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Assessing the profitability of organic agriculture in India: A meta-analytical approach

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Abstract

Global concerns about the sustainability of chemical-intensive farming have spurred interest in organic agriculture, which promotes ecological balance and avoids synthetic inputs. In India, with its strong tradition of organic farming, the potential for expanding organic agriculture is significant. However, debates persist regarding its economic viability compared to conventional methods. This study addresses this issue by analyzes and investigates the profitability of organic farming across India using meta-analysis, synthesizing findings from 27 studies that compared mean incomes from organic and inorganic farming. The results reveal a significant variation in the performance of organic farming, with mean incomes ranging from Rs. 801.60 per acre (Red gram) to Rs. 13,799.20 per acre (Tomato). While most studies indicate higher profitability for organic agriculture, four studies reported negative gains, with losses ranging from Rs. -8,092.30 per acre (Turmeric) to Rs. -1,935 per acre (Cotton). The meta-analysis, employing a Random Effect Model due to significant heterogeneity, confirms an average profit of Rs. 3,850 per acre for organic agriculture over inorganic farming in India. These findings are consistent with global studies and highlight the economic viability of organic agriculture, although the benefits may vary depending on the crop and region. The study provides crucial insights for policymakers and farmers, emphasizing the need for targeted support to enhance the profitability and adoption of organic farming practices in India.

Keywords: Organic agriculture, inorganic farming, random-effect model, meta-analysis, cumulative meta-analysis

Introduction

Globally, various analyses, including the United Nations-led International Assessment of Agricultural Knowledge, Science, and Technology for Development (IAASTD) in 2008 and the High Level Panel of Experts on Food Security and Nutrition (HLPE) in 2019, have raised significant concerns regarding the sustainability of current chemical and input-intensive agricultural models. These reports stress that continuing with agriculture as usual is no longer an option, particularly in light of alarming projections such as the 2015 Food and Agriculture Organization (FAO) estimate that only 60 harvest years remain due to soil degradation. The urgency of reforming food systems has been highlighted, with agro-ecology, an approach that applies ecological principles to agricultural systems, being proposed as a comprehensive solution. Agro-ecology is seen as key to achieving food sovereignty, addressing issues such as hunger, poverty, climate change, and biodiversity loss. It is increasingly being recognized as a holistic approach that not only contributes to sustainable food systems but also supports the United Nations' Sustainable Development Goals (SDGs) for 2030.

Organic agriculture, a significant component of agro-ecology, promotes the health of soils, ecosystems, and people by relying on natural processes rather than harmful inputs (Srivastava 2023) [18]. It integrates traditional knowledge, innovative science, and ecological principles to create a sustainable and equitable food system. The core principles of organic agriculture include using nature as a model for farming, maintaining soil fertility, preserving wildlife and their habitats, and enhancing genetic diversity (Thakur *et al*. 2022) [19]. Unlike conventional agriculture, which often depends on synthetic inputs, organic farming emphasizes locally adapted, environmentally sustainable practices (Gamage *et al*. 2023) [10]. This approach not only aims to produce high-quality food but also seeks to improve the overall quality of life for all stakeholders involved. In contrast, inorganic agriculture focuses on maximizing yield and profit through the use of man-made chemicals like pesticides, herbicides, and synthetic fertilizers, often at the expense of long-term environmental and soil health (Soni *et al*. 2022) [17].

In India, organic agriculture has deep historical roots and significant potential for growth in both national and international markets. Despite its rich tradition, organic farming in India remains in its infancy, with only 2% of the country's net sown land being farmed organically. The Indian government has made efforts to promote organic farming, primarily through export-focused strategies and third-party certification systems. However, the organic farming movement in India is still more of a niche than a widespread practice, with only a small percentage of farmers registered for organic farming. The potential for organic agriculture in India is immense, but it requires more research and information on the economics of producing and marketing organic products, particularly in comparison to inorganic farming. This gap in research is crucial to address as it could provide the necessary data to encourage more farmers to adopt organic practices and help India establish itself as a leader in sustainable agriculture on the global stage. To address this gap, the present study aims to estimate the profitability of organic agriculture in India through a meta-analysis, offering a more comprehensive understanding of the economic viability of organic farming compared to inorganic methods (Seshia Galvin 2021, Shweta *et al*. 2023) [15, 16].

Materials and methods

Location and classification of studies from the literature:

The meta-analysis focused on identifying and analysing studies on the profitability of organic agriculture in India, covering both published and unpublished sources to minimize publication bias (Challinor *et al*. 2014) [6]. The search spanned from 2008 to 2021, adhering to PRISMA guidelines. A systematic review was conducted using targeted keywords and Boolean operators, yielding 50 relevant studies—36 from Google Scholar and 14 from Krishikosh. The selected studies included peer-reviewed publications, conference proceedings, and thesis data, ensuring a comprehensive analysis of the profitability of organic farming in comparison to inorganic methods (Amenumey *et al*. 2009) [1].

Table 1: Source wise studies located for the study

Name of source	Number of studies selected
Google Scholar	36
Krishi kosha thesis	14
Total	50

Analytical and Exploratory Meta-Analysis

Analytical meta-analysis aims to estimate key metrics and summarize data quantitatively, providing a clear overview of results (Durgesh Yadav 2017) [8]. In contrast, exploratory meta-analysis investigates sources of variability among studies, seeking to identify factors that might affect results, such as study design or demographic differences (Djokoto *et al*. 2016) [7].

Selection Criteria of Studies

To ensure quality and relevance, studies were selected based on specific inclusion and exclusion criteria (Ghagare and Deshmukh 2019) [11]. Inclusion criteria required studies to provide separate net returns for both organic and inorganic farming and have sample sizes available. Studies were excluded if they were conducted outside India or did not involve agricultural crops (Bisoyi *et al*. 2003) [3]. Initially, 50 articles were reviewed, and after applying the criteria, 27 studies were selected for meta-analysis—23 from Google Scholar and 4 from Krishikosh theses, as detailed in Table 2.

Table 2: Source wise studies selected for the study

Name of source	Number of studies selected
Google Scholar	23
Krishi kosha thesis	04
Total	27

A total of 23 articles were excluded from the study for various reasons. Thirteen articles were rejected because they were not conducted in India. Six articles were excluded for not providing distinct estimates for organic and inorganic materials. Additionally, four articles were rejected as they were not focused on agricultural crops.

Data Extraction

Data from 27 selected studies were extracted, as summarized in Table 3. Key details included the study title, author, publication year, state, crop, journal, sample size, and mean income for organic and inorganic agriculture.

Further analysis, presented in Table 4, categorized studies by author, crop, and state, using the Bootstrapping method. This method helped estimate standard deviations and construct confidence intervals for both organic and inorganic agriculture, ensuring a precise and reliable analysis of the data.

Statistical Methods in Meta-analysis

Meta-analysis Master Sheet

The meta-analysis commenced with the creation of a master sheet that systematically listed the included studies in chronological order. This master sheet contained key variables, including the mean difference (MD) between organic and inorganic agriculture outcomes and the associated standard error (SE) for each study. The mean difference (MD) was calculated as follows (Fourichon *et al*. 2000) [9]:

$$MD = (M_o - M_i)$$

Where, MD represents the mean income difference between organic and inorganic agriculture, M_o is the mean income from organic agriculture and M_i is the mean income from inorganic agriculture.

$$SE(MD) = \sqrt{\frac{SD_o^2}{n_o} + \frac{SD_i^2}{n_i}}$$

Table 3: List and details of selected studies for the study

S. No	Title of study selected	Authors	crop	state	Year of publication	Name of the Journal
1	Economics of major crops grown under organic and inorganic farming in Parbhani district of Maharashtra	Sanap Dattaray *et al*.	Cotton	Maharashtra	2008	Thesis
2	Economics of major crops grown under organic and inorganic farming in Parbhani district of Maharashtra	Sanap Dattaray *et al*.	Soyabean	Maharashtra	2008	Thesis
3	Economics of organic farming over conventional farming in India	D. Kumara charyalu *et al*.	Paddy	Punjab	2010	Bilingual journal of Humanities &Social Sciences
4	Economics of organic farming over conventional farming in India	D. Kumara charyalu *et al*.	Wheat	Punjab	2010	Bilingual journal of Humanities &Social Sciences
5	Economics of organic farming over conventional farming in India	D. Kumara charyalu *et al*.	Cotton	Punjab	2010	Bilingual journal of Humanities & Social Sciences
6	Economics of organic farming over conventional farming in India	D. Kumara charyalu *et al*.	Paddy	Uttar Pradesh	2010	Bilingual journal of Humanities & Social Sciences
7	Economics of organic farming over conventional farming in India	D. Kumara charyalu *et al*.	Sugarcane	Uttar Pradesh	2010	Bilingual journal of Humanities & Social Sciences
8	Economics of organic farming over conventional farming in India	D. Kumara charyalu *et al*.	wheat	Uttar Pradesh	2010	Bilingual journal of Humanities & Social Sciences
9	Economics of organic farming over conventional farming in India	D. Kumara charyalu *et al*.	Sugarcane	Maharashtra	2010	Bilingual journal of Humanities & Social Sciences
10	Economics of organic farming over conventional farming in India	D. Kumara charyalu *et al*.	Cotton	Gujarat	2010	Bilingual journal of Humanities & Social Sciences
11	A comparitive economics of organic and inorganic farming	A.G. Tripathi	Cotton	Andhra Pradesh	2010	Hind agricultural research and training institute
12	A comparitive economics of organic and inorganic farming	A.G. Tripathi	Pigeon Pea	Andhra Pradesh	2010	Hind agricultural research and training institute
13	A comparitive economics of organic and inorganic farming	A.G. Tripathi	Mung	Andhra Pradesh	2010	Hind agricultural research and training institute
14	A comparitive economics of organic and inorganic farming	A.G. Tripathi	Wheat	Andhra Pradesh	2010	Hind agricultural research and training institute
15	Organic and inorganic cultivation of chilli and its marketing- An economic analysis*	V.R. Naik *et al*.	Chilli	Karnataka	2012	Karnataka Journal of Agricultural Sciences
16	Economics of organic versus chemical farming for three crops in Andhra Pradesh, India	P. Srikrishna Sudheer	Paddy	Andhra Pradesh	2013	Journal of Organic Systems
17	Economics of organic versus chemical farming for three crops in Andhra Pradesh, India	P. Srikrishna Sudheer	Red Gram	Andhra Pradesh	2013	Journal of Organic Systems
18	Economics of organic versus chemical farming for three crops in Andhra Pradesh, India	P. Srikrishna Sudheer	Groundnut	Andhra Pradesh	2013	Journal of Organic Systems
19	Economics of sugarcane cultivation under organic and inorganic farming in Bagalkot district of Karnataka	M Shivashankar etal	Sugarcane	Karnataka	2014	International Journal of Commerce and Business Management
20	Comparative economics of cost and returns of organic tomato production with inorganic tomato production in Kolar district of Karnataka	R.D. Shelke *et al*.	Tomato	Karnataka	2016	International Research Journal of Agricultural Economics and Statistics
21	Comparitive Economics Of Tomato Production Under Organic And Inorganic Farming Practices In Khargone District Of Madhya Pradesh	Durgesh Yadav	Tomato	Madhya Pradesh	2017	Thesis
22	Economics of organic farming over conventional farming – A case study in Karnataka India	M. Mohan kumar *et al*.	Ragi	Karnataka	2017	International journal of current microbiology and applied sciences
23	Economics of organic farming over conventional farming – A case study in Karnataka India	M. Mohan kumar *et al*.	Maize	Karnataka	2017	International journal of current microbiology and applied sciences
24	A comparitive economic analysis of organic inorganic wheat in Punjab	Shakthi Singh	Wheat	Punjab	2018	Journal of agricultural development and policy
25	Economics of organic and inorganic farming in Satara District, Maharashtra	M.S. Deshmukh *et al*.	Jowar	Maharashtra	2019	Indian Journal of Economics and Development
26	Economics of organic and inorganic farming in Satara District, Maharashtra	M.S. Deshmukh etal	Turmeric	Maharashtra	2019	Indian Journal of Economics and Development
27	A comparitive Analysis of performance of organic and conventional paddy farmers in Karnataka	Kavyashree H.V.	Paddy	Karnataka	2021	Thesis

Table 4: List and details of selected studies for the study with sample size and standard deviation.

Authors	Crop	State	Organic		Inorganic	
			Sample size	SD	Sample size	SD
P. Srikrishna Sudheer	Paddy	Andhra Pradesh	150	905.61	100	656.69
P. Srikrishna Sudheer	Red Gram	Andhra Pradesh	100	745.35	50	672.21
P. Srikrishna Sudheer	Groundnut	Andhra Pradesh	100	832.66	50	548.21
Durgesh Yadav [8]	Tomato	Madhya Pradesh	25	547.11	25	761.11
M. Mohan kumar *et al.*	Ragi	Karnataka	45	874.62	45	751.77
M. Mohan kumar *et al.*	Maize	Karnataka	45	907.51	45	676.65
D. Kumara charyalu *et al.*	Paddy	Punjab	15	901.65	15	815.96
D. Kumara charyalu *et al.*	Wheat	Punjab	15	903.35	15	862.36
D. Kumara charyalu *et al.*	Cotton	Punjab	15	958.64	15	737.51
D. Kumara charyalu *et al.*	Paddy	Uttar Pradesh	15	926.13	15	787.27
D. Kumara charyalu *et al.*	Sugarcane	Uttar Pradesh	15	791.73	15	532.54
D. Kumara charyalu *et al.*	wheat	Uttar Pradesh	15	963.75	15	585.8
D. Kumara charyalu *et al.*	Sugarcane	Maharashtra	15	791.7	15	711.13
D. Kumara charyalu *et al.*	Cotton	Gujarat	15	691.58	15	684.99
Kavyashree H.V.	Paddy	Karnataka	60	754.22	60	866.56
Sanap Dattaray *et al.*	Cotton	Maharashtra	60	1056.53	60	478.6
Sanap Dattaray *et al.*	Soyabean	Maharashtra	60	1063.45	60	1064.8
Shakthi Singh	Wheat	Punjab	70	642.57	54	829.46
M.S. Deshmukh etal	Jowar	Maharashtra	250	755.86	150	682.91
M.S. Deshmukh etal	Turmeric	Maharashtra	250	668.15	150	781.13
R.D. Shelke *et al.*	Tomato	Karnataka	48	810.81	48	503.05
M Shivashankar etal	Sugarcane	Karnataka	60	739.28	60	768.9
V.R. Naik *et al.*	Chilli	Karnataka	30	526.34	30	774.83
A.G. Tripathi	Cotton	Andhra Pradesh	50	617.04	50	692.33
A.G. Tripathi	Pigeon Pea	Andhra Pradesh	50	1056.58	50	510.77
A.G. Tripathi	Mung	Andhra Pradesh	50	830.89	50	886.64
A.G. Tripathi	Wheat	Andhra Pradesh	50	815.87	50	664.55

The SE represents the variability in the mean difference between organic and inorganic agriculture. The standard deviation for organic agriculture is denoted as SD_o, while SD_i represents the standard deviation for inorganic agriculture. The sample sizes for organic and inorganic agriculture are indicated by n_o and n_i, respectively. This structured methodology ensures consistency in capturing and analyzing key metrics from each study, thereby providing a solid foundation for the meta-analysis.

Meta-analysis Plots

To understand heterogeneity, various plots are used. A forest plot displays the estimated effects of each study along with confidence intervals, while a funnel plot helps identify publication bias by showing the relationship between study size and effect size (Lauren Elizabeth Griffith 2009) [13].

Methods for Pooling Estimates

Two main models are used to pool estimates: the fixed effects model and the random effects model.

- **Fixed Effects Model:**
  The fixed effects model assumes a common effect size across all studies, meaning that any observed differences between studies are attributed to sampling error rather than actual variability. Estimates are combined by calculating a weighted average, where the weights

  w_i are based on the precision of each study's estimate (Broeze *et al.* 2010) [5]. The weight for the i^{th} study is determined by:

$$w_i = \frac{1}{SE_i^2}$$

- Here, SE_i represents the standard error of the effect size for the i^{th} study, indicating that more precise estimates are given greater weight in the combined effect size.
- The standard error of the overall effect size $\hat{\theta}$ is calculated as:

$$SE(\hat{\theta}) = \sqrt{\frac{1}{\sum w_i}}$$

- The heterogeneity across studies is assessed using the Q statistic, calculated as:

$$Q = \sum w_i (\theta_i - \hat{\theta})^2$$

  Where θ_i is the effect size for the i^{th} study, and $\hat{\theta}$ is the overall effect size estimate.
- The Q statistic follows a chi-square distribution with (k - 1) degrees of freedom, where k is the number of studies included in the meta-analysis. This test provides insight into whether the observed variability across studies is greater than what would be expected by chance alone.

Random Effects Model

The random effects model accounts for variability between studies by assuming that effect sizes differ across studies. Unlike the fixed effects model, which assumes a common effect size, the random effects model incorporates this variability into the pooled estimate (Bravo-Ureta *et al*. 2007) [4]. The pooled estimate under the random effects model is given by:

$$\hat{\theta}_{RE} = \frac{\sum w_i \theta_i}{\sum w_i}$$

Here, $\hat{\theta}_{RE}$ is the pooled estimate, θ_i represents the effect size for the i^{th} study, and the weights w_i are calculated similarly to the fixed effects model but adjusted to account for between-study variability.

The heterogeneity statistic τ^2 is estimated as:

$$\tau^2 = \frac{Q - (k-1)}{\sum w_i - \sum {w_i}^2 / \sum w_i}$$

Where Q is the heterogeneity statistic, k is the number of studies, and τ^2 quantifies the degree of variability across studies. If τ^2 is less than (k - 1), it is set to zero. In this model, the weights are adjusted to reflect both within-study precision and between-study variability:

$$w_i = \frac{1}{SE_i^2 + \tau^2}$$

The pooled estimate under the random effects model is then calculated as:

$$\hat{\theta}_{RE} = \frac{\sum w_i \theta_i}{\sum w_i}$$

Model Selection

The choice between the fixed effects and random effects models is guided by the p-value of the heterogeneity statistic. If the p-value is greater than 0.05, the fixed effects model is used. Otherwise, the random effects model is preferred, ensuring that the analysis reflects both within-study and between-study variability (Bangar *et al*. 2015) [2].

Results and Discussion

The study is restricted to data pertaining to the selected studies from the literature on profitability of organic agriculture over inorganic agriculture across the country.

Estimating the profitability of organic agriculture in India through meta-analysis

Performance of organic agriculture from selected studies

The performance of organic agriculture was assessed by comparing mean incomes from organic and inorganic farming across 27 studies. The mean income for organic agriculture ranged from Rs. 801.60 per acre (Redgram) to Rs. 13,799.20 per acre (Tomato). This aligns with Kondaguri (2012) [12], who found higher net returns and B:C ratios for organic farms compared to inorganic ones.

Conversely, four studies reported negative gains from organic agriculture, with losses ranging from Rs. -8,092.30 per acre (Turmeric) to Rs. -1,935 per acre (Cotton). These results are consistent with Raghuvanshi (2010), who observed a negative gain for organic paddy compared to inorganic paddy.

Table 5: Performance of organic agriculture from selected studies

Authors	Crop	State	Mean income of organic agriculture (Rs./acre)	Mean income of inorganic agriculture (Rs./acre)	Mean income gain through organic agriculture (Rs./acre)
			(a)	(b)	(a-b)
P. Srikrishna Sudheer	Paddy	Andhra Pradesh	3482.4	2192	1290.4
P. Srikrishna Sudheer	Red Gram	Andhra Pradesh	2428.4	1626.8	801.6
P. Srikrishna Sudheer	Groundnut	Andhra Pradesh	3638	1476.4	2161.6
Durgesh Yadav [8]	Tomato	Madhya Pradesh	25085.2	11286	13799.2
M. Mohan kumar *et al.*	Ragi	Karnataka	3388.73	2573.6	815.11
M. Mohan kumar *et al.*	Maize	Karnataka	11136.8	4614.8	6522.07
D. Kumara charyulu *et al.*	Paddy	Punjab	17828	20897	-3069
D. Kumara charyulu *et al.*	Wheat	Punjab	21208	18319	2889
D. Kumara charyulu *et al.*	Cotton	Punjab	17673	19608	-1935
D. Kumara charyulu *et al.*	Paddy	Uttar Pradesh	11488	17190	-5702
D. Kumara charyulu *et al.*	Sugarcane	Uttar Pradesh	30961	26054	4907
D. Kumara charyulu *et al.*	wheat	Uttar Pradesh	14045	10101	3944
D. Kumara charyulu *et al.*	Sugarcane	Maharashtra	38854	28680	10174
D. Kumara charyulu *et al.*	Cotton	Gujarat	34299	27112	7187
Kavyashree H.V.	Paddy	Karnataka	14174.2	8854.4	5319.8
Sanap Dattaray *et al.*	Cotton	Maharashtra	10136.4	7567.5	2568.9
Sanap Dattaray *et al.*	Soyabean	Maharashtra	9260.8	6628.4	2632.4
Shakthi Singh	Wheat	Punjab	51700	39917	11783
M.S. Deshmukh *et al.*	Jowar	Maharashtra	-5542	-12048	6506
M.S. Deshmukh *et al.*	Turmeric	Maharashtra	134888.1	142980.4	-8092.3
R.D. Shelke *et al.*	Tomato	Karnataka	86635.4	75770.6	10864.84

M Shivashankar *et al.*	Sugarcane	Karnataka	36353.9	27028.1	9325.72
V.R. Naik *et al.*	Chilli	Karnataka	18227	7984	10243
A.G. Tripathi	Cotton	Andhra Pradesh	7753.45	4371.8	3381.62
A.G. Tripathi	Pigeon Pea	Andhra Pradesh	9878.5	8001.5	1876.93
A.G. Tripathi	Mung	Andhra Pradesh	7028.8	5577	1451.33
A.G. Tripathi	Wheat	Andhra Pradesh	7970.5	5701.5	2269

Overall estimate of performance of organic agriculture from selected studies

The meta-analysis results for the performance of organic agriculture across 27 studies are summarized in Table 6. The estimates ranged from Rs. 801.60 per acre (Redgram) to Rs. 13,799.20 per acre (Tomato). The meta-analysis confirmed the performance trends identified through individual statistical procedures, aligning with Janne *et al.* (2005), who found organic farming often enhances species richness, though results vary.

Negative estimated values were also reported, ranging from Rs. -1,935 per acre (Cotton) to Rs. -8,092.30 per acre (Turmeric). These findings corroborate those from previous analyses, showing consistency between meta-analytic and standard statistical approaches.

Table 6: Overall estimate of performance of organic agriculture from selected studies through meta-analysis

S. No.	Author name_(crop)	Estimate value (Rs./acre)	Lower estimate value (Rs./acre)	Upper estimate value (Rs./acre)
1	Sudheer Paddy	1290.4	1096.57	1484.23
2	Sudheer_Redgram	801.6	564.84	1038.36
3	Sudheer_Groundnut	2161.6	1938.61	2384.59
4	Yadav_Tomato	13799.2	13431.77	14166.63
5	Kumar_Ragi	815.11	478.14	1152.08
6	Kumar_Maize	6522.07	6191.33	6852.81
7	Charyulu_Paddy_Punjab.	-3069	-3684.39	-2453.61
8	Charyulu_Wheat_Punjab.	2889	2256.99	3521.01
9	Charyulu_Cotton	-1935	-2547.08	-1322.92
10	Charyulu_Paddy_Uttar Pradesh	-5702	-6317.13	-5086.87
11	Charyulu_Sugarcane_Uttar Pradesh	4907	4424.13	5389.87
12	Charyulu_Wheat_Uttar Pradesh	3944	3373.26	4514.74
13	Charyulu_Sugarcane_Maharashtra.	10174	9635.46	10712.54
14	Charyulu_Cotton	7187	6694.4	7679.6
15	Kavyashree_Paddy	5319.8	5029.12	5610.48
16	Dattaray_Cotton	2568.9	2275.42	2862.38
17	Dattaray_Soybean	2632.41	2251.63	3013.2
18	Sing_Wheet	11783	11515.41	12050.59
19	Deshmukh_Sorghum	6506	6362.05	6649.95
20	Deshmukh_Termeric	-8092.3	-8242.25	-7942.35
21	Shelre_Tomato	10864.84	10594.9	11134.78
22	Shivashankar_Sugarcane	9325.72	9055.83	9595.61
23	Naik_Chilly	10243	9907.81	10578.19
24	Tripathi_Cotton	3381.62	3124.56	3638.68
25	Tripathi_Redgram	1876.93	1551.64	2202.22
26	Tripathi_Moong	1451.33	1114.52	1788.14
27	Tripathi_Wheat	2269	1977.33	2560.67

Overall profitability of organic agriculture from selected studies

Table 7 presents the results of the meta-analysis on the profitability of organic agriculture using different statistical methods. The analysis, employing the Random Effect Model due to significant heterogeneity (p = 0.000), revealed an average profit of Rs. 3,850 per acre for organic agriculture compared to inorganic agriculture in India. This significant result was supported by the Random Effect Model's estimate.

Figure 1 shows the Forest plot, illustrating that the estimated profit from organic agriculture (Rs. 3,850 per acre) is represented by the size of the boxes, with the confidence intervals depicted by the arms. These findings align with David W. C. *et al.* (2015), who reported greater profitability of organic agriculture globally across 55 crops in 14 countries.

Table 7: Profitability of organic agriculture from selected studies through meta-analysis with different statistical methods

Name of statistical method	Estimate value (Rs./acre)	P value
Fixed effect model	3127.54	0.000*
Random effect model	3850	0.001*
Heterogeneity statistics	4200	0.000*

*Significant at 5%

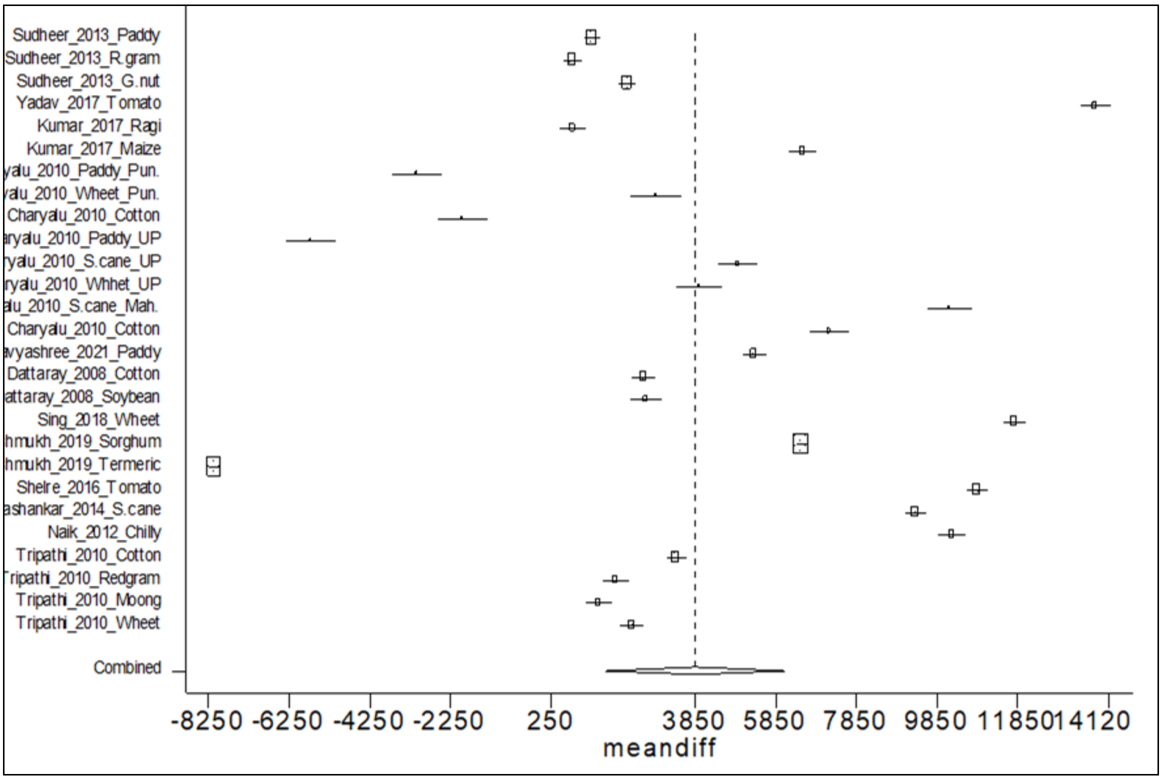

Fig 1: Forest plot analysis of selected studies

Conclusion

Global reports like the 2008 UN-led IAASTD and the 2019 HLPE on Food Security emphasize the urgent need to shift away from chemical-intensive agriculture, advocating for organic farming as a more sustainable alternative. Organic farming, which relies on natural processes and biodiversity, contrasts with inorganic methods that use synthetic inputs like pesticides and fertilizers. Despite India's rich history in organic farming, there is limited research comparing the economic outcomes of organic and inorganic practices. To address this gap, a meta-analysis of 27 studies was conducted, sourced from platforms like Google Scholar and Krishi Kosha. Using statistical methods such as Fixed and Random Effect Models and cumulative analyses, the study processed data with STATA, producing Forest and Funnel plots. The findings showed that organic farming incomes varied from Rs. 801.60/acre to Rs. 13,799.20/acre, with four studies reporting losses. Despite variability, the Random Effect Model indicated an overall profit of Rs. 3,850/acre for organic farming compared to inorganic, suggesting that organic farming offers a generally profitable alternative in India.

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