rama *et al*., 2019) and also climate change is likely to modify the balance among insect pests, their natural enemies and their hosts. Climate change additionally affects the ecology and biology of insect pest. Increased temperature reasons migration of insect species towards higher latitudes, while there has been a common decline inside the severity of major crop pests, the occurrence of numerous different secondary insect pests has proven a growing trend. The viable consequences of converting climate on insects ought to result in their outbreaks, migration, change in biodiversity, species extinction, alternate in host shift, and emergence of latest pests or biotypes (Kumar and Singh, 2016). So, to rebuilt our earth and to gain healthy increase of

our global food production we have to adopt our old and golden techniques in agriculture and its allied sectors. So, we focused on indigenous technical knowledge (ITKs) to select which was scientifically accepted and suitable to farmers for specified location and crops.

Farmers all over the global have a wealth of information in their very own surroundings and have evolved appropriate indigenous farming systems and practices. The price of these indigenous information structures in facilitating sustainable development turned into now being broadly identified. The indigenous know-how is to be introduced in to attention and popularized, systematic studies are important. Traditional technologies are a lot in tune with the cultural ethos and environmental situations of the country. For a developing country like India with an extremely good report of technology and era, traditional technology truly worth up gradation and modernization and they are able to in reality meet big portion of the demands in agriculture. Interest in Indigenous Technical Knowledge (ITK) has been fuelled by way of the current global wide ecological crisis and the belief that it is reasons lie partially in the over exploitation of natural assets primarily based on beside the point attitudes and technologies. Scientists now recognize that farmers who are following ITKs have controlled the environments in which they have got lived for generations, regularly without drastically unfavourable local ecologies. Hence, for the locations like India, the opportunity for the contemporary technologies are indigenous strategies. Also the capital and technological talent requirements inside the use of indigenous strategies are generally low and their adoption regularly calls for little restructure of the conventional societies. Indigenous techniques are nothing but indigenous expertise or ITK. By adopting such indigenous knowledge our ancestors did not face any hassle of huge scale pest out ruin or financial crisis not like the contemporary farmer.

Integration of those indigenous technical information and techniques with our formal variation strategies become overlooked for a long time. As a consequence, till these days' farmers are the most prone phase to climate change. Now it is time to understand ITKs wisdom, to take the benefit of already available information and combine that expertise with our formal simple research. In this context, the present study geared toward documenting and calculating scientific rationality of various indigenous practices of crop protection on the subject of climate change.

MATERIAL AND METHODS

The present study was taken in Krishna Godavari zone and Scarce rainfall zone of Andhra Pradesh. These zones comprise an area of food grain crops of 2.88 Mha in 2019-20 (Anonymous, 2020). The annual precipitation of these two zones is 907 mm in 2019-20. Major crops grown in these zones are paddy, groundnut, jowar, bajra, tobacco, cotton, chillies, korra, millets, pulses and horticultural crops are the important crops grown. Indigenous methods of crop production followed by farmers, called as Indigenous Technical Knowledge (ITK) were collected from different sources. Guntur, Prakasam, Kurnool and Anantapur districts was selected for collecting ITKs. Two villages form each district namely, Athota, Pasumarru, Bodanampadu, Reddinagar, Gajuladinne, Kandanathi, Neelareddipalli and Peddamatlagondi respectively were selected. Primary data on indigenous traditional knowledge of the farmers on crop production and secondary data was collected research articles, books and magazines were collected using checklist guided focus group discussions. In each village 40 farmers were selected for data collection. Finally, sample size was 320

farmers for the study. A list of indigenous methods was prepared and interview schedule was prepared to assess their scientific rationality and was introduced to 30 agronomy experts. Experts were asked to rate ITKs based on the extent at which they perceive ITKs as scientifically rational. This rating was based on their knowledge and academic experience in the field. Based on their ratings ITKs were categorised into three groups as highly scientific, moderately scientific and less scientific by using group mean and standard deviation. ITK falling under each category was listed and presented in tabular form. The data was compiled and subjected to descriptive statistics to draw meaningful inferences. To know whether responses obtained from sample group are in agreement with the population, one-sample chi square test was calculated using SPSS version 23. Null hypothesis of ITKs having Chi-square value with Pe" 0.5 are accepted.

RESULTS AND DISCUSSION

Climate change situations of drought, untimely rainfall and flood related ITKs were documented. Pest control, time of sowing, seed treatment, post-harvest management, different cropping systems, inter cropping and cropping sequence related ITKs are taken for the scientific rationale test. It could be observed from the above Table 1 that out of 40 ITKs in general 5 ITKs (12.50%) were judged highly rational by the scientists and 15 ITKs (37.50%) were judged as moderately rational and 20 ITKs (50.00%) are judged as least rational. The categorisation of ITKs with mean score presented in fig 1.

Highly rational ITKs are PP29, PP31, PP32, PP33 and PP34. ITK 29 explains to control birds, farmers are beat the drums in the field to create big sounds to scare the birds in the field (Marsh *et al*., 1991). ITK 31 refers fencing the G.I. wire in the field to restrict the wild boar to enter into the field, a study by Lakshmi *et al.* (2017), revealed that GI wire was found to cost effective and better in minimizing crop damage by wild boar. ITK 32 is sarees with bright colour will be tied on the field bunds to scare the wild boar. ITK 33 was to reduce the rat damage, Coir was burned to generate smoke and placed at rat holes in the fields to make the rats or run way from the

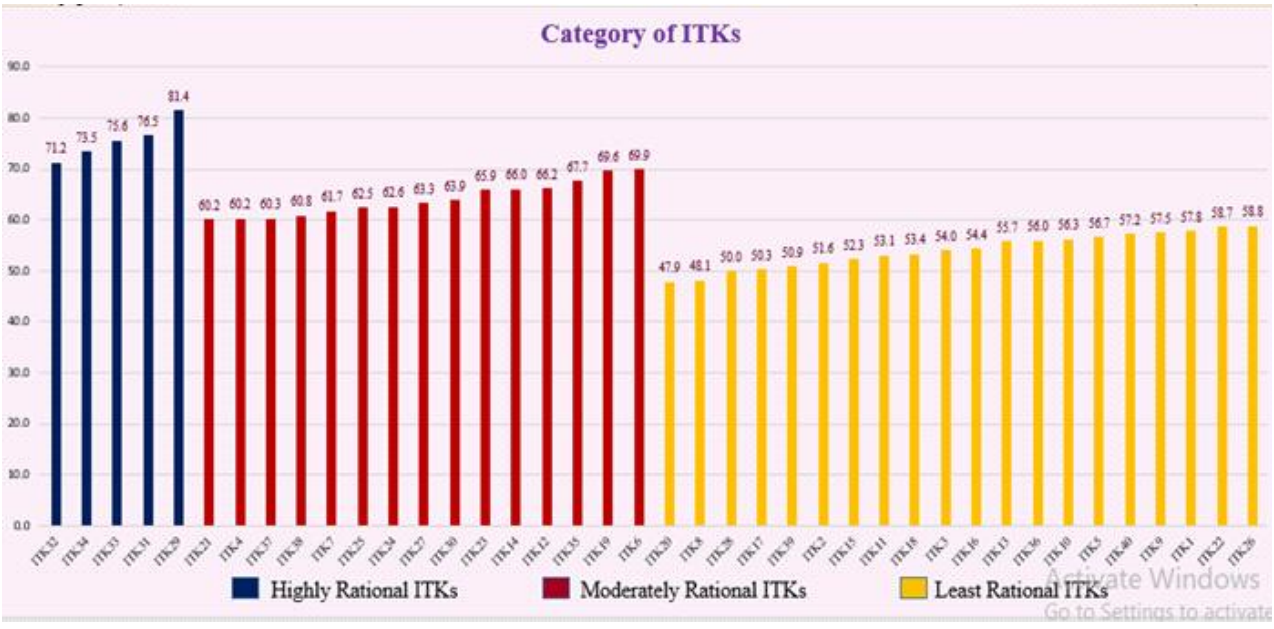

Fig 1. categorisation of ITKs

Table 1. Scientific rationality of Crop Protection ITKs

ITKs		Mean score	Chi Square value	df
Highly rational ITKs				
PP29	To control birds, farmers beat the drums in the field, as a result the birds will get scared and run away from the fields of paddy, pulse and ground nut.	81.4	23.53*	10
PP31	G.I. Wire is put as border fence on field bunds to restrict the wild boar to enter into the field and to avoid wild boar damage to the crops.	76.5	11.8	10
PP32	Sarees with bright colour will be tide on the field bunds to scare the wild boar & restrict their entry in the field and avoid damage to the crops.	71.2	14.73	10
PP33	To reduce the rat damage, Coir was burned to generate smoke and placed at rat holes in the fields to make the rats or run way from the fields.	75.6	31.00*	14
PP34	The seeds of pulses especially green gram and black gram are mixed along with wood ash and neem leaves for the purpose of storage loss due to stored grain pests and diseases.	73.5	11.8	10
Moderately rational ITKs				
PP4	Farmers prepare ash from leaves and small twigs of neem and incorporate it in Parathion (a chemical pesticide) powder. The mixture is dusted on infestation of aphids to minimize infestation in cotton	60.2	12.46	12
PP6	Sowing cowpea as an intercrop in sorghum (4:1) to minimize stem borer attack due to its repellent smell .	69.9	13	14
PP7	Dusting ash on the infected leaves of sorghum to prevent the pest incidence .	61.7	6	14
PP12	Cow urine, neem oil and tobacco decoction are mixed and 'sprayed to control all sucking pest .	66.2	13	14
PP14	A mixture of fish meal and Jaggery at 2:1 ratio is broadcasted on cotton fields to attract cranes and bulbuls, which feed on tobacco cut worms (Also for groundnut) .	66	18.00*	15
PP19	Long whistling by mouth is done to ward off birds in ground nut .	69.6	6.8	11
PP21	Growing of tantepu chettu (Cassia tora) around the plants. It acts as a trap crop nematodes in Banana .	60.2	8	14
PP23	Milled chickpea, green gram and other pulses are stored after thoroughly treated with mustard oil to prevent storage pest damage .	65.9	11.06	13

PP24	Putting salt crystals in the bored holes of The pseudo stem, after cleaning the Banana plant, so as to control Pseudo stem weevil. After that the Boreholes may be closed with clay. In the initial stages, grubs are confined to outer leaf Sheath. Salt may kill the grubs by exosmosis. Furthermore, it deters the weevil from entering and Laying eggs in the pseudo stem .	62.6	17	14
PP25	Seed mixed with Acorus calamus powder in the ratio of 10 kg: 1 kg, would help in preserving the seed free from stored pests for long time .	62.5	5.2	15
PP27	spraying a mixture (Panchagavya)prepared by mixing 5 parts milk, 2 parts curd, Â½ part ghee, 2 parts cow urine, Â½ part cow dung and 10 parts water to control fungal diseases in cotton. The mixture is kept for 7 days before it is sprayed in field where fungal disease is predominant. Spray of the mixture also controls leaf shedding and enhances flower setting .	63.3	18.00*	14
PP30	The farmers used to keep Disti bomma in the fields to scare the birds and protect crops from birds attack.	63.9	7.4	16
PP35	Fruits are covered with Palmyra leaves Fruit covers to prevent the birds attack and avoid damage to fruits in orchards.	67.7	9.46	15
PP37	For protecting the vegetable seed nurseries from ants, finely grinded ash powder will be put as a band and it will act as a repellent for the ants, those coming to eat away the sown seeds.	60.3	17	14
PP38	To prevent leaf folder attack in paddy and ragi, sand is sprayed on the leaves that are wet with fog, so that sand sticks to the leaves. This sand prevents the larva from attacking the crop and feeding on the leaves. The sand also abbreviates the skin of the larvae and causes desiccation and death of the larva.	60.8	25.46*	15
Least rational ITKs				
PP1	Soaking the sorghum seeds in cow urine for half-an-hour and sun drying them before sowing to control smut disease and to induce drought tolerance in Sorghum crop .	57.8	15.73	13
PP2	Burning cow dung cakes to reduce the infestation of aphids in sorghum crop .	51.6	37.00*	14
PP3	Leaves of Calotropis plant are immersed in water channel during irrigation to minimize aphid infestation in cotton .	54	16.8	12

PP5	To control leaf curl and to encourage good growth in chillies the leaves of neem, oleander, nochi (Vitex egundo), nuna (Moruuiatinctoria), thulasi (Ocimum canum), humbai (Leucas asapera)and Calotropis gigantea are pounded, soaked in cow urine for a day after which it is filtered, diluted for 10 times and sprayed .	56.7	10.13	13
PP8	Putting fresh cow dung on both the fields and bunds to reduce rat problem in paddy field .	48.1	15.93	12
PP9	Putting the pods of dried chillies in the red gram containers to control bruchids (beetle) attack .	57.5	14.4	17
PP10	Applying of fresh cow dung near the collar region of chilli plant to control fungal disease, viz. damping off and dieback .	56.3	10.53	15
PP11	Sprinkling of lime powder to control mealy bugs .	53.1	16.8	17
PP13	Foliar application of wood ashes in the noon hours of the day keeps away aphids, pod borers and diseases from plant .	55.7	8	14
PP15	20 kg of Casuarina equisetifolia leaves are boiled in water for 20 min. After cooling, the solution should be filtered. Then the extract is diluted with water and can be given to control some bacterial and fungal disease .	52.3	12.4	11
PP16	Mixing neem oil and castor oil together and spraying it to control cotton boll worms .	54.4	7.6	11
PP17	Before sowing, maize seeds are soaked in warm water for 3-6 hours and shade dried to induce better germination under drought condition and to control shoot borer .	50.3	5.2	15
PP18	Grinding and dissolving of 10kg leaves of Aloevera in liter of water and spraying for an acre to control red hairy caterpillar in ground nut.	53.4	20.26*	12
PP20	To control groundnut ring mosaic, dried sorghum or coconut leaves are powdered and boiled in water to 60Â° C for one hour, filtered, diluted and sprayed for two times at 10 and 20 days after sowing .	47.9	7.33	13
PP22	Filling the leaf axils of banana plant with a mixture of salt and ash (1:1) or Salt alone or ash alone. The mixture acts as physical poison reduces the Hiding area for the banana Pseudo stem weevils. The salt moving down into the fronds and pseudo stem may control the Grubs by ex-osmosis. Besides, it may deter egg Laying and damage by the weevil .	58.7	10.8	16
PP26	To control onion blight, 100 lit. of cow dung solution is sprayed for one acre through hand sprayer by dissolving 1kg. of cow dung in 2 lit. of water .	58.8	7.6	11

PP28	One Kg jaggery is mixed with 10-12 litres of water, and, 5-6 litres of this solution is sprayed on one acre of Cotton crop to control whitefly .	50	18.00*	14
PP36	The ash incorporated in the soil will act as repellent and prevents the soil born pests those attacks the crop.	56	9	14
PP39	Mixing of horse gram seed with red gram at sowing time to manage ashy weevil damage .	50.9	15.06	12
PP40	Mixing of kerosene + forate granules with redgram at sowing time to manage ashy weevil .	57.2	20.00*	14

fields. ITK 34, The seeds of pulses especially green gram and black gram are mixed along with wood ash and neem leaves for the purpose of storage loss due to stored grain pests and diseases (Parimala *et al.*, 2013).

Moderately rational ITKs are PP4, PP6, PP7, PP12, PP14, PP19, PP21, PP23, PP24, PP25, PP27, PP30, PP35, PP37, PP38. ITK 4 explains Farmers prepare ash from leaves and twigs of neem and mix it in Parathion powder and dusted on plants to kill aphids in cotton. ITK 6 explains sowing cowpea as an intercrop in sorghum (4:1) to minimize stem borer (Degri *et al*., 2014). ITK 7 says dusting ash on the infected leaves of sorghum to prevent the pest incidence. ITK 12 suggests Cow urine, neem oil and tobacco decoction are mixed and 'sprayed to control all sucking pest. ITK 14 tells a mixture of fish meal and Jaggery at 2:1 ratio on cotton fields to attract cranes and bulbuls, which feed on tobacco cut worms (Giri and Hedayetullah, 2020). ITK 19 says long whistling by mouth is done to ward off birds in ground nut. ITK 21 Growing of cassia tora in banana as trap crop for nematode (Mokrini *et al*., 2018). ITK 23 Milled chickpea, green gram and other pulses are stored after thoroughly treated with mustard oil to prevent storage pest damage (Reddy and Sanjeeva, 2006). ITK 24 says to control Pseudo stem weevil putting salt crystals in the bored holes of the pseudo stem in banana plant may kill the grubs by exosmosis. ITK 25 says seed mixed with Acorus calamus powder in the ratio of 10 kg: 1 kg help in preserving the seed free from stored pests for long time (Roy *et al*., 2015). ITK 27 says spraying Panchagavya to control fungal diseases in cotton. ITK 30 says use of Disti bomma (effigy) to scare birds in the fields. ITK 37 says that to protect vegetable seeds in nurseries from ants, use finely grinded ash powder as a band and it will act as a repellent. ITK 38 says to prevent leaf folder attack, sand is sprayed on the leaves that are wet with fog, so that sand abbreviates the skin of larva cause death.

Least rational ITKs includes drying, management of pest using cow dung and leaf extracts. ITK 1 explains the soaking sorghum seeds in cow urine and sun drying them before sowing to control disease and induce drought tolerance. ITK 2 was burning of cow dung cakes reduce the infestation of aphids explained in a study (Anonymous, 2018). ITK 3 were Calotropis leaves are immersed in water channel to minimize aphid infestation in cotton (Sabesh, 2003). To control leaf curl in chillies the leaves of neem, oleander, nochi, nuna, thulasi, humbai and Calotropis are pounded, soaked in cow urine for a day & filtered, diluted for 10 times and sprayed (ITK5). ITK 8 was putting fresh cow dung on both the fields and bunds to reduce rat problem in paddy field repellent (Muthuraman *et al*., 2009). ITK 9 was putting the pods of dried chillies in the red gram

containers to control bruchids attack and it was adopted by 83.33 % of the respondent from a study done by (Venkatesan and Sundaramari, 2016). ITK 10 indicates that applying of fresh cow dung near the collar region of chilli will reduce the fungal infestation was given by (Kumar *et al.,* 2021). ITK 11 was sprinkling of lime powder to control mealy bugs (Somasundaram *et al*., 2021). ITK 13 explains the foliar application of wood ashes in the noon hours of the day keeps away aphids, pod borers and diseases from plant. ITK 15 was to control bacterial and fungal disease, 20 kg of *Casuarina equisetifolia* leaves are boiled in water for 20 min. after cooling, the solution should be filtered then the extract is diluted with water and spray it on crop, this ITK was explained in the study by (Roy *et al.,* 2015). ITK 16 mixing neem oil and castor oil together and spraying it to control cotton boll worms. ITK 18 grinding and dissolving of 10kg leaves of Aloevera in liter of water and spraying for an acre to control red hairy caterpillar in ground nut. ITK 20 was for control of groundnut ring mosaic, dried sorghum or coconut leaves are powdered and boiled in water to 60°C for one hour, filtered, diluted and sprayed for two times at 10 and 20 days after sowing. ITK 22 is filling the leaf axils of banana plant with a mixture of salt and ash (1:1) or salt alone or ash alone. The mixture acts as physical poison reduces the hiding area for the banana Pseudo stem weevils. The salt moving down into the fronds and pseudo stem may control the Grubs by ex-osmosis. Besides, it may deter egg Laying and damage by the weevil reported by (Husain and Sundaramari, 2018.) ITK 26 was to control onion blight spray the solution 100 lit. of cow dung solution is sprayed for one acre through hand sprayer by dissolving 1kg. of cow dung in 2 lit. of water. ITK 28 to control whitefly mix the one Kg jaggery with 10-12 litres of water and spray the 5-6 litres solution. ITK 36 was ash incorporated in the soil will act as repellent and prevents the soil born pests those attacks the crop. ITK 39 is mixing of horse gram seed with red gram at sowing time to manage ashy weevil damage. ITK 40 was mixing of kerosene and forate granules with redgram at sowing time to manage ashy weevil.

CONCLUSION

Being low in cost, it will also benefit farmers economic condition and sustainable agricultural development. ITK are valuable assets to climate change. They are used combining traditional skills, culture, knowledge and tools of the native communities. The documented ITK showed importance and effectiveness in climate resilient farming. Effective actions should be taken to preserve and promote ITK with blending of indigenous and scientific knowledge. There is necessity to combine ITK with the scientific cognizance strategy with its proper documentation and apply them in filed with rationality for their use of ITK in future.

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