



Weather ready: Innovative technologies for weather vagaries

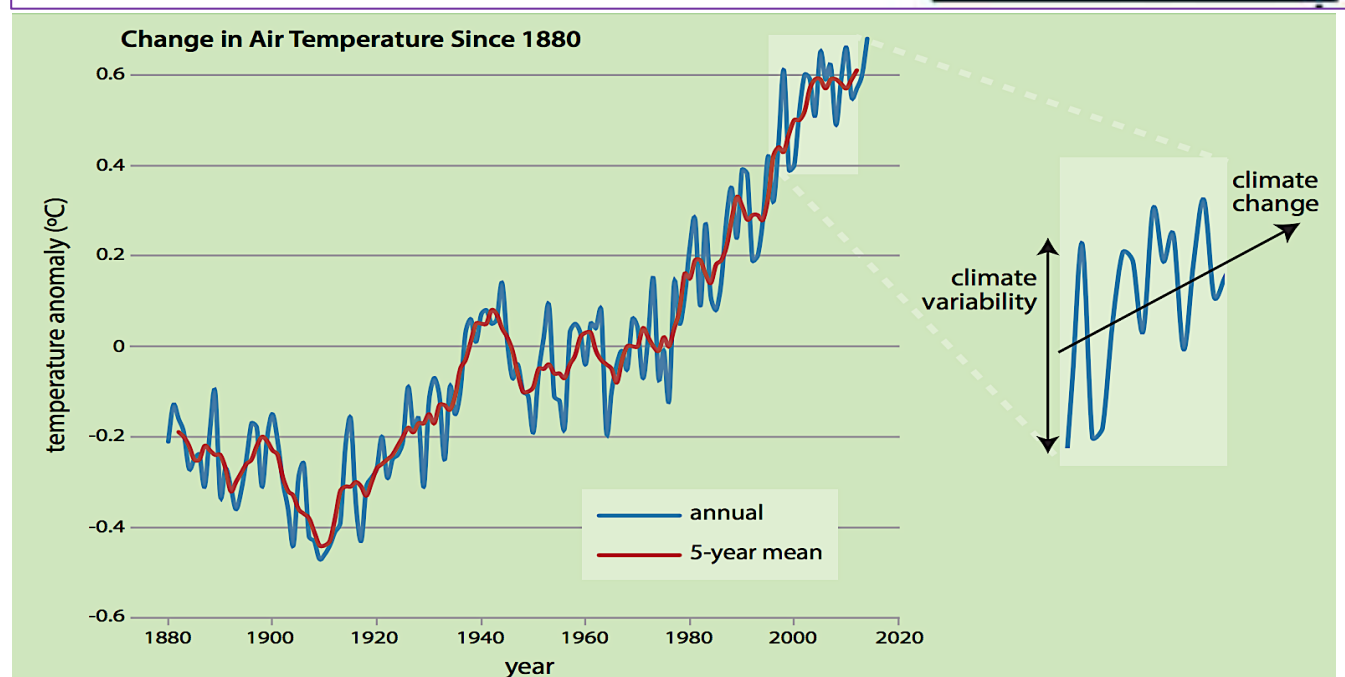
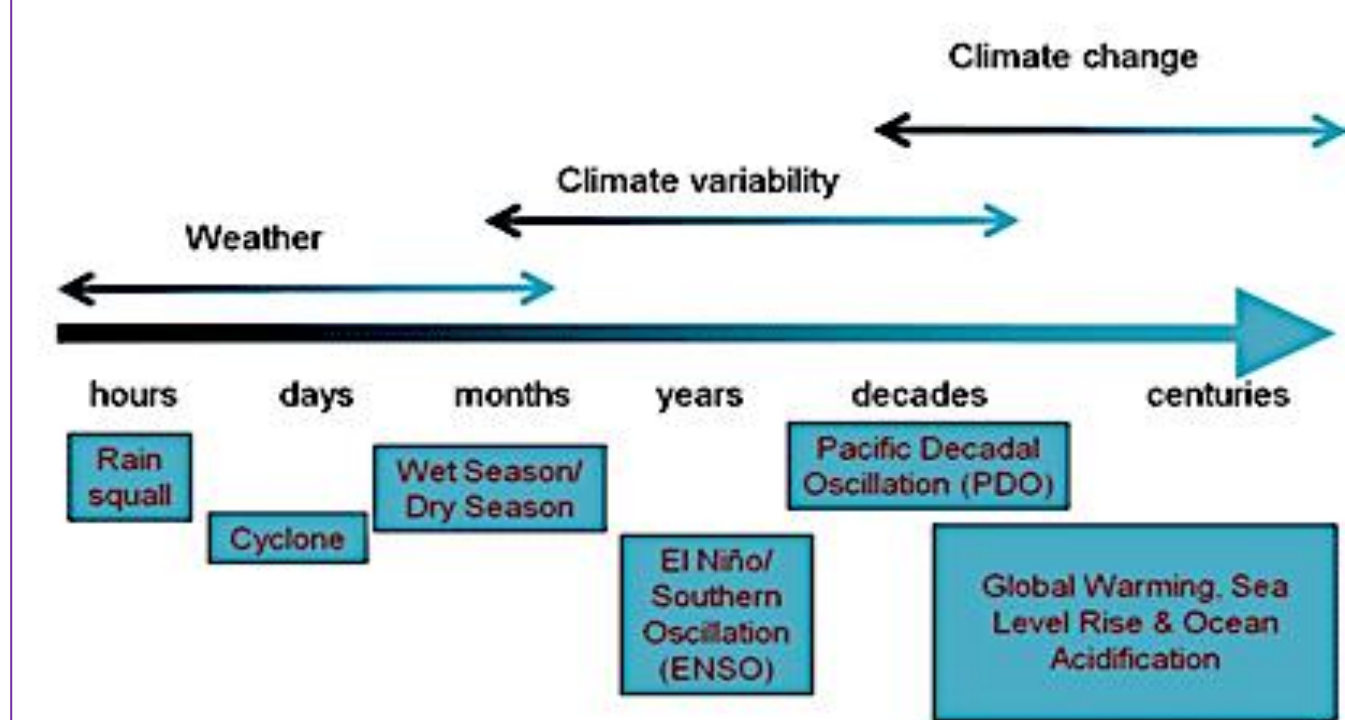


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Weather, Climate, Variability & Change

- **Weather:** Changes within a short period
- **Climate:** Ave. weather over a period & large area
- **Climate variability:** Reversible deviation from the normal
- **Climate change:** Irreversible changes over a period

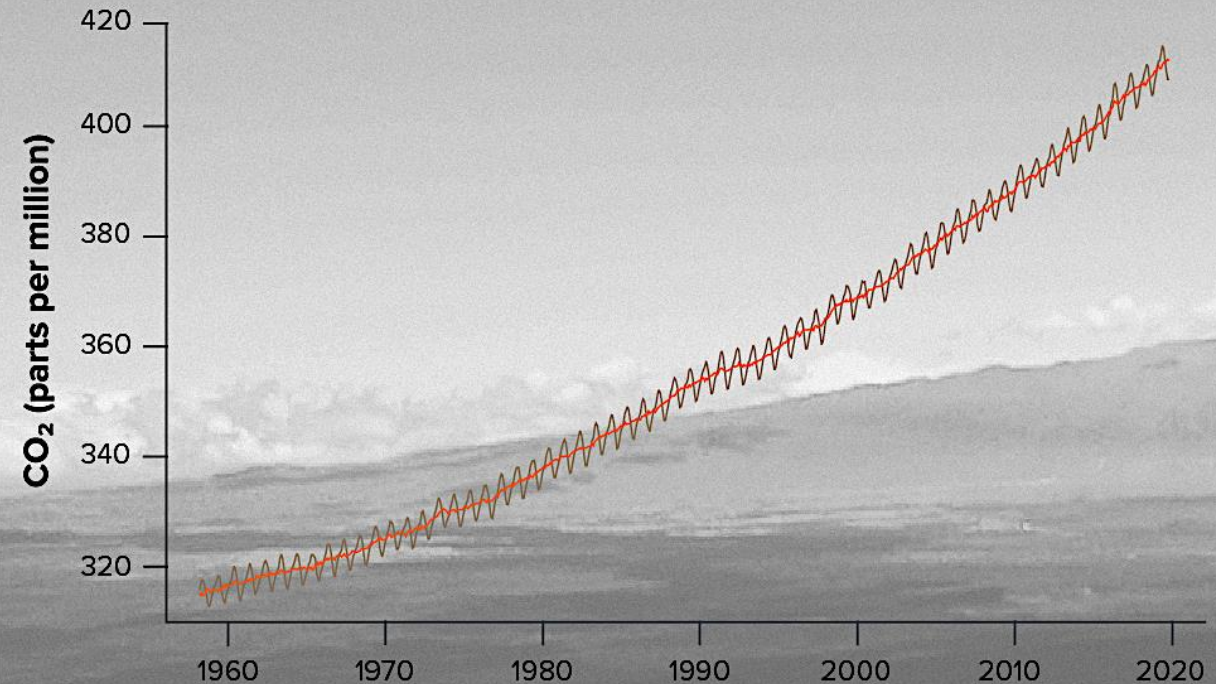




Global CO₂ level at Mauna Loa

Mauna Loa, the world's largest volcano,
Located on the south-central island of Hawaii, U.S.,

Atmospheric CO₂ at Mauna Loa Observatory



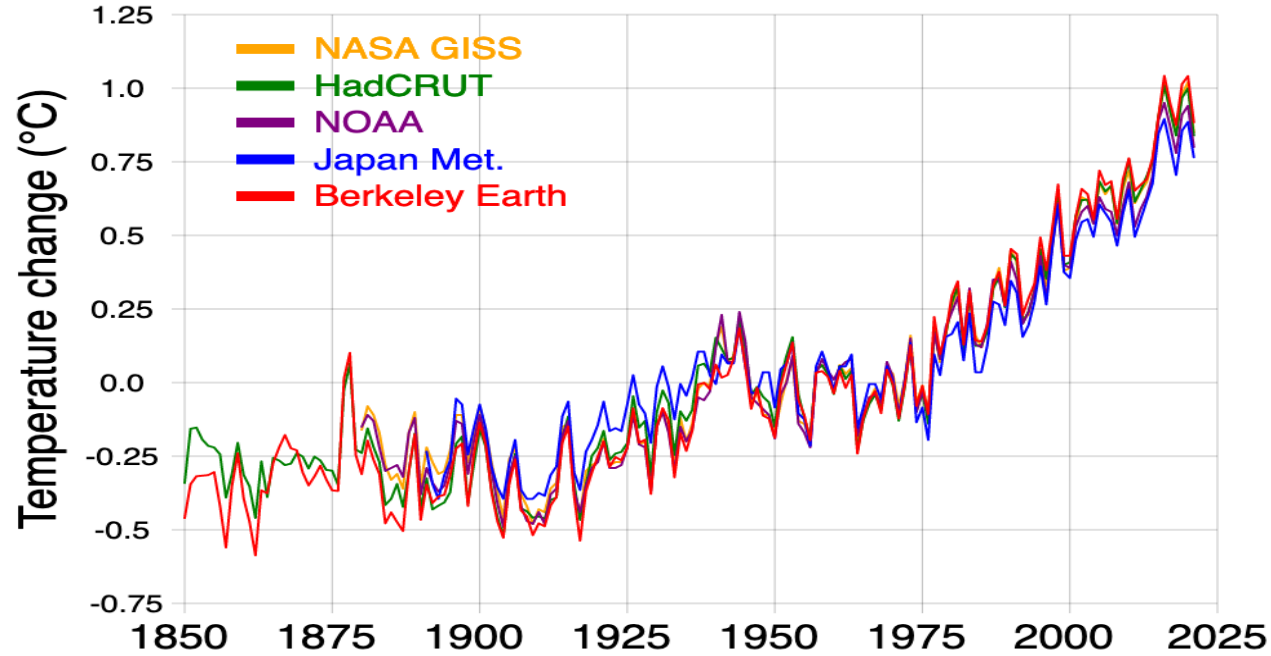
June 2020 416.60 ppm
June 2021 418.94 ppm
June 2022 420.99 ppm
June 2023 423.68 ppm

Impact of Climate Change

Global Temperature

- 1850 - 1975 (125 years) → 0.25°C
- 1975 - 2000 (25 years) → 0.75°C
- 2000 - 2020 (20 years) → 1.00°C
- Approximately 0.5°C per decade

Global average temperature change



Sea Level rise

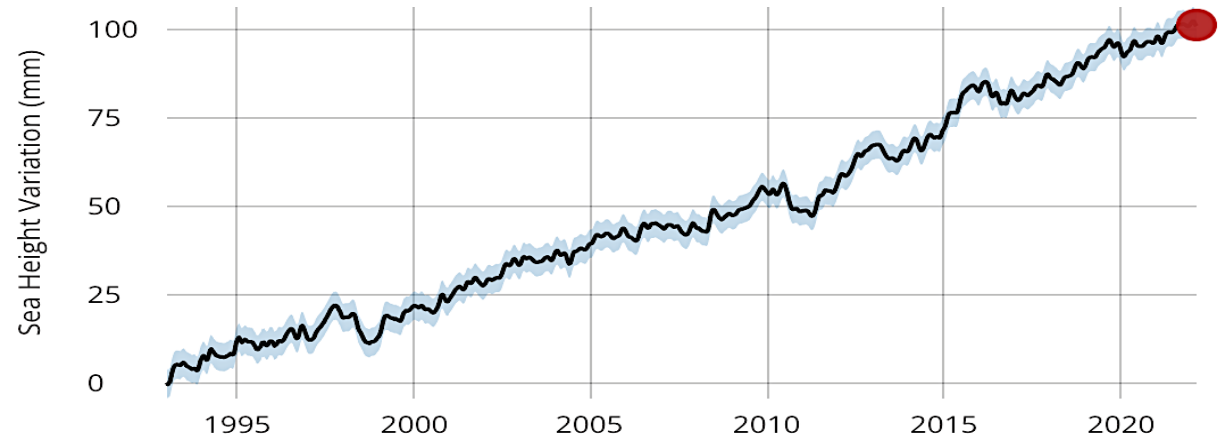
- 1995 - 2010 → 50 mm (3.3mm/yr)
- 2010 - 2015 → 75 mm (5.0 mm/yr)
- 2015 - 2020 → 100 mm (5.0 mm/yr)
- 1995 - 2020 → 100 mm (4.0 mm/yr)

SATELLITE DATA: 1993 - PRESENT

Data source: Satellite sea level observations. Credit: GSFC/PO.DAAC

RATE OF CHANGE

↑ 3.4
(± 0.4) mm/yr



Temperature Effects on Crop Yield

Crop	T _{opt} , °C	T _{max} °C	Yield at T _{opt} t/ha	Yield at 28°C, t/ha	Yield at 32°C t/ha	% decrease (28 to 32°C)
Rice	25	36	7.55	6.31	2.93	54
Soybean	28	39	3.41	3.41	3.06	10
Dry bean	22	32	2.87	1.39	0.00	100
Peanut	25	40	3.38	3.22	2.58	20
Sorghum	26	35	12.24	11.75	6.95	41

Global emissions by sector

Percent share of 2020 net GHG emissions

Buildings

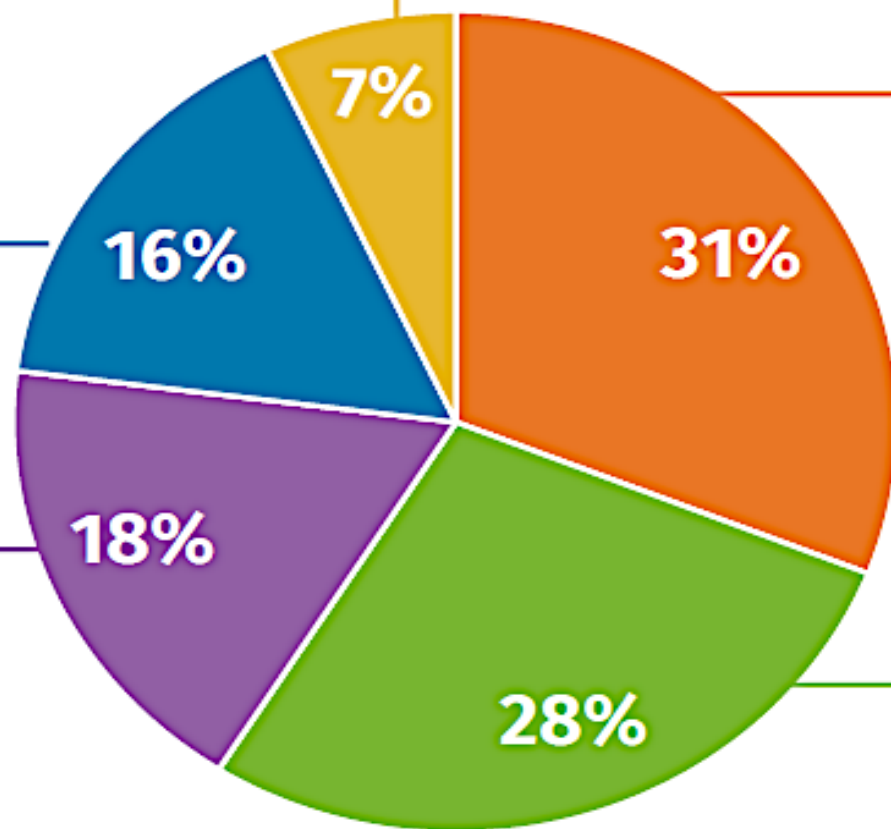
5% Residential
1% Commercial
1% Refrigerants

Transport

12% Road
2% Ships
1% Aviation

Agriculture, land use and landfills

7% Crops
6% Livestock
4% Landfills & waste
1% Land use & forests
<1% Agriculture fuel combustion



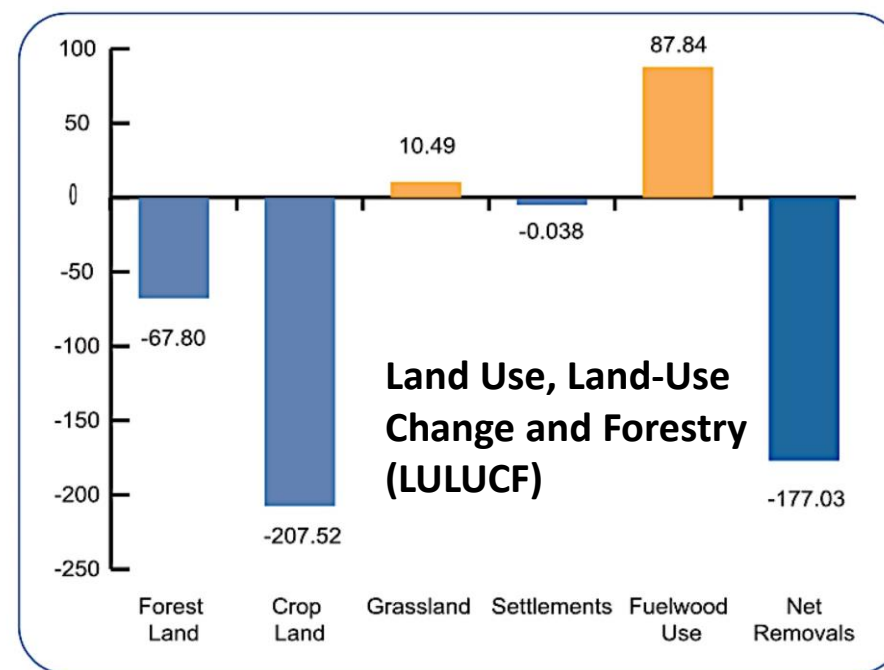
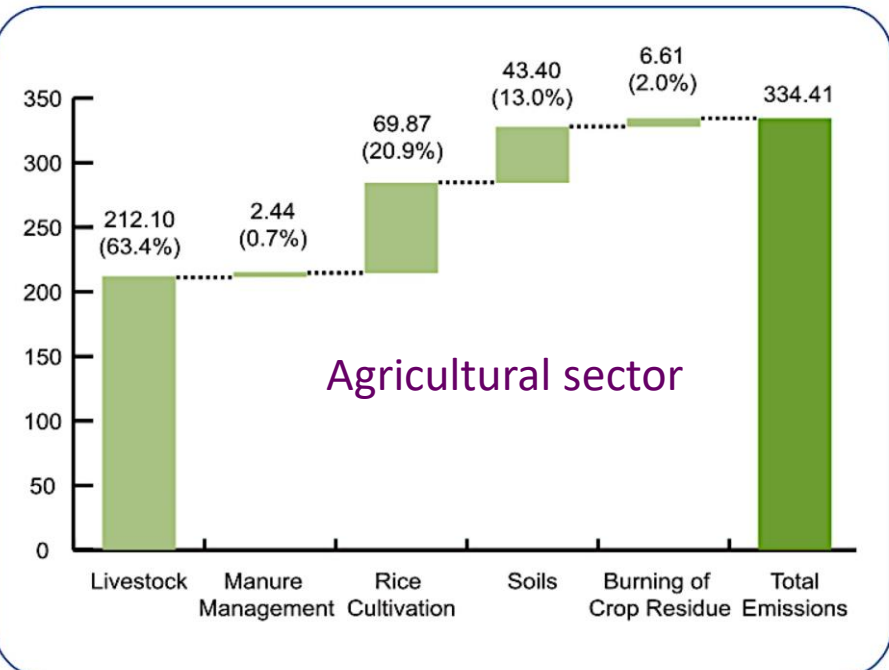
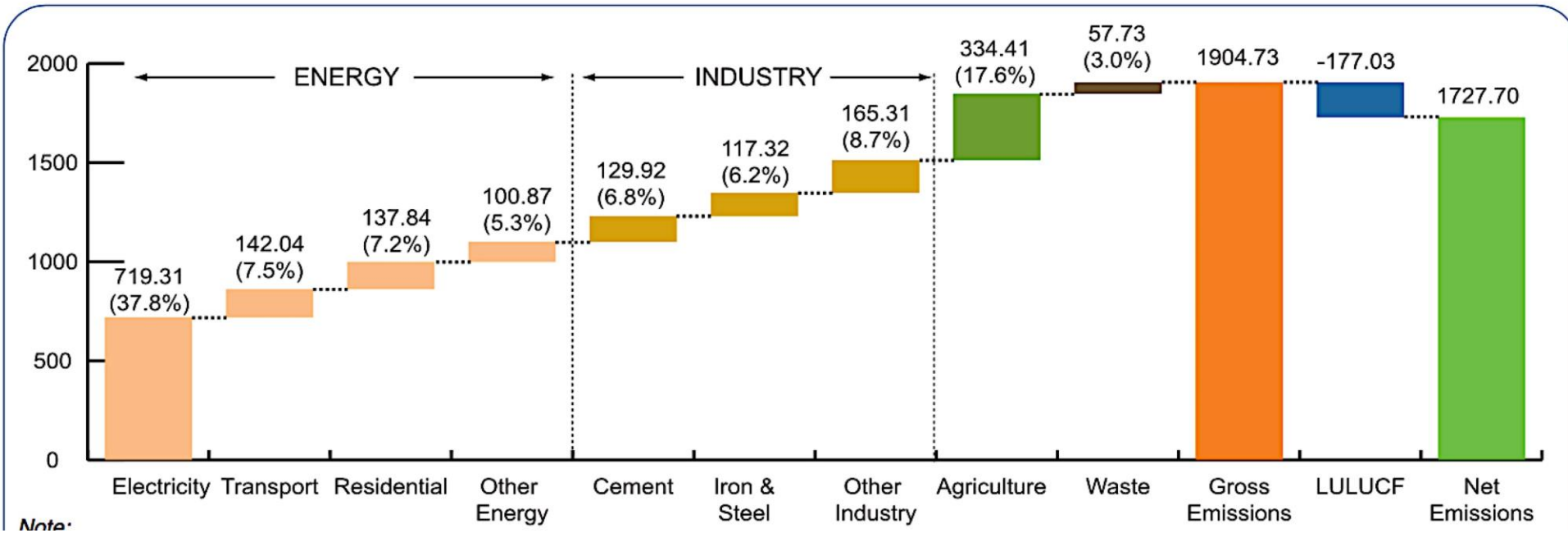
Industry

5% Iron & steel
5% Oil & gas production
5% Cement
4% Chemicals
2% Coal mining
1% Refining
9% Other industries

Electricity

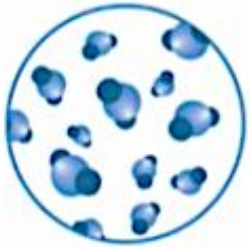
20% Coal
6% Natural gas
1% Oil

GHG emission from different sectors (MT CO₂)





CO₂
concentration



Highest
in at least
2 million years

Sea level
rise



Fastest rates
in at least
3000 years

Arctic sea ice
area



Lowest level
in at least
1000 years

Glaciers
retreat



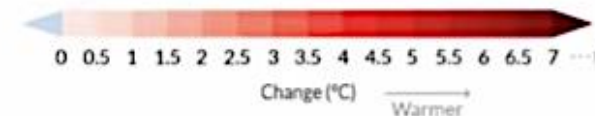
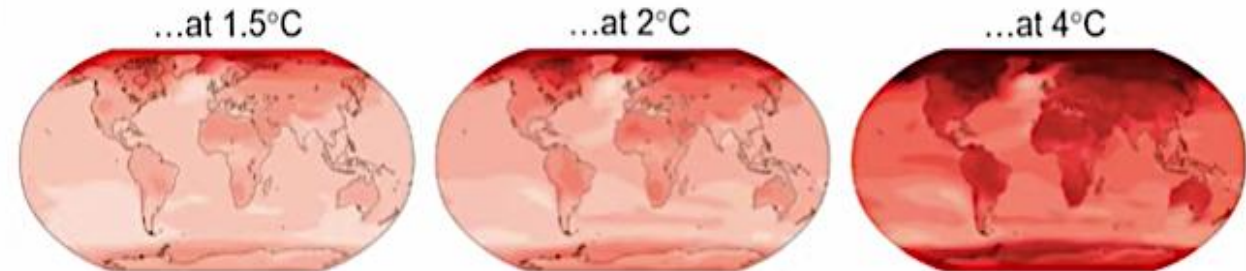
Unprecedented
in at least
2000 years

IPCCs VI Assessment Report

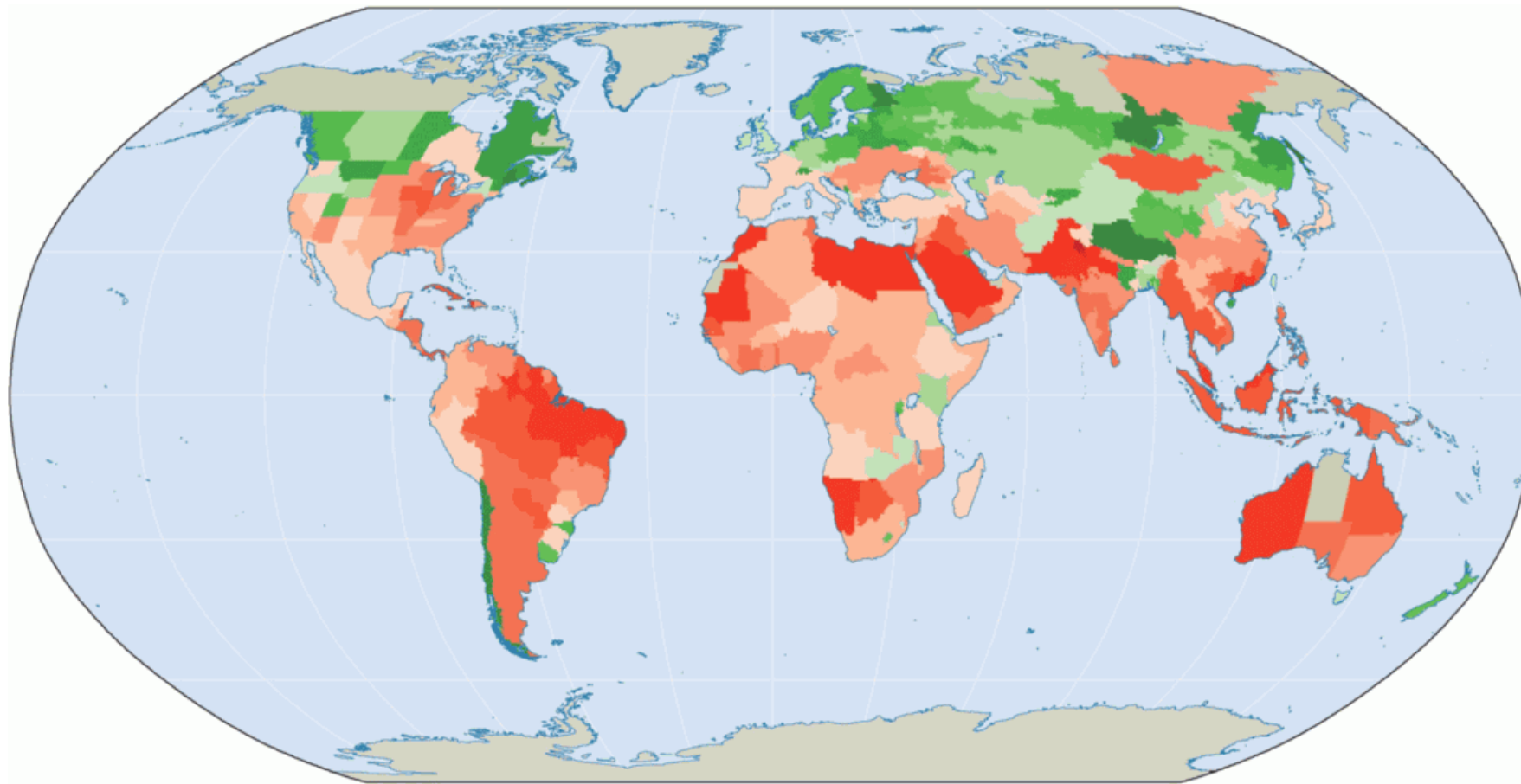


With every additional amount of global warming, changes get larger.

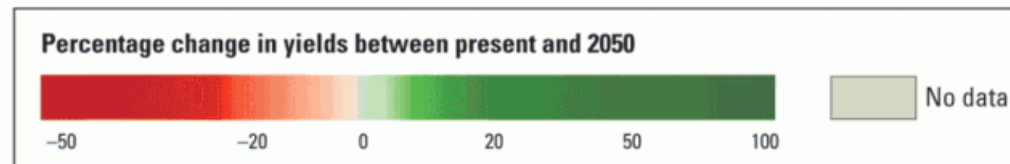
Simulated changes...



Percentage change in crop yield between present and 2050



15 – 25 % yield reduction in India

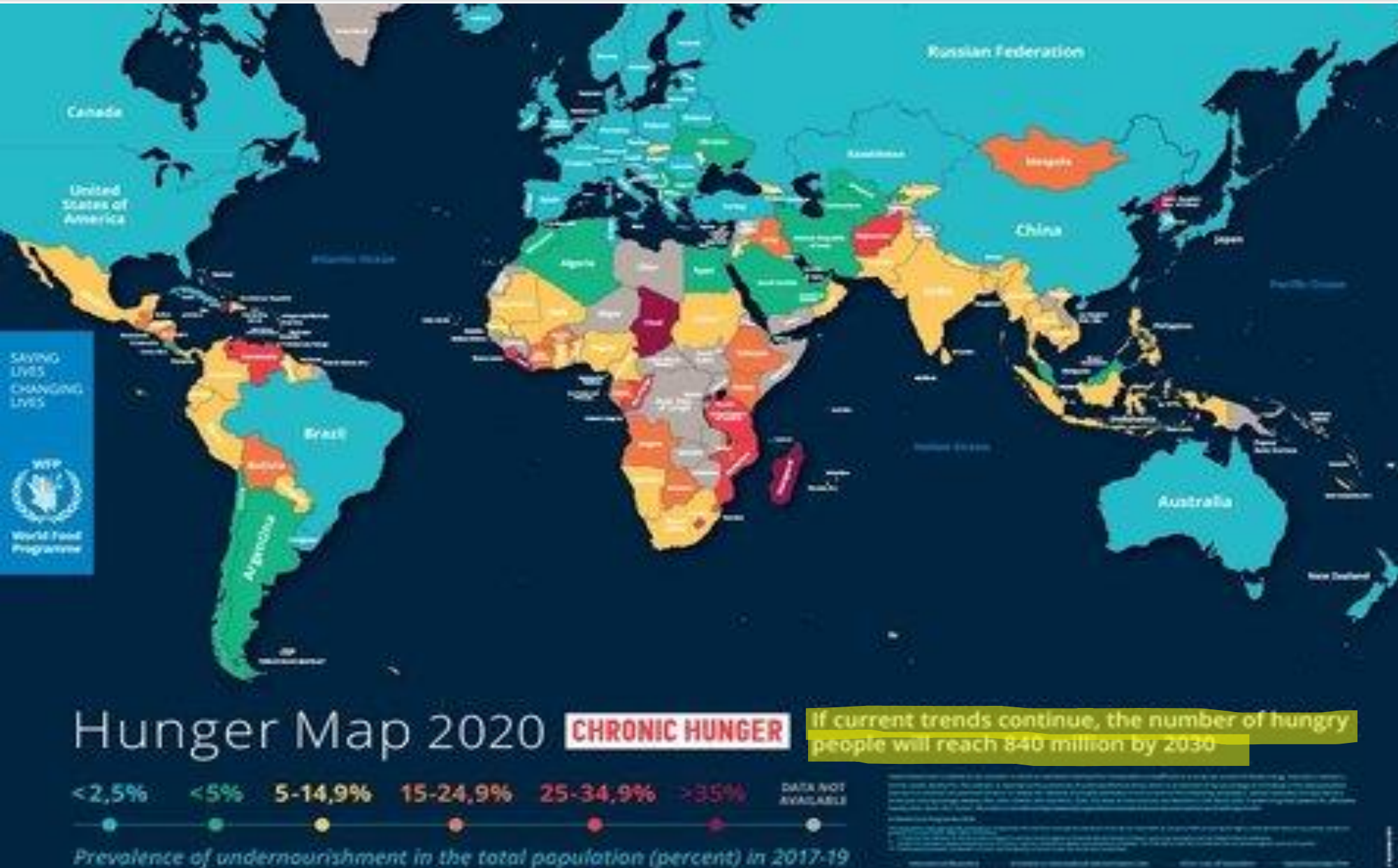


Source : IPCC VI AR 2022

Global Hunger



India 15 - 25% increase hungry population



Extreme events

Drought: Prolonged periods of low precipitation can lead to drought conditions, causing **soil moisture deficits** and **water shortages** for irrigation.

Floods: Excessive rainfall and flooding can **saturate fields, erode soil, and damage crops** and detrimental.

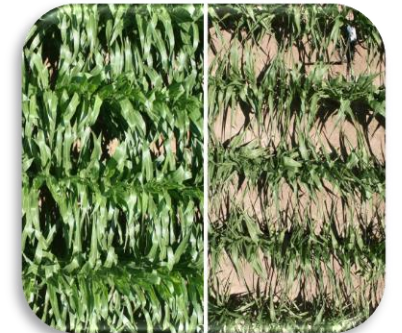
- Lead to the spread of **diseases and pests**
- Post-flood **soil contamination** can impact the quality and safety of produce.

Heat wave & Cold wave

- High temperatures causes heat stress in plants
- Causing reduced photosynthesis
- Wilting, and decreased fruit set.
- Frost and freeze events can damage sensitive crops
- Lead to significant **yield losses**, especially during critical growth stages.

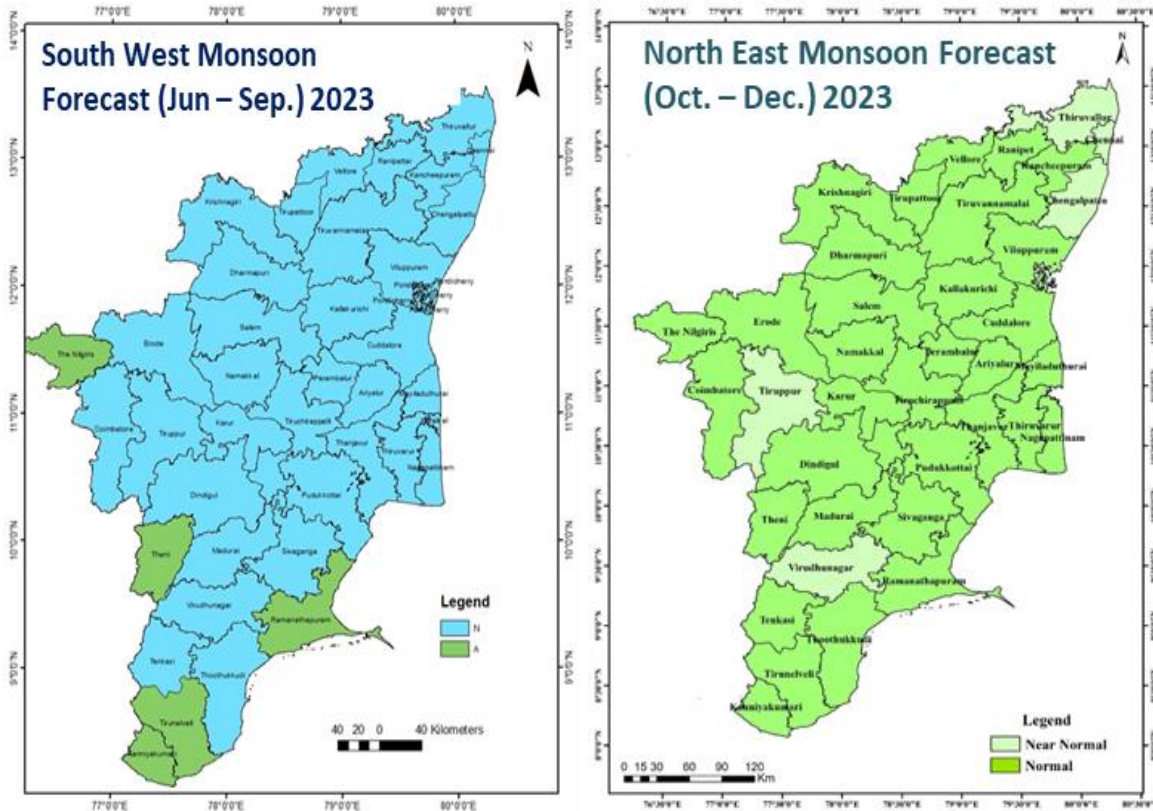
Hailstorms

- Physically damage crops, leading to yield losses
- **Reduced marketable quality.**
- These events are highly detrimental during flowering and fruiting stages.



Innovative Climate Resilient Technologies

TNAU's District Level Seasonal Rainfall Forecast



- TNAU provides district level SRF, since 2014
- Twice during May (SWM) & Sep. (NEM)
- Disseminating thro' Email & Mass media

TNAU's Village Level Medium Range Forecast

Tamil Nadu Agricultural University
DIRECTORATE OF CROP MANAGEMENT
ROTO CLIMATE RESEARCH CENTRE
COMBATORE-561 002

Village Level Forecast

Map View | Table View | Desktops

Weather plays a major role in agriculture and the magnitude of weather events decides the success of the crop production. Weather based response farming practices sustainable productivity and net return by lowering input loss risk and increasing input use efficiency. The response farming is highly dependent on the accurate weather information in advance, at least for a week. Though every region has a unique seasonal climate pattern, the weather over the next few days is highly dynamic, depending on geographical location, topography, and green fractions and other factors. Timely and accurate medium range weather information become critical information for the planning of day today farm activities. In this forecast since 2011, for the next six days and updating every day morning 10 AM. In case of downloaded spatially (kilos level) (3km resolution) and temporally (15minutes), hourly and daily forecast has been verified in 17 locations covering all the seven Agro Climate Zones of Tamil Nadu during Summer (JWP, March - May), 0.55 and 0.70 during South West Monsoon (SWM, Jun - Sep) and 0.55 and 0.70 during North East Monsoon (NEM, Oct - Dec). Percentage had ranged between 60 - 80 during CWP, 40 - 60 during JWP, 50 - 70 during SWS.

Next 1 hour forecast

10.581164 N - 77.537887 E 23-05-2022, 05:30:00 AM

26 °C Current Air Temperature
64 % Relative Humidity
0 mm Rainfall / Hour
4 km ph Wind Speed 2 m height
16 km ph Wind Speed 10 m height

View Full Details

Date	Time	Temp, °C	Humidity, %	Rainfall, mm	Wind Speed, km ph	Wind Speed, 10 m height, km ph	Wind Dir, deg
2022-05-24	05:30	26.1	64.0	0.0	4.0	16.0	135
2022-05-24	06:30	26.5	63.7	0.0	4.0	16.0	135
2022-05-24	07:30	26.9	63.4	0.0	4.0	16.0	135
2022-05-24	08:30	27.3	63.1	0.0	4.0	16.0	135
2022-05-24	09:30	27.7	62.8	0.0	4.0	16.0	135
2022-05-24	10:30	28.1	62.5	0.0	4.0	16.0	135

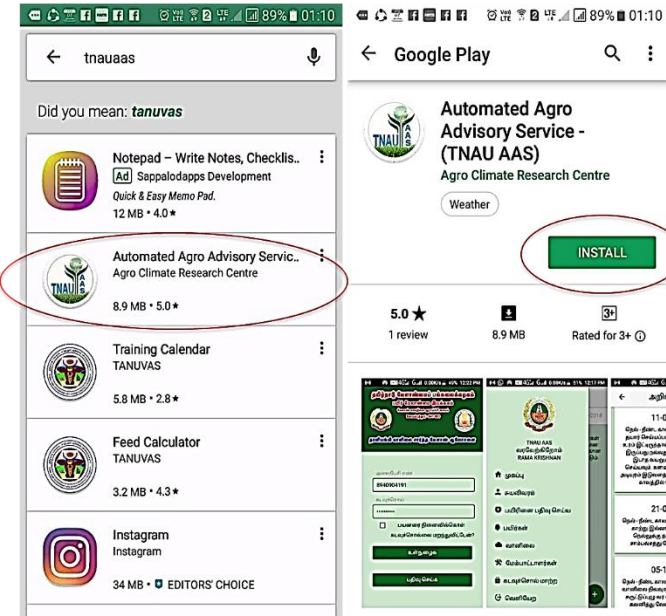
- Block level (2011-21) to Village level (2022 onwards)
- 3 km resolution for next 6 days
- Linked with 18555 revenue villages (>75% accuracy)

TNAU – AAS : web cum Mobile App “Automation in Agromet Advisory Services”

TNAU’S Weather Whatsapp Group



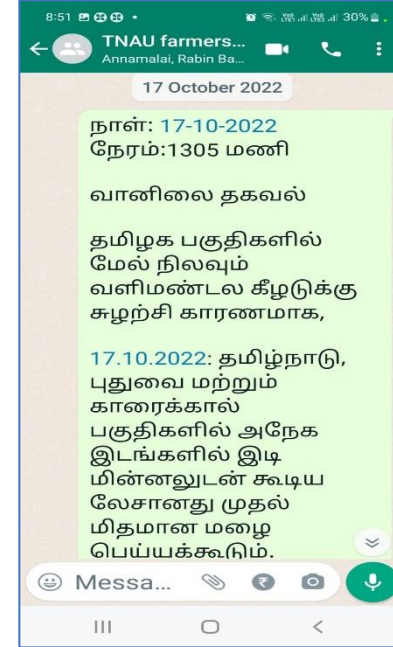
Android mobile App



- Google Play store
- Search TNAUAAS
- Select Automated Agro advisory service
- Install
- Register with mobile number



<https://aas.ktrack.in>



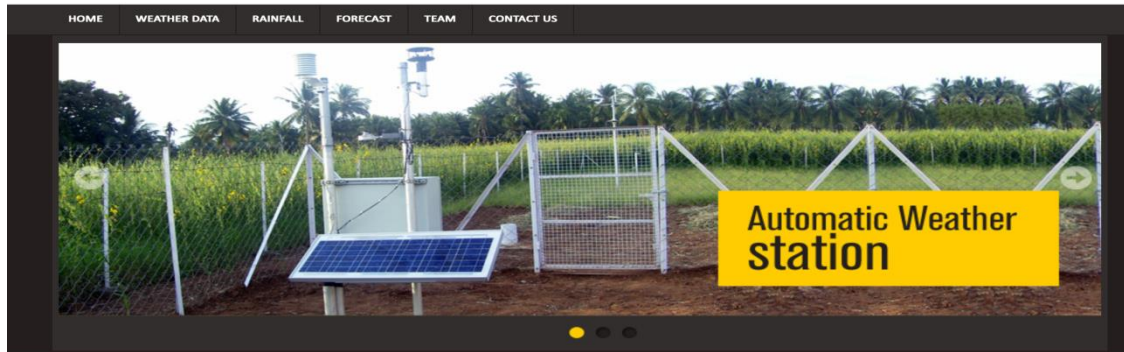
- Tailored crop production and protection advisories directly to farmers
- 108 crops, 6 stages, 54 weather perils
- Weather based, farm, crop and stage specific advisories
- Agromet advisories to mobile as SMS/ WhatsApp
- 9.25 lakh farmers receiving SMS thro' mKisan
- Block-wise WhatsApp group (385 Nos.)
- Sharing forecast, advisories & extremes weather
- Now advisories are shared as Audio & Video files

Risk Assessment & Management

Tamil Nadu Agricultural Weather Network

தமிழ்நாடு வேளாண் வானிலை வலையிணைப்பு
TamilNadu Agriculture Weather Network

Language : English தமிழ்



Automatic Weather Station

தமிழ்நாடு வேளாண் வானிலை வலையிணைப்பு
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Language : English தமிழ்

HOME WEATHER DATA RAINFALL FORECAST TEAM CONTACT US

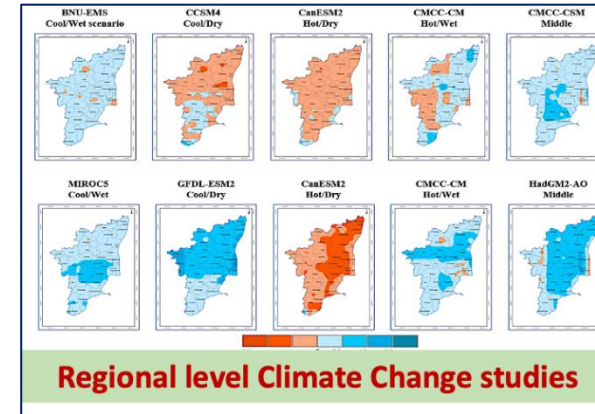
Weather Data For TamilNadu
Daily mean till 8:30 AM

District: Block:

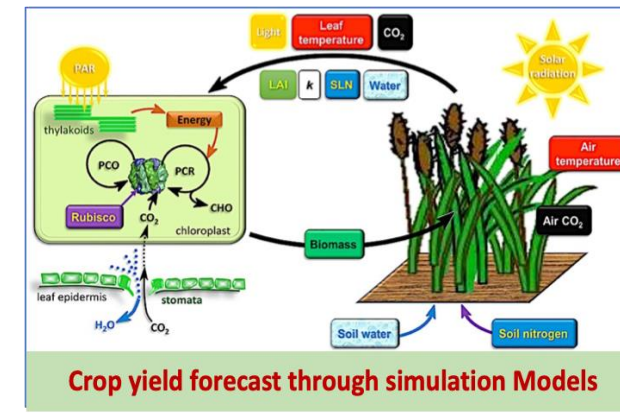
Districts	AirTemp (o C)		Relative Humidity(%)	Wind Speed(Kmph)	Soil Moisture 15cm(%)	Soil Temp. 15cm (o C)	Rainfall (mm)	Solar Radiation (cal/cm2)	Atmospheric Pressure (hpa)	Leaf Wetness(hr)
	Maximum	Minimum								
Aranykul	29.5	24.0	97.5	2.9	-NA-	0.0	0.0	147.2	1006.5	23.6
Coimbatore	30.4	23.0	72.6	4.0	35.5	22.3	1.2	182.2	856.6	2.3
Cuddalore	28.4	24.5	89.4	3.4	19.1	22.9	6.3	237.9	996.9	0.5
Dharmapuri	28.1	21.6	92.4	3.1	13.1	14.3	0.0	100.2	840.2	11.8
Dindigul	28.0	21.8	87.3	3.4	25.2	24.0	8.3	121.3	955.6	10.8
Erode	29.8	22.6	86.2	3.1	26.6	21.6	7.6	230.4	986.0	3.0
Kanchipuram	28.0	24.4	74.2	2.3	26.7	28.3	2.9	236.4	881.5	2.3
Kanyakumari	31.4	24.5	90.3	1.8	22.8	11.7	2.5	169.0	1002.0	6.3
Karur	29.1	22.9	90.0	2.5	18.5	24.6	2.9	139.8	960.4	5.2
Krishnagiri	24.5	20.6	92.4	2.7	9.7	15.6	4.2	77.0	940.9	8.6
Madurai	30.9	23.7	74.9	4.0	26.4	25.1	3.5	504.1	990.8	5.6
Nagapattinam	28.6	24.4	93.8	5.4	27.3	8.7	4.5	182.5	902.0	2.3

- Real time weather uploaded in <http://tawn.tnau.ac.in>
- Data is useful for forecast & advisory preparation
- 257 AWS handed over to Revenue Department

Advanced climate change studies



GHG Emission Studies & Gas Chromatography



115 years old Principal Meteorological Observatory

- River basin wise climate change studies and management
- Crop Yield forecast to major crops, twice during kharif & Rabi
- Pioneer in GHG emission studies

Climate smart crops and genotypes tolerant to abiotic stress

Crop	Varieties	Type of stress
Rice	PMK1, PMK2, PMK3, Anna 4, MDU5	Drought and High temperature
	CO 43, TRY1,2,3	Salinity
	CR1009 Sub 1	Flood and submergence and tolerance
	MDU3	Low temperature
Green gram	CO 6, Paiyur 1	Drought
	ADT 3	Salt stress and Flooding
Black gram	VBN 6	Drought
	ADT 3	Flooding
Groundnut	TMVGn 13, ALR 3, TMV 8	Drought
Sesame	CO 1 & VRI5	Drought
Sunflower	COSFV 5, CO 4	Drought and Salinity
Coconut	ALR (CN) 1	Drought
Horse gram	Paiyur1 and Paiyur 2	Cold or frost tolerant

Crop Management Technologies for Sustainable Production under Changing Climate

Direct Seeded Rice (DSR)

Wet direct seeded rice

- Reduced input cost – Nursery and transplanting cost; Less labour
- Using paddy drum seeder row to row spacing is maintained
- Optimum plant stand; Less seed rate (25 kg/ha)
- Higher grain yield (5.5 t/ha)
- All season except heavy downpour monsoon period
- Area : 50,000 ha in Tamil Nadu



Water Saving : 15%

Labour Saving : 20%

Dry direct seeded rice – (Semi dry rice)

- Ramanathapuram & Sivaganga districts (Tank irrigated)
- Nagapattinam & Tiruvarur districts (Canal irrigated)
- Around 3.00 lakh ha & Yield 4.5 t/ha
- Sowing by using tractor attached seed drill @ 40 kg/ha
- Row to row spacing is maintained; Optimum plant stand
- PE Pretilachlor @ 0.45 kg /ha on 5 DAS + two machine weeding (power weeder) on 30 and 45 DAS + AWD + STCR based NPK



Water Saving : 25%

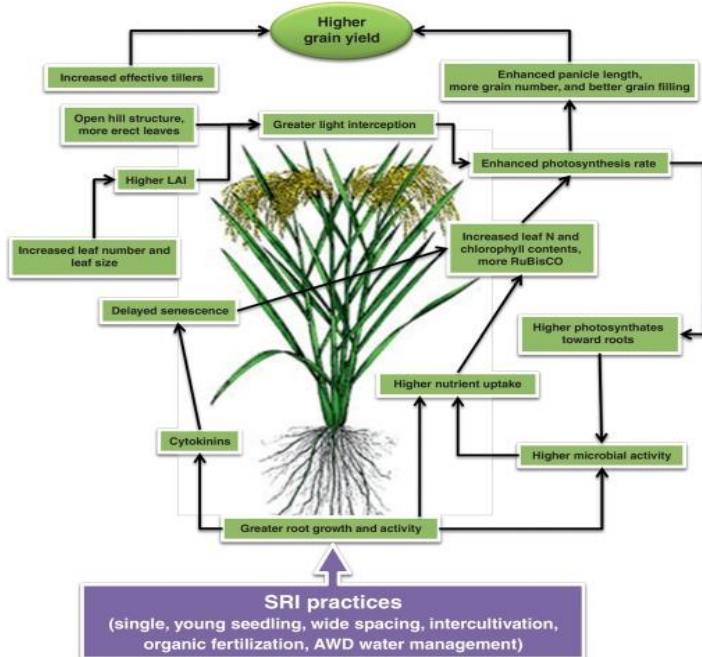
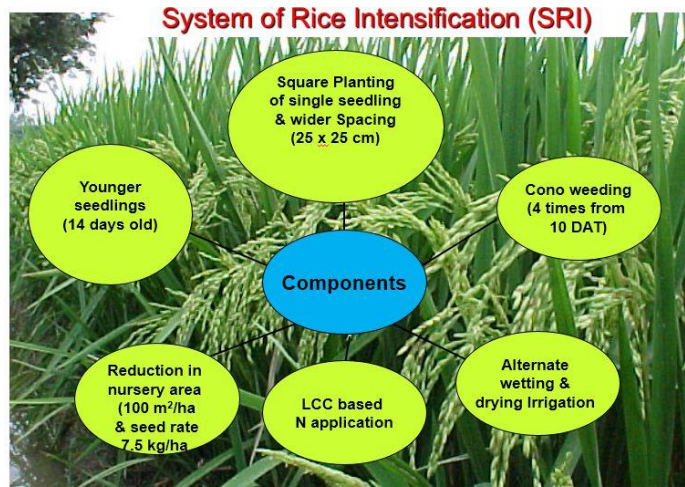
Labour Saving : 20%

Low GHG emission



System Intensification of Crops for Efficient Use of Natural Resources

Rice (SRI)



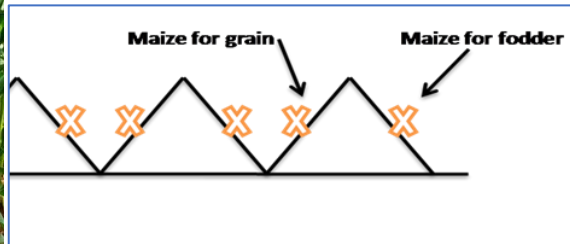
Sugarcane (SSI)



Particulars	Conventional	SSI
Seed/Setts/acre	4 tonnes / acre	0.5 tonnes / acre
Nursery	No	Yes
Spacing (Row)	2.0 -3.0 ft.	5.0 ft.
Planting	setts (30,000)	25 days old seedlings (5000)
Water	Flood irrigation	Drip fertigation
Mortality rate	High	Low
No. of tillers/plant	6 - 8	15 - 20
Intercrop	NIL	Possible
Yield (t / ha)	98 t/ha	175 t/ha
Net income	Rs. 92,440 /ha	Rs. 2,64,773 /ha

Resilient Technologies for Climate Variability

Grain cum Fodder Maize



- ✓ Dual purpose (Grain + Fodder) at 30x25 cm
- ✓ Reduced risk of crop failure due to terminal drought
- ✓ Grain (6.64t/ha) at 110 days & Fodder (16.6 t/ha) at 50 DAS, Net returns of Rs.76510/ha.

Redgram Transplanting



- ✓ Suitable for delayed monsoon onset
- ✓ Transplanting 25 days old seedlings raised in polybags
- ✓ Yield enhancement : 28 %

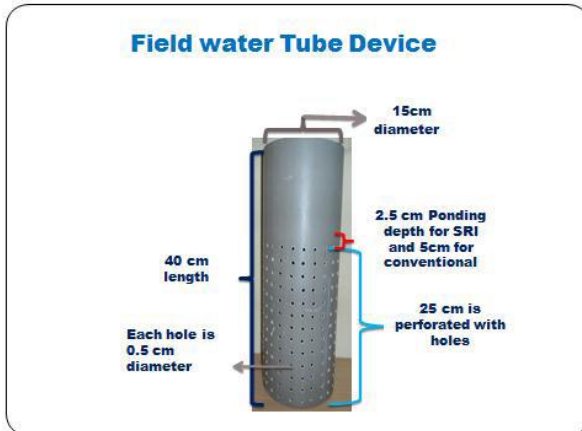
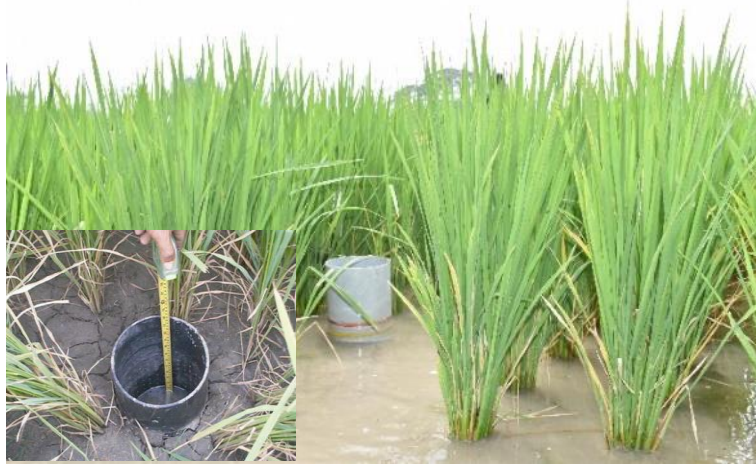
HDPS in Cotton



- ✓ 100 cm X 10 cm (1,00,000 plants /ha)
- ✓ Effective use of natural resources
- ✓ Synchronized harvest and mechanization
- ✓ Additional yield of 400 - 600 kg/ha

Technologies for water conservation

Smart Water Saving Technology (AWDI) in Rice



- ✓ AWDI of 10 cm depletion in light soils and 15 cm depletion in heavy soils
- ✓ Water saving 20-25 % and reduced GHG emission
- ✓ Yield increment 20%

Suitable land configuration for rainfed Sorghum in rainfed Vertisols

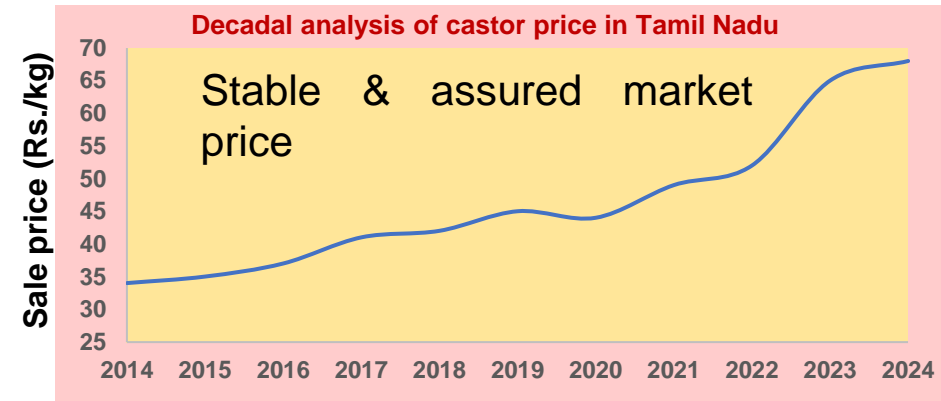


- **Tied Ridge method (45 x 15 cm spacing)**
- ❖ **Special features**
 - Uniform crop growth
 - Reduced Run off & Increased Infiltration
- ❖ **Advantages**
 - ✓ Higher grain (1673 kg/ha) and fodder yield (4107 kg/ha)
 - ✓ *In-situ* moisture conservation
 - ✓ Reduced soil erosion

Climate resilient crops and cropping systems

Castor as a sole crop: A money spinner for resource poor farmers

- ❖ Fertilizer responsive crop under drip system
- ❖ Suitable for all seasons and soil type
- ❖ Rainfed ecosystem : 2500 kg/ha
- ❖ Irrigated condition : 4000 kg/ha
- ❖ Good foreign exchange
- ❖ Area : 16,250 ha



Best Sowing Time for Enhancing the Productivity of Rainfed Winter Pulses

Bengalgram:

- **Sowing time and Method:** Sowing with seed drill **during first week of November.**
- **Productivity:** **12.5% increase in yield (800 kg/ha)** compared to sowing during second week of November (691 kg/ha) and 14 % increase in yield compared to broadcasting (688 kg/ha).
- **Economics:** Net return: 18365/ ha with B:C ratio 2.04.

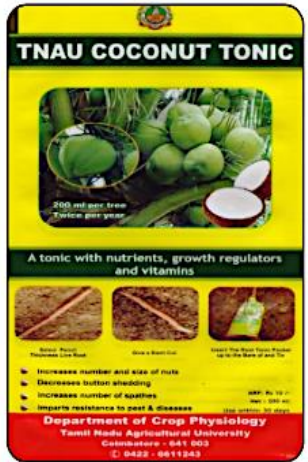


Horsegram:

- **Sowing time and Method:** Line or seed drill sowing **during last week of October.**
- **Productivity:** **13% increase in yield (779 kg/ha)** over November first week sowing (693 kg/ha) and 14% increase in yield than broadcasting.
- **Economics:** **Line sowing:** Net return: Rs 11568/ha; BCR:1.74.
or **Seed drill sowing:** Yield: 788 kg/ha;
Net return: Rs 11540/ha; BCR: 1.72).



TNAU Crop Boosters Developed for Increasing the Yield of Major Crops



Coconut Tonic
Yield ↑ 25%
BCR : 3.3



Pulse Wonder
Yield ↑ 22%
BCR : 2.8



Maize Maxim
Yield ↑ 20%
BCR : 2.8



Castor Gold
Yield ↑ 27%
BCR : 2.5



Rice Bloom
Yield ↑ 15%
BCR : 2.1



Groundnut Rich
Yield ↑ 17%
BCR : 3.25



Cotton Plus
Yield ↑ 18%
BCR : 2.4



Cane Booster
Yield ↑ 24%
BCR : 3.5



Cassava Booster
Yield ↑ 26%
BCR : 3.1



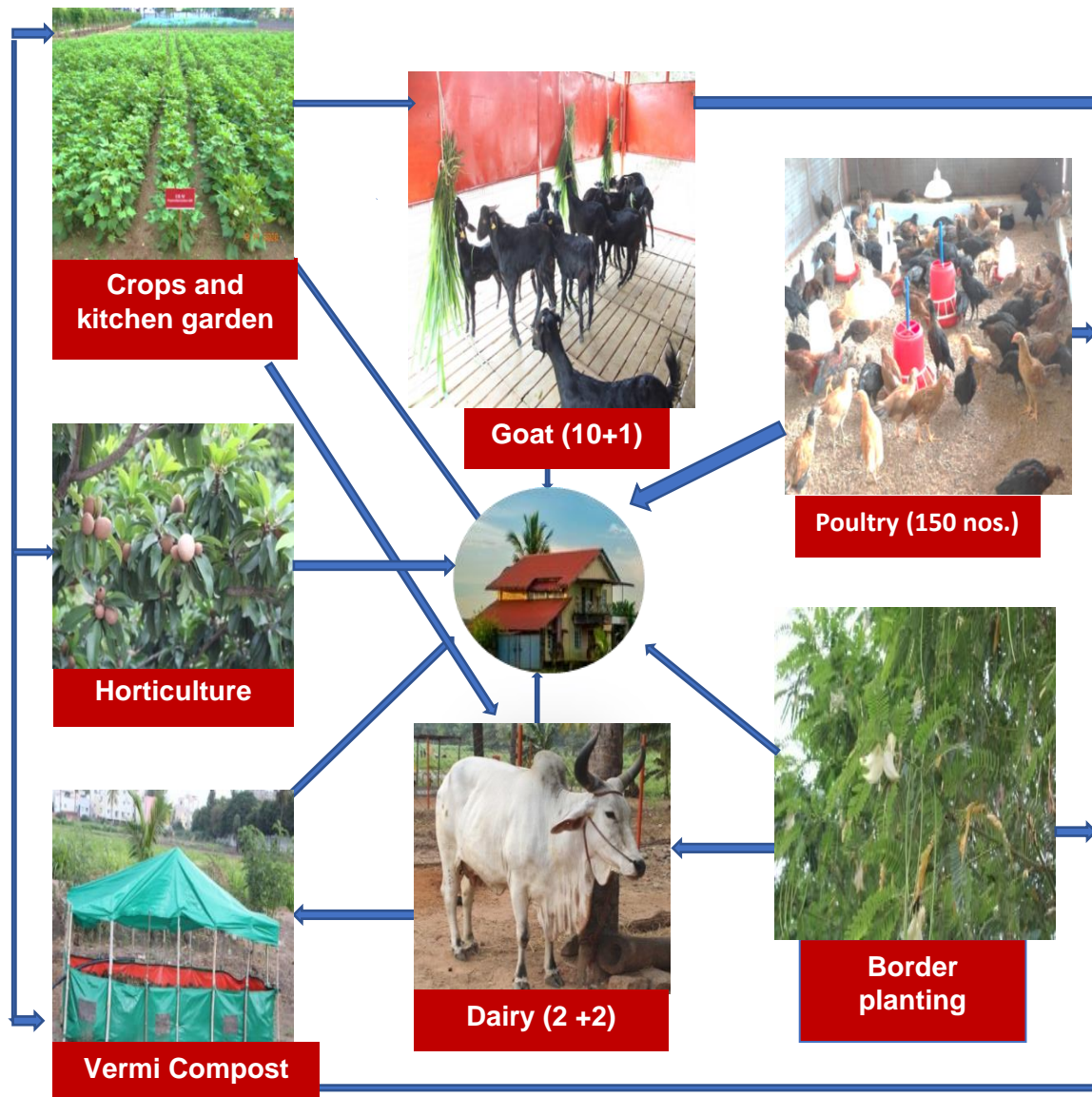
Horsegram Wonder
Yield ↑ 14%
BCR : 2.3

TNAU Crop Shine (Abiotic stress mitigation)

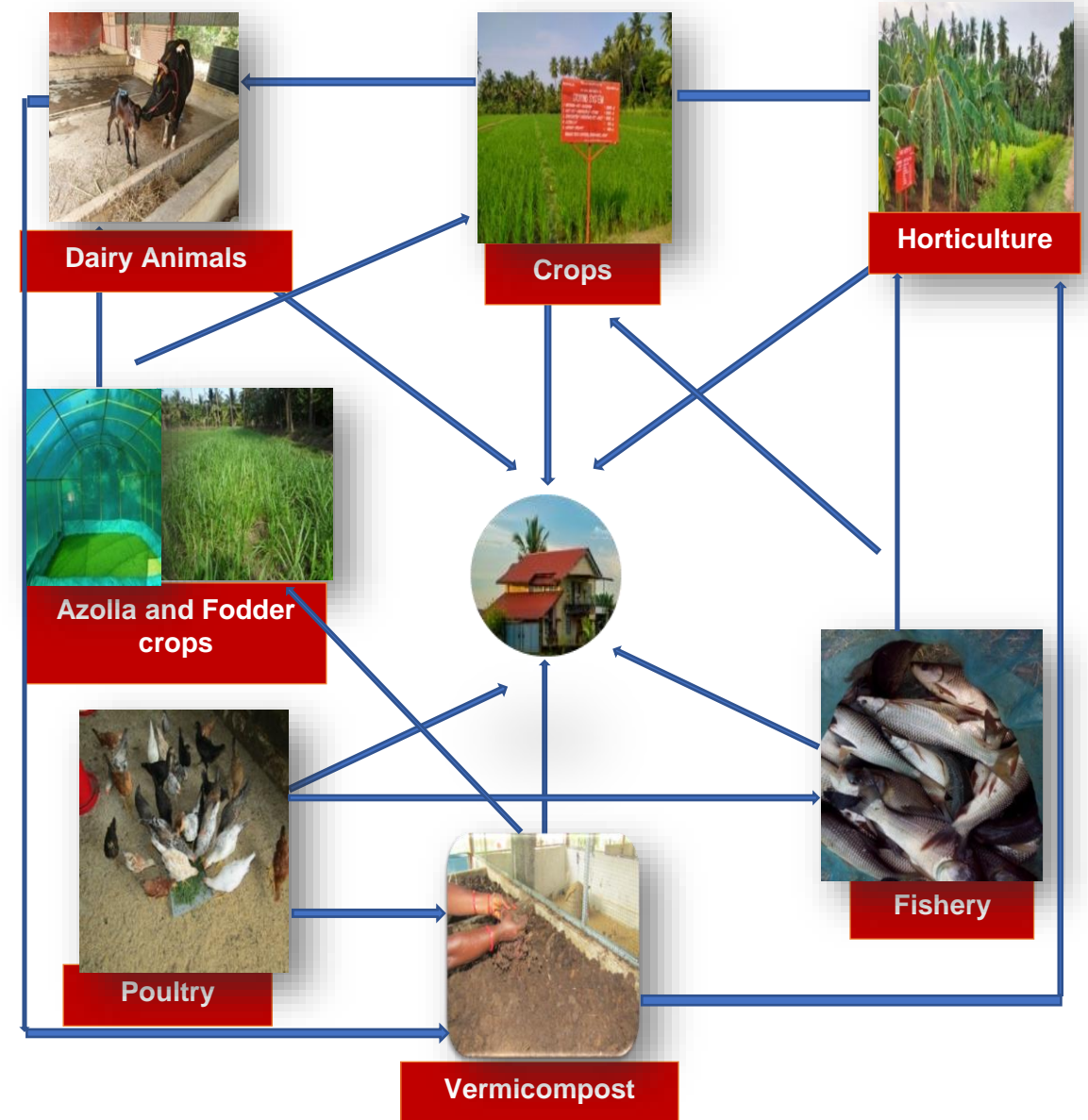


- Advantages**
- Nullifies the ill effects of abiotic stresses
 - Increases fertility coefficient and grain/seed filling percentage
 - Minimizes the yield reduction under abiotic stresses
 - Increases the yield of crops ranging from 10 to 35%
 - Increases benefit cost ratio ranging from 1.70 to 2.25 among the crops

Climate Resilient Integrated Farming Systems



Garden Land Ecosystem



Wetland Ecosystem

Climate Resilient Integrated Farming Systems

Sl. No	Particulars	Garden Land Ecosystem	Wetland Ecosystem
1.	Components (1 ha)	Crops (0.60 ha) + Horticulture (0.10 ha) + Dairy: 2 cow with calves (50 m ²) + Goat : Salem black - 10 F + 1 M (50 m ²) + Poultry: Aseel-150 Nos./year (50 m ²) + Fodder crops (25 m ²) + Supplementary - Vermicompost, border planting, kitchen garden (35 m ²)	Crops and fodder (0.61 ha) + Horticulture (0.10 ha) + Fishery (0.08 ha) : Composite culture + Dairy: Milch cow with calves (20 m ²) + Poultry: Aseel - 150 Nos. / year (10 m ²) + Supplementary: Vermicompost (20 m ²), border planting (50 m ²)
2.	Regeneration	Nutrient recycled: 197:75:123 kg NPK /ha	Nutrient recycled : 256:29:226 kg NPK / ha
3.	Income	3.00 Lakhs	2.75 Lakhs
4.	Employment	501 man days / year	403 man days / year
5.	Nutritional security for farm families	100%	100%
6.	Water Use Efficiency	2.46 kg m⁻³	2.14 kg m⁻³
7.	Energy productivity	1.44 MJ ha⁻¹	0.49 MJ ha⁻¹

Tamil Nadu Agroclimate Zones



Agro climatic Zones	Diversified cropping pattern
North Eastern	Rice – pulses/sesame/maize Sugarcane - ratoon sugarcane (Dec.-Nov.) - rice (Dec.-May) - groundnut (June-Sep./Oct.) - 3 years rotation
North Western	Irrigated: Cotton + pulses (Aug - Jan) – finger millet / little millet / foxtail / prosomillet (Feb - April) Groundnut (June - Sep) - wheat / cole vegetables/ chickpea / horsegram (Oct - Feb) - pulses / sesame (Feb-May) Maize (Aug - Nov) – Cotton/ Maize (Dec - May) Tomato/brinjal/chillies/gourds/raddish (Aug - Dec) Rainfed:Tomato (Aug - Dec)
Western	Turmeric (May-Jan.) - rice (Feb.-April) Maize / millets (July-Sept.) - pulses (Sep.-Dec.) Cotton (Aug.-Dec) - /vegetables (Jan.-July)
Cauvery Delta Zone (CDZ)	Maize / pulses / vegetables (June-Sep.) - rice (Oct.- Jan.) - pulses / cotton / sesame/ sunflower (Feb.-May) Rice (June-Sep.) - rice (Oct.-Jan.) - pulses / sesame(Feb.-May)
Southern	Irrigated: Kudiraivali/ragi/varagu (June -Sep) – rice (Oct.-Jan.) – pulses/sesame (Feb.-April) Rainfed: Fodder sorghum (Oct-Jan)
High Rainfall	Rice (April - Aug) - rice (Sep - Jan) – Blackgram (Jan - Mar) Flower crops / Yam and Colocasia
Hilly and High Altitude	Tea, coffee and vegetables



Thank You