Original Research Article

Understanding the Knowledge Level of Farmers towards Climate Smart Agricultural Technologies in Agro-Climatic Zones of Tamil Nadu

ABSTRACT

Aims: Despite the various constraints faced by the farmers, climate change acts as the root cause of several other constraints. Climate change consequences drastically reduces agricultural yield by affecting critical changes of crop growth and questions food and nutritional security; additionally it also impose economic loss to the country. Hence, to ensure food and nutritional security for the growing population and to ensure sustainable income for the farming community, a farmer has to tackle the consequences of climate change by adoption of CSA technologies Farmer's knowledge level towards any technology, determine its rate of adoption. Hence, this study aims to assess the knowledge level of farmers towards CSA technologies in Agro-climatic zones of Tamil Nadu.

Study design: Ex-post facto research design was employed in the study.

Place and Duration of Study: The study was carried out in Villupuram district of North Eastern Zone, Namakkal district of North Western Zone, Coimbatore district of Western Zone, Tiruvarur district of Cauvery Delta Zone, Ramanthapuram district of Southern Zone, Kanyakumari district of High Rainfall Zone and the Nilgiris district of the Hilly Zone of Tamil Nadu during 2022-23.

Methodology: From each of Agro-climatic zones of Tamil Nadu, the vulnerable districts or the districts with NICRA project have been identified and the CSA technologies adopted by the farmers were documented. Thirty farmers who adopts CSA technologies from each agro-climatic zone were selected and interviewed personally to assess their knowledge level towards those technologies in a five point continuum ranging from 'No knowledge' (1), 'Minimal knowledge' (2), 'Basic knowledge' (3), 'Adequate knowledge' (4) and 'Superior knowledge' (5) respectively.The gathered responses were subjected to suitable statistically analysis.

Results: The findings revealed that Villupuram, Coimbatore and Tiruvarur farmers had superior knowledge on precision based nutrient management, Namakkal farmers had superior knowledge on use of additives and supplements in livestock feed, Ramanathapuram farmers had superior knowledge on utilization of weather based agro-advisory services, Kanyakumari farmers had superior knowledge on adoption of moisture conservation practices and Nilgiris farmers had superior knowledge on adoption of improved seed varieties and use of biofertilizers.

Conclusion: Farmers had superior knowledge on CSA technologies based on their perceived climatic change consequences and their accessibility to location specific technologies. Further, it was suggested that, farmers should be made aware of other CSA technologies by conducting awareness campaigns, establishing demonstration units and outreach centers as it helps to improve resilience.

Keywords: [CSA technologies, Climate Smart Agriculture, Agro-Climatic Zones, Tamil Nadu, Knowledge level, Climate change}

1. INTRODUCTION

Climate change is the change in weather conditions due to natural and man-made causes for a prolonged period which alters the global composition and results in negative consequences such as severe drought, delayed rainfall, increased

intensity of rainfall, unpredictable rainfall, flood and so on. Climate change declines the production and reproduction efficiency of livestock (Sejian, 2013); causes respiratory tract infection in children and asthma in adults (Majra and Gur, 2009); affects spatial distribution of agro-ecological zones (Easterling *et al.,* 2007) and so on. Though several sectors are invariably affected by consequences of climate change, agriculture is the severely affected sector as it highly depends on natural resources like soil, water and air.

Several studies reported that climatic change consequences such as increase in temperature reduce wheat production (Swaminathan and Rengalakshmi, 2016), affects the fiscal policies of highland range (Kohler *et al.,* 2012), increase autotrophic CO_2 losses from soil as a result of increased soil temperature (Mahato, 2014) and dry season below temperature damages crop growth (Mendelsohn, 2014). Among the several climatic change consequences, increasing temperature and declining rainfall are the significant negative impact of climate change that threatens agricultural production and food security (Parry *et al.,* 2007). Saravanakumar (2015) pointed out that climate change is expected to reduce rice yields by 283 kg per ha per decade and sorghum yields by 88 kg per ha per decade by 2100, representing a 10% and 9% fall in yields by the end of the 21st century, respectively, compared to average yields from 1971 to 2009**.**

While, IFPRI (International Food Policy Research Institute) in their Global Food Policy report mentioned that climate change will push 90 million towards hunger. Several studies revealed that majority of the farmers had knowledge about climate change (Afsar and Idrees, 2019; Islam *et al.,* 2019); whereas, two-fifth of the paddy growers in Mandya had medium level of knowledge on climate resilient technologies (Manjunath, 2018) and nearly three-fifth of the farmers in Ananthapuram district of Andhra Pradesh had medium level of knowledge on climate resilient technologies due to the impact of NICRA project (Kalyan, 2019).

Statement of the problem

Apart from ensuring food security to the World population, agriculture provides employment opportunity large number of Indian population. Among the Indian farmers, approximately 82 per cent of them are small farmers and they have to encounter several production, technical, technological and marketing related constraints in agriculture. Additionally, the consequences of climate change pose additional threats such as increasing the incidence of pests and diseases, deterioration in soil fertility, promote salinity, defiance many pesticides and herbicides and deterioration of quality of irrigation water (Gupta *et al.,* 2020). Hence, to tackle the aforementioned constraints, the farmers has to adopt Climate Smart Agriculture (CSA) technologies which improve productivity, improve resilience and reduce emission of greenhouse gas. Whereas, to adopt the CSA technologies, it become necessary that the farmer should had prior knowledge about the available CSA technologies. In this context, the present study aims to assess the knowledge level of the farmers towards CSA technologies in agro-climatic zones of Tamil Nadu.

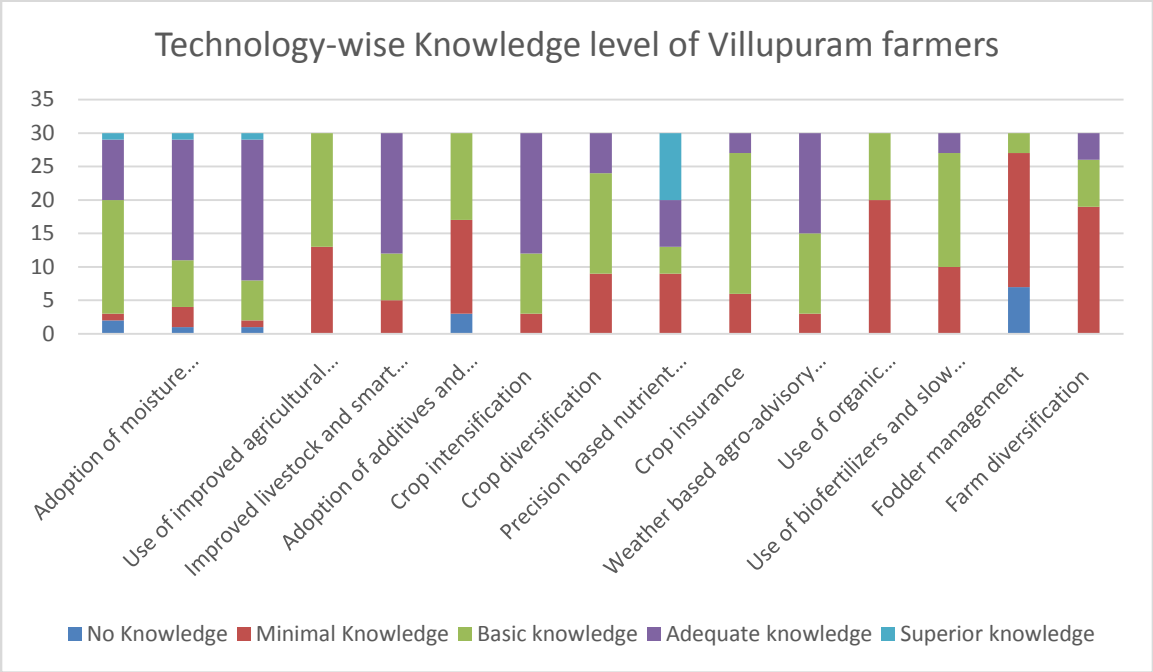
2. METHODOLOGY

To achieve this objective, the present study was conducted in seven different agro-climatic zones of Tamil Nadu. Villupuram district of North Eastern Zone, Namakkal district of North Western Zone, Coimbatore district of Western Zone, Tiruvarur district of Cauvery Delta Zone, Ramanthapuram district of Southern Zone, Kanyakumari district of High Rainfall Zone and the Nilgiris district of the Hilly Zone were selected to understand the knowledge level of farmers towards CSA technologies. From each agro-climatic zone, the adopted CSA technologies were documented by employing Focus Group Discussion & CSA rural appraisal techniques. Later, the documented CSA technologies from all the agro-climatic zones of Tamil Nadu were compiled and the knowledge level of the farmers towards CSA technologies in Agro-Climatic Zones of Tamil Nadu is assessed against the five point continuum, ranging from 'No knowledge' (1), 'Minimal knowledge' (2), 'Basic knowledge' (3), 'Adequate knowledge' (4) and 'Superior knowledge' (5) respectively. The gathered responses are subjected to statistically analysis and the findings are presented in the subsequent sections.

3. FINDINGS AND DISCUSSION

The Technology wise knowledge level of Villupuram farmers towards CSA technologies is presented in figure 1.

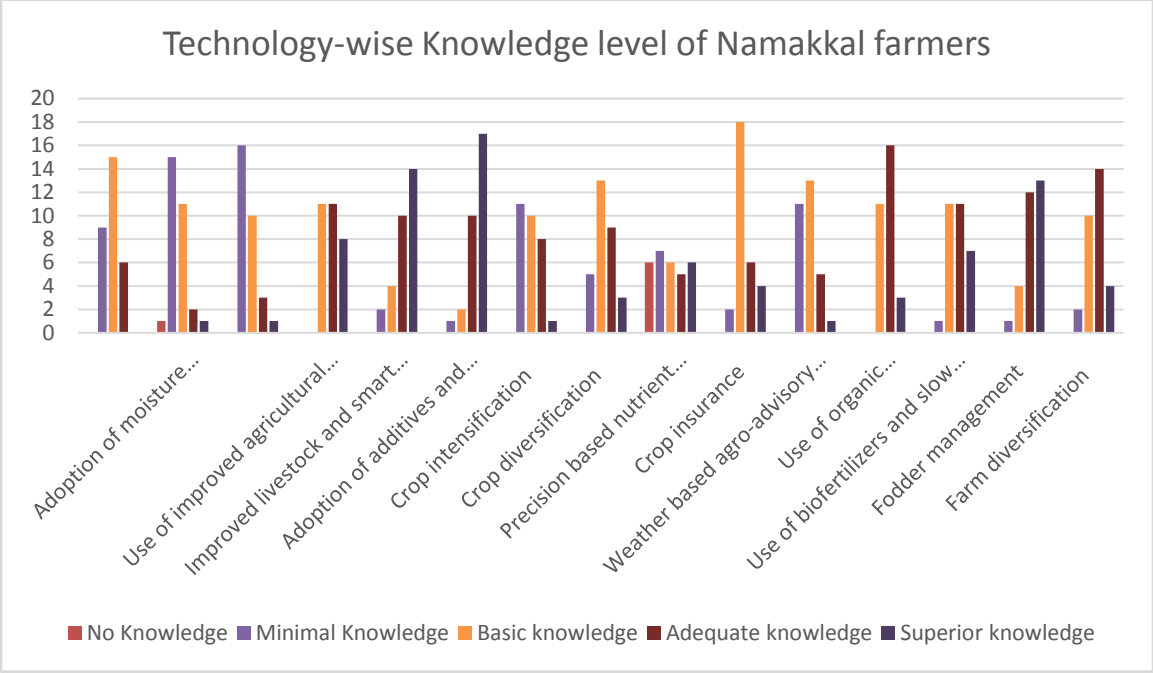
Fig 1. Distribution of Villupuram farmers based on their knowledge level towards CSA technologies



Regarding the technology-wise knowledge level of Villupuram farmers (fig.1.), it can be understood that higher percentage of the farmers had basic knowledge on crop insurance (70.00%), improved seed varieties (56.67%), use of biofertilizers and slow releasing nitrogenous fertilizers (56.67%), use of improved agricultural implements (56.67%) and crop diversification (50.00%). Meanwhile, most of the farmers had adequate knowledge on adoption of micro-irrigation measures (70.00%) and moisture conservation practices (60%), adoption of improved livestock breeds and use of smart house for livestock (60.00%), crop intensification (60.00%) and utilization of weather based agro-advisory services (50.00%). Whereas, higher percentage of the farmers had minimal knowledge on fodder management (66.67%), use of organic manures, fertilizers, green manures and green leaf manures (66.67%), diversification of farm (63.33%) and use of additives and supplements in livestock feed.(46.67%). Eventually, 33.33 per cent of the farmers had superior knowledge on precision based nutrient management.

The Technology wise knowledge level of Namakkal farmers towards CSA technologies is presented in figure 2.

Fig 2. Distribution of Namakkal farmers based on their knowledge level towards CSA technologies

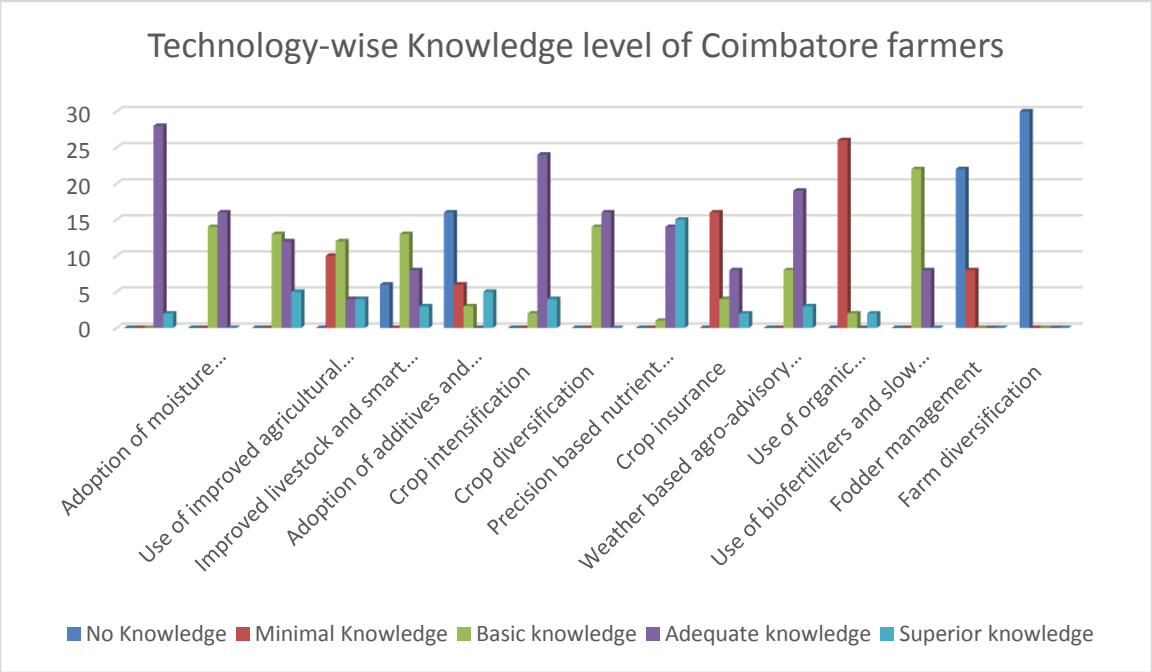


With respect to technology wise knowledge level of Namakkal farmers, it was revealed that farmers had basic knowledge in utilization of crop insurance (60.00%), adoption of improved seed varieties (50.00%), crop diversification (43.33%) and utilization of weather based agro-advisory services (43.33%). Further, famers had minimal knowledge on

adoption of micro-irrigation measures (53.33%), adoption of moisture conservation practices (50.00%) and crop intensification (36.67%); whereas, most of the farmers had adequate knowledge on use of organic manures, fertilizers, green manures and green leaf manures (53.33%). Similarly, higher percentage of the farmers had superior knowledge on adoption of additives and supplements in livestock feed (56.67%), use of improved livestock breed and smart house for livestock (46.67%), fodder management (43.33%), use of improved agricultural implements (26.66%), use of biofertilizers and slow releasing nitrogenous fertilizers (23.33%) and precision based nutrient management (20.00%).

The Technology wise knowledge level of Coimbatore farmers towards CSA technologies is presented in figure 3.

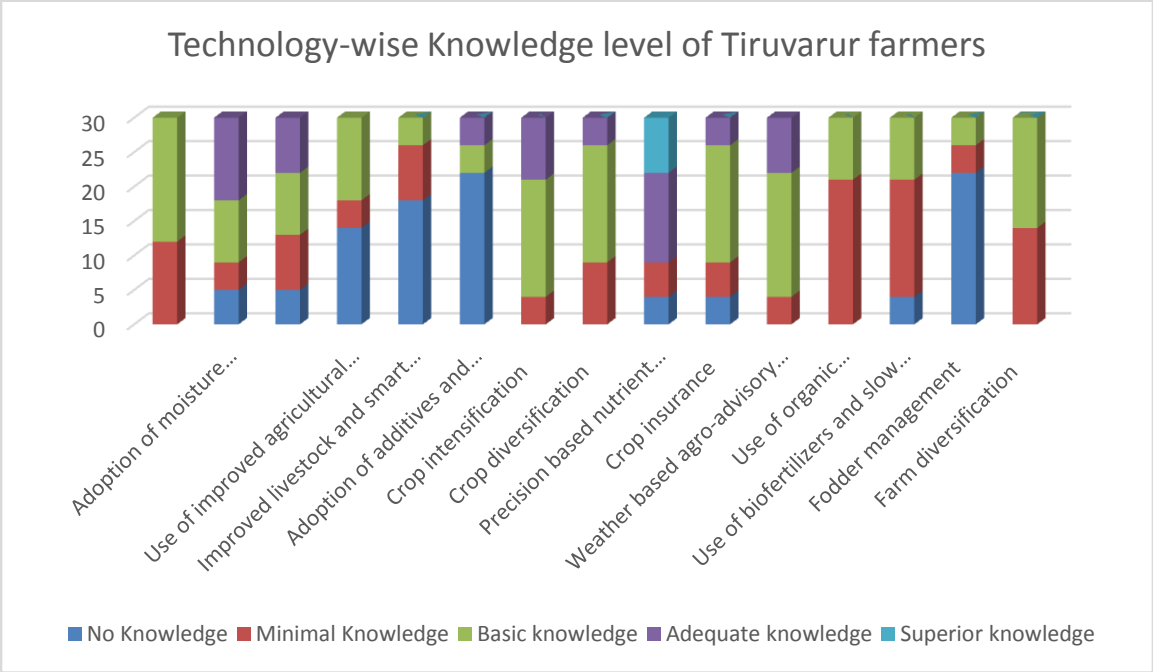
Fig 3. Distribution of Villupuram farmers based on their knowledge level towards CSA technologies



The knowledge level of Coimbatore farmers towards CSA technologies (figure.3) revealed that, majority of the farmers had adequate knowledge on adoption of improved seed varieties (93.33%), crop intensification (80.00%), weather based agro-advisory services (63.33%), crop diversification (53.33%) and adoption of moisture conservation practices (53.33%). Meanwhile, most of the farmers had basic knowledge on use of biofertilizers and slow releasing nitrogenous fertilizers (73.33%), adoption of micro-irrigation measures (43.33%), adoption of improved livestock breed and use of smart house for livestock (43.33%) and use of improved agricultural implements (40.00%). Whereas, farmers had no knowledge in diversification of farm (100%), fodder management (73.33%) and adoption of additives and supplements in livestock feed (53.33%); Superior knowledge on precision based nutrient management (50.00%). In the meantime, farmers had minimal knowledge on use of organic manures, organic fertilizers, green manures and green leaf manures (86.66%), crop insurance (53.33%).

The Technology wise knowledge level of Tiruvarur farmers towards CSA technologies is presented in figure 4.

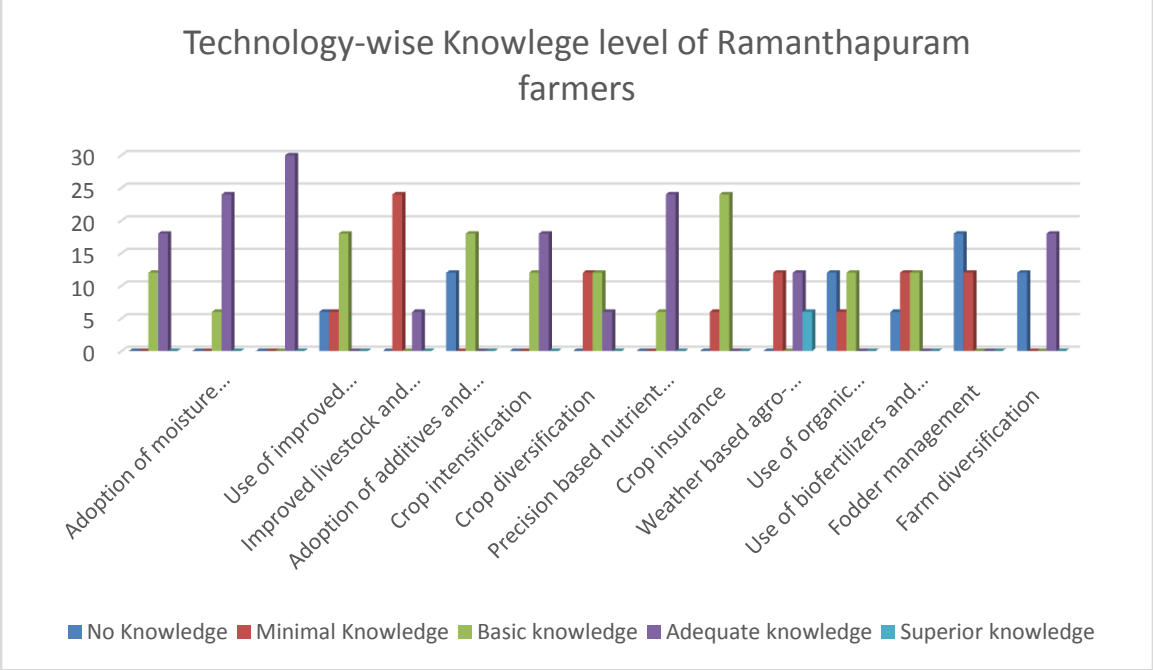
Fig 4. Distribution of Tiruvarur farmers based on their knowledge level towards CSA technologies



Considering the technology wise knowledge level of Tiruvarur farmers (figure 4), it was found that exactly three-fifth of the farmers had basic knowledge on adoption of improved seed varieties (60.00%), weather based agro-advisory services (60.00%), crop intensification (56.67%), crop diversification (56.67%), crop insurance (56.67%) and diversification of farm (53.33%). Meanwhile, most of the farmers had adequate knowledge on precision based nutrient management (43.33%) and adoption of moisture conservation practices (40.00%); basic knowledge on adoption of micro-irrigation measures (30.00%) and minimal knowledge on use of organic manures, organic fertilizers, green manures and green leaf manures (70.00%) and use of biofertilizers and slow releasing nitrogenous fertilizers (56.67%). Eventually, higher percentage of the farmers had no knowledge on use of additives and supplements in livestock feeds (73.33%), fodder management (73.33%), adoption of improved livestock breeds and use of smart house for livestock (60.00%) and use of improved agricultural implements (46.67%).

The Technology wise knowledge level of Ramanathapuram farmers towards CSA technologies is presented in figure 5.

Fig 5. Distribution of Ramanathapuram farmers based on their knowledge level towards CSA technologies

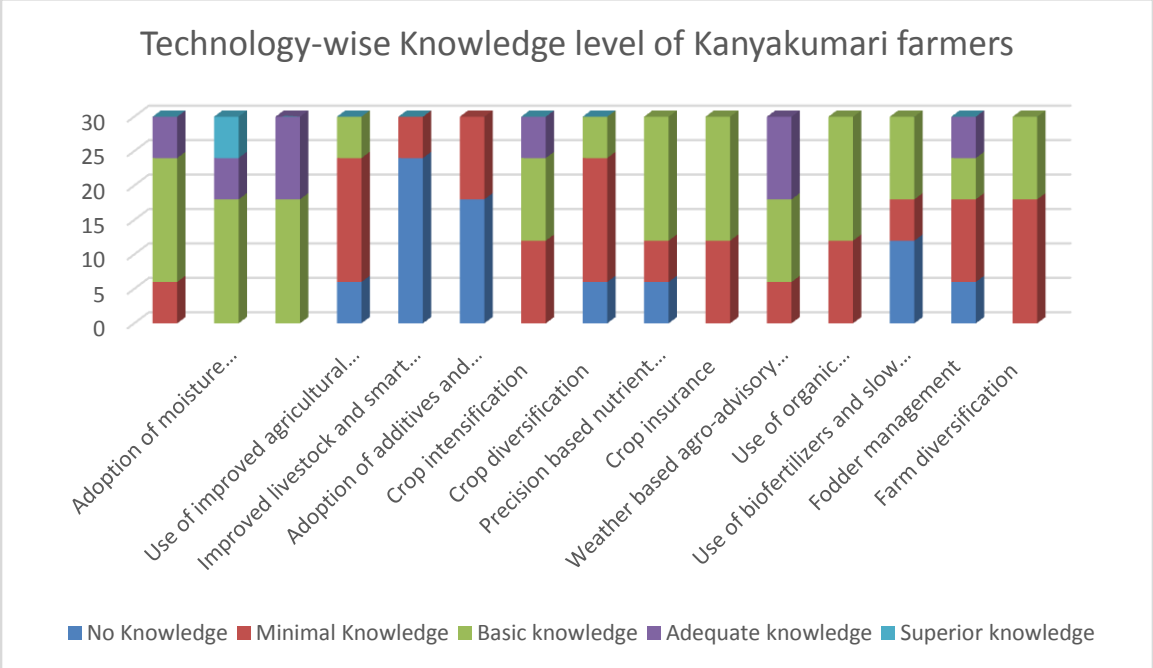


With respect to the technology wise knowledge level of Ramanathapuram farmers (figure 5), most of the farmers had adequate knowledge on adoption of micro-irrigation measures (100%) and moisture conservation practices (80.00%),

precision based nutrient management (80.00%), adoption of improved seed varieties (60.00%), crop intensification (60.00%), diversification of farm (60.00%) and weather based agro-advisory services (40.00%). Meanwhile, Ramanathapuram farmers had basic knowledge on crop insurance (80.00%), use of improved agricultural implements (60.00%), adoption of additives and supplements in livestock feed (60.00%), crop diversification (40.00%), use of organic manures, organic fertilizers, green manures and green leaf manures (40.00%), use of biofertilizers and slow releasing nitrogenous fertilizers (40.00%). Eventually, it is observed that farmers had minimal knowledge on adoption of improved livestock breed and use of smart house for livestock (80.00%) and no knowledge on fodder management (60.00%).

The Technology wise knowledge level of Kanyakumari farmers towards CSA technologies is presented in figure 6.

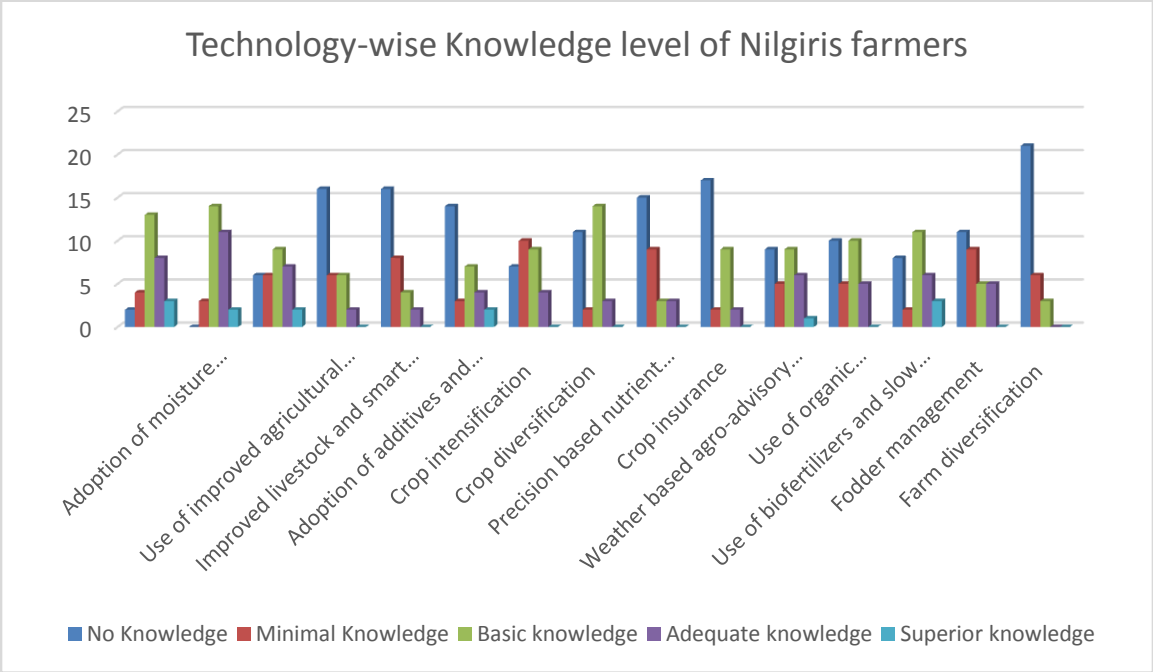
Fig 6. Distribution of Kanyakumari farmers based on their knowledge level towards CSA technologies



Considering the technology-wise knowledge level of Kanyakumari farmers (figure 6), it can be understood that higher percentage of farmers had basic knowledge on adoption of improved seed varieties (60.00%), adoption of moisture conservation practices (60.00%), precision based nutrient management (60.00%), crop insurance (60.00%), adoption of micro-irrigation measures (60.00%), use of organic manures, organic fertilizers, green manures and green leaf manures (60.00%), crop intensification (40.00%) and use of biofertilizers and slow releasing nitrogenous fertilizers (40.00%). Meanwhile, most of the farmers had adequate knowledge on weather based agro-advisory services (40.00%); minimal knowledge on use of improved agricultural implements (60.00%), diversification of farm (60.00%), crop diversification (60.00%) and fodder management (40.00%). Eventually, some of the farmers had no knowledge on adoption of improved livestock breeds and use of smart house for livestock (80.00%) and adoption of additives and supplements in livestock feed (60.00%).

The Technology wise knowledge level of Nilgiris farmers towards CSA technologies is presented in figure 7.

Fig 7. Distribution of Nilgiris farmers based on their knowledge level towards CSA technologies



Regarding the technology wise knowledge level of Nilgiris farmers (figure.7), most of the farmers had basic knowledge on adoption of moisture conservation practices (46.67%), crop diversification (46.67%), adoption of improved seed varieties (43.33%), use of biofertilizers and slow releasing nitrogenous fertilizers (36.67%), use of organic manures, organic fertilizers, green manures and green leaf manures (33.33%), adoption of micro-irrigation measures (30.00%), crop intensification (30.00%) and weather based agro-advisory services (30.00%). Meanwhile, most of the farmers had no knowledge on farm diversification (70.00%), crop insurance (56.67%), precision based nutrient management (50.00%), use of improved agricultural implements (53.33%), adoption of improved livestock breed and use of smart house for livestock (53.33%), adoption of additives and supplements in livestock feed (46.67%) and fodder management (36.67%).

Based on the findings, it was revealed that Villupuram, Coimbatore and Tiruvarur farmers had superior knowledge on precision based nutrient management as they were aware of importance fertilizers application based on soil analysis. Additionally, accessibility to the soil testing centers, trainings attended by the farmers, awareness campaigns conducted by the State Department of Agriculture and the demonstrations conducted by the extension officers contributed to the increased knowledge level of the farmers. Similarly, Namakkal farmers had superior knowledge on use of additives and supplements in livestock feed, as they grew livestock along with carrying out agricultural activities. Though livestock is an indispensable part of farmer's life, prolonged drought and unpredicted rainfall made the farmers to be depend on livestock for their livelihood. Additionally, presence of TANUVAS KVK and implementation of NICRA project created awareness among the farmers towards CSA technologies in other allied sectors.

Meanwhile Ramanathapuram farmers had superior knowledge on utilization of weather based agro-advisory services, as the district experiences high temperature and optimum irrigation water, onset of rain helps the farmers to mitigate water stress. Sometimes, early and delayed onset of rainfall during harvesting and sowing reduce the crop yield. Hence, farmers utilize Kisan Call Centre, mobile apps and news in TV and radio to know the weather forecast to carry out agricultural activities. Whereas, Kanyakumari farmers had superior knowledge on adoption of moisture conservation practices as opening of dams is not planned and couldn't had any water conservation measures like check dam, reduced water conservation. To fuel it up, consequences of climate change such as delayed onset of rainfall and increased rainfall intensity at critical stages of crop growth reduced crop yield. Hence, the farmers had superior knowledge on several moisture conservation measures to conserve water.

Eventually, Nilgiris farmers had superior knowledge on adoption of improved seed varieties and use of biofertilizers as they had to adopt improved seed varieties which are resistant to frost, pest and disease resistant, water logging resistant to encounter increased pest and disease attack, severe frost damage, unpredictable and increased rainfall intensity. By understanding the knowledge level of the farmers towards CSA technologies, interventions and policies can be formulated to increase the adoption of CSA technologies and to reduce the impact of climate change on agriculture and other allied sectors thereby improving the livelihood of the farmers.

4. CONCLUSION

Being an agricultural economy and to ensure food and nutritional security for the growing Indian population, farmers has to tackle the consequences of climate change. As the farmers have to combat with climate change, in addition to several

other production, technical and marketing constraints, provision of timely weather based agro-advisory services enable them to reduce yield losses. Thus, it can be concluded that, farmers had superior knowledge on CSA technologies based on their perceived climatic change consequences and their accessibility to location specific technologies. Further, it was suggested that, farmers should be made aware of other CSA technologies by conducting awareness campaigns, establishing demonstration units and outreach centers as it helps to improve resilience.

CONSENT

All authors declare that 'research was conducted with ethical considerations and respondents were interviewed after obtaining oral consent for publication of the results.

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