

A research in Agriculture and Climate Change in India with International Collaboration: A Scientometrics Perspective

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Abstract

The Government of India has consistently promoted sustainable farming practices and the adoption of climate-resilient methodologies. These measures are designed to enhance farmers' incomes while simultaneously creating new opportunities for entrepreneurship and innovation in the agricultural sector. This study presents a scientometrics analysis of research on agriculture and climate change in India, with a focus on international collaboration. Using data from the Web of Science (1995–2025), 2,460 publications with 3,19,979 citations were examined through Biblioshiny, VOSviewer, and HistCite to assess publication trends, citation impact, and collaborative networks. Findings reveal contributions from 127 countries, with the United States (354 publications; 26,538 citations), United Kingdom (156; 17,027), and Australia (147; 15,148) as leading collaborators. Analysis of Total Global Citation Scores (TGCS) and Total Local Citation Scores (TLCS) highlights dual patterns of influence: research powerhouses such as the USA and UK show high global and local impact, while countries like Mexico and Kenya demonstrate strong local influence despite moderate global citations. Emerging contributors, including Bangladesh, the Philippines, and Pakistan, are gaining visibility in both global and regional research networks. The results underscore that global citation dominance does not always align with local scholarly integration, and balanced international collaboration is essential for addressing region-specific agricultural challenges under climate change. The study analyzed the characteristics of articles published by Scientists in the field of climate change in agriculture in India total 2430 Publications retrieved from the Scopus online database were analyzed. There were as many as 127 countries actively engaged research with researchers. The most productive and the highest number of collaborations with USA, with (TP=354, TC=26,538), followed by the UK (156), with (TP=375, TC=17,027), Australia (TP=194, TC=15,148), Germany (TP=156, TC=11,668), and People's R China (TP=140, TC=11,451).

Keywords: Agriculture; Climate Change; Sustainable Agriculture; Agriculture-India.

Introduction

The scientometrics study of research has become one of the most widely used techniques for evaluating the performance of individual researchers, departments, institutions, countries, subject domains, and journals. The purpose of this study is to provide a scientometrics evaluation of global research performance on climate change and its impact on agriculture during the period 1995–2025. Such an analysis will help scientists and policymakers understand the progress and trends in research and development within this field. By mapping publication patterns, collaboration networks and citation impact, the study offers valuable insights for guiding future research priorities in climate change and agriculture.

Agriculture is a critical sector for global food security, rural livelihoods, and economic stability, particularly in developing nations. However, the sector faces unprecedented challenges due to the adverse impacts of climate change, including temperature fluctuations, erratic rainfall patterns, increased frequency of extreme weather events, and shifting pest and

disease dynamics. These challenges threaten not only crop productivity but also the sustainability of natural resources and the resilience of farming systems.

In recent times, research relating agriculture and climate change has extended quickly, driven by the urgency to develop adaptive policies, improve resource efficiency, and enhance climate resilience. Given the multidisciplinary nature of this field-spanning agronomy, environmental science, policy studies, and socio-economic research-collaboration across national boundaries has become essential for knowledge sharing, technology transfer, and policy innovation.

Scientometrics analysis offers a systematic approach to evaluate the patterns, trends, and impact of research outputs in a given domain. By examining publication records, citation metrics, collaboration networks, and keyword occurrences, it becomes possible to map the intellectual structure and identify research hotspots. Such analyses not only highlight the contributions of leading countries, institutions, and researchers but also reveal the extent of international cooperation in addressing complex

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global challenges.

The present study employs scientometric techniques to analyse research publications on agriculture and climate change in India, with a special focus on international collaboration patterns. Based on a dataset comprising 2,460 publications and 3,19,979 citations, the study identifies key collaborating countries, highly cited papers, and thematic research trends. The findings aim to provide a comprehensive overview of the global research landscape in this domain, thereby guiding policymakers and researchers toward more targeted and impactful comparisons.

OBJECTIVES

The main objective of this study is to analyze the research performance in the field of "Agriculture and Climate Change in India" as reflected in the publication and citation output during 1995-2025. In particular, the study focuses on the following aspects:

1. To study the share of publications of highly productive countries;
2. To study the Total Local publications citations;
3. To study the Total Global publications citations Score;
4. To study the hot and highly cited publications;

MATERIALS AND METHODS

Web of Science database was used for collecting data on climate change by using the search term "Agriculture and climate change" with title field and "India" with address field. Records relating to climate changes were retrieved 2,460 papers for the period of 1995-2025 and it was developed only the papers which has contributed only by India.

A total of 2,460 publications registered 38,345 Citations were transferred to Biblioshiny, VoSViewer and Histcite for tabulation and visualization of Concept Mapping and the data were analyzed as per the objectives of the study.

Data analysis and interpretation

The comparative analysis of Total Global Citation Scores (TGCS) and Total Local Citation Scores (TLCS) reveals important patterns in the scholarly impact and collaborative footprint of different countries in agriculture and climate change research.

The United States, United Kingdom, and Australia consistently occupy the top positions in both TGCS and TLCS, reflecting not only high productivity but also significant scholarly influence at both the global and local (dataset) levels.

The USA leads with 354 publications, 26,538 TGCS, and 436 TLCS, highlighting its central role in shaping the research landscape.

The UK ranks second in both metrics (156 publications; 17,027 TGCS; 375 TLCS), while Australia demonstrates strong visibility (147; 15,148 TGCS; 194 TLCS).

Some nations achieve disproportionately high TLCS compared to their TGCS, indicating strong influence within the core dataset despite smaller global citation counts.

Mexico (73 publications; 7,549 TGCS; 299 TLCS) stands out for its exceptionally high TLCS-to-TGCS ratio, suggesting that its research is deeply embedded and frequently referenced within the main network of studies.

Kenya (51; 5,590 TGCS; 137 TLCS) also shows a strong local research influence, particularly relevant to climate-vulnerable agricultural regions.

Some countries have high TGCS but relatively lower TLCS, suggesting broader international visibility rather than dominance in the local dataset.

Germany (125; 11,668 TGCS; 156 TLCS) and China (129; 11,451 TGCS; 140 TLCS) both fit this pattern, with extensive international citations yet moderate internal network citations. Japan (47; 3,419 TGCS; 9 TLCS) exemplifies a large gap, indicating that its work is more recognized globally than within the dataset's main citation clusters.

Several developing nations contribute significant volumes of research, with varying degrees of citation influence.

Bangladesh (78; 2,576 TGCS; 93 TLCS) and Philippines (23; 2,168 TGCS; 84 TLCS) demonstrate growing integration into global and local citation networks.

Pakistan (50; 2,109 TGCS; 31 TLCS) and Indonesia (20; 2,543 TGCS; 16 TLCS) contribute steadily but have lower citation metrics, suggesting opportunities for increased International collaboration.

Countries with smaller publication volumes but high per-paper citation impact include Ireland (13; 4,447 TGCS; 57 TLCS) and New Zealand (12; 2,948 TGCS; 29 TLCS). This indicates highly targeted, high-quality contributions that resonate with both local and international audiences.

Interpretation

The dual TGCS-TLCS perspective shows that:

1. TGCS dominance reflects global reach, often associated with large research networks and collaborations.
2. TLCS strength indicates centrality within the field's core literature and strong thematic integration.
3. Countries with high TLCS but moderate TGCS are often regionally focused yet deeply engaged in the specialized discourse.
4. Nations with high TGCS but low TLCS tend to work on topics with broader, possibly interdisciplinary, appeal beyond the dataset's primary network.

Global citations and local citation networks reveal deeper thematic relevance and scholarly integration, particularly valuable in applied and region-specific domains like agriculture and climate change.

International Collaboration (Citation Impact)

International Collaboration Over the 30-year periods, the 128 most prolific countries saw an increase generally in the number of publications and Citations. Table_1 shows the number of these countries' publications accounted for total number of publications worldwide. The most productive and the highest number of collaborations with USA with (TP=354, TC=26,538), followed by the UK (156), with (TP=375, TC=17,027), Australia (TP=194, TC=15,148), Germany (TP=156, TC=11,668), and People's R China (TP=140, TC=11,451).

There are clear benefits to be had from international collaboration in research, and researchers can access skills and experience from others scientists. Publications are an indicator that can be used for the detailed analysis of scientific output of a country. These can be used as a proxy measure to examine the relative strengths and weaknesses of a country. There were as many as 127 countries actively engaged in Agriculture and climate change research in India, which produced 2,460 papers during 1930-2020.

TABLE - I

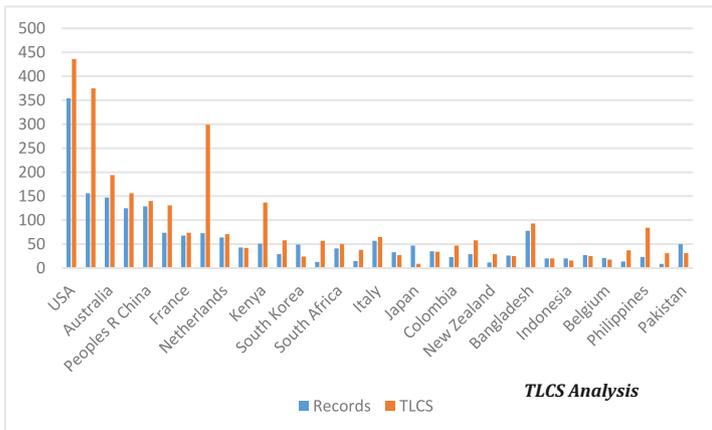
Sl	Country	Records	TLCS	TGCS
1	USA	354	436	26538
2	UK	156	375	17027
3	Australia	147	194	15148
4	Germany	125	156	11668
5	Peoples R China	129	140	11451
6	Canada	74	131	9595
7	France	68	74	9054
8	Mexico	73	299	7549
9	Netherlands	64	71	6669
10	Spain	43	42	5633
11	Kenya	51	137	5590
12	Russia	29	58	5270
13	South Korea	49	24	4588
14	Ireland	13	57	4447
15	South Africa	41	50	4414
16	Denmark	15	38	3964
17	Italy	57	65	3869
18	Switzerland	33	27	3682
19	Japan	47	9	3419
20	Brazil	35	34	3241
21	Colombia	23	47	3090
22	Thailand	29	58	3035
23	New Zealand	12	29	2948
24	Austria	26	25	2825
25	Bangladesh	78	93	2576
26	Taiwan	20	20	2556
27	Indonesia	20	16	2543
28	Sweden	27	25	2359
29	Belgium	21	18	2334
30	Nigeria	14	37	2294
31	Philippines	23	84	2168
32	Finland	9	31	2133
33	Pakistan	50	31	2109
34	Nepal	48	80	1851
35	Uruguay	2	26	1769
36	Saudi Arabia	82	5	1764
37	Norway	20	11	1723
38	Malaysia	29	15	1685
39	Singapore	11	2	1396
40	Argentina	11	6	1271
41	Ethiopia	29	6	1266
42	New Caledonia	2	2	1191
43	Ghana	13	15	1126
44	Mali	11	20	1126
45	Tunisia	11	15	1124
46	Iran	16	17	1112
47	Israel	20	11	1078
48	Hungary	15	0	1075
49	U Arab Emirates	21	11	1070
50	Portugal	15	2	1055
51	Zimbabwe	6	40	1028
52	Greece	13	3	1011
53	Cuba	3	5	998
54	Peru	13	11	885
55	Egypt	36	5	873
56	Poland	16	0	830
57	Uganda	8	14	788
58	Czech Republic	20	1	756
59	Romania	12	5	736
60	Morocco	12	10	730
61	Vietnam	16	22	711
62	Slovakia	14	2	697
63	Turkey	9	13	677
64	Sri Lanka	19	6	664
65	Afghanistan	16	80	655
66	Chile	9	0	653
67	Fiji	4	5	556
68	Benin	6	0	502
69	Unknown	6	114	479
70	Laos	6	14	460
71	Bahamas	2	0	442
72	Jamaica	2	0	442
73	Sudan	2	9	442
74	Trinidad Tobago	3	0	418
75	Ecuador	4	2	357
76	Senegal	6	1	330
77	Niger	2	5	320
78	Croatia	7	1	274
79	Venezuela	2	0	273
80	Qatar	7	8	261
81	Bolivia	2	2	259
82	Slovenia	2	0	245
83	Latvia	2	0	220
84	Bhutan	5	3	218
85	Estonia	6	0	218
86	Syria	6	2	191
87	Papua N Guinea	2	0	188
88	Tanzania	5	2	187
89	Micronesia	1	0	183
90	Zambia	3	6	173
91	Serbia	7	6	170
92	Oman	5	0	148
93	Iraq	11	0	138
94	Turkiye	14	0	130
95	Bulgaria	5	0	123
96	Cambodia	4	10	117
97	Nicaragua	1	0	109
98	Lebanon	3	2	92
99	Mozambique	2	0	85
100	Iceland	2	0	83
101	Malawi	2	0	73
102	Sierra Leone	2	4	71
103	Guatemala	2	2	69
104	Costa Rica	2	0	56
105	Algeria	1	2	55
106	Rwanda	2	0	50
107	Jordan	5	1	31
108	Cameroon	2	0	24
109	DEM REP CONGO	1	0	20
110	Cyprus	1	0	17
111	Armenia	3	0	16
112	Burkina Faso	1	0	14
113	Libya	1	0	14
114	Mauritius	1	0	14
115	Gambia	1	0	12
116	Azerbaijan	1	0	10
117	Panama	1	0	8
118	Guyana	1	0	5
119	Maldives	1	0	4
120	Bosnia & Herceg	3	0	3
121	Uzbekistan	4	0	3
122	Cote Ivoire	1	0	2
123	North Macedonia	1	0	2
124	Montenegro	1	0	1
125	Kyrgyzstan	1	0	0
126	Lithuania	1	0	0
127	Timor-Leste	1	0	0

Overall, TLCS analysis underscores that while research volume and local influence are often correlated, certain countries achieve high recognition through impactful and highly cited contributions, regardless of their total publication count.

TABLE - II

Sl	Country	Records	TLCS
1	USA	354	436
2	UK	156	375
3	Australia	147	194
4	Germany	125	156
5	Peoples R China	129	140
6	Canada	74	131
7	France	68	74
8	Mexico	73	299
9	Netherlands	64	71
10	Spain	43	42
11	Kenya	51	137
12	Russia	29	58
13	South Korea	49	24
14	Ireland	13	57
15	South Africa	41	50
16	Denmark	15	38
17	Italy	57	65
18	Switzerland	33	27
19	Japan	47	9
20	Brazil	35	34
21	Colombia	23	47
22	Thailand	29	58
23	New Zealand	12	29
24	Austria	26	25
25	Bangladesh	78	93
26	Taiwan	20	20
27	Indonesia	20	16
28	Sweden	27	25
29	Belgium	21	18
30	Nigeria	14	37
31	Philippines	23	84
32	Finland	9	31
33	Pakistan	50	31

Chart - I



National Research Influence in Agriculture and Climate Change: TLCS Analysis

An assessment of Total Local Citation Scores (TLCS)—which measures the influence of publications within the specific dataset—provides insights into the relative recognition and impact of each country's research contributions in agriculture and climate change.

The United States leads with 354 records and the highest TLCS of 436, reflecting its central position and sustained influence within the core literature of this field. The United Kingdom follows with 156 publications and a TLCS of 375, indicating a strong scholarly footprint despite a smaller publication volume compared to the USA. Australia ranks third with 147 publications and a TLCS of 194, showing notable recognition within the research network.

Mexico emerges as a distinctive case with 73 publications but a remarkably high TLCS of 299, suggesting that its research outputs are highly interconnected and influential within the dataset. Similarly, Kenya (51 publications; TLCS 137) demonstrates strong local impact, indicating active engagement in regionally and globally relevant research themes. European countries such as Germany (125 publications; TLCS 156), France (68; TLCS 74), and the Netherlands (64; TLCS 71) maintain visible positions, while China (129; TLCS 140) and Canada (74; TLCS 131) reflect both substantial contributions and growing scholarly influence.

Notably, Bangladesh (78; TLCS 93) and Philippines (23; TLCS 84) represent developing nations whose research is gaining local citations, pointing to increasing integration into the global research network. Smaller nations such as Ireland (13; TLCS 57) and New Zealand (12; TLCS 29) exhibit high per-publication impact, even with limited outputs.

Some countries, such as Japan (47; TLCS 9) and Indonesia (20; TLCS 16), show relatively lower TLCS despite significant publication numbers, suggesting either newer research outputs that have not yet accumulated citations or a focus on niche topics with limited cross-referencing in the dataset.

TABLE - II

The scientometric analysis of International collaboration in agriculture and climate change research reveals significant disparities in publication output and citation impact across countries. The top contributors demonstrate both high research productivity and substantial global scientific influence, as indicated by Total Global Citation Scores (TGCS).

Sl	Country	Records	TGCS
1	USA	354	26538
2	UK	156	17027
3	Australia	147	15148
4	Germany	125	11668
5	Peoples R China	129	11451
6	Canada	74	9595
7	France	68	9054
8	Mexico	73	7549
9	Netherlands	64	6669
10	Spain	43	5633
11	Kenya	51	5590
12	Russia	29	5270
13	South Korea	49	4588
14	Ireland	13	4447
15	South Africa	41	4414
16	Denmark	15	3964
17	Italy	57	3869
18	Switzerland	33	3682
19	Japan	47	3419
20	Brazil	35	3241
21	Colombia	23	3090
22	Thailand	29	3035
23	New Zealand	12	2948
24	Austria	26	2825
25	Bangladesh	78	2576
26	Taiwan	20	2556
27	Indonesia	20	2543
28	Sweden	27	2359
29	Belgium	21	2334
30	Nigeria	14	2294
31	Philippines	23	2168
32	Finland	9	2133
33	Pakistan	50	2109

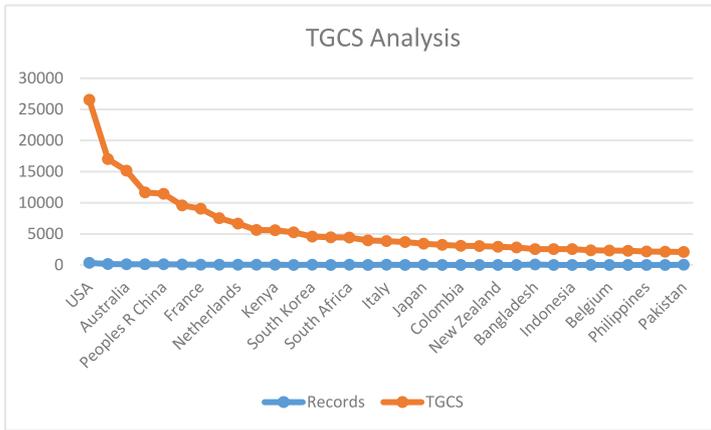


Chart- II

The United States leads with 354 publications and an impressive 26,538 citations, reflecting its dominant role in advancing research in this domain and its strong citation impact. The United Kingdom ranks second, contributing 156 publications with 17,027 citations, closely followed by Australia with 147 publications and 15,148 citations, indicating active engagement and high research visibility.

European countries such as Germany (125 publications; 11,668 citations), France (68 publications; 9,054 citations), and the Netherlands (64 publications; 6,669 citations) show strong research outputs, with notable influence in global scholarship. China also emerges as a significant contributor, with 129 publications and 11,451 citations, reflecting its growing role in climate and agriculture research.

Countries from the Global South, such as Mexico (73 publications; 7,549 citations), Kenya (51 publications; 5,590 citations), South Africa (41 publications; 4,414 citations), and Brazil (35 publications; 3,241 citations), indicate active participation, often in collaboration with global research networks. Asian nations, including Bangladesh (78 publications; 2,576 citations), Pakistan (50 publications; 2,109 citations), Thailand (29 publications; 3,035 citations), and Indonesia (20 publications; 2,543 citations), also contribute significantly, highlighting the importance of agricultural and climate research in climate-vulnerable regions.

Smaller nations such as Ireland (13 publications; 4,447 citations) and New Zealand (12 publications; 2,948 citations) exhibit high citation averages per publication, suggesting that their research outputs, while fewer in number, are highly impactful in the scientific community.

Yearwise growth of publications

Overall, the data highlights that while high-income countries dominate in both volume and impact, emerging economies and climate-affected regions are increasingly visible in the international research landscape, underscoring the collaborative and globally relevant nature of agriculture and climate change research.

Keyword occurrences

The analysis of indexed keywords reveals the thematic focus areas in agriculture and climate change research. Frequently occurring terms represent the conceptual backbone of the field, indicating both established areas of inquiry and emerging trends.

The most prominent keyword in the dataset is "climate change" and "agriculture" which confirms the strong emphasis on agricultural systems within the climate change discourse.

Highly Cited Countries

The analysis of highly cited countries, based on Total Global Citation Scores (TGCS) and Total Local Citation Scores (TLCS), reveals clear differences between research productivity, international recognition, and influence within the core literature of agriculture and climate change research.

1. Global citations

The United States is the most influential contributor, with 354 publications, the highest TGCS (26,538) and TLCS (436), reflecting both exceptional global reach and strong embeddedness within the field's citation network. The United Kingdom follows with 156 publications, 17,027 TGCS, and 375 TLCS, indicating a substantial research footprint. Australia ranks third in global citations (15,148 TGCS) and TLCS (194), with high per-paper influence.

2. High Local Impact Relative to Global Recognition

3. Global Reach but Lower Local Integration

Some research outputs are widely cited internationally but less central to the dataset's citation clusters.

i) Germany (125; 11,668 TGCS; 156 TLCS) and China (129; 11,451 TGCS; 140 TLCS) have extensive global reach yet moderate TLCS values.

ii) Japan (47; 3,419 TGCS; 9 TLCS) is an extreme case of high global but low local impact, indicating work that appeals to broader, possibly interdisciplinary audiences outside the dataset's thematic core.

4. Evolving Contributors from Developing Regions

Several developing countries show rising research presence, with growing TGCS and TLCS.

i) Bangladesh (78; 2,576 TGCS; 93 TLCS) and the Philippines (23; 2,168 TGCS; 84 TLCS) have strong integration into the network and address regionally critical topics.

ii) Pakistan (50; 2,109 TGCS; 31 TLCS) and Afghanistan (16; 655 TGCS; 80 TLCS) also contribute meaningfully, with increasing scholarly visibility.

5. High Citation Efficiency in Small Output Nations

Some nations produce a limited number of publications but achieve high average citation rates, indicating targeted, high-quality contributions.

i) Ireland (13; 4,447 TGCS; 57 TLCS) and New Zealand (12; 2,948 TGCS; 29 TLCS) exemplify this pattern.

ii) Uruguay (2; 1,769 TGCS; 26 TLCS) shows extremely high global citations per publication.

Findings and conclusions

1. Dominance of High-Income Countries

Apart from India the USA, UK and Australia are the top three contributors in both publication volume and citation impact (TGCS and TLCS), indicating their leadership in agriculture and climate change research.

2. Dual Impact Patterns

Some countries (e.g., USA, UK) score highly in both TGCS and TLCS, reflecting global reach and local thematic integration. Others (e.g., Japan, Germany, China) have strong TGCS but relatively lower TLCS, suggesting global visibility without centrality in the dataset's core literature.

3. Regional Leaders with Strong Local Impact

Mexico, Kenya, and Nepal show high TLCS relative to TGCS, indicating strong influence within regional or thematic research clusters despite moderate global citation counts.

4. Emerging Contributors from Developing Regions

Bangladesh, the Philippines, Pakistan, and Afghanistan demonstrate growing research outputs and integration into the global network, especially on regionally critical issues like food security and adaptation.

5. High Citation Efficiency in Low-Volume Nations

Countries such as Ireland, New Zealand, and Uruguay have small publication counts but high average citations per paper, indicating targeted, high-impact research contributions.

Conclusions

This scientometric analysis shows that agriculture and climate change research are both globally distributed and regionally specialized in India.

High-income nations dominate in terms of both quantity and global citation impact, leveraging large-scale collaborations and well-resourced research systems.

Certain developing and climate-vulnerable countries achieve high local citation influence, suggesting deep thematic engagement within their regions and networks.

The dual TGCS-TLCS approach reveals that global impact does not always align with local network influence—both metrics are necessary to fully understand scholarly leadership.

Strengthening collaboration between global leaders and regionally embedded researchers could enhance knowledge exchange, increase research relevance, and bridge the gap between global visibility and local problem-solving.

The Indian agricultural sector actually requires very advanced designs for the upliftment of this sector. Also, without automation, agriculture is hard and back-breaking work. This has resulted in most farmers' children leaving farming and going for other vocations. Farmers get more money in selling their land to constructors, malls and workshops. This has put more pressure on farmland, thereby requiring technologies to increase productivity so that shrinking farmland can feed the billion-plus people of India in the future. India, though one of the biggest producers of agricultural products, has very low farm productivity, with the average only 33 percent of the best farms world wide. This needs to be increased so that farmers can get more remuneration from the same piece of land with less labour. Overall, the findings highlight the importance of balanced international collaboration, ensuring that research is not only widely cited but also deeply connected to the contexts where climate change impacts on agriculture in India are most acute.

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