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ADOPTION DETERMINANTS, CONSTRAINTS AND FARMERS' SUGGESTIONS FOR COW-BASED NATURAL FARMING

Riya Parmar[1], Rachana Bansal[2] and Anjali Pal[3]

1 Research Scholar, Department of Agricultural Economics, BACA, AAU, Anand-388110
2 Associate Professor, Department of Agricultural Economics, BACA, AAU, Anand-388110
3 Research Scholar, Department of Agronomy, BACA, AAU, Anand-388110
Email : riyaparmar7530@gmail.com

ABSTRACT

The current investigation examines the factors influencing the adoption, constraints encountered and the suggestions given by farmers in relation to Cow-Based Natural Farming (CBNF) in okra and tomato cultivation in Middle Gujarat. Findings indicated that farmers who were relatively young and better educated, as well as those maintaining strong connections with ATMA (FIGs), showed a higher tendency to adopt natural farming practices in the study region. The odds ratio for key variables i.e. age (0.921), education (1.358), family size (0.977), farm size (1.034) and association with ATMA (FIGs) (10.535), indicate the extent to which a one-unit change in these covariates influences the likelihood of adopting CBNF. Among the constraints, farmers ranked the "lack of a specialized market/premium prices for their produce" as the critical issue faced by them, followed by low yield in initial years and high labour utilization, specifically for weed management. Other problems reported by them include tedious and time-consuming process for preparing bio-inputs, limited commercial availability of natural bio-inputs and inadequate consumer awareness, certification and quality standards. To tackle these barriers, farmers suggested strengthening market support, followed by standardizing input preparation methods, ensuring local availability of CBNF inputs, providing practical hands-on training, enhancing government assistance and promoting consumer education regarding natural produce. The study underscores the importance of promoting specialized markets for natural produce, making certification more efficient, and increasing the accessibility of CBNF inputs through appropriate policy measures. By taking these actions, farmers will find it easier and more feasible to implement natural farming on a larger scale.

Keywords*: CBNF, ATMA (FIGs), odds ratio, adoption determinants, constraints*

INTRODUCTION

India is an agrarian economy, with agriculture and allied sectors employing about 46.00 *per cent* of the workforce and contributing around 18.00 *per cent* to the national GDP (Anonymous, 2024_a). A continuous upward trend in population growth has been observed in India over the years. As of May 2025, India's present population is 1.46 billion, making it the most populous country, surpassing China (Worldometer, 2025). Considering the country's population size, current agricultural practices must ensure food and nutritional security while also addressing concerns related to sustainability, conservation of natural resources and climate change.

In today's era of widespread pesticide use, a substantial proportion of agricultural produce is cultivated with indiscriminate application of chemicals and fertilizers, which makes the produce toxic. Natural farming, also known as Prakritik Krishi, is a low-input, climate-resilient traditional agricultural practise that entirely rejects synthetic chemical agro-inputs. It follows agro-ecological practices, prioritizing the use of bio-inputs produced on the farm rather than purchasing outside inputs (Sheoran *et al.,* 2022). Studies on sustainable farming systems, such as organic farming, have shown that farmers generally exhibit a high level of perception towards eco-friendly practices, which promotes their adoption behaviour (Desai *et al.,* 2024). At the national level, Andhra Pradesh leads in natural farming with an area of 290000 ha *i.e.* 30.45 *per cent* of the total area followed by Gujarat, Madhya Pradesh, Uttar Pradesh and Kerala, constituting 186000 (19.53%), 111000 (11.65%), 97460 (10.23%) and 82000 (08.61%), respectively, during the year 2022-23 (Anonymous, 2023).

India is the world's largest producer of okra, with a production of 7.16 million MT, constituting 62.12 *per cent* of global okra production (11.52 million MT), followed by Nigeria (16.27%), Mali (06.59%), Sudan (02.63%) and Pakistan (02.62%) (FAOSTAT, 2023). Within India, Gujarat ranked 1st in area and production of okra *i.e.* 16.76 *per cent* to the total area (93.33 thousand ha) and 15.51 *per cent* of the total production (1133.08 thousand MT), followed by Madhya Pradesh with 12.02 *per cent* of the total area (66.96

thousand ha) and 13.22 *per cent* of the total production (965.48 thousand MT) during the year 2023-24 (Anonymous, 2024_b). In Gujarat, the Middle zone ranked second in both area and production, with 26984 hectares (28.91%) and 316749 metric tonnes (27.61%), respectively (Anonymous, 2024_c).

India occupied the second position in terms of both production and area under cultivation *i.e.* 20.42 million MT and 0.84 million hectares, respectively in terms of tomato production in the world (FAOSTAT, 2023). Among the states cultivating tomatoes in India, the top five states, including Madhya Pradesh, Andhra Pradesh, Karnataka, Gujarat and Odisha, contribute around 50 *per cent* of the nation's tomato production during the year 2023-24 (Anonymous, 2024_b). According to the data, Middle Gujarat ranked 1st in both area and production *i.e.* 26,892 hectares (40.40% of total Gujarat's area under tomato farming) and producing 6,93,905 MT of tomatoes (38.34% of Gujarat's total tomato production) for 2023-24 (Anonymous, 2024_c).

With Gujarat actively promoting CBNF, particularly in vegetable-growing regions, it becomes important to evaluate its adoption potential. Therefore, this study aims to investigate the factors influencing CBNF adoption among okra and tomato growers in Middle Gujarat, along with the constraints they face and their suggestions for improving CBNF practices in the region.

OBJECTIVES

(1) To identify the factors influencing the adoption of CBNF in okra and tomato crops

(2) To identify the constraints faced by CBNF farmers and document suggestions to overcome them

METHODOLOGY

The research is framed within a positivist philosophy, as it relies on empirical data and quantitative analysis to examine the factors influencing the adoption of Cow-Based Natural Farming (CBNF). A deductive research approach was adopted to investigate the relationships between selected socio-economic variables and adoption behaviour. The study adopted a quantitative methodological approach using a survey research strategy. It follows a cross-sectional design, as data were collected at a single point in time during the agricultural year 2024–25.

There are 33 districts in Gujarat state. Among them, nine districts, which include Ahmedabad, Anand, Vadodara, Kheda, Panchmahals, Dahod, Botad, Mahisagar and Chhota Udepur fall under the region of Middle Gujarat. This research was limited to the region of Middle Gujarat. A multi-stage sampling method was employed for selecting farmers adopting both CBNF and non-CBNF in Middle Gujarat for the entire study.

Anand and Vadodara districts from the Middle Gujarat region were intentionally selected, as the number of farmers practicing CBNF in vegetable cultivation was relatively high in these localities. Among various vegetable crops grown in the region, okra and tomato were identified as the major crops cultivated under CBNF practices; thus, these two crops were deliberately chosen for the investigation. From these two districts, four talukas were chosen and from each taluka, two villages were purposively selected based on the concentration of okra and tomato growers following the CBNF approach. Farmers adopting CBNF were selected based on criteria that they must have been using at least two components of CBNF for the last three years and must not be applying any chemical inputs such as fertilizers, pesticides, or growth promoters. From each of these villages, five farmers were selected, resulting in a total of 40 CBNF farmers and 40 non-CBNF farmers for both okra and tomato cultivation. Thus, a total of 160 respondents were selected, comprising 80 each engaged in CBNF and 80 in non-CBNF.

A pre-tested interview schedule was administered for primary data collection to gather data from both CBNF and non-CBNF farmers cultivating okra and tomato, employing a survey approach for the year 2024-25. The data were compiled, systematically analysed and presented in tabular form. A binary logistic regression model was employed to examine the factors influencing the adoption of CBNF among the respondents, and the statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS) software (version 22.0).

Binary Logistic Regression Model

To quantify the relative influence of selected socio-economic factors on the decision of respondents to adopt CBNF in okra and tomato cultivation, a binary logistic regression model was employed. The model suggests that the likelihood of CBNF adoption (Li) is influenced by variables such as age, education, family size, farm size, and association with ATMA through FIGs. The index function L_i indicates whether a respondent adopts CBNF or not and is expressed as a linear combination of the explanatory variables.

Thus, the logit regression model was specified as following Equation:

$$\mathbf{L_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + U_i}$$

Where,

X_1 = Age of the respondent (years)

X_2 = Education (years)

X_3 = Family Size (No.)

X_4 = Farm size (ha)

X_5 = Association with ATMA (FIGs)

β_0 = Constant

U_i = Error-term

The dependent variable (L_i) is dichotomous, taking the value 1 if the respondent adopts CBNF and 0 otherwise. The logit model estimates the logarithm of the odds ratio, enabling interpretation of how a unit change in each independent variable affects the likelihood of adopting CBNF.

Garrett's ranking technique

Garrett's ranking technique was adopted to analyse the constraints experienced by the respondents practicing CBNF. The position in percentage terms for each rank was computed using the equation given below:

$$\textit{Per cent} \text{ position of each rank} = \frac{100\ (Rij\text{-}0.5)}{Nj}$$

Where,

R_{ij} = Rank given for the i^{th} items by the j^{th} individual and

N_j = Number of items ranked by the j^{th} individual.

Using the conversion table suggested by Garrett and Woodworth (1971), percentage values of ranks were converted into corresponding scores.

RESULTS AND DISCUSSION

The findings of factors affecting the adoption of CBNF by the sampled farmers are discussed herewith.

Table 1: Logistic regression results for the adoption of CBNF of okra and tomato farming

(n=160)

Sr. No.	Particulars	B	St. Error	Significance	Expectation β
1	**Age (years)**	-0.082***	0.025	0.001	0.921
2	**Education (years)**	0.306***	0.070	0.000	1.358
3	**Family size (No.)**	-0.24	0.068	0.730	0.977
4	**Farm Size (ha)**	0.34	0.043	0.430	1.034
5	**ATMA (FIGs)**	2.355***	0.674	0.000	10.535
6	**Constant**	-1.021	1.344	0.447	0.360
-2Log Likelihood		159.697			
Percentage Correct		83.80			
Chi-Square (χ^2)		62.11**			
Count R^2		76.30			
No. of observations		160			

Source: Field Survey

***significant at 1 per cent and ** significant at 5 per cent

The factors influencing the adoption of CBNF among the chosen farmers were examined using the binary logistic regression model. The significant chi-square value of 62.11** and the prediction accuracy of 76.30 per *cent* indicate that the model worked well overall and that the factors that were chosen to explain the adoption behaviour fairly well. The -2Log Likelihood value of 159.697 further confirms the adequacy of model fit. Age exhibited a negative and highly significant relationship with adoption (B = -0.082, p = 0.001), implying a 7.9 per cent reduction in the odds of adopting CBNF with each additional year (odds ratio = 0.921). The finding implies that adoption of natural farming is more common among younger farmers, as they tend to be more open, environmentally aware and willing to experiment with new approaches. This finding is also supported by Rana and Patel (2022), who noted that farmers' attitude strongly affects their behaviour and that improvements in knowledge and attitude take place before natural farming practices are adopted. It was noticed that education displayed a positive and highly significant effect (B= 0.306, p=0.000), with an odds

ratio of 1.358, meaning that each additional year of education increased the probability of adoption by 35.8 *per cent.* Education improves farmers' ability to understand natural farming methods, evaluate their long-term benefits along with recognizing the drawbacks of conventional farming. Family size with a B value of -0.024 and p-value of 0.730, as well as farm size with a B value of 0.034 and p-value of 0.430, were statistically insignificant, with an odds ratio close to 1, indicating no meaningful impact on the adoption. This may be because both family size and farm size were more or less similar under both approaches. The primary determinant was membership in ATMA (FIGs), which demonstrated a substantial and highly significant effect (B=2.355, p=0.000) with an odds ratio of 10.535, meaning that farmers who belonged to ATMA were more than ten times more likely to adopt CBNF than those who did not. In essence, the data tells that respondents who are younger, educated and connected to institutions are considerably more likely to embrace CBNF. These findings are in line with Vinaya *et al.* (2013) and Patel *et al.* (2025), also reported that socio-economic characteristics and institutional linkages significantly influence the adoption of natural farming practices. Also, Gamit and Vinaya (2024) found that motivated, innovative and socially active respondents are more likely to adopt natural farming, which supports the present results. Further support is drawn from Gamit and Vinaya (2021) and Khodifad *et al.* (2024), reported that age, mass media exposure and environmental attitude influence perceptions of natural farming. Although based on agricultural professionals, the findings support the present results on the role of awareness and exposure in CBNF adoption.

Constraints Faced by CBNF Farmers

The constraints faced by farmers growing okra and tomato under CBNF were recorded and ranked in Table 2.

Table 2: Constraints faced by farmers adopting CBNF (n=160)

Sr. No.	Problems	*Per cent* Position	Garrett's Score	Rank
1	Lack of specialized market and premium price of produce	15.02	70	I
2	Low yield in initial years	31.37	59	II
3	High labour utilization	51.35	49	III
4	Procedure for making inputs is tedious and time-consuming	70.82	39	IV
5	Inputs for natural farming are not commercially available	81.73	32	V
6	Lack of consumer awareness towards natural produce	86.42	28	VI
7	Lack of certification and standards	91.33	23	VII

Source: Field Survey

It was noticed that with a score of 70, lack of a specialized market and premium price of produce ranked at 1st position, followed by low yield in initial years and high labour utilization, with scores of 59 and 49, respectively. Although farmers sell some portion of their produce through initiatives such as Sristi Haat, they still have to depend on normal markets where natural produce is not valued differently and fetches similar prices to conventionally grown crops. Therefore, it is essential for the government to actively promote and establish such marketing initiatives across regions to ensure fair prices. In the case of weed management, the CBNF system discourages the use of chemicals, instead of that, it emphasizes manual weeding, which substantially increases labour charges compared to conventional systems. Moreover, rural areas across India along with many developing economies are experiencing acute labour shortages due to development in alternative industries and increased rural to urban migration. The lower yields in initial years can be attributed to the transition from synthetic chemical-based inputs to natural bio-inputs like jeevamrit, beejamrit and other natural mixtures, that often require time to restore the soil's organic matter, microbial life and nutrient cycles. Other important constraints recorded were the procedures for making inputs are tedious and time-consuming, with a score of 39, inputs for natural farming are not commercially available, with a score of 32, unawareness of consumers towards natural produce, with a score of 28 and lack of certification and standards, with a score of 23, which secured 4th, 5th, 6th and 7th ranks, respectively. Similar results were reported by Priya and Naidu (2019), Vashishat *et al.* (2021) and Aishwarya *et al.* (2024) who also highlighted market-related issues, labour constraints and lack of awareness as major barriers to natural farming adoption. In addition, Bansal and Parmar (2025) reported that economic and infrastructural constraints such as high initial investment and inadequate resources also hinder the adoption of improved agricultural technologies.

Suggestions Given by CBNF Farmers

Key suggestions given by CBNF adopters to overcome the constraints were analysed and recorded in Table 3.

The recommendations given by farmers adopting CBNF were analysed and ranked by using Garrett's ranking technique. Findings revealed that with a score of 62, providing market support for the assured price secured the first position. Without assured markets or premium prices, farmers fear income losses and transitioning from chemical to natural farming involves initial costs. It was followed by the standardization of procedures and methods for making bio-inputs and the commercial availability of CBNF inputs with scores of 55 and 50, respectively. Other suggestions included conducting more practical, hands-on training programs to enhance farmer skills with a score of 42, offering comprehensive and targeted government subsidies with a score of 39 and promoting consumer awareness towards the benefits of chemical-free produce with a score of 33, which secured 4th, 5th and 6th ranks, respectively. Results correspond with those reported by Priya and Naidu (2019), Zala (2021), Zala et al. (2025), Thakur (2021) and Sakhiya (2021) who emphasized the need for market support, training and awareness for promoting natural farming.

Table 3: Suggestions given by CBNF farmers

Sr. No.	Suggestions	*Per cent* Position	Garrett's Score	Rank
1	Government should support the establishment of specialized markets to ensure fair pricing	26.22	62	I
2	There should be standardization of procedures and methods for making bio-inputs	39.96	55	II
3	CBNF inputs should be commercially available	50.00	50	III
4	There should be more training programs to enhance farmers' skills	64.76	42	IV
5	Government should increase its support by offering more comprehensive and targeted subsidies	71.73	39	V
6	Awareness campaigns should be actively conducted to educate consumers about the benefits of natural farming	80.77	33	VI

Source: Field Survey

CONCLUSION

This study examined the factors influencing adoption, the major constraints encountered and the suggestions proposed by farmers practicing Cow-Based Natural Farming (CBNF) in okra and tomato cultivation in the Middle Gujarat region. The findings indicate that younger farmers demonstrated a higher likelihood of adopting CBNF compared to older farmers. Education also played a significant role, as higher educational attainment further increased the probability of adopting natural farming practices. Among all determinants, membership in ATMA (FIGs) emerged as the most influential factor, highlighting the critical role of institutional engagement in facilitating information flow, building capacity and promoting the uptake of innovative and sustainable farming systems. Strengthening and expanding ATMA's Farmer Learning Groups (FLGs) could therefore substantially enhance farmer participation and accelerate the spread of CBNF.

The key problems faced by CBNF farmers were a lack of specialized markets and premium price of produce, followed by low yields in the initial years, high labour requirements for weeding, lack of consumer awareness towards natural produce, the tedious and time-consuming process of preparing inputs and the commercial unavailability of natural inputs. To tackle these barriers, most CBNF farmers suggested strengthening market support, followed by standardizing input preparation methods and ensuring local availability of CBNF inputs, practical hands-on training, government assistance and consumer education.

Overall, the study highlights that coordinated actions involving institutional support, market development and consumer awareness can lead to wider acceptance of CBNF. Scaling CBNF as a resilient and farmer-friendly production system will require promoting the long-term benefits of natural farming, such as increased net returns, economic viability and environmental sustainability.

POLICY IMPLICATIONS

The findings suggest that policymakers should prioritize the development of dedicated markets offering premium prices for natural produce to ensure better returns to farmers. Strengthening institutional support through ATMA and enhancing the availability of CBNF inputs at the local level can further facilitate adoption. Additionally, promoting consumer awareness and providing targeted subsidies during

the transition phase can significantly improve the adoption of natural farming practices.

CONFLICT OF INTEREST

No conflict of interest among researchers.

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