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EDITORIAL ANALYSIS

Averages and Hotspots: Pesticide Intensity, Residue Limits and Trade

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ECONOMY**ENVIRONMENT****IR****GS3****GS2**

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Averages and Hotspots: Pesticide Intensity, Residue Limits and Trade

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GS3

GS2



INTERVIEW ANGLE

"A national average of 0.3 kg per hectare and a farmworker in an intensively sprayed cotton block are both true descriptions of Indian pesticide use. If you were designing regulation, which number would you regulate against, and what would you lose by choosing the other?"

✓ Every fact web-verified against primary sources

THE LIFT LINE

A national average of 0.3 kilograms a hectare and a farmworker in a sprayed cotton block are both accurate descriptions of Indian pesticide use. Only one of them is an answer to a safety question.

WHY THIS EDITORIAL MATTERS FOR YOUR EXAM

Agricultural-trade answers tend to stop at “non-tariff barriers restrict Indian exports” without explaining the mechanism. This supplies it: the shift of residue limits from a toxicological to an analytical basis, and the WTO discipline that makes it contestable. It also carries an unusually clean example of how a true statistic, the national application average, can be used to answer a question it does not actually address.

GS Paper 3: Agriculture, issues of buffer stocks and food security, marketing and transport constraints, e-technology in aid of farmers; economics of animal rearing and food processing; environmental pollution.

GS Paper 2: Bilateral, regional and global groupings and agreements involving India; effect of policies of developed countries on India’s interests.

CONCEPT	MEANING	WHY IT IS TESTABLE
Maximum Residue Limit (MRL)	The highest permissible concentration of a pesticide residue in a food product	The operative instrument in this dispute
Non-tariff barrier	A trade restriction other than a tariff: standards, certification, testing, licensing	The category MRLs can fall into when set without toxicological basis
SPS Agreement	The WTO Agreement on Sanitary and Phytosanitary Measures	Requires measures to rest on scientific principles and not be maintained without sufficient evidence
RASFF	The EU's Rapid Alert System for Food and Feed	The mechanism through which consignments are halted and notified
Pre-Harvest Interval	The minimum period between last application and harvest	The single most important on-farm practice for residue compliance
Codex Alimentarius	The FAO and WHO joint food standards body	The international reference point the SPS Agreement recognises

BACKGROUND AND CONTEXT

The author is **Sarath Babu Balijepalli**, writing in The Statesman on 5 August 2026.

The context is an agricultural export sector stagnant at about **\$50 billion**, against a claimed potential of \$100 billion within three years, and a rising volume of consignment rejections in destination markets.

COUNTRY OR REGION	PESTICIDE USE PER AREA OF CROPLAND, KG/HA (FAOSTAT)
China	13.07 (2018)
Japan	11.80
Germany	4.00
United States	3.57
Global average	2.40 (2023)
India	roughly 0.3 to 0.4

These six values are **not all drawn from the same reference year**. The world figure is for 2023; China's 13.07 corresponds to 2018, since when its rate has fallen; India's has been reported at 0.37 kg/ha for 2022, with the lower 0.29 to 0.31 range corresponding to 2018 and 2019. A table that selects each country's most convenient year and presents the result as a single comparison is doing exactly what this editorial accuses residue enforcement of doing, and it should not be reproduced in an answer without the caveat attached.

The **direction survives the caveat on any consistent year**: India applies roughly **six to eight times below the global average** and an order of magnitude below China and Japan. It is the precise multiple, not the ranking, that is year-sensitive.

TRADE FRICTION	DETAIL
RASFF notifications against Indian consignments, mid-2024 to mid-2026	365
Recurring flashpoints	Ethylene oxide in spice blends; tricyclazole in basmati rice, where the EU cut the maximum residue limit from 1.0 ppm to 0.01 ppm , a hundredfold tightening reported to have reduced basmati exports to the EU by over 45 per cent
EU default analytical threshold	0.01 mg per kg , roughly one gram of active ingredient per 100 metric tonnes
APEDA's estimated annual loss	About \$340 million

THE CORE ARGUMENT / ISSUE

Why the threshold argument is the strong one

The most persuasive element of the case is not the comparative-intensity table but the nature of the limit being enforced.

A **toxicological** residue limit is derived from an acceptable daily intake, itself derived from animal studies with safety factors applied, and then translated into a permissible concentration given expected consumption. It answers the question: at what concentration does this substance begin to pose a risk?

An **analytical default** limit of 0.01 mg per kg answers a different question: what is the smallest quantity our instruments can reliably detect? Those are not the same standard, and only one of them is a health standard.

The consequence is peculiar. As detection technology improves, the effective stringency of a default limit **increases automatically**, without any new toxicological finding and without any regulatory decision being taken. A consignment acceptable in 2015 can be rejected in 2026 on the same residue level, because the instrument now sees it.

This is where the **SPS Agreement** bites. It permits members to adopt measures necessary to protect human health, but requires that such measures be **based on scientific principles** and **not maintained without sufficient scientific evidence**, and that where an international standard exists, notably a **Codex MRL**, a member adopting a stricter one must justify it by risk assessment. A default threshold set at the limit of detection, applied to a substance with an established Codex limit, is precisely the kind of measure that discipline exists to test.

Why the intensity argument needs care

Here the editorial's own case has to be handled with more discipline than advocacy usually applies, and a strong answer says so.

A national average is a quotient, not a description of practice. India cultivates a very large number of distinct crops, put at **554** in the editorial though the figure could not be traced to an official source, across agro-climatic zones ranging from Kerala's wet tropics to Rajasthan's arid west. By most estimates only **a quarter to a half of cultivated land receives structured plant protection at all**, with published work putting pesticide application at around a quarter of the cultivated area. That means the denominator includes very large areas of low-input and rainfed cultivation that apply almost nothing, which pulls the national mean sharply down.

The **corollary** is that intensive blocks, in cotton, in vegetables under polyhouse cultivation, in table grapes grown for export, can and do apply at rates far above the mean. The relevant figure for a **farmworker's occupational exposure**, or for a **specific consignment's residue level**, is the local application rate, not the national average.

An argument that meets a hotspot concern with a national mean is answering a different question. The trade argument survives this; the general safety argument does not follow from it.

The comparative cancer figures, and why they prove less than they appear

The editorial cites age-standardised cancer incidence per 100,000 from IARC's GLOBOCAN. The current edition, **GLOBOCAN 2022**, gives a world rate of **196.9**, with **Australia at 462.5**, **New Zealand 427.3**, **Denmark 374.7**, the **United States 367.0**, and **India at 98.5**.

The editorial's own set mixes editions: its New Zealand, United States and India values, and its inclusion of Ireland at 375.5, are GLOBOCAN 2020-era figures, and Ireland does not appear in the 2022 top five at all. Use the 2022 numbers.

The figures are real. The inference drawn from them is weaker than it looks, for a reason worth understanding.

Recorded incidence is a function of detection. A country with universal screening programmes, high diagnostic access and a complete population-based cancer registry will find and record cancers that a country with limited screening, later presentation and partial registry coverage will not. India's cancer registry coverage extends to a fraction of the population, and a substantial share of Indian cancers present at an advanced stage, which is itself evidence of under-detection at earlier stages.

Some of the gap between 104.1 and 365.0 is therefore real difference in incidence, driven by age structure, since cancer is overwhelmingly a disease of older populations and India's median age is far lower, and by risk-factor prevalence. Some of it is difference in **finding**. The data cannot separate the two, and a comparison used to argue that Indian agriculture is safe is loading more weight on it than it will bear.

The "cancer train" and what can honestly be said about it

The editorial addresses the well-known train, **No. 14888/339**, running overnight across roughly **325 km** from **Bathinda in Punjab to Bikaner in Rajasthan**, which acquired its popular name from the number of cancer patients travelling on it.

Its argument is that the traffic is explained by **economics rather than environment**: Indian Railways provides free tickets to cancer patients and steep concessions for an accompanying attendant, and the destination is the **Acharya Tulsi Regional Cancer Hospital and Research Centre at Bikaner**, which offers subsidised oncology. On this account, the train concentrates patients travelling toward affordable treatment rather than revealing a concentration of disease at the origin.

That mechanism is real and is frequently omitted from popular accounts. **But it does not settle the question**, and it should not be presented as though it does.

A subsidised-care explanation accounts for **why patients travel on that route**. It does not by itself establish the **underlying incidence** in the districts they come from, which is a separate **empirical** question requiring registry data rather than transport data. The editorial's further claim, that Punjab ranks in the lower-to-moderate range on per-capita cancer incidence relative to other states, is the load-bearing assertion in this section and is contested in the literature. It should be treated as a claim requiring verification against population-based registry data, not as an established finding.

Population-based registry data do not support the op-ed's claim as stated. The **Patiala Population-Based Cancer Registry** records an age-adjusted incidence of **124.6 per 100,000 for women and 108.2 for men**, roughly 21 and 16 per cent **above** the corresponding national averages, and above Delhi, Patna and Bhopal. Punjab is nonetheless far below India's highest-incidence registries, which are in the Northeast, where **Aizawl records 269.4 for men and Papum Pare 219.8 for women**.

So Punjab sits **above the national average and well below the national maximum**. The claim that it ranks lower-to-moderate is defensible only against the Northeast and is contradicted by the comparison that matters, which is against the national average and against comparable north Indian registries.

Neither position establishes anything about **causation**, which is a separate question requiring exposure data rather than incidence data. Cancer is multifactorial: tobacco use, diet, obesity, infection, genetics and above all age. That is a reason for caution about attributing a cancer cluster to pesticides. It is equally a reason for caution about ruling the attribution out.

The problem the low average genuinely conceals

The strongest evidence that a low registered-use average is not a sufficient safety argument comes from the editorial's own reporting.

Market surveillance in **Karnataka** reportedly examined **250 suspicious samples** and found them entirely illicit, with some carrying up to **twelve undeclared synthetic molecules**.

One caution on this passage, because the editorial's own version contains an error worth not repeating. It names **pyridaben** as unregistered in India; pyridaben is in fact **registered and commercially sold here**, marketed for mite control on tea, cotton and chilli. Nitenpyram appears not to hold Indian registration, though that could not be confirmed. The smuggling inference should therefore not rest on the identity of any particular molecule.

What actually matters is simpler and survives the correction: the product was **undeclared**. A formulation sold without a truthful label claim is one whose residues no buyer can test for, no advisory can anticipate and no pre-harvest interval can govern.

Counterfeit and undeclared product does not appear in application statistics, because it is not sold through recorded channels and not counted. A country can therefore have a genuinely low **registered** application intensity and a real residue problem at the same time, and the two facts are not in tension.

HOW TO THINK ABOUT THIS (ANALYTICAL FRAME)

When an aggregate statistic is offered as an answer to a distributional question, check whether the aggregate could be low while the thing being asked about is high. A national average pesticide intensity, a national per-capita income, a national sex ratio, a national forest cover figure: each is a true number that can coexist with severe local conditions, because an average is a quotient over a denominator that may be dominated by cases unlike the one in question. The diagnostic question is always what the denominator contains. This is not an argument against aggregates; it is an argument for matching the level of the statistic to the level of the question, and it applies to almost every "India ranks X" claim a candidate will encounter.

THE DIAGRAM IN WORDS

Picture India's cultivated land as a very large sheet of paper, most of it left almost bare, with a scattering of small dark patches where spraying is intensive. Now weigh all the chemical applied and divide it by the whole sheet. The number that comes out is genuinely small, and it is genuinely India's average. But nobody lives on the average. The farmworker lives in one of the dark patches, and the export consignment that gets stopped at Rotterdam came from one too. Meanwhile, at the edge of the sheet, unrecorded product crosses a border and lands on patches that no ledger counts at all. The average is not a lie. It simply is not a map of where anybody is standing.

WAY FORWARD

- 1 **Contest analytically-derived residue limits through the SPS Agreement**, pressing the requirement that measures rest on scientific principles and that departures from Codex standards be justified by risk assessment.
- 2 **Negotiate mutual recognition of accredited testing**, so that a residue result certified in India is accepted at the port of entry, which addresses the cost of rejection without weakening the standard.
- 3 **Build residue-testing capacity to export-market specification**, since the ability to demonstrate what is in a consignment before it ships is worth more than any argument made after it is rejected.
- 4 **Enforce pre-harvest intervals through farmer-producer organisations**, which is the single highest-return on-farm intervention for residue compliance and requires advisory capacity rather than new regulation.
- 5 **Attack the counterfeit and smuggled-molecule trade directly**, through serialised traceability, and treat this as a food-safety measure rather than only as an industry-protection measure, since unregistered molecules are the residues nobody can predict or test for.
- 6 **Legislate the pending reform.** The **Insecticides Act, 1968** remains the operative statute. The **Pesticide Management Bill, 2020** was introduced in the Rajya Sabha in March 2020 and reported on by the Standing Committee on Agriculture in December 2021, but has never been passed; a fresh draft was circulated for comment in **January 2026**. Enact it, with periodic review of existing registrations, and pair it with support for the shift to green-chemistry molecules applied at grams rather than kilograms per hectare.
- 7 **Publish disaggregated application data by crop and district**, which would end the argument about averages by making the distribution visible.

PYQ LINKAGE AND PRACTICE

UPSC has tested agricultural exports, non-tariff barriers, the WTO agreements, food safety regulation and pesticide use across GS2 and GS3. The analytical-versus-toxicological distinction in residue limits is the technical detail that turns a general answer about [protectionism](#) into a specific one.

Practice question: “Maximum residue limits set at the limit of analytical detection are trade instruments wearing the clothes of food safety.” Examine this claim with reference to India’s agricultural exports, and assess what domestic capability India would need to contest such measures successfully. (250 words, 15 marks)

Interview angle: A national average of 0.3 kg per hectare and a farmworker in an intensively sprayed cotton block are both true descriptions of Indian pesticide use. If you were designing regulation, which number would you regulate against, and what would you lose by choosing the other?

Sources: The Statesman, APEDA, FAO, World Trade Organization

Source: Averages and Hotspots: Pesticide Intensity, Residue Limits and Trade — Ujjyari.com | Free UPSC & State PCS Editorial Analysis

● KEY ARGUMENTS AT A GLANCE

India's pesticide application intensity, at roughly 0.3 to 0.4 kg per hectare against a global average of 2.40, is among the lowest in the world, which makes blanket characterisations of Indian agriculture as chemically excessive quantitatively unfounded; and increasingly stringent maximum residue limits, enforced at analytical thresholds near the limit of detection, function in practice as non-tariff barriers that constrain a \$50 billion agricultural export sector.



SUPPORTING

- The comparative figures are stark on FAOSTAT data: China applies about 13.07 kg per hectare, Japan 11.80, Germany 4.00 and the United States 3.57, against India's roughly 0.3 to 0.4, placing India some six to eight times below the global average and an order of magnitude below China and Japan. The caveat is that these values are not all drawn from the same reference year, so the ranking is robust while the precise multiple is not.
- Enforcement operates at thresholds that are analytical rather than toxicological. The European Union's default limit of 0.01 mg per kg corresponds to about one gram of active ingredient distributed across a hundred metric tonnes of produce, a quantity detectable by modern instrumentation but of no established health significance, and the EU's Rapid Alert System for Food and Feed recorded 365 notifications halting Indian consignments between mid-2024 and mid-2026, with APEDA estimating losses near \$340 million a year.
- India's regulatory architecture is being modernised rather than defended as it stands: first-generation organochlorines including endrin, lindane and HCH are banned, DDT is restricted to public-health vector control with a stated intention to replace it entirely, and the proposed Pesticides Management Bill would supersede the Insecticides Act, 1968 with a sunset window for reviewing registrations and severe penalties for counterfeiting.



COUNTER

A low national average does not establish low exposure, and this is where the argument requires discipline. India cultivates a very large number of distinct crops across radically different agro-climatic zones, and by most estimates only a quarter to a half of cultivated land receives structured plant protection at all, which means the national mean is depressed by vast areas of low-input cultivation while intensive cotton, vegetable and grape blocks can apply at rates far above it.

The relevant exposure for a farmworker in such a block is the local application rate, not the

national average, and an argument that answers a hotspot concern with a national mean is answering a different question. Comparative cancer-incidence figures require the same caution, since age-standardised incidence reflects screening coverage, diagnostic access and registry completeness as much as true incidence, and a country that detects less will record less.

→ **WAY FORWARD**

Pursue the trade argument and the domestic safety agenda as separate tracks rather than as one: contest residue limits that lack toxicological justification through the WTO SPS Agreement's science-based-measure requirement and through mutual recognition of testing, while simultaneously building the domestic capability that makes the contest winnable, through traceability, spray advisory at farmer-producer-organisation level, enforcement of pre-harvest intervals, accredited residue-testing capacity, and suppression of the counterfeit and undeclared-formulation trade that no export negotiation can defend.


MAINS ANSWER FRAMEWORK
QUESTION

Examine the proposition that maximum residue limits function as non-tariff barriers to Indian agricultural exports, and assess whether India's low national pesticide-application intensity establishes that its produce is safe. (250 words)

INTRODUCTION

Two propositions are commonly conflated in discussion of Indian agriculture and agrochemicals: that Indian produce carries excessive chemical residue, and that India uses pesticides intensively. The second is quantitatively false on the available data, and the first does not follow from it either way. Separating them is the precondition for assessing whether maximum residue limits imposed on Indian exports are a food-safety measure or a trade instrument.

BODY

On intensity, the FAO data is unambiguous. India applies roughly 0.3 to 0.4 kg of pesticide per hectare against a global average of 2.40, with China at about 13.07, Japan 11.80, Germany 4.00 and the United States 3.57, though these values are not all drawn from the same reference year.

India therefore sits some six to eight times below the world average on any consistent basis. On enforcement, the significant feature is that residue limits have migrated from toxicological to analytical foundations: the European Union's default limit of 0.01 mg per kg is a detection threshold rather than a health threshold, equivalent to about a gram of active ingredient in a hundred tonnes of produce, and as instrumentation improves the effective standard tightens without any new finding about risk.

Between mid-2024 and mid-2026 the EU's Rapid Alert System recorded 365 notifications against Indian consignments, with ethylene oxide in spice blends and tricyclazole in basmati as recurring flashpoints, and APEDA estimates the cost near \$340 million a year against exports stagnant at about \$50 billion. The WTO Agreement on Sanitary and Phytosanitary Measures requires such measures to rest on scientific principles and not to be maintained without sufficient scientific evidence, which is the legal hook for contesting limits set at the limit of detection.

But the domestic case requires more care than the trade case. A national average conceals distribution: with a very large number of crops cultivated and only a quarter to a half of cultivated land under structured plant protection, intensive horticulture and cotton blocks can apply at multiples of the mean, and it is application at that local level, not the national figure, that determines what a farmworker inhales or a consumer ingests.

Market surveillance in Karnataka reportedly found 250 suspicious samples entirely illicit, some carrying up to twelve undeclared synthetic molecules. The editorial names pyridaben among them as unregistered in India, which is incorrect since pyridaben is registered and sold here; what matters is not the identity of any molecule but that the formulations were undeclared, and undeclared product is precisely what a low registered-use average cannot capture.

CONCLUSION

The two agendas should be pursued separately and simultaneously. Internationally, India should contest residue limits that cannot be justified toxicologically, using the SPS Agreement's science-based-measure discipline and pressing for mutual recognition of accredited testing.

Domestically, it should build the traceability, spray advisory, pre-harvest-interval enforcement, residue-testing capacity and anti-counterfeiting enforcement that make the international argument credible, on the reasoning that a country able to demonstrate what is in its produce is in a far stronger position than one asserting that it uses little.

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