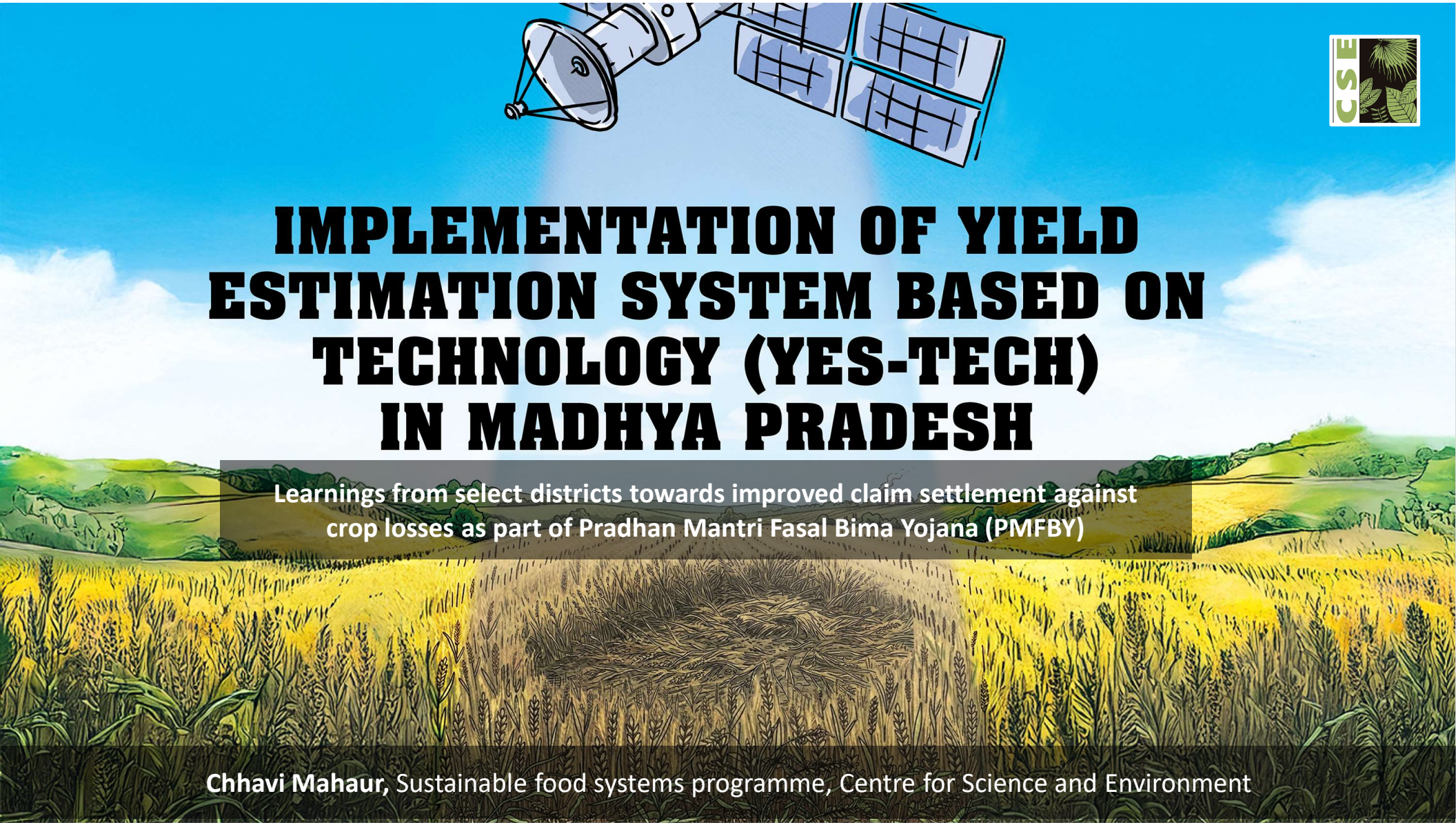


IMPLEMENTATION OF YIELD ESTIMATION SYSTEM BASED ON TECHNOLOGY (YES-TECH) IN MADHYA PRADESH

Learnings from select districts towards improved claim settlement against crop losses as part of Pradhan Mantri Fasal Bima Yojana (PMFBY)

Chhavi Mahaur, Sustainable food systems programme, Centre for Science and Environment

Introduction to YES-TECH

- As part of PMFBY, manual crop cutting experiments (CCEs) typically done for yield/crop loss estimation, are:
  - Resource-intensive
  - Time-consuming
  - Highly susceptible to errors and manipulation
- YES-TECH - A framework utilising **satellite-based remote sensing**, **weather data**, and **analytical models** for yield estimation (introduced by GoI in 2023)
- **Twelve states** are implementing YES-TECH (phased manner, varying weightage - minimum 30 per cent, rest to CCEs)

Andhra Pradesh	Tamil Nadu	Uttar Pradesh	Madhya Pradesh
Karnataka	Maharashtra	Assam	Jharkhand
Odisha	Haryana	Rajasthan	West Bengal (not under PMFBY)

Manual Crop Cutting Experiments (CCEs)

- CCE – Field based study to **estimate average yield of crop** in a **unit** of **notified area** chosen at **random**
- Small plot marked, harvested crop weighed and results recorded
- The recorded 'actual yield (AY)' compared with 'threshold yield (TY)'
- The difference leads to claim amount if **AY < TY**

Introduction to YES-TECH in Madhya Pradesh

- Madhya Pradesh - only **major agrarian state** to allocate **100 per cent** weightage to **YES-TECH** for claim settlements, building on its 2022 pilot Agri-GIS project (Unnati)

  Notified crops – **Soybean** and **Paddy** in kharif season and **Wheat** in rabi season

- Recent media reports[1,2,3] (September, 2025) highlighted - farmers in a few districts of MP were **unhappy** with the **claims received** and were calling out for its rollback

- PMFBY dashboard suggests reduction in claims in these few districts between 2021–24 compared to previous years

Agri-GIS project (Unnati)

Collaboration among:
- Madhya Pradesh Council of Science and Technology (MPCST)
- National Remote Sensing Centre (NRSC) Hyderabad
- Madhya Pradesh State Electronics Development Corporation (MPSEDC)

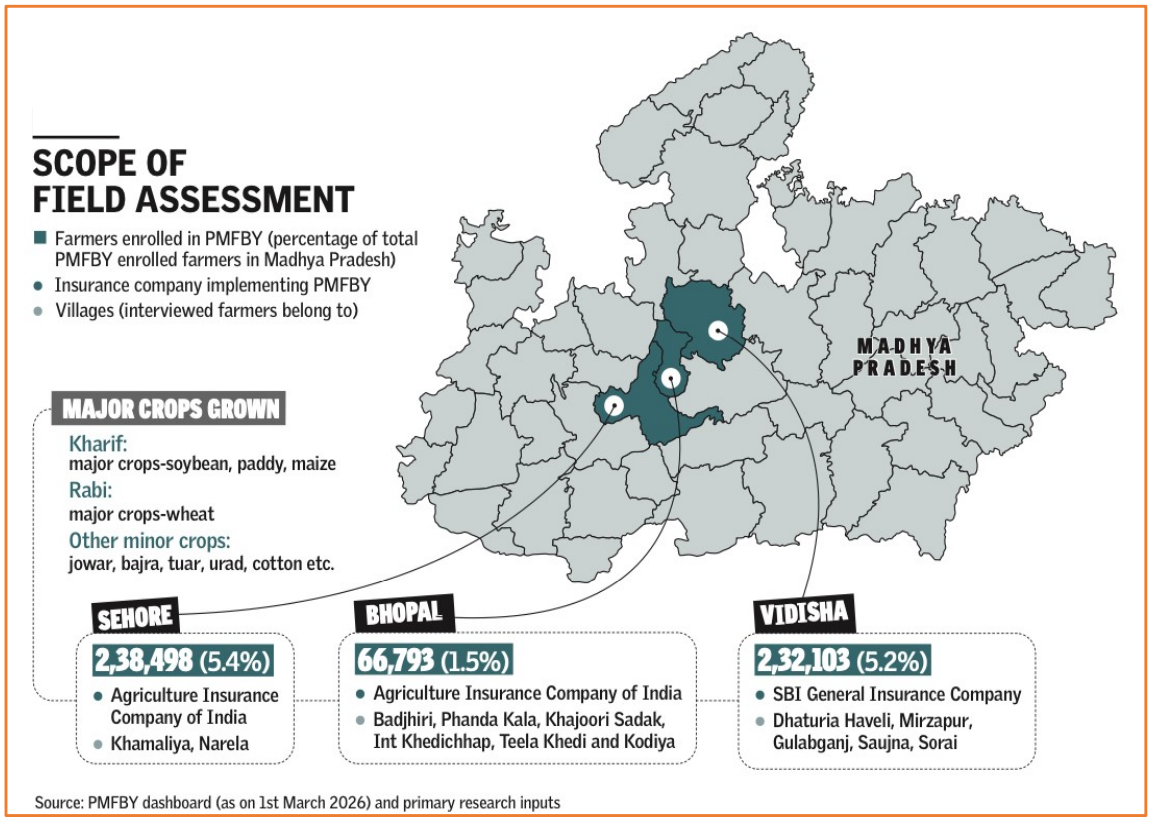
Implemented for
- Kharif - Soybean, paddy, maize, arhar and cotton
- Rabi - Wheat, gram, mustard, lentil and linseed

Results used to disburse PMFBY claims for crop losses

[1] https://l1nq.com/nhr5kht , [2] https://sl1nk.com/dolg5nv , [3] https://l1nq.com/7ppqg0a

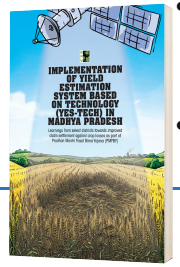
Field assessment

- About **50 farmers (Sehore, Vidisha, Bhopal) -** growing soybean, wheat, paddy
- **State Agriculture Department and** Local/district administration **(patwari**, **rural agriculture extension**, **district agriculture)**
- **Civil society** and **FPOs** in Madhya Pradesh
- **Madhya Pradesh Council of Science and Technology**
- **Insurance companies -** PMFBY in three districts (AIC, SBI General Insurance) and other areas in MP (HDFC Ergo) and their **remote sensing departments**

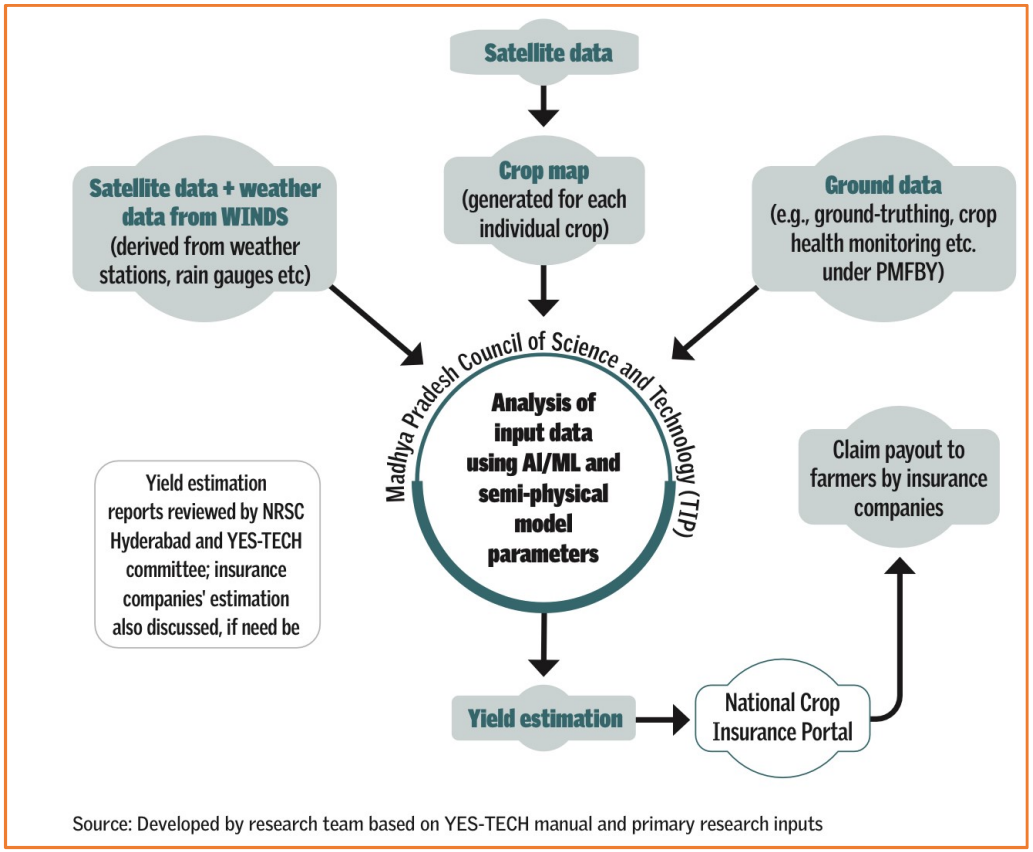


YES-TECH implementation in Madhya Pradesh

- **MPCST** - Technology Implementation Partner for three years (TIP)
- **National Remote Sensing Centre** (NRSC), Hyderabad - Mentor Institution for Technology Roll out (MITR)
- MPCST responsible for **crop mapping**, **data collection**, **analysis** of **satellite** and **weather data** and **ground-truthing**
- Data is run into the **'AI/ML model'** (kharif) and **'semi-physical model'** (rabi) to estimate the yield or into a set of their merged parameters, if needed
- Periodic reports generated, reviewed by YES-TECH committee
- Data then used by insurance companies to disburse claims



YES-TECH implementation in Madhya Pradesh

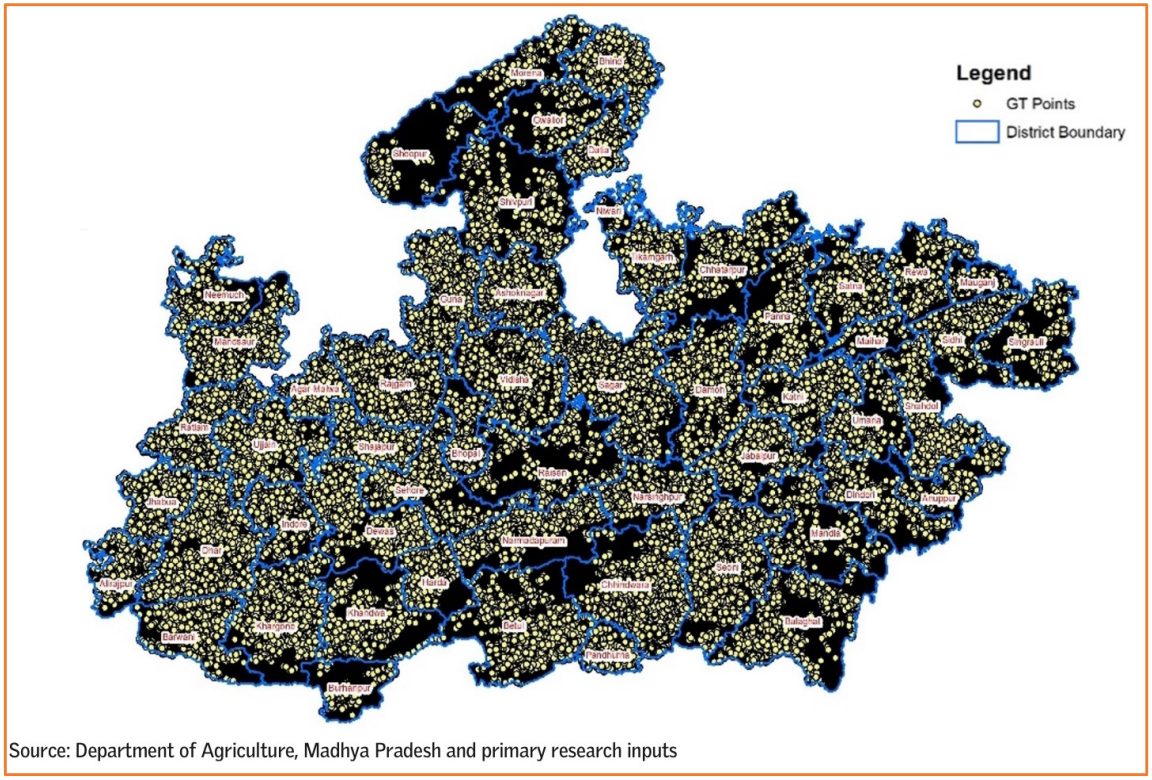


Source: Developed by research team based on YES-TECH manual and primary research inputs

Ground truthing (GT) to validate satellite and weather data

- **Geo-tagged points** are set up **across state**
- GT helps **validate** the data used to model the estimates.
- Field agents conduct their GT by filling a list of attributes of **on-ground crop conditions** throughout crop cycle in **prescribed mobile applications**
- As of August 2025, MP had **130,989 GT points.**
  - 41 per cent of soybean, 23.8 per cent of paddy and 20.9 per cent of maize - **marking higher density of ground-validated input data**

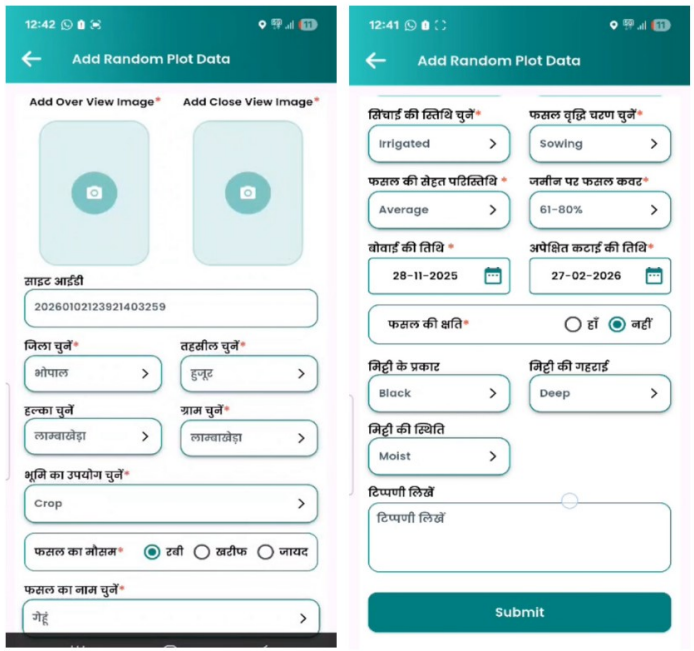
Ground Truthing (GT) points of TIP in Madhya Pradesh for kharif 2025



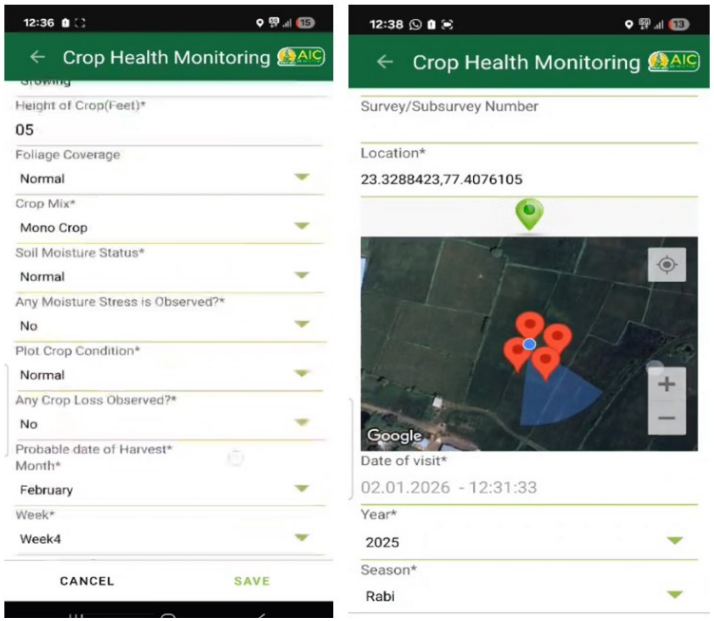
Source: Department of Agriculture, Madhya Pradesh and primary research inputs

Crop health monitoring - smartphone-based photographs

Mobile applications used for ground truthing in Madhya Pradesh



Unnati



AIC form

Source: Primary research inputs

Strengths and limitations of YES-TECH models (1/2)

Models adopted in MP

Model and key features[11]	Strengths	Limitations	States
Semi-physical These models use basic crop science to estimate yield and track how much sunlight the crop absorbs, how efficiently it converts this into biomass, and how weather conditions such as rainfall and temperature influence growth. Satellite imagery is used to monitor vegetation indices (e.g., NDVI – Normalised Difference Vegetation Index) over the season, and yield is estimated using crop-specific conversion factors.	Relatively transparent and easier to communicate, relies on established agronomic inputs. Demonstrate strong performance for crops such as wheat and paddy, where canopy growth closely reflects final yield. Lower data intensity compared to simulation models. No dependence on historical yield data.	Constrained by cloud cover in optical data (usually in kharif season). Limited sensitivity to stress factors that do not visibly alter canopy greenness.	Andhra Pradesh, Haryana, Tamil Nadu (kharif), Madhya Pradesh (rabi)
AI/ML (Artificial Intelligence/ Machine Learning) These models identify patterns between yield and inputs such as satellite indices, weather, soil conditions, and historical yield data. Trained to predict yields for the current season using past data.	High predictive power when trained on robust datasets. Capable of integrating diverse and high-dimensional datasets. Adaptive to changing climatic and agronomic conditions.	Quality of historical yield data is critical (often biased due to CCE distortions). Limited explainability ('black box') reduces trust among stakeholders. Requires validation through ground truthing and cross-checks with other models.	Rajasthan, Uttar Pradesh, Madhya Pradesh (kharif)

Strengths and limitations of YES-TECH models (2/2)

Model and key features[11]	Strengths	Limitations	States
Crop Health Factor (CHF) - Parametric The parametric index is derived from satellite and weather indicators. Infers performance of the crop based on index behavior (e.g. moisture available for the crop etc.).	Better suited to homogeneous cropping systems. Operationally simple and scalable. Faster claim settlement due to index-based triggers.	Basis risk: Index may not accurately reflect actual yield loss. Limited applicability in diverse cropping systems. Weak sensitivity to localised shocks (e.g. pest outbreaks, micro-climatic variation).	Odisha (high paddy cultivated land), West Bengal (as part of Bangla Shasya Bima Yojana)
Crop simulation These models replicate plant growth processes using daily weather data, soil characteristics, crop calendars, and management practices. Simulate multiple growth scenarios and estimate yield-based on physiological responses to environmental conditions.	Strong theoretical grounding in plant physiology. Capable of scenario analysis (climate variability, input changes). Useful for long-term planning and policy modelling.	Highly data-intensive (requires dense weather station networks and granular soil data). Limited scalability in regions with fragmented landholdings.	Maharashtra, Karnataka, Tamil Nadu (rabi)
Ensemble These models blend any two or more models.	Reduces reliance on single model and improves robustness. Better suited for heterogeneous agro-climatic conditions.	Requires higher system complexity and strong institutional capacity. Difficult to communicate composite outputs.	Assam (combining AI/ML, semi-physical and CHF)

Source: YES-TECH manual 2023 and research inputs

Farmers' perspective (1/2)

- **Large soybean farmers expressed dissatisfaction** with **shift to YES-TECH**, reporting decline in claims received compared to manual CCEs
- **Compensation received** does not adequately reflect the extent of crop losses experienced; some large soybean farmers strongly advocated **rolling back** to the earlier system of manual CCEs
- Under the earlier CCE-based system, farmers expressed greater confidence as local officials visited their fields, allowing them to **directly discuss** crop conditions and share **concerns**
- Concerns centred on:
  - Perceived **lack of transparency**
  - Potential **inaccuracies in calculations**
  - **Absence** of **direct human interaction**

FARMERS' PERSPECTIVE – SELECT EXCERPTS

'I have suffered losses in soybean as well as wheat and paddy in multiple cropping seasons. Despite this, I have not received claims for not just one, but several cropping season losses. At the same time, year after year, I have witnessed farmers related to the *patwari* receiving claims for their losses. Manual CCEs allowed the *patwari* to note and average out losses. However, they have not reported our losses accurately. Even with the advent of technology I have not received my claims. Small and marginal farmers will always remain at a disadvantage.'

—Farmer from Dhaturia Haveli, Vidisha

'I have not received any claims in the last four years, despite suffering more than 60 per cent loss in my soybean crop in at least two of those years. Earlier, I used to receive some compensation. Now, with the shift to technology-based assessment, I am not receiving the claims I am entitled to.'

—Farmer from Khamaliya, Sehore

Farmers' perspective (2/2)

- Small farmers highlighted friendly ties between big farmers and local administration, patwaris or political leaders; which was leveraged to secure adequate or even higher claims than the losses
- Some farmers **expressed satisfaction** - they appreciated the timeliness of claim disbursement compared earlier settlement time
- **Farmers not enrolled** in PMFBY **did not intend to enroll** - citing **uncertainties** in the **claim settlement** process
- **Wheat** and **paddy farmers** experienced **lesser losses** as they are seen as sturdier crops

FARMERS' PERSPECTIVE – SELECT EXCERPTS

'Earlier, we could talk to our *patwari* to understand our claim settlement. Now, technology has made that process completely opaque. We do not know when the satellite went from above us and took a photograph of our fields. When we cannot see the satellite, how do we trust that it has correctly noted all our losses?'

—Farmer from Gulabganj, Vidisha

'Merely a few days ago, an entire herd of deer ruined our crops. What will the satellite do in that case? We have no trust in satellite.'

—Farmer from Khamaliya, Sehore

'Technology has not been able to successfully capture the losses we have incurred. There have been instances when the soybean crop stood in the field ready for harvest, appearing lush and healthy. But when we harvested it, the pods were empty, without the beans inside. How can a satellite capture what is happening inside the pod? If it could, why are commensurate claims for these losses still not reaching us?'

—Farmer from Badjhiri, Bhopal

Perspective of district and local officials

- Local and district level authorities agreed to some of the concerns raised by disgruntled farmers
    - Technology-based process is **opaque due to** the way **data is collected** and **processed**
    - **Inconsistencies** highlighted in the **amount of claims received** against **similar crop losses.** With the **introduction** of **technology**, such **inconsistencies** have **reduced**
- Administrative staff would benefit from **training** to **improve understanding** and **respond** more **effectively** to **farmers' grievances**
- Farmers' agitation is not due to gaps in technology – it is the **manipulation** in claim settlement process **at the local level**
- **However, they were unsure** whether **satellites can adequately capture** the reality of **crop yield**, particularly given the high density at which soybean is often cultivated

Insurance companies' perspective (1/3)

- Technology-based yield estimation is a **better alternative** than manual CCEs
- Farmers' perception of reduced claims – not from technological errors, but from **comparatively lower yield estimates recorded through manual CCEs**
- Large and powerful soybean farmers were able to shape outcomes of manual CCEs by **influencing local administrative processes** – resulting in **yield estimates lower than actual production** and **consequently higher claim payouts** – the **situation** has **now shifted**
- Because of no manual interface in current YES-TECH, **farmers** are **not able** to **influence** the **yield values**

Insurance companies' perspective (2/3)

Threshold yield and its influence on claims (an illustration)

- **Claims = [(TY – AY)/TY] * Sum Insured**
- **Threshold yield (TY)**: Average of the best five out of the last seven years' yield multiplied by an indemnity notified by the state for the respective season and crop. It is usually the benchmark for a good yield
- **Actual yield (AY):** Yield of a particular season in context, arrived at because of estimation (via manual CCEs or remote sensing)
- **Sum insured (SI):** Maximum amount assured to farmer in the event of losses.

For example, if the AY of an insurance unit (typically a village or gram panchayat) for soybean across the last seven kharif years are as follows:

	2019	2020	2021	2022	2023	2024	2025
AY (Kg/ha)	1,050	1,100	800	1,000	1,150	1,250	750

TY based on average of the best five years and an indemnity of 90 per cent, will be:
TY = {(1050+1100+1000+1150+1250)/5} *90 = **999 Kg/ha**

Assuming the sum insured of Rs 42,000 per ha (in 2025), the claim generated will be about **Rs 10,468** per ha {(999-750)/999} *42,000

The following example illustrates low claims received in the event of lower actual yields reported in earlier years.

	2019	2020	2021	2022	2023	2024	2025
AY (Kg/ha)	750	850	810	825	850	900	750

In this case, TY = {(850+810+825+850+900)/5} *90 = **762.3 Kg/ha**

Assuming the sum insured of Rs 42,000 per ha, the claim generated will be about **Rs 677** per ha {(762.3-750)/762.3} *42,000

Source: Developed by research team based on PMFBY operational guidelines and primary research inputs

Insurance companies' perspective (3/3)

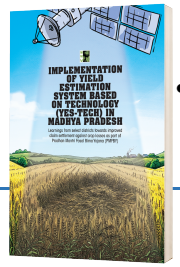
- The technology is poised (if not now, then in the future) to capture yield values more accurately - estimated yields will be closer to reality in the future
- The remote sensing teams of insurance companies also run yield estimation models in parallel and their results are factored in TIP's results, if need be, after discussions
- Concerns around exact accuracy and granularity remain and there was room for **20–30 per cent error**
- Layers of **checks and balances** (such as ground truthing), help move towards better accuracy
- **Suggested potential solution – insurance units could move beyond threshold yield values and instead adopt benchmark 'ideal' yield values that more closely reflect long-term yield realities**

Perspective of Technology Implementation Partner

- Their key job is to estimate actual yield as mandated in YES-TECH guidelines by using remote sensing and modelling
- Inaccuracies in documenting historical yield have led to a threshold yield that could be the reason for no or low claims received by farmers
- In the **next few years**, the **threshold yield would be rectified** and be **closer to actual figures** and **appropriate claims** would reach farmers in the event of losses
- **Results** will **improve towards accuracy** as the **input data** values become more **granular**
- **Satellite data** used in the models - currently obtained from **open-source data** (such as Sentinel-1, European Space Agency) and not Indian satellites
- Weather datasets include those sourced from automatic weather stations (AWS) and automatic rain gauges (ARG) of government and private sectors

State agriculture department's perspective

- Issue of technology-driven claim settlements – **localised phenomenon** rather than **deficits in the technology**
- YES-TECH **models** in use have been **trained on historical CCE data**, as is the case for training any model - **accuracy depends on** the **accuracy of historical yield data**
- **Ground truthing** is also occurring in parallel to **validate** the **input data**
- **Farmers' perception** (some soybean pods were empty) **cannot be attributed** to a **technological flaw**; rather, it is more likely linked to **farm management practices** and the **specific crop** or **seed varieties** used
- **Technology-based yield estimation** overcomes the **earlier constraints** of **manual CCEs for all stakeholders** involved in the processes
- In the **next few years**, as the **models** become **trained on technology-based yield values**, the **claims** will be even **more accurate**
- **Improved access of data to stakeholders** will help address data **transparency concerns**



Conclusion

- Across India, **robust crop insurance** can provide the **required safety net** against increasing **extreme weather events.** It will add to **farmers' resilience** and contribute to **sustainable food systems** in the country
- While **PMFBY adoption** has **increased** over the years its **overall coverage** remains **limited** in the country. **Timely** and **satisfactory claim settlement** is a **critical bottleneck** in the desired **scale-up of PMFBY**
- YES-TECH is potentially a **promising alternative** to address the concerns with **manual CCEs.**
- **The main reason for such hefty claims in the past was incorrect reporting (**during the times of manual CCEs) to show lower yields and thereby higher losses
- **Lower claims in recent years are also rooted in historically under-reported yields**
- **Farmers' lack of trust** in YES-TECH appears to be a **localised phenomenon**, particularly **among large soybean farmers** in select districts
- However, it warrants attention alongside **concerns of district and state-level stakeholders** of **limited awareness** and **restricted access to data specifics**
- **Restoring stakeholder confidence** will also **require greater transparency** around the validation of input data used in the models

Way ahead

Madhya Pradesh should consider/continue to:

- Invest in/adopt **robust validation** of **input data.**
- Invest in building/using technology infrastructure for **hyper-local** and **accurate input data** and **training models** for **yield estimation**
- **Improve stakeholder awareness** and **build capacity**, **strengthen communication** to foster more **trust** among **farmers**
- **Include more crops** in YES-TECH in addition to soybean, wheat and paddy
- Continue to **guide and help other states** towards **adopting/scaling up YES-TECH** implementation

At the national level:

- **States who have adopted the YES-TECH** should consider adding the weightage and with time increase it to 100 per cent through a **phased approach** incorporating **learnings from initial years** and in **consultation with local stakeholders** (including **farmers**) to build trust and confidence
- **States that have not yet adopted** the YES-TECH should consider doing so starting with one or more key crops. It would be useful to coordinate with Madhya Pradesh to incorporate their learnings in the beginning

Thank you

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