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Prediction of High-Risk Probability Areas under Current and Future Climate Scenarios in India for the Establishment of Fall Armyworm

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***Abstract*— *The Fall Armyworm (FAW) or Spodoptera frugiperda, is an endemic and agriculturally important insect pest in tropical and subtropical regions of the Americas causing severe impact estimated at millions of dollars. FAW has been recently identified for the first time in India and is also a first record in Asia threatening the food security and livelihoods of millions of farmers. The insects are affected by climatic factors, and climate change may affect geographical distribution, abundance, growth rate, survival, mortality, number of generations per year and other characteristics. These climate change effects on insects are difficult to project due to complex interaction among insects, hosts and predators. Moreover, agricultural pest management may become more challenging under future climate change and variation. The present study aims to project the impact of climate change on future suitability for the expansion of FAW as well as highlight the high risk probability areas due to the pest using the historical and future climatic conditions. The modelling was carried out using CLIMEX model, GIS, the known distribution of the species and the CliMond meterological database. The analysis has indicated high climatic suitability for FAW occurrence in India with Eco-climatic Index (EI) values above 20. Further, the high risk probability areas for the FAW establishment up to district level were also identified for the major maize growing states. The areas where the pest is currently reported in the country are coinciding with the predicted potential areas in India validating the current analysis. The analysis using two general circulation models (GCMs), CSIRO MK3.0 and MIROC-H, for 2030 and 2050 under the A2 Special Report on Emissions Scenarios (SRES) indicated the possible reduction of climatically suitable areas for the FAW establishment in India. This kind of analysis assessing the possible impacts of FAW under future climate conditions is essential for the future economic production of crops.*

Keywords*— *Fall army worm, Spodoptera frugiperda, Endangered areas, High Risk Probability, Ecoclimatic index (EI), CLIMEX.

I. INTRODUCTION

The fall armyworm, *Spodoptera frugiperda* (J.E.Smith) is an agriculturally important insect of more than 80 plant species, causing damage to economically important cultivated cereals such as maize, rice, sorghum, and also to vegetable crops and cotton with a particular preference for maize, a main staple crop around the world threatening food security and biosecurity. This highly-destructive and invasive pest has been seen in the Americas since several decades, but its prevalence outside was noted for the first time in West Africa in early 2016 (IITA 2016; IPPC 2016), and it has subsequently been recorded in most sub-Saharan countries (ACAPS 2017). It has spread to 44 countries across the continent, barring North Africa (CIMMYT 2018). Sightings of damage to maize crops in India due to fall armyworm mark the first report of the pest in Asia in 2018. In India it was reported for the first time from Karnataka (ICAR-NBAIR, 2018a) and Andhra

Pradesh (EPPO, 2018). The pest has also been reported in Telangana, Tamil Nadu, Maharashtra and Gujarat.

Fall armyworm (FAW) causes major damage to economically important crops. In sub-Saharan Africa, where fall armyworm is devastating maize crops, estimates indicate 13.5 million tons of maize valued at $3 billion are at risk in 2017-2018, which is equivalent to over 20 percent of total production for the region (CABI, April 2017). In America, FAW is listed as one of the major pest of maize and causing severe economic losses, with infection level up to 70%. According to the International Maize and Wheat Improvement Centre (CIMMYT) at Mexico, FAW has, over the last two years, damaged more than 1.5 million hectares of Africa's maize crop. (Carolyn Cowan, Jennifer Johnson / August 13, 2018, CIMMYT). Moreover, FAW has suddenly become a major pest in Kenya, causing losses of about a third of the annual maize production, estimated at about 1 million tonnes (HugoDe Groote et al 2020).

Fall Armyworm is native to tropical and subtropical regions. However, it may also be found in temperate regions (Luginbill 1928; Sparks 1979; Clark *et al*. 2007). FAW does not possess a capability to enter diapause, due to this; FAW cannot survive extended periods of freezing temperature but must migrate northwards each spring if it is to re-infest cropping areas in temperate regions (Luginbill 1928).

The life cycle, behaviour, survival and spread of insects are affected by climate factors, especially temperature, which has a strong influence on all ectothermic organisms (Rosenzweig *et al*. 2001; Fhrer 2003; Diffen). Outbreaks of FAW are closely related to climatic conditions, and migrant adults can move northwards up to 483 km/generations with good winter and spring conditions (Sparks 1979). Climate change will have different effects on insects, directly impacting their life cycle or indirectly impacting hosts or predators (Cannon 1998; Patterson *et al*. 1999; Bale *et al*. 2002). Some of the expected effects are changes in geographic range, growth rate, migration, host preferences, abundance, synchronization, survival, mortality, number of generation per year and others (Tauber *et al*. 1986; Parry *et al*. 1990).

Climate change effects on insects are difficult to project due to complex interaction among insects, hosts and predators. Some modelling techniques have been developed to forecast the species distribution *viz*., Classification and Regression Tree Analysis (CART), Logistic Multiple Regression (LMR), Regression Tree Analysis (RTA), Maximum Entropy (MAXENT) and Bioclimatic Variable (BIOCLIM). Nevertheless, CLIMatic IndEX (CLIMEX) is especially appropriate for projecting the effects of variations in climate change on insects, since the model matches the presence of a particular organism with ranges of temperature, moisture and climatic stresses. In contrast to other models, CLIMEX uses more than one limiting factor to project current and future suitability (Sutherst *et al*. 1995; Patterson *et al*. 1999; Crozier & Dwyer 2006; Shabani & Kotey 2016). It has been widely used to project the current and future potential distribution of different pest (Kriticos *et al.* 2015b).

The main aim of the current research is to predict the high risk probability areas based on historical climatological data (centred at 1975) derived from Climond: global climatologies for bioclimatic modelling developed by The Commonwealth Scientific and Industrial Research Organisation, Australian federal government agency. An attempt has also been made to project the impact of climate change on future suitability of India for FAW, based on current known distribution using CLIMEX modelling and biological data obtained from the literature.

II. MATERIAL AND METHODS

CLIMEX (version 4.0) is a computational tool for studying the effects of climatic conditions on species distribution and relative abundance. The CLIMEX Model is based on the assumption that we can infer the suitable climatic conditions for a target species when information about its habitat is known. The compare location application was used to project the current probable distribution and spread of FAW in India.

"Compare Locations," application can predict the potential geographical distribution of target species with regard to climatic conditions (Jung *et al* 2016; Kriticos and Leriche 2010; Kriticos *et al* 2015; Stephens *et al* 2007). The species information necessary for the model is a series of parameters that describes responses to temperature, moisture and climatic stresses along with long term meteorological database for the location under study. The model assumes that the known distribution of the species infers the climatic conditions in which it can survive. The model parameters are divided among the population growth indexes, stress indexes and the constraint values, such as the length of the growing season (degree day per generation, PDD), which may exclude the organism from a particular location.

Growth index describes favorable season based on temperature, soil moisture, radiation, substrate, amount of light exposed, and diapause ability, whereas stress index is calculated from four stress indices, i.e., cold stress (CS), heat stress, wet stress, and dry stress, all of which are factors that limit the species population (Byeon *et al* 2017; Hill *et al* 2014; Kriticos *et al* 2015). The results of

CLIMEX Model are represented by the Ecoclimatic index (EI), which indicates the survival and growth of a species in many different locations based on the climate. Ecoclimatic index (EI) describes the level of favourability of a location for the particular organism to survive when the conditions are favourable. The EI, expressed as numbers between 0 (Unfavourable conditions) and 100 (ideal conditions), is calculated by multiplying growth index, stress index, and interaction stress index. EI values near 0 represents a location where the species has poor conditions for long-term survival, while EI values > 30 indicate remarkably good conditions for establishment and survival of the species, and values close to 100 represent perfect conditions for the species (Sutherst *et al*. 2007; Kriticos *et al.* 2015a). These perfect conditions are difficult to achieve in nature but can be obtained in laboratory experiments (Sutherst *et al.* 2007; Kriticos *et al.* 2007a). In this present paper/study, the EI categorization was EI = 0 = unsuitable, a region where the population does not persist; EI = 1 – 10 = marginal, where the population has limited conditions to persist; EI = 10-20 = medium, where the region can support large population; and EI > 20 = optimal, where the population has highly favourable conditions to persist. These categorizations were developed by taking into account previous studies and the information in the user manual (Sutherst & Maywald 1985; Shabani *et al*. 2014; Kriticos *et al* 2015a; NYZ RAMIREZ-CABRAL *et al* 2017; Hannalene du Plessis *et al*. 2018).

For modelling the potential spread of FAW in the country (India), the current geographical distribution of FAW is necessary. The known geographical distribution was gathered from CABI (2020) and literature resources (Ramirez Cabral *et al*. 2017 and Westbrook *et al*. 2016)

CLIMEX parameters:

CLIMEX (Sutherst and Maywald 1985; Kriticos *et al*. 2015) uses a visual, iterative process to fit the stress parameters. In the present study, stress parameters that limit the species suitability have been taken from two different hypothesis of N.Y. Z. Ramirez – Cabral *et al.*, and Hannalene Du Plessis *et al*. The stress parameters of both hypotheses have been tested to ensure the similarity of the generated potential geographic distribution with the species known geographic distribution. The hypothesis of Hannalene Du Plessis *et al.*, fitting stress parameters appears to be more matching with the species known geographic distribution specified in CABI, 2020. Hence, the above hypothesis has been chosen to run the model and generate the CLIMEX simulation consistent with the current distribution of FAW. CLIMEX parameter values used for modelling the distribution of FAW is given in the table 1.

Table 1: CLIMEX parameter values for modelling the distribution of FAW

Parameter	Description	Values
Moisture		
SM0	Lower soil moisture threshold	0.15
SM1	Lower optimal soil moisture	0.8
SM2	Upper optimal soil moisture	1.5
SM3	Upper soil moisture threshold	2.5
Temperature		
DV0	Lower temperature threshold	12 ºC
DV1	Lower optimal temperature	25 ºC
DV2	Upper optimal temperature	30 ºC
DV3	Upper temperature threshold	39 ºC
Cold Stress		
TTCS	Cold stress temperature threshold	12 ºC
THCS	Cold stress accumulation rate	0.001 $week^{-1}$
Heat Stress		
TTHS	Heat stress temperature threshold	39 ºC
THHS	Heat stress accumulation rate	0.005 $week^{-1}$
Dry Stress		

SMDS HDS	Soil moisture dry stress threshold Dry stress accumulation rate	0.1 -0.005 week^{-1}
Wet Stress		
SMWS HWS	Soil moisture wet stress threshold Wet stress accumulation rate	2.5 0.002 week^{-1}
Threshold Annual Heat Sum		
PDD	Minimum degree day sum needed to complete a generation	600 ºC

Once the parameters were included, the CLIMEX output was exported to Arch Map GIS and maps of climate suitability (EI) for establishment of FAW were generated for India and its individual states (Source of GIS maps: Indian Space Research Organisation, Dept. of Space, Govt. of India, Balanagar, Hyderabad). Validation was also done with the existing locations of occurrence in India.

An attempt was also made to project the future climatic suitability for the years 2030 and 2050. The current suitability was modelled with the Climond 10' baseline data, gridded historical climate data and the average 1961-90 baseline period in Climex format (Kriticos *et al*. 2012b). Among the different future climate scenarios (A1B, A2, B1 and B2), A2 scenario was chosen to model the future climatic suitability owing to its emission scenario with actual CO_2 emissions, increase in greenhouse gases and agricultural productivity. Two Global Climate Models (GCM's) were used to model the future climatic suitability for FAW with future data, *viz*., CSIRO MK3.0, from the Common Wealth Scientific and Industrial Research Organisation from Australia (Gordon *et al*. 2010), and MIROC-H from the Centre for Climate Research in Tokyo, Japan (Shiogama *et al*. 2010). These GCMs were chosen because of the availability of climatic variables required for CLIMEX.

OBSERVATIONS:

The parameter values from the hypothesis of Hannalene Du Plessis *et al*., relevant to species biology under "Wet Tropical" species condition were considered to project potential distribution of FAW. The parameters are explained in detail below-

- The Moisture Index is estimated from a hydrological model based on soil moisture, rainfall and evaporation, with information of the previous and current week. This index denotes the response of the organism to soil moisture and assumes it to be constant over a 24h period. A value of zero indicates no soil moisture and no growth. The parameters are SM0 = lower soil moisture threshold, SM1 = lower optimal soil moisture, SM2 = upper optimal soil moisture and SM3 = upper soil moisture threshold (Sutherst *et.al* 2007). Because FAW depends on a host survival, the insect will be unable to survive if the crop or plant is dead. Based on this assumption, the SM0 was set at 0.15, the wilting point value most frequently used (Kriticos *et al.* 2014), which is almost in agreement with the SMDS. Moisture is known to affect the pupal stage, and excessive dryness retards emergence (Vickery 1929). Soil moisture parameters were set to biologically reasonable values. The soil moisture limit for growth was set to approximate permanent wilting point (Kriticos *et al*. 2003). The upper limit for optimal growth (SM2) was set to 2.5, acknowledging that *S. frugiperda* can tolerate conditions with substantial water-logging. The lower limit for optimal growth (SM1) was adjusted to provide appropriate suitability in marginally dry areas.
- The Temperature Index is one of the main components of the growth index. It denotes suitable temperature ranges in which the organism can live, with values ranging from 0 to 1. There are four parameters of this index: the lower temperature threshold (DV0), the lower optimum temperature (DV1), the upper optimum temperature (DV2) and the upper temperature threshold (DV3) (Sutherst *et al.* 2007). The lower temperature threshold for growth is 12°C which reflect the tropical distribution of *S. frugiperda*. The lower temperature for optimal growth is 25 °C, the upper optimal temperature for growth is 30 °C (Simmons 1993), and the maximum temperature is 39 °C, near the threshold of 39.8°C reported by Valdez- Torres *et al*. (2012). Taking into account the above experimental results, the value for DV0 was set at 12ºC. DV1 and Dv2 were set as 25 ºC and 30 ºC respectively.
- FAW does not diapause and cannot survive the winters in temperate areas (Luginbill 1928;

Johnson 1987). Diapause was therefore not included in this model.

- The cold stress temperature threshold (TTCS) and the accumulation rate of this threshold (cold stress temperature rate, THCS) were used to project current suitability for FAW. A temperature threshold model of Cold Stress was used, with a 12°C threshold and a stress accumulation rate of -0.001 week^{-1}. CLIMEX can calculate the cold stress and exclude the survival of an insect when exposed to low temperatures (Sutherst *et al.* 2007). Although FAW does not tolerate prolonged and extreme cold periods, periods of mild cold and rainfall promote the abundance of the insect (Luginbill 1928; Westbrook *et al.* 2016).
- The heat stress temperature threshold (TTHS) and its accumulation rate (heat stress accumulation rate, THHS), were used to limit the survival of FAW at high temperatures. When the average maximum temperature is below TTHS, the heat stress is equal to zero (Sutherst *et al* 2007). The threshold of 39 °C is the same as the upper temperature limit for development.
- CLIMEX accumulates dry stress when soil moisture is lower than the dry stress threshold (SMDS). This stress is accumulated weekly and is multiplied the dry stress rate (HDS) (Sutherst *et al* 2007). There is evidence that during a dry season, few adult moths are trapped and the population peaks are delayed (Andrews 1988). The dry stress was set at SMDS= 0.1 to avoid the persistence of FAW. Dry Stress was given by using the lower soil moisture growth threshold and adjusting the rate to limit the distribution to tropical and subtropical regions where it has been reported.
- Wet stress accumulates when soil moisture exceeds the wet stress threshold (SMWS). Annual wet stress depends on the sum of weeks per year during which this stress occurs. Wet stress accumulates at a wet stress rate (Sutherst *et al.* 2007). A higher number of FAW moths have been recorded when rainfall is plentiful. While heavy rains reduce the population density of larvae in the early instars, this does not affect late instars or the adult stage (Luginbill 1928; Andrews 1988). The SMWS was set high at 1.5, with an accumulation rate of 0.002/week^{-1}, to allow persistence throughout the known distribution.
- This parameter describes the necessary number of growing degree days to complete a generation. It acts as a constraint, limiting the organism according to the level of suitability of a specific location. If the minimum PDD is not met, the EI equal to 0 (Sutherst *et al.* 2007). Studies have reported that the life cycle takes between 38 and 62 calendar days to complete, depending on temperature and humidity (Vickery 1929; Sparks 1979). However, this is not an exact measurement in that it varies according to climatic zones. Growing degree days allow a more accurate measurement of the growth and development of insects during the growing season. Valdez-Torres *et al.* (2012) calculated the PDD for FAW at 504, with a temperature base (T_b) of 8.7^{O}C, while another experiment used PDD = 559.1, with T_b = 10.9ºC (Ramirez Garcia *et al.* 1987). In the current study, PDD was set at 600, as per Ramirez Cabral *et al.* 2017, because T_b is closer to DV0 i.e., 12ºC. This value is the time from egg to adult.

The resulting maps show areas that are likely to be at different level of risk of FAW as determined from the climatic suitability range (Fig 1). The current climate conditions modelled for FAW showed suitability for FAW occurrence in India.

- Tropical regions were found to be more suitable for its establishment which is similar to the observations of Luginbill 1928. High risk suitability areas with EI=>20 for FAW occurrence in India are projected in Fig 2.
- Currently, infestation of FAW is reported in twelve states in India *viz.*, Andhra Pradesh, Bihar, Chhattisgarh, Goa, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Telangana and West Bengal (CABI, 2020). The current analysis with Compare locations (Species 1) application has also indicated high climatic suitability in the above states with 20-95 EI values validating the present study (Fig 2).
- Climate is not the only factor limiting species geographical distribution (Brown *et al.*, 1996). Host availability is also important in actual determination of potential geographic areas. Though, FAW is polyphagous attacking about 80 plant species, it is reported mainly on maize in India. Therefore, 12 major Maize growing areas *viz.*, Andhra Pradesh, Bihar, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh

and West Bengal are considered while predicting the climatically suitable potential areas showing EI values between 20 - 95 for FAW establishment and the potential areas were given up to Taluk level (Table 2).

- High risk suitability areas are mostly noticed in South India and North east India. High risk potential areas were noticed in eight major maize growing states *viz*., Andhra Pradesh, Bihar, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu and Telangana while risk potential was medium to low in states of Rajasthan, Gujarat and Uttar Pradesh.
- The probable areas for the establishment of FAW based on climatic suitability and presence of major host, *i.e.*, Maize are projected in the Indian map (Fig 3), while the State maps are projected in Fig 5.

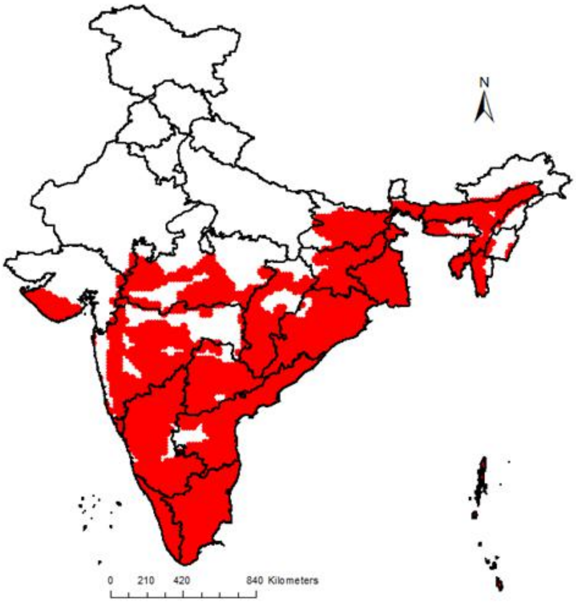

Fig 2: High Risk probability areas in India for the Establishment of Fall army worm

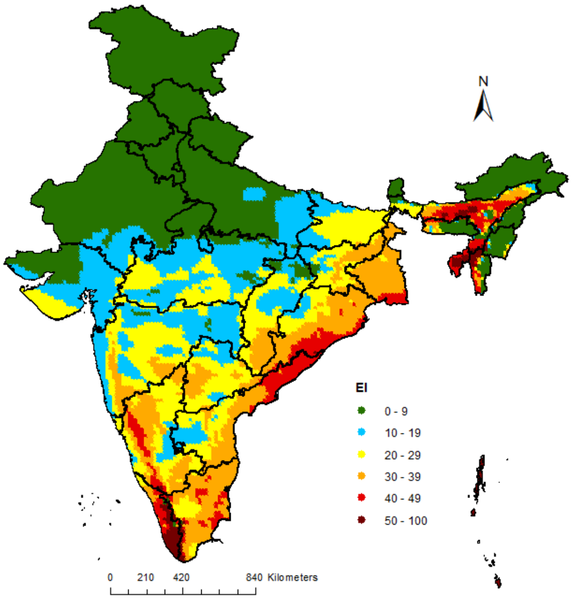

Fig 1: Different Risk probability areas in India for the Establishment of Fall army worm

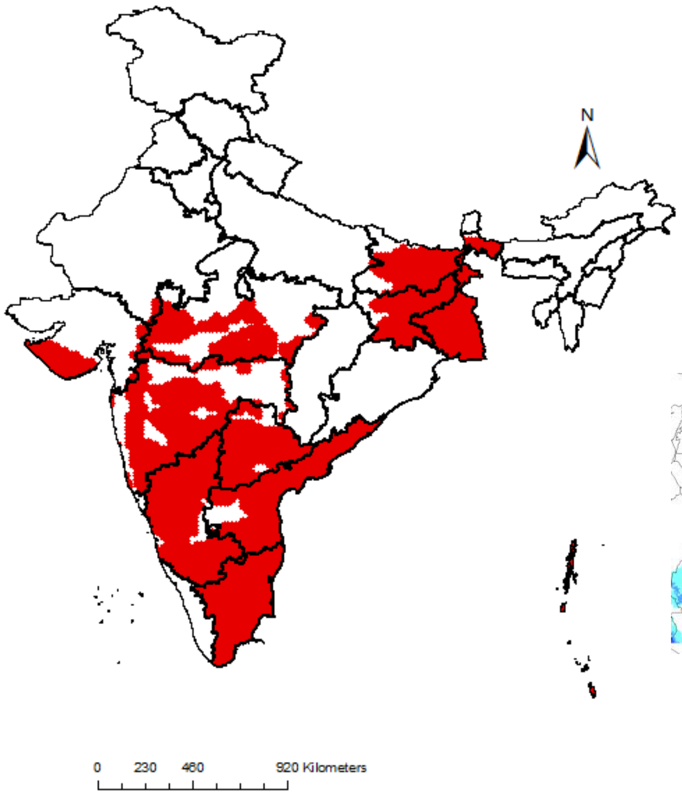

Fig 3: High Risk probability areas for the Establishment of Fall army worm in major Maize growing states in India

The CSIRO 2030, CSIRO 2050, MIROC 2030 and MIROC 2050 scenarios implemented under A2 emission scenario follow a similar pattern with different suitability with marked reduction by 2050 in the potential area for establishment of FAW (Fig 4a, 4b, 4c & 4d). The potential area will decrease its suitability significantly under MIROC 2050 in southern India eliminating few states *viz.*, Madhya Pradesh, Maharashtra, Telangana and Andhra Pradesh compared with the current scenario for FAW risk.

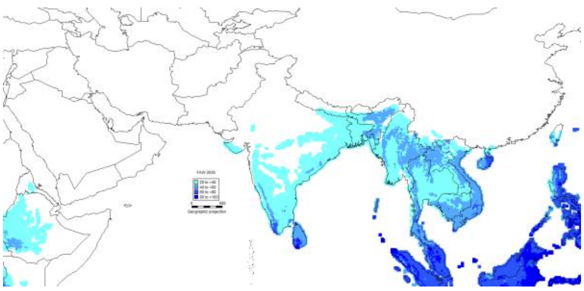

Fig 4a: CSIRO 2030

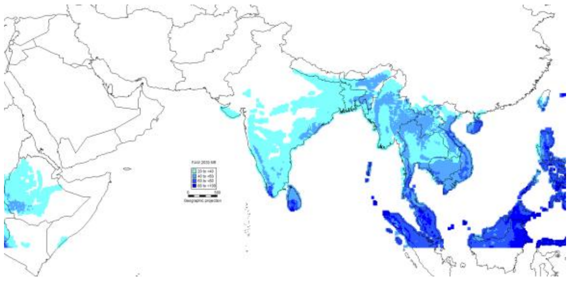

Fig 4b: MIROC 2030

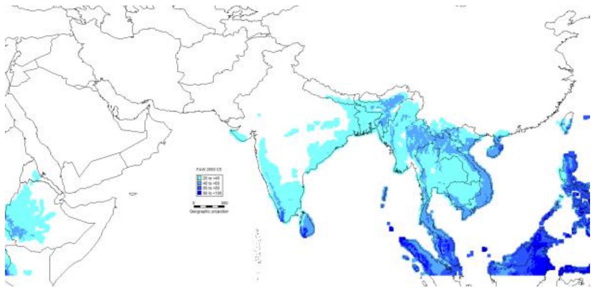

Fig 4c: CSIRO 2050

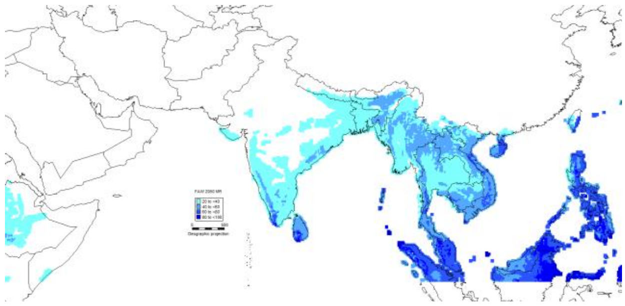

Fig 4d: MIROC 2050

III. DISCUSSION

The current FAW climate conditions projected for the model closely matches previous distributions, where FAW is listed as the major maize pest. In the present study, the reliability, accuracy and robustness of Climex model are reflected in high proportions from the validation area falling within the modelled area. The currently generated potential areas for fall army worm also include the recently infested areas in India thus validating the current prediction model. The maps generated based on Compare species 1 option appears to be more precise for the FAW species establishment. Hence, this option is recommended for better analysis subjected to the availability of the data on growth and stress parameters of the species. The data on the potential districts and their respective taluks for the establishment of pests is also generated using Arc GIS.

High suitability was shown in tropical wet and dry regions in India *i.e.,* South Indian states as per Koppen classification (Köppen, W *etal*., 1884). The marginal suitability projected by the model in few humid subtropical regions as in the case of Bihar, Jharkhand and Madhya Pradesh could be due to the fact that FAW occurs seasonally by migration from warm climates to subtropical regions. This migration has been estimated at a rate of movement of 40km/generation in years with favourable climate conditions (Westbrooks & Sparks 1986) that allow FAW to migrate.

The modelling carried out under the A2 scenario, predicts an increase in temperature for 2030 and 2050. These small increases in temperature are likely to change the current suitability of the climate for FAW in India leading to the reduction of potential area especially in Southern India. In tropical areas, insects are close to their thermal tolerance limits and so, small increase in temperature may reduce or prevent their survival. Conversely, the increase in temperature in cold places may enhance the insect fitness and survival indicating that the impact in tropical regions may be more drastic than in temperate regions and that the benefit of warmer temperatures will depend on the temperature sensitivity of the species (Helmuth *et al*. 2002, Deutsch *et al*. 2008, Tewksbury *et al*. 2008). Further, polyphagous pests adapt better to climate change due to their phenotypic and genotypic plasticity and may even feed on the hosts of lower quality when preferential hosts are not available (Sparks, 1979, Randall 1986, Bale *et al* 2002). The above results are consistent with the studies of Svobodova *et al*. 2014 and Ramirez cabral *et al*. 2017 explaining the reduction in suitable areas due to increased temperatures and reduced moisture levels.

IV. CONCLUSION AND WAY FORWARD

The FAW is polyphagous pest with many economically important hosts majorly attacking maize in India. Predicting the climatically suitable areas in India is essential to protect the future production of both staple and non-staple crops, since FAW attacks both. With this information, farmer, policy makers and government could implement adaption measures, such as the new technology, new varieties and management practices to overcome the impacts of FAW on important economic crops.

Pest management in agriculture may be more challenging under future climate and variability. The risk maps generated has application for mainly three types of personnel: pest survey specialists, program managers, and risk analysts for implementing surveys, for allocation of resources and to assess the potential establishment for high-risk pathways, commodities, or pests, respectively. Risk maps may also be useful in delimiting surveys or for managing pest eradications.

The results can be used to help guide pest risk assessments by the National Plant Protection Organization (NPPO), effective monitoring and surveillance of the unintentional introductions of this pest *via* trade from currently infested countries, and, policy makers and trade negotiators in making science-based decisions. In addition, India which is dealing with a relatively recent introduction and spread of fall army worm, the generated maps can be used to identify areas most at risk of the expansion of this pest. Efforts can be coordinated and concentrated strategically across susceptible areas to stem the incursion. An additional potential application of these maps is for Regional Central Integrated Pest Management Centres (CIPMCs) in the identification of areas most suitable for area-wide pest suppression or eradication. Areas with established populations of pests which are on the extreme margins of climate suitability can be targeted as the most likely locations for these suppression and eradication efforts.

The current modelling approach was carried out using only the climate data, which ignore potential genetic changes in species and adaption to new climatic conditions (Bradshaw & Holzapfel 2006). Future studies at global and regional levels are essential for better understanding of the FAW risk.

Table 2: Major Maize growing states with high risk probability areas for the establishment of Fall Armyworm with EI=>20.

Major Maize Growing States	**Potential Districts**	**Potential Taluks**
Andhra Pradesh	Anantapur	Gudibanda, Hindupur, Kadiri, Penukonda, Madakasira
	Chittoor	Satyavedu, Puttur, Chandragiri, Chittoor, Srikalahasti, Palamaner, Punganur, Kuppam, Vayalpad, Madanapalle
	Cuddapah	Rajampet, Rayachoti, Sidhout, Badvel, Proddatur, Cuddapah
	East Godavari	Prathipadu, Ellavaram, Razole, Amalapuram, Mummidivaram, Kakinada (Urban), Peddapuram, Rampachodavaram, Kothapeta, Kakinada (Urban), Peddapuram, Tuni, Ramachandrapuram1, Rajahmundry (Urban).
	Guntur	Repalle, Tenali, Bapatla, Guntur, Narasaraopet , Sattenapalle, Vinukonda, Gurazala
	Krishna	Machilipatnam, Avanigadda, Kaikalur, Gudivada, Nuzvid, Tiruvuru, Vijayawada (Urban), Gannavaram, Nandigama, Jaggayyapeta
	Kurnool	Nandyal, Atmakur2, Allagadda, Emmiganuru, Pattikonda, Alur1, Nandikotkur, Dhone, Kurnool
	Nellore	Sullurpeta, Venkatagiri, Gudur1, Nellore, Kavali, Rapur, Atmakur3, Kovur, Rapur, Udayagiri
	Prakasam	Markapur, Giddalur, Addanki, Kandukur, Darsi, Chirala, Ongole, Kanigiri, Podili
	Srikakulam	Palakonda, Pathapatnam, Srikakulam, Sompeta, Ichchapuram, Tekkali, Narasannapeta
	Visakhapatnam	Chodavaram, Ananthagiri, Chintapalle, Narsipatnam, Anakapalle, Visakhapatnam (Urban), Paderu, Bheemunipatnam, Yelamanchili.
	Vizianagaram	Srungavarapukota, Salur, Parvathipuram, Vizianagaram, Chipurupalle, Pusapatirega
	West Godavari	Narsapuram, Polavaram, Bhimavaram, Tanuku, Tadepalligudem, Kovvur, Tadepalligudem, Eluru.
Telangana	Adilabad	Asifabad, Utnoor, Luxettipet, Boath, Nirmal, Khanapur, Adilabad, Mudhole.
	Hyderabad	Hyderabad
	Karimnagar	Sircilla, Huzurabad, Karimnagar, Sircilla, Karimnagar, Manthani, Medipalle, Jagtial, Sultanabad
	Khammam	Burgampahad, Kothagudem1, Madhira, Yellandu, Nugur, Khammam (Urban).
	Mahbubnagar	Achampet, Farooqnagar, Kodangal, Kollapur, Mahbubnagar, Kalwakurthy, Nagarkurnool, Makthal, Wanaparthy, Gadwal, Atmakur1, Alampur.
	Medak	Zahirabad, Narayankhed, Sangareddy, Gajwel, Andole, Siddipet, Narsapur, Medak

	Nalgonda	Bhongir, Devarakonda, Ramannapeta, Nalgonda, Suryapet, Huzurnagar
	Nizamabad	Kamareddy, Yellareddy, Madnoor, Armur, Banswada, Nizamabad, Armur, Bodhan
	Rangareddi	Pargi, Tandur, Vicarabad, Chevella, Rajendranagar, Medchal, Ibrahimpatnam, Hayathnagar
	Warangal	Narsampet, Jangaon, Hanamkonda, Mulug1, Mahabubabad, Parkal
Karnataka	Bagalkot	Badami, Bilgi, Jamkhandi, Hungund, Bagalkot, Mudhol
	Bangalore	Anekal, Bangalore South, Bangalore North
	Bangalore Rural	Ramanagaram, Kanakapura, Magadi, Nelamangala, Devanahalli, Dod Ballapur, Channapatna, Hosakote.
	Belgaum	Sampgaon, Hukeri, Belgaum, Parasgad, Gokak, Chikodi, Ramdurg, Khanapur , Raybag, Athni.
	Bellary	Hadagalli, Sandur, Hospet, Kudligi, Hagaribommanahalli, Siruguppa
	Bidar	Bidar, Homnabad, Bhalki, Aurad, Basavakalyan, Aurad
	Bijapur	Bijapur, Basavana Bagevadi, Muddebihal, Sindgi, Indi.
	Chamarajanagar	Kushtagi, Yelbarga, Koppal, Gangawati.
	Chamaraja-nagar	Gundlupet, Kollegal, Yelandur, Chamrajnagar
	Chikmagalur	Narasimharajapura, Tarikere, Chikmagalur, Kadur, Koppa, Mudigere, Sringeri
	Chitradurga	Holalkere, Chitradurga, Hosadurga
	Dakshina Kannada	Sulya, Puttur, Beltangadi, Bantval, Mangalore.
	Davanagere	Honnali, Channagiri, Harpanahalli, Harihar, Davanagere, Jagalur.
	Dharwad	Kalghatgi, Hubli, Dharwad, Navalgund
	Gadag	Shirhatti, Mundargi, Gadag, Ron, Nargund.
	Gulbarga	Sedam, Chincholi, Shorapur, Gulbarga, Yadgir, Aland, Jevargi, Chitapur, Shahpur, Afzalpur.
	Hassan	Arkalgud, Hassan, Belur, Alur, Belur, Hole Narsipur, Manjarabad, Channarayapatna, Arsikere.
	Haveri	Hangal, Shiggaon, Hirekerur, Haveri, Savanur, Ranibennur, Hirekerur
	Kodagu	Virajpet, Somvarpet, Madikeri
	Kolar	Chik Ballapur, Gauribidanur, Sidlaghatta, Kolar, Chintamani, Bagepalli, Malur, Bangarapet, Mulbagal, Gauribidanur
	Mandya	Maddur, Malavalli, Shrirangapattana, Krishnarajpet, Maddur, Pandavapura, Nagamangala
	Mysore	Heggadadevankote, Piriyapatna, Hunsur, Nanjangud, Krishnarajanagara, Tirumakudal Narsipur, Mysore
	Raichur	Lingsugur, Devadurga, Raichur, Manvi, Sindhnur

	Shimoga	Shimoga, Sorab, Bhadravati, Shikarpur, Sagar, Tirthahalli, Hosanagara
	Tumkur	Kunigal, Tumkur, Gubbi, Koratagere, Turuvekere, Tiptur, Chiknayakanhalli, Madhugiri, Pavagada.
	Udupi	Karkal, Udupi
	Uttara Kannada	Haliyal, Mundgod, Yellapur, Supa, Sirsi, Siddapur, Ankola, Karwar, Kumta
Tamil Nadu	Ariyalur	Udayarpalayam, Ariyalur
	Chennai	Chennai
	Coimbatore	Coimbatore, Pollachi, Udumalaipettai, Mettupalayam, Avanashi, Palladam, Udumalaipettai.
	Cuddalore	Kattumannarkoil, Virudhachalam, Cuddalore, Chidambaram
	Dharmapuri	Harur, Denkanikottai, Pennagaram, Palakkodu, Uthangarai, Krishnagiri
	Dindigul	Kodaikanal, Palani, Dindigul, Natham, Nilakkottai, Vedasandur
	Erode	Sathyamangalam, Bhavani, Perundurai, Dharapuram, Erode.
	Kancheepuram	Cheyyur, Sriperumbudur, Uthiramerur, Chengalpattu, Kancheepuram, Tambaram
	Kanniyakumari	Vilavancode, Thovala, Kalkulam
	Karur	Kulithalai, Krishnarayapuram, Karur
	Madurai	Usilampatti, Melur, Madurai North, Vadipatti, Madurai South, Thirumangalam
	Nagapattinam	Vedaranyam, Mayiladuthurai, Tharangambadi, Sirkali
	Namakkal	Namakkal, Rasipuram, Tiruchengode
	Perambalur	Perambalur, Thuraiyur
	Pudukkottai	Aranthangi, Pudukkottai, Alangudi, Thirumayam, Kulathur
	Ramanathapuram	Tiruvadanai, Ramanathapuram, Paramakudi, Mudukulathur, Kamuthi
	Salem	Salem, Attur, Omalur, Mettur, Sankari
	Sivaganga	Tirupathur, Karaikkudi, Sivaganga, Devakottai, Ilayangudi.
	Thanjavur	Pattukkottai, Peravurani, Orathanadu, Papanasam, Kumbakonam, Thanjavur
	The Nilgiris	Udhagamandalam, Gudalur, Kotagiri
	Theni	Uthamapalayam, Periyakulam
	Thiruvallur	Tiruttani, Uthukkottai, Ambattur, Pallipattu, Ponneri, Gummidipoondi
	Thiruvarur	Mannargudi, Nannilam, Thiruvarur
	Thoothukkudi	Kovilpatti, Sathankulam, Vilathikulam, Ottapidaram, Tiruchendur, Srivaikuntam, Thoothukkudi
	Tiruchirappalli	Manapparai, Lalgudi, Tiruchirappalli
	Tirunelveli	Tenkasi, Shenkottai, Ambasamudram, Sivagiri, Sankarankoil, Radhapuram, Nanguneri, Tirunelveli, Palayamkottai

	Tiruvannamalai	Polur, Vandavasi, Arani, Cheyyar, Chengam, Tiruvannamalai, Chengam
	Vellore	Tirupathur, Vaniyambadi, Vellore, Arcot, Arakonam, Walajapet
	Viluppuram	Kallakkurichi, Tirukkoyilur, Viluppuram, Tindivanam, Gingee
	Virudhunagar	Rajapalayam, Srivilliputhur, Sattur, Tiruchuli, Virudhunagar, Aruppukkottai.
Maharashtra	Ahmadnagar	Mahal, Sangamner, Pathardi, Parner, Shevgaon, Karjat, Nevasa, Shrigonda
	Amravati	Chikhaldara, Melghat, Morshi, Achalpur, Warud.
	Aurangabad	Khuldabad, Kannad, Sillod, Aurangabad, Aurangabad, Gangapur, Vaijapur, Soegaon, Paithan.
	Bid	Kaij, Ambejogai, Patoda, Bid, Ashti1, Georai, Manjlegaon.
	Buldana	Buldana, Chikhli, Deolgaon Raja, Mehkar, Lonar, Motala, Khamgaon.
	Chandrapur	Rajura
	Dhule	Sakri, Shirpur
	Gadchiroli	Etapalli, Dhanora, Aheri, Kurkheda.
	Gondiya	Deori
	Hingoli	Hingoli, Kalamnuri, Basmath
	Jalgaon	Jamner, Jalgaon
	Jalna	Bhokardan, Jafferabad, Jalna, Ambad.
	Kolhapur	Gadhinglaj, Kagal, Karvir, Hatkanangle, Shirol, Ajra, Panhala, Radhanagari, Shahuwadi, Chandgad, Bhudargad, Bavda.
	Latur	Nilanga, Udgir, Ausa, Nilanga, Latur, Ahmadpur.
	Nagpur	Parseoni, Katol, Narkhed, Savner, Ramtek, Hingna.
	Nanded	Mukhed, Kandhar, Bhokar, Kinwat, Deglur, Biloli, Hadgaon.
	Nandurbar	Akhrani, Akkalkuwa, Nandurbar
	Nashik	Nashik, Sinnar, Dindori, Niphad, Nandgaon, Kalwan, Chandvad, Baglan, Igatpuri, Niphad, Peint, Yevla, Surgana, Malegaon.
	Osmanabad	Umarga, Osmanabad, Kalamb, Tuljapur, Bhum, Paranda
	Parbhani	Manwath, Jintur, Pathri.
	Pune	Bhor, Haveli, Mulshi, Mawal, Purandhar, Khed, Ambegaon, Junnar, Velhe, Shirur, Mawal
	Raigarh	Mahad
	Ratnagiri	Sangameshwar
	Sangli	Walwa, Shirala, Jat, Tasgaon, Miraj, Kavathemahankal, Khanapur, Atpadi
	Satara	Karad, Satara, Wai, Khandala, Koregaon, Phaltan, Man, Patan, Khatav, Jaoli, Mahabaleshwar
	Sindhudurg	Sawantwadi, Devgad, Vengurla, Malwan
	Solapur	Sangole, Barshi, Akkalkot, Solapur South, Mangalvedhe, Mohol, Madha, Karmala, Mangalvedhe, Pandharpur
	Thane	Palghar

	Wardha	Karanja
	Washim	Risod, Malegaon, Mangrulpir, Manora
	Yavatmal	Pusad, Umarkhed, Mahagaon
Madhya Pradesh	Balaghat	Baihar, Waraseoni, Lanji, Balaghat
	Barwani	Sendhwa, Barwani, Pansemal
	Betul	Betul, Bhainsdehi, Multai
	Bhopal	Huzur, Berasia
	Chhindwara	Amarwara, Chhindwara, Parasia, Sausar.
	Damoh	Damoh
	Dewas	Bagli, Dewas, Sonkatch
	Dhar	Badnawar, Dhar, Kukshi, Manawar, Sardarpur
	Dindori	Dindori
	East Nimar	Burhanpur, Khandwa.
	Harda	Harda
	Hoshangabad	Sohagpur, Pipariya, Itarsi.
	Indore	Depalpur, Mhow, Indore, Sawer
	Jhabua	Jobat, Jhabua, Petlawad, Alirajpur, Petlawad, Thandla
	Mandsaur	Mandsaur
	Narsimhapur	Narsimhapur, Gadarwara
	Raisen	Goharganj, Baraily, Udaipura, Raisen, Gairatganj, Silwani, Begamganj
	Rajgarh	Sarangpur,Narsinghgarh,Rajgarh,Khilchipur,Biaora
	Ratlam	Ratlam, Sailana, Jaora, A lot.
	Rewa	Gurh,Mauganj,Sirmour,Teonthar
	Sagar	Rehli, Sagar, Banda1.
	Sehore	Nasrullaganj,Budni,Ashta,Ichhawar, Sehore
	Satna	Maihar,Amarpatan,Nagod, Raghurajnagar
	Seoni	Seoni, Lakhnadon.
	Shahdol	Pushparajgarh,Anuppur,Sohagpur1,Jaisinghnagar,Beohari
	Shajapur	Shajapur,Shujalpur,Agar,Susner
	Sheopur	Sheopur,Vijaypur
	Shivpuri	Kolaras,Khaniyadhana,Pohari,Shivpuri,Karera
	Sidhi	Gopadbanas,Singrauli,Deosar
	Tikamgarh	Tikamgarh,Jatara, Niwari
	Ujjain	Badnagar, Khacharod, Ujjain, Tarana, Mahidpur.
	Umaria	Bandhogarh
	Vidisha	Vidisha,Basoda,Lateri,Kurwai,Sironj
	West Nimar	Bhagwanpura,Jhiranya,Segaon,Khargone,Bhikangaon,Kasrawad,Barwaha,Ma

		heshwar
Bihar	Araria	Araria
	Banka	Banka
	Begusarai	Begusarai
	Bhagalpur	Bhagalpur, Naugachhia
	Bhojpur	Arrah
	Buxar	Buxar
	Darbhanga	Benipur, Darbhanga.
	Gaya	Gaya
	Gopalganj	Gopalganj
	Jamui	Jamui
	Jehanabad	Jehanabad
	Katihar	Katihar
	Kaimur (Bhabua)	Bhabua
	Khagaria	Khagaria
	Katihar	Katihar
	Khagaria	Khagaria
	Kishanganj	Kishanganj
	Lakhisarai	Lakhisarai
	Madhepura	Madhepura, Udakishanganj
	Madhubani	Jhanjharpur,Madhubani,Benipatti
	Munger	Munger
	Muzaffarpur	Purba muzaffarpur
	Nalanda	Bihar, Hilsa.
	Nawada	Nawada
	Pashchim Champaran	Bettiah
	Patna	Dinapur-Cum-Khagaul,Masaurhi,Patna city,Barh,Patna Rural
	Purba Champaran	Motihari,Dhaka
	Purnia	Purnia East
	Rohtas	Sasaram
	Saharsa	Sonbarsa
	Samastipur	Rosera, Samastipur, Dalsinghsarai.
	Saran	Chapra
	Sheikhpura	Sheikhpura
	Sheohar	Sheohar
	Sitamarhi	Purba sitamarhi
	Siwan	Siwan
	Supaul	Supaul, Saraigarh Bhaptiyahi.

	Vaishali	Hajipur
Gujarat	Amreli	Jafrabad, Dhari, Rajula, Savar Kundla, Kunkavav Vadia, Amreli, Lilia, Babra.
	Bhavnagar	Mahuva, Talaja, Palitana.
	Dohad	Dohad, Limkheda, Jhalod.
	Jamnagar	Kalyanpur, Bhanvad, Jamjodhpur, Khambhalia, Lalpur, Kalavad.
	Junagadh	Patan-Veraval, Kodinar, Una, Malia, Talala, Manavadar, Mangrol, Keshod, Mendarda, Visavadar, Vanthali, Junagadh, Bhesan.
	Narmada	Dediapada
	Porbandar	Kutiyana, Ranavav, Porbandar.
	Rajkot	Upleta, Dhoraji, Jetpur, Jamkandorna, Gondal.
	The Dangs	The Dangs
	Vadodara	Chhota Udaipur
West Bengal	Bankura	Vishnupur, Bankura
	Barddhaman	Burdwan – I, Kalna – I, Katoya.
	Birbhum	Bolpur Sriniketan, Rampurhat, Suri – I.
	Dakshin Dinajpur	Balurghat
	Darjiling	Darjeeling Pulbazar
	Haora	Shyampur-I, Sankrail, Uluberia-I
	Hugli	Arambag, Serampur Uttarpara, Hugli.
	Jalpaiguri	Jalpaiguri, Alipurduar
	Koch Bihar	Dinhata – I, Tufanganj-I, Mathabhanga – II, Cooch Behar – I, Mekliganj,
	Maldah	Maldah (Old)
	Medinipur	Contai – I, Tamluk, Midnapore, Jhargram, Ghatal.
	Murshidabad	Murshidabad Jiaganj, Berhampore, Jalangi, Kandi1.
	Nadia	Kalyani, Ranaghat, Krishnagar – II.
	North Twenty Four Paraganas	Basirhat – I, Bongaon
	Puruliya	Puruliya-1
	South Twenty Four Paraganas	Diamond Harbour – I, Bhangar-I.
	Uttar Dinajpur	Raiganj, Islampur.
Jharkhand	Bokaro	Bermo
	Chatra	Chatra
	Deoghar	Deoghar
	Dhanbad	Baghmara-Cum-Katras, Dhanbad-Cum-Kenduadih-Jagta.
	Dumka	Dumka, Jamtara.
	Giridih	Giridih

	Godda	Godda
	Gumla	Simdega, Gumla.
	Hazaribagh	Hazaribag
	Kodarma	Kodarma
	Pakaur	Pakaur
	Palamu	Latehar, Daltonganj.
	Pashchimi Singhbhum	Chaibasa, Kharsawan, Chakradharpur.
	Purbi Singhbhum	Dhalbhumgarh
	Ranchi	Khunti, Ranchi.
	Sahibganj	Rajmahal
Uttar Pradesh	Agra	Kheragarh,Bah,Kiraoli,Agra,Etmadpur
	Aligarh	Khair,Atrauli
	Allahabad	Meja,Karchhana,Allahabad,Phulpur1,Handia, Soraon
	Ambedkar Nagar	Akbarpur1,Tanda
	Auraiya	Auraiya,Bidhuna
	Azamgarh	Lalganj,Azamgarh,Phulpur, Sagri
	Baghpat	Baghpat
	Bahraich	Kaiserganj,Nanpara
	Ballia	Ballia,Rasra,Bansdih
	Balrampur	Utraula,Balrampur
	Banda	Naraini,Banda,Baberu
	Barabanki	Haidergarh,Nawabganj,Ramsanehighat
	Bareilly	Aonla,Bareilly,Faridpur,Baheri
	Basti	Basti,Harraiya
	Bijnor	Bijnor,Dhampur,Nagina,Najibabad
	Budaun	Dataganj,Budaun,Gunnaur,Sahaswan,Bisauli
	Bulandshahar	Khurja,Bulandshahr,Anupshahr,Sikandrabad
	Chandauli	Chakia,Chandauli,Sakaldiha
	Chitrakoot	Karwi,Mau
	Deoria	Salempur,Deoria
	Etah	Jalesar,Etah,Aliganj,Kasganj
	Etawah	Bharthana,Etawah
	Faizabad	Bikapur,Faizabad
	Farrukhabad	Kaimganj
	Fatehpur	Khaga,Fatehpur,Bindki
	Firozabad	Shikohabad,Firozabad,Jasrana
	Gautam Buddha Nagar	Dadri

	Ghaziabad	Hapur,Ghaziabad,Garhmukteshwar
	Ghazipur	Saidpur,Ghazipur,Mohammadabad
	Gonda	Tarabganj,Gonda
	Gorakhpur	Bansgaon,Gorakhpur
	Hamirpur	Maudaha,Rath,Hamirpur
	Hardoi	Sandila,Bilgram,Hardoi,Shahabad
	Hathras	Sadabad,Hathras,Sikandra Rao,Sasni **
	Jalaun	Konch,Orai,Kalpi,Jalaun
	Jaunpur	Machhlishahr,Mariahu,Kerakat,Jaunpur,Shahganj
	Jhansi	Jhansi,Mauranipur,Garautha,Moth
	Jyotiba Phule Nagar	Hasanpur,Amroha
	Kannauj	Chhibramau,Kannauj
	Kanpur Dehat	Bhognipur,Pukhrayan,Derapur,Akbarpur2
	Kanpur Nagar	Kanpur
	Kaushambi	Manjhanpur,Sirathu
	Kheri	Mohammdi,Nighasan,Lakhimpur
	Kushinagar	Hata,Padrauna
	Lalitpur	Mahroni,Lalitpur
	Lucknow	Mohanlalganj,Lucknow,Malihabad
	Mahoba	Kulpahar,Mahoba,Charkhari
	Mahrajganj	Pharenda
	Mainpuri	Karhal,Bhogaon,Mainpuri
	Mathura	Mathura,Chhata,Mat
	Mau	Maunath Bhanjan,Ghosi
	Meerut	Meerut,Mawana,Sardhana
	Mirzapur	Mirzapur,Chunar
	Moradabad	Sambhal,Bilari,Moradabad,Thakurdwara
	Muzaffarnagar	Budhana,Jansath,Kairana,Muzaffarnagar
	Pilibhit	Bisalpur,Puranpur,Pilibhit
	Pratapgarh	Kunda,Patti
	Rae Bareli	Salon,Dalmau,Rae Bareli,Maharajganj
	Rampur	Rampur,Suar
	Saharanpur	Nakur,Deoband,Saharanpur
	Sant Kabir Nagar	Khalilabad
	Sant Ravidas Nagar Bhadohi	Gyanpur
	Shahjahanpur	Farrukhabad,Shahjahanpur,Tilhar,Powayan
	Shrawasti	Bhinga
	Siddharthnagar	Domariyaganj,Bansi,Naugarh

	Sitapur	Misrikh,Sidhauli,Biswan
	Sonbhadra	Dudhi,Robertsganj
	Sultanpur	Amethi,Sultanpur,Kadipur,Gauriganj,Musafirkhana
	Unnao	Purwa,Unnao,Safipur,Hasanganj
	Varanasi	Varanasi
Rajasthan	Ajmer	Beawar,Kekri,Bhinay,Sarwar,Ajmer,Nasirabad,Kishangarh
	Alwar	Thanagazi,Rajgarh1,Lachhmangarh,Alwar,Bansur,Ramgarh,Mandawar,Kishangarh Bas,Behror,Tijara
	Banswara	Kushalgarh,Kalinjara,Banswara,Garhi
	Baran	Chhipabarod,Chhabra,Atru,Baran,Kishanganj,Shahbad
	Barmer	Chohtan,Gudha Malani,Siwana,Sheo,Barmer,Pachpadra
	Bharatpur	Bayana,Weir,Rupbas,Nadbai,Nagar,Deeg,Kaman
	Bhilwara	Sahara,Mandalgarh,Bhilwara,Kotri,Mandal,Jahazpur,Asind,BaneraShahpura, Hurda
	Bikaner	Kolayat,Nokha,Bikaner,Lunkaransar
	Bundi	Bundi,Hindoli,Keshoraipatan,Nainwa
	Chittaurgarh	Arnod,Pratapgarh,BariSadri,Chhoti,Sadri,Nimbahera,Bhadesar,Kapasan, Begun,Rashmi,Gangrar
	Churu	Sujangarh,Dungargarh,Ratangarh,Churu,Sardarshahar,Taranagar
	Dausa	Lalsot,Dausa,Sikrai,Mahwa,Baswa
	Dhaulpur	Baseri,Bari,Dhaulpur
	Dungarpur	Sagwara,Simalwara,Dungarpur,Aspur
	Ganganagar	Gharsana,Anupgarh,Vijainagar,Suratgarh,Raisinghnagar,Padampur, Karanpur,Ganganagar,Sadulshahar
	Hanumangarh	Rawatsar,Nohar,Bhadra,Pilibanga,Tibi,Hanumangarh,Sangaria
	Jaipur	Dudu (Hq. Mauzamabad),Phagi,Chaksu,Sanganer,Bassi, Phulera (Hq.Sambhar),Jaipur,Jamwa Ramgarh,Amber,Chomu,Viratnagar,Kotputli
	Jaisalmer	Jaisalmer,Pokaran
	Jalor	Sanchore,Raniwara,Bhinmal,Jalor,Ahore
	Jhalawar	Gangdhar,Pirawa,Jhalrapatan,Aklera,Pachpahar,Khanpur
	Jhunjhunun	Nawalgarh,Udaipurwati,Khetri,Jhunjhunun,Chirawa
	Jodhpur	Jodhpur,Shergarh,Bilara,Bhopalgarh,Osian,Phalodi
	Karauli	Sapotra,Karauli,Nadoti,Todabhim,Hindaun
	Kota	Ramganj Mandi,Sangod,Ladpura,Digod,Pipalda
	Nagaur	Merta,Degana,Parbatsar,Nagaur,Jayal,Nawa,Didwana,Ladnu
	Pali	Bali,Desuri,Pali,Jaitaran,Sojat
	Rajsamand	Nathdwara,Railmagra,Kumbhalgarh,Rajsamand,Amet, Deogarh,Bhim
	Sawai Madhopur	Sawai Madhopur,Khandar,Bonli,Bamanwas
	Sikar	Sikar,Sri Madhopur,Neem-Ka-Thana
	Sirohi	Abu Road,Reodar,Pindwara,Sirohi,Sheoganj

	Tonk	Uniara,Todaraisingh,Tonk,Malpura,Niwai
	Udaipur	Kherwara,Phalsiya,Sarada,Salumbar,Kotra,Girwa,Vallabhnagar, Gogunda

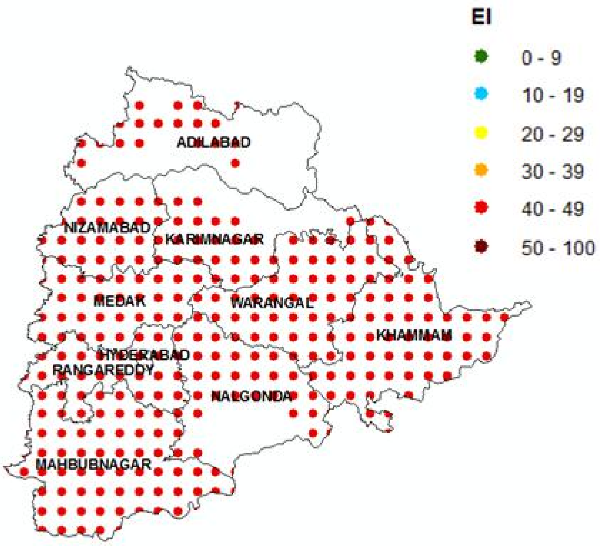

Fig 5a: Telangana

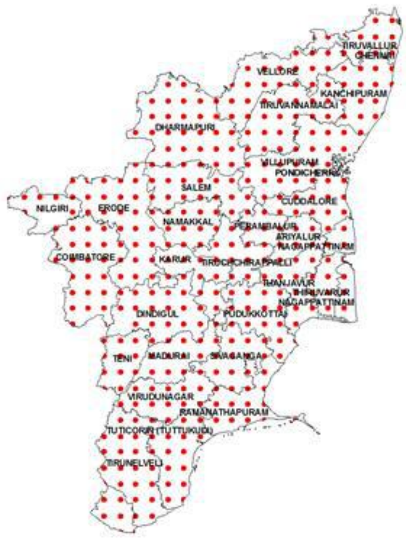

Fig 5c: Tamil Nadu

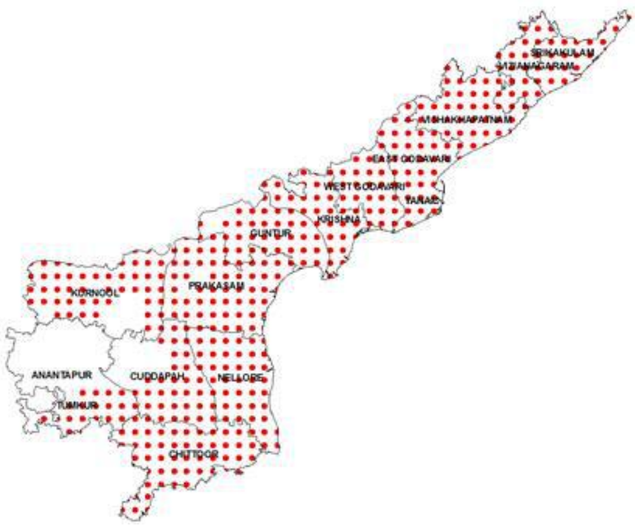

Fig 5b: Andhra Pradesh

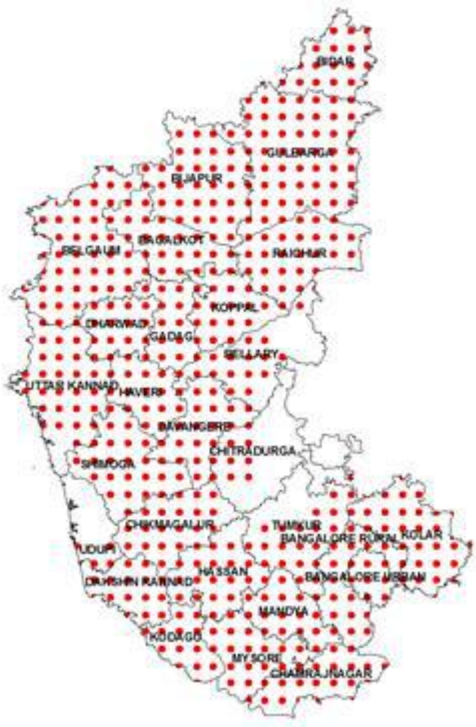

Fig 5d: Karnataka

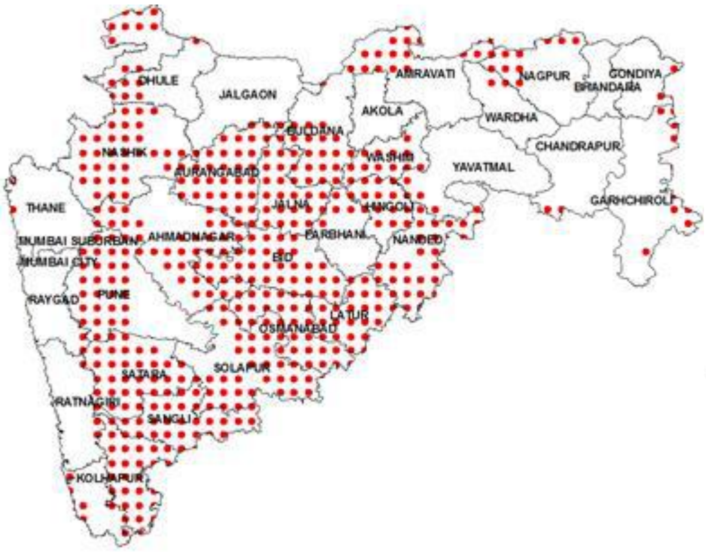

Fig 5e: Maharashtra

Fig 5f: Madhya Pradesh

Fig 5g: Uttar Pradesh

Fig 5h: Bihar

Fig 5i: Rajasthan

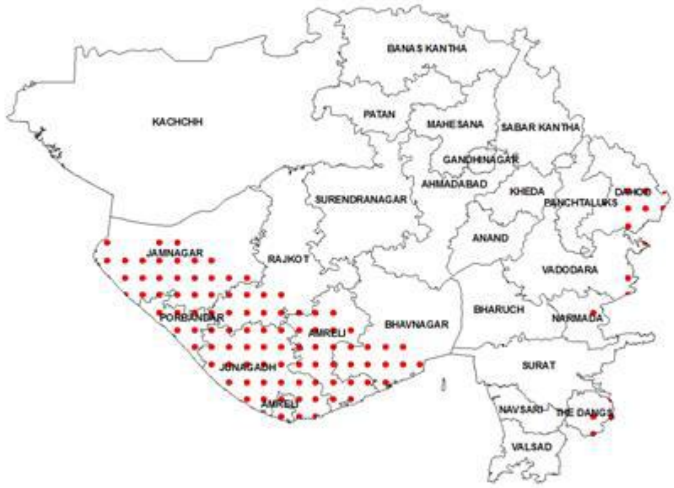

Fig 5j: Gujarat

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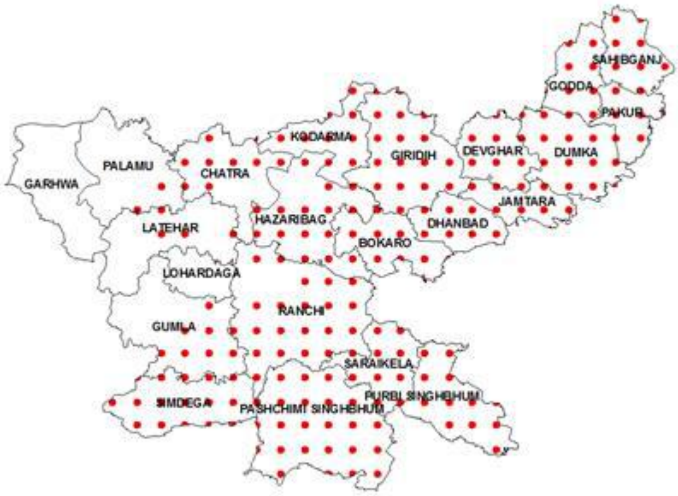

Fig 5l: Jharkhand

Fig 5k: West Bengal

Fig 5: Risk probability areas in the Major Maize Growing States

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