Indian Research Journal of Extension Education
RESEARCH ARTICLE

Adoption of Natural Farming Practices in Hill and Plain Region of North India: An Empirical Illustration

Neha Padaliya[1], H.R. Meena[2], B.S. Meena[3], Alok Dube[4], S. Zade[5] and Apoorva Veldandi[6]

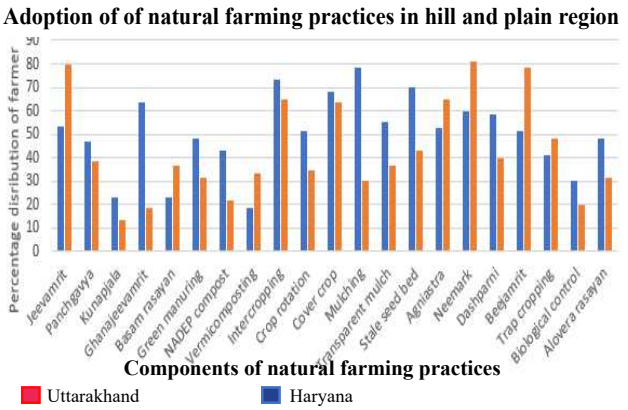
1,5&6. Ph. D Scholar, 3.PS, Dairy Extension Division, NDRI, NDRI, Karnal, Haryana, 2. HOD and PS, Extension Division, IVRI, Izatnagar, Bareilly, 4.Ph.D. Scholar, Agril. Ext., ICAR-IARI, Pusa, New Delhi,

Corresponding author's email: drhrms@gmail.com

HIGHLIGHTS

- Promotion of natural farming practices can benefits farmers by reducing input costs and also contributes to sustainable agricultural development.
- Some practices were found to be less popular among farmers, indicating a gap in the promotion of natural farming practices.
- Effective dissemination of these practices through training programs, workshops, and demonstration in progressive farmer field with the involvement of extension functionaries and organizations related to organic and natural farming are crucial for bridging this gap.

GRAPHICAL ABSTRACT



ARTICLE INFO

Editor:
Dr. Kausik Pradhan
Dr. Pallavi Bora

Key words:
Adoption, Environment friendly, Hill, Plain, Natural farming

Received : 05.09.2024
Accepted : 24.09.2024
Online published : 01.10.2024

doi:10.54986/irjee/2024/oct_dec/113-121

IRJEE METRICS

Google citations	- 9424
h-index	- 44
i10-index	- 304
NAAS rating	- 4.99

ABSTRACT

Context: The FAO states, the adoption of natural farming practices can lead to increased soil fertility, enhanced biodiversity, and reduced greenhouse gas emissions. As of 2023, an estimated 4.09 lakh hectares of land in India is under natural farming practices. This approach supports a variety of agroecological practices, rooted in rich traditional knowledge including jeevamrita, beejamrita, mulching, crop rotation, composting and integration of farm animals, promoting a holistic farming system.

Objective: To explore the adoption of natural farming components practiced by the farmers in hills and plain region of north India.

Method: A total of 120 respondents who were registered in Participatory Guarantee System of India were randomly selected for the study. The questionnaire was pre-tested in a pilot study, and adjustments were made with the help of feedback. Finally, the collected data were systematically organized and analyzed using frequency counts and percentage distributions.

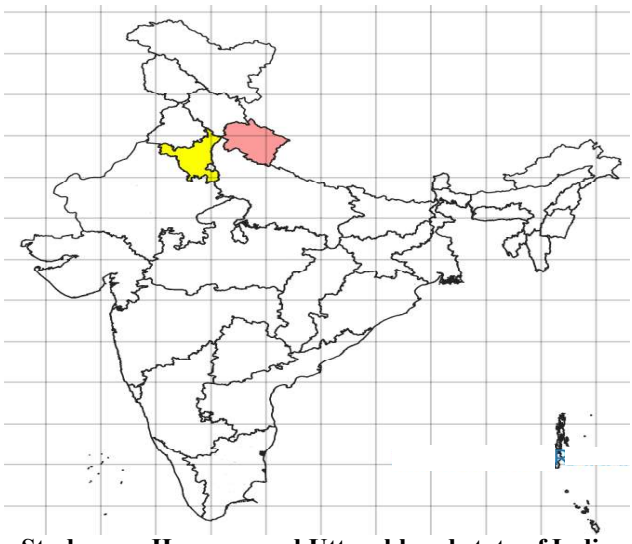
Results & Discussion: The study revealed that 66.00 per cent farmer were practicing jeevamrit, an organic bio-fertilizer that enhances soil fertility followed by cover cropping 65.83 per cent, helps to retain moisture. Green manuring, practiced by 55.00 per cent of farmers, enriches the soil with organic matter and nutrients by incorporating specific crops into the soil. However, some practices are less popular among farmers, indicating a gap in the promotion of sustainable agricultural practices.

Significance: Study would create more awareness about natural farming practices, critical gaps in sustainable farming activities.

Nature friendly and eco-based agricultural practices, have gained popularity as an alternative approach to agriculture to make conventional farming more sustainable (FAO, 2017; HLPE, 2017). In 2023, the Government of India has introduced the National Mission on Natural Farming (NMNF) with the goal of encouraging farmers to transition to chemical-free farming practices. The mission aims to expand the adoption of natural farming across the country, targeting 10 million hectares of land by 2025. Natural farming is a neoteric approach to improve both traditional and modern agricultural practices, which aims to safeguard the environment, public health, and communities (Mishra, 2013). India's diverse agro-climatic conditions and rich traditional knowledge provides great potential for enhancing the production of natural and organic products. Natural farming processes help to restore soil fertility and organic matter, reduce water usage, and support a climate-friendly agricultural system (Economic Survey, 2019). The use of organic inputs like straw, animal manure and green manures has contributed to enhance soil organic matter content. (Panagos *et al*., 2015). The APEDA, 2021 report states that India has 4.3 million hectares allocated to organic farming, with 1.6 million hectares designated for wild harvest and 2.6 million hectares for cultivable land. Uttarakhand has officially certified 23 per cent of its total land for organic farming and became the first Indian state to introduce a state-level Organic Agriculture Act by 2019. Haryana State Cooperative Supply and Marketing Federation has allocated around 1,000 acres for organic basmati rice cultivation across three districts in Haryana. The state has a total of 5,303 hectares dedicated to certified organic farming, with 4,903 hectares registered under the National Programme for Organic Production and 400 hectares certified under the Partnership Guarantee System. Economic Survey (2019) stated the alternative farming practices such as natural farming as a type of organic farming model. Both natural and organic farming contribute to restoring soil organic matter and fertility, reducing water usage, and fostering a climate-friendly agricultural system. In organic farming, practices like green manuring, the use of vermicompost, oil cakes, farmyard manure, and bio-fertilizers are employed to improve soil health, increase biodiversity, and provide nutritious food (Das *et al.,* 2021). The adoption of organic and natural farming practices has accelerated since 2005, with wheat (76.32%) and basmati rice (55.26%) being the primary crops cultivated by farmers in North-West region in India (Aulakh *et al.,*2022). Natural farming technique include crop rotation, bio-pesticides such as agniastra, neem-based solutions, bio-control agents, and stale seed beds. Additionally, organic farming supports economic, environmental, and social sustainability, aligning with sustainable development goals (Bandanaa et al., 2021). A scale was developed to measure the attitude of farmers towards natural farming having a higher reliability coefficient (0.79) and validity. (Zala and Kalsariya, 2022). The Paramparagat Krishi Vikas Yojana (PKVY) sub-scheme, Bhartiya Prakritik Krishi Padhati (BPKP), has been promoting traditional indigenous practices since 2020–21. The Indian government has also initiated two distinct programs—Paramparagat Krishi Vikas Yojana (PKVY) and the Mission Organic Value Chain Development in the North East Region (MOVCDNER)—to promote natural and organic farming. Natural farming practices like cover cropping, crop rotation, reduced tillage, and habitat diversification are vital for biodiversity conservation. The use of organic mixtures like panchagavya, beejamrit, and jeevamrit can enhance plant growth and yield. Naturally formulated insecticides, including neemastra, agniastra, and brahmastra, are effective in eradicating pests during the initial stages of larvae development while also hindering their feeding. Farmers have developed many such organic formulations based on indigenous traditional knowledge, but a significant number of these mixtures lack documentation. Therefore, the purpose of this study is to identify the adoption of natural farming practices by the farmers in the hill and plain region.

METHODOLOGY

The study was conducted in Uttarakhand (located at 29.38°N 79.45°E,) and Haryana state (located at 30°44′N 76°47′E), four districts (Almora and Nainital) and Karnal and Jind) were chosen for the study from both the state. These districts were chosen based on the higher number of registered natural crop growers listed on the PGS-India website. From each district, two blocks were randomly selected. Within each block, 30 farmers practicing natural farming were randomly chosen for interviews, resulting in a total sample size of 120 respondents. Thus, a descriptive research design was used to investigate the adoption of natural farming practices among farmers in North India.



Study area Haryana and Uttarakhand state of India

It focused on popular practices including beejaamrit, ghanajeevamrit, jeevamrit, stale seedbed preparation, agniastra, neemastra, and dashparni. A mixed-methods approach was employed, incorporating both qualitative and quantitative data collection techniques. A comprehensive semi-structured interview schedule was designed to gather information the adoption of diverse natural farming practices. This comprising both closed and open-ended inquiries, were preliminary tested with a selected group of respondents to make findings more clear and valid. Subsequently, a thorough exploratory data analysis was undertaken to process the quantitative information. The data were coded, tabulated, analyzed, and presented in the table. The frequency, per centage, correlation, regression, statistical methods, and techniques were used with the help of the SPSS software. Based on a comprehensive review of the literature, pilot study, and expert consultation, natural farming practices practices were identified and categorized. The practices were identified as follows:

Jivamrita: Dung and urine of a desi cow were combined by thoroughly mixing 1 kg of dung, 1 liter of urine, 200 g of jaggery, 200 g of pulse flour, and 100 g of soil in a large tank cover it with a permeable jute bag should be placed in shade. The mixture was stirred vigorously for 10-15 minutes three times a day. For, one acre field the entire 200 liters jivamrita can be applied.

Panchgavya: It is prepared by mixing 5 kg of fresh desi cow dung in a mud pot and with 500 g cow ghee. On fifth day add cow urine, milk, curd then jaggery with water or sugarcane juice and banana fruit.

Kunapjal: It is a mixture of 25 kg Nettle grass, 2 kg sprouted black gram, 2 kg jaggery, mustard/neem oil cake.

Ghanajivamrita: Evenly spread 200 kg of cow dung on the ground, then add 20 liters of liquid Jivamrita and mix well. Let it ferment for 48 hours. After fermentation, it is spread out to dry in the sun. Around 200 kg of Ghanajivamrita per acre is used during the sowing phase.

Basam rasayan: It's rich in nutrients like mg, cu, fe and other essential macro and micro nutrients consists of 8 kg salt mixed with 100g borax.

Green manuring: Green undecomposed material used as manure. Green manuring crops such as sunhemp, dhaincha, sesbania, cluster beans are usually grown in fields. Legumes mobilise organic and insoluble P in the soil through the mycorrhizal network, phosphatase secretion, and exudation of protons or carboxylates (Homulle *et al.*, 2022).

NADEP compost: NADEP compost uses cow dung, agricultural waste (straw, leaves, crop residues), soil, and water. In a rectangular pit, layer 100 kg of agricultural waste, 4 kg of cow dung, 60 kg of soil, and 100 liters of water and keep moist for 3-4 months. This technique yields 40 kilograms of nutrient-rich compost from every 1 kilogram of animal manure.

Vermicomposting: It involves raising earthworms in controlled environments, such as brick tanks or near trees, to produce compost. Earthworm are feed on biomass to produce required quantities of vermicompost.

Intercropping: By combining deep-rooted and shallow-rooted crops in intercropping. Growing different crops together increases biodiversity, which can reduce pest pressure. Intercropping maize with beans can destroy pests that target monocultures.

Crop rotation: Rotating crops like legumes with cereals such as maize-mustard-rice-wheat rotation adds nitrogen, reducing fertilizer use. Changing crops, such as rotating carrots with lettuce, disrupts pest cycles and minimizes diseases.

Cover crop: Cover crops, such as clover or rye, fava beans, sorghum oats, barley protect soil from erosion by providing ground cover during off-seasons before the field is ready for main crop. These crops compete with weeds for light, water, and nutrients, reducing the need for herbicides.

Mulching: By spreading mulching materials, such as plastic sheeting or bark chips, over the soil, farmers can reduce moisture evaporation and minimize weed growth.

Dashparni: Mixing of leaves of different types of medicinal plants 2 kg karanja, 2 kg datura, 2 kg neem, 2 kg bael, 2 kg tulsi, 2 kg marigold, 2 kg cow dung, 10lt. Cow urine, 1lt water, 5 g each garlic and turmeric.

Beejamrit: A natural seed treatment solution can be made by mixing 20 lt of water, 5 kg of cow dung, 5 lt of cow urine, and 50 grams of lime and soil in a tank. Stir the mixture clockwise, cover it, and let it sit in the shade for one day. This solution is effective for treating 100 kilograms of seeds.

Trap cropping: Planting okra with cotton; tomato with cabbage; mustard with cabbage; planting marigolds to lure aphids away from vegetables like tomatoes can effectively controls pest damage.

Biological control: Trichogramma sp. are released to control borer, predators such as lady bird beetles and lacewings.

Agniastra: Agniastra is a natural pest repellent, is prepared by combining 10 lt of cow urine, 1 kg of tobacco leaves, 500 grams of green chili, 500 grams of local garlic, and 5 lt. of pulped neem leaf. To combat pests like leaf rollers, stem borers, fruit borers, and pod borers, mix two tablespoons of agniastra with 100 lt. of water.

Transparent mulch: Transparent mulch is a method of weed control that involves covering a pre-soaked fallow field with a thin plastic sheet. The sun's heat is trapped under the plastic, causing the weeds to dry out.

Stale seedbed: The stale seedbed technique allows weeds to grow and then be eliminated before planting the main crop. It is particularly useful in areas with many weeds.

Neemastra: It is a natural pest control solution made by combining 5 lt cow urine, cow dung about 5 kg, neem leaves 5kg, and neem pulp 5 kg in a sealed container for 24 hours. It is highly effective against mealy bugs and other sucking pests.

Alovera rasayan: It is prepared by using 1 kg leaf pulp of alovera mixed with 10 lt of water, addition of micobial inoculum and some amount of jaggery.

RESULTS

Nutrient and soil management practices : The data presented in Table 1 reveals that approximately 80 per cent of farmers in Haryana were applying jeevamrit in their fields, while 61.66 per cent incorporate green manuring to enhance soil organic matter and fertility. Jeevamrit, a fermented microbial culture composed of clean soil, cow urine, jaggery, pulse flour, and cow dung, is sprayed bi-monthly at a rate of 500 liters per hectare. For natural farming, one native cow is sufficient for every 30 acres of land. The use of cow dung and urine supports the development of beneficial microbial habitats, including plant-growth-promoting bacteria that can produce growth regulators. Additionally, a significant portion of organic farmers are employing various natural formulations: 38.33 per cent use panchagavya, 36.66 per cent use basam rasayan, and 33.33 per cent use aloevera rasayan. Furthermore, 31.66 per cent utilize the NADEP compost method, 21.66 per cent rely on vermicomposting, 18.33 per cent prepare ghanajeevamrit, and 13.33 per cent apply kunapjal. These natural farming practices are predominantly utilized in the cultivation of rice-wheat systems, sugarcane, and vegetables. In Uttarakhand, 63.33 per cent of farmers utilized ghanajeevamrit, reflecting its importance for soil management in the region. Jeevamrit was used by 53.33 per cent of farmers, followed by green manuring by 50.00 per cent of farmers, contributing to soil nutrient replenishment, NADEP compost about 48.33 per cent of farmers, panchagavya adopted by 46.67 per cent of farmers, Vermicomposting, used by 43.33 per cent of farmers. Basam rasayan, kunapjal and aloe vera rasayan were less common in the region only used by 23.00, 23.33 and 18.33 per cent of the farmers respectively, for specialized soil and plant health management. These practices collectively show the diverse and region-specific approaches to sustainable farming in Uttarakhand.

Table 1. Distribution of farmers based on nutrient and soil management practices

Practices	Haryana (n=60)	Uttarakhand (n=60)	Pooled (n=120)
Jeevamrit	48 (80.00)	32 (53.33)	80 (66.67)
Panchgavya	23 (38.33)	28 (46.67)	51(42.50)
Kunapjala	8 (13.33)	14 (23.33)	22 (18.33)
Ghanajeevamrit	11 (18.33)	38 (63.33)	49 (40.83)
Basam rasayan	22 (36.66)	14 (23.00)	36 (30.00)
Green manuring	19 (31.66)	29 (48.33)	48 (40.00)
NADEP compost	13 (21.66)	26 (43.33)	39 (32.00)
Vermicomposting	20 (33.33)	11 (18.33)	31(25.00)
Alovera rasayan	19 (33.33)	29 (48.33)	48 (40.00)

Figure in the parenthesis indicate percentage

Cultural practices: The data presented in Table 2 highlights notable differences in the adoption of sustainable agricultural practices among organic

Table 2. Distribution of farmers based on cultural practices

Practices	Haryana (n=60)	Uttarakhand (n=60)	Pooled (n=120)
Intercropping	39 (65.00)	44 (73.33)	83 (69.16)
Crop rotation	21 (35.00)	31 (51.66)	52 (43.33)
Cover crop	38 (63.33)	41 (68.33)	79 (65.83)
Mulching	18 (30.00)	47 (78.33)	65 (54.00)

(Figure in the parenthesis indicate percentage)

crop growers in Haryana and Uttarakhand. In Haryana, approximately 65.00 of farmers engaged in intercropping, and 63.33 per cent utilized cover crop methods. These practices are integral to manage soil fertility and optimizing land use. Crop rotation and mulching was practiced by 35.00 and 30.00 per cent of farmers was less commonly adopted, practices into their fields. In contrast, Uttarakhand showed higher adoption for these practices. A substantial 78.33 per cent of organic crop growers in Uttarakhand practiced intercropping, and 73.33 per cent implemented mulching. These higher rates highlight the region focus on optimizing limited land and conserving moisture in hilly terrains. Additionally, more than half of the farmers in Uttarakhand using cover cropping practices, and 51.66 per cent following crop rotation, indicates the importance of these practices in maintaining soil health and enhancing crop productivity through diverse and integrated approaches in this region. Most farmers practiced a two-year crop rotation, planting wheat, barley, and lentils in the rabi season and rice and barnyard millet in the kharif season. In the subsequent kharif season, they cultivated legumes, finger millet, and amaranth in an intermixed pattern. This rotation enhances soil fertility and productivity by fixing atmospheric nitrogen through pulses, which benefits the millets. Applying mulch effectively controls weeds by blocking light, smothering seedlings, and altering soil conditions. As mulch decomposes, it forms humus that preserves topsoil, retains moisture, and boosts soil nutrients while suppressing weeds. Green manure further improves soil by enhancing its chemical, biochemical, and microbiological properties, and integrating crop rotation and intercropping practices promotes overall agricultural sustainability and bacterial diversity. Cover crops reduce nutrient loss caused by soil erosion and leaching, whereas rotating legumes enhances the overall nitrogen content in the soil.

Weed management practices: Table 3 highlights the weed management practices employed by organic crop growers in Haryana and Uttarakhand. In Haryana, 43.33per cent of farmers used the stale seed bed method, and 36.66 per cent utilized transparent mulch. Conversely, in Uttarakhand, 70.00 per cent of farmers adopted the stale seed bed method, and 55.00 per cent applied transparent mulch. The stale seed bed technique involves preparing a seedbed to allow weed seeds in the topsoil to germinate before the main crop is planted. By maintaining adequate soil moisture, farmers promote the germination of weed seeds, which are then removed prior to planting. This approach effectively reduces weed growth and minimizes competition with the main crop. Transparent mulch serves as an additional barrier to weed development, suppressing seedling emergence and reducing weed-related issues. Also, manual weeding is occasionally done, further minimizing the reliance on herbicides and enhancing the overall effectiveness of the weed management strategy.

Table 3. Distribution of farmers based on weed management practices

Practices	Haryana (n=60)	Uttarakhand (n=60)	Pooled (n=120)
Transparent mulch	22 (36.66)	33 (55.00)	55 (45.00)
Stale seed bed	26 (43.33)	42 (70.00)	68 (56.00)

(Figure in the parenthesis indicate per centage)

Disease and pest management practices : The data presented in Table 4 reveal that about 78.33 per cent of organic farmers in Haryana followed seed treatment with beejamrit, as it is necessary to protect crops from seed and soil-borne diseases prevalent in the area. Beejamrit is applied as a seed treatment, incorporating extracts from neem leaves, pulp, tobacco, and green chilies to effectively control insects and pests. Seed treatment with beejamrit provides protection against

Table 4. Distribution of farmers based on disease and pest management practices

Diseases and pest management practices	Haryana (n=60)	Uttarakhand (n=60)	Pooled (n=120)
Agniastra	39 (65.00)	32 (53.00)	71 (68.00)
Neemark	49 (81.00)	36 (60.00)	85 (70.00)
Dashparni	24 (40.00)	35 (58.33)	59 (49.00)
Beejamrit	47 (78.33)	31 (51.67)	78 (65.00)
Trap cropping	29 (48.00)	25 (41.00)	54 (59.16)
Biological control	12 (20.00)	18 (30.00)	30 (25.00)

(Figure in the parenthesis indicate percentage)

diseases affecting seeds. In Haryana, most farmers use beejamrit for seed treatment due to serious disease problems in crops, necessitating effective seed treatment.

More than half of the organic crop growers in Haryana use neemark and agniastra for disease and pest management, followed by trap cropping at about 48.00 per cent, dashparni at 40.00 per cent, and only 20.00 per cent using biological control methods for pest management. In Uttarakhand, the most popular methods are neemark and dashparni, used by approximately 60.00 per cent and 58.33 per cent of farmers, respectively. It requires 1 to 1.5 liters of neemark and dashparni per acre in crop fields. About 53.00per cent of farmers use agniastra, followed by trap cropping at about 41.00 per cent, and biological control methods at about 30.00 per cent among organic crop growers.

The components of natural farming practices were correlated with the index value of adoption. The index value of adoption of natural farming practices is calculated by using the formula given below:

Index value of adoption=Obtained value of respondent / Maximum obtainable value

The results of correlation analysis show that the overall components of natural farming practices had positive and significant relationship at 1 per cent level of significance with the adoption of natural farming practices as given in the Table 5. Further, cultural practices (0.658) were found to be highly correlated with adoption of natural farming practices followed by weed management practices (0.583), disease and pest management practices (0.548) and nutrient and soil management practices (0.380). This might be due to the regular practicing of cultural operations like intercropping, mulching, cover crops and crop rotation by the farmers to generate income and to prevent erosion, conservation of soil moisture content and maintain the overall fertility of soil.

Further, regression analysis was carried out with the same data and it was found that the model explains the 96.9 per cent variation in the dependent variable i.e., the components of natural farming practices were found to contribute 96.9 per cent variation in the adoption of natural farming practices as given in the Table 6. The Table 7 shows that the model is statistically significant. According to the Table 8, all the components of natural farming practices were significantly contributing to the adoption of natural farming practices in the study area. The adoption of natural farming practices increases by 0.049 units followed by disease and pest management practices contributing to an increase of 0.048 units, weed management practices contributing to an increase of 0.045 units and nutrient and soil management practices

Table 5. Correlation analysis between components of natural farming practices with adoption of natural farming practices

Natural farming practices	Adoption
Nutrient and soil management practices	0.380**
Cultural Practices	0.658**
Weed management practices	0.583**
Disease and pest management practices	0.548**

**Correlation is significant at the 0.01 level (2-tailed).

Table 6. Regression analysis between components of natural farming practices with adoption of natural farming practices

Model	R	R^2	Adjusted R^2	SE of the Estimate
1	0.984	0.969	0.968	0.019965

Predictors:(Constant), Disease and pest management practices, cultural practices, nutrient and soil management practices, weed management practices

Table 7. ANOVA

Model 1	SS	df	MS	F	Sig.
Regression	1.435	4	0.359		
Residual	0.046	115	0.000	899.762	0.000[b]
Total	1.481	119			

Dependent variable: Adoption

Predictors:(Constant), Disease and pest management practices, cultural practices, nutrient and soil management practices, weed management practices

Table 8. Coefficients values for the components of natural farming practices

Model 1	Unstandardized coefficients		Standardized coefficients	t value	Sig.
	B	SE	Beta		
(Constant)	0.017	0.009		1.885	0.062
Nutrient and soil management practices	0.038	0.001	0.447	27.155	0.000
Cultural practices	0.049	0.002	0.505	28.107	0.000
Weed management practices	0.045	0.002	0.330	18.221	0.000
Disease and pest management practices	0.048	0.002	0.501	30.162	0.000

a. Dependent variable: Adoption (Significant at the 0.01 level)

contributing to an increase of 0.038 units in the study area.

DISCUSSION

In both regions, natural formulations are widely used for nutrient management, but preferences differ based on local conditions. Farmers in Uttarakhand, with its limited water availability, prefer ghanajeevamrit in solid form and predominantly cultivate vegetables and spices, using these bio-formulations for effective nutrient and soil management. In contrast, Haryana's farmers apply a broader range of natural practices across rice-wheat systems, sugarcane, and vegetables. The findings of this study are in line with Dayanand (2020), who reported that nearly (88.00 %)of farmers practiced beejamrit for seed treatment, while only 12.00 per cent practiced biofertilizer treatment. The results are also consistent with Prasad (2020), who reported that the majority of farmers adopted jeevamrit as a nutrient supply intervention. All plant growth stages showed an overall increase in plant height and branch count following the foliar application of 3 per cent panchagavya (Swarnam *et al.* 2016). Panchagavya, made from cattle waste and by-products, enhances soil fertility by increasing organic matter, macro and micronutrient content, and improving nutrient uptake in plants (Bajaj *et al.* 2022). All these natural formulations have contributed to crop growth and yield through their various nutrient contributions and soil conditioning properties. Jeevamrit is a great source of macro and micronutrients, such as N 1.97 per cent, P (0.172 per cent, K 0.29 per cent, Mn (47 ppm), and Cu (50 ppm), and has an acidic property having pH of 4.93 (Kumar *et al*., 2021). Utilizing the crop rotation and intercropping practices has enhanced the agricultural sustainability and application of green manure in crop fields has increased bacterial diversity. Cover crops has reduced nutrient loss caused by soil erosion and leaching, wherea rotating legumes enhances the overall nitrogen content in the soil. Among crop management practices, intercropping was the most widely adopted, with (90.00%) of farmers practicing it, ranking it first, followed by crop rotation, adopted by (72.00%) of farmers, ranking it second (Patel *et al.* 2018). Organic farmers had a mean IAC index score of 81.05, significantly higher than the conventional farmers score of 46.35, practices such as crop rotation and reduced tillage, contribute to higher adaptive capacity. (Sangeetha *et al*. 2018). The study supported by (Shanthy *et al.* 2023) who recorded (85%) of respondents had reduction in cultivation costs, and (81.67%) benefited from diverse intercrop produce like pulses and vegetables along with several advantages of intercropping in sugarcane, including interim income within three months, improved soil health, reduced weed growth, and availability of fodder for livestock. The findings indicated that (89%) of respondents had a medium level of adoption of organic farming practices (Bhattacharjee *et al*.2020). The application of growth promoters and regular nutrient supplements has accelerated flowering in tomato plant, with (50%) of the plants flowering six days earlier compared to conventional practices as reported by Sathya**,** 2024. Overall, achieved a yield increase of (14.59%) compared to conventional practices. Narain *et al*. 2024 reported the key factors driving the choice of organic farming for tulsi were reduced production and management expenses, favourable market prospects, established quality standards, safety and security, innovative technologies, agro-ecological conditions, and environmentally friendly practices. The study revealed that a comprehensive training program is effective in boosting farm women's understanding of environment friendly organic farming practices. Positive results were noticed as a result of a multimodal approach that included exposure visits, practical training, and need based content materials (Kumar *et al*. 2024). The study on organic and natural farming in north-west India, particularly in Punjab, support this study in which farmers utilized various methods for soil health management, including farmyard manure, green manuring, and vermicompost. They also employed liquid organic manures such as jeevamrit and vermiwash, along with botanicals like neem biopesticides and agniastra, brahmastra for pest and disease management. This study supported by Singh *et al*. (2012) who reported a significant increase in farmers adoption of neem biopesticides over time, with (67.2%) of farmers preparing and (65.6%) applying the biopesticide after six months of the exposure of information found it as important bio-pesticide. Weed Management Practices includes manual weeding was the predominant method for weed management, adopted by over (70%) of the farmers. However, it was noted that no farmer practiced a complete package of natural farming; instead, many integrated one or more natural farming practices with organic farming. In the pest and disease management a significant portion of farmers (29.61%) used biological control methods

like Tricho-cards during the kharif season, while neem-based products were also widely used for pest management. The use of homemade and commercial neem products was reported by (21.05%) and (9.87%) of farmers respectively. Aulakh *et al. (*2022). The various practices were adopted in soyabean crop includes vermicomposting, (70%) of beneficiaries fully implemented its use with (65%) practiced crop rotation for weed management, while in pest management, (55%) utilized summer ploughing. Additionally, 60% of beneficiaries partially adopted the collection and destruction of larvae, egg, and pupae of pest. About (60%) of beneficiaries fully incorporated crop residues into the soil and only (45%) of beneficiaries fully adopted the practice of seed treatment. (Raghuwanshi, V. 2018). Farmers use black and transparent films in their crop fields, which reduce the emergence of weeds. Plastic mulch has been shown to significantly reduce the dry matter accumulation of weeds by (37.4%) compared to rice straw mulch. This reduction was because most weed seeds are light-sensitive and fail to germinate beneath plastic mulch, resulting in a lower weed population (Mahajan *et al.* 2007). The lowest dry weight of weeds recorded with black film mulch is attributed to its poor light transmission, which reduces the photosynthetic activity of weeds (Subrahmaniyan *et al.,* 2011). Preparing a stale seedbed through two shallow hoeing's over 14 days has been shown to be effective, leading to an 80 per cent to 88 per cent decrease in weed population and a 40 per cent to 39 per cent reduction in weed dry weight 20 days after sowing (Sindhu *et al.* 2011). Beejamrita solution includes a wide range of beneficial microorganisms, including nitrogen-fixing bacteria, actinomycetes, phosphorus-solubilizing agents, and fungi. (Devakumar *et al.* 2014). The use of crop rotation, intercropping, and biofertilizers can reduce the reliance on chemicals in the field. This approach aligns with the findings of Prasad (2020), who reported that (97.44%) of the respondents adopted neemastra as a plant protection intervention.

CONCLUSION

The study highlights several indigenous agricultural practices adopted by farmers, including beejaamrit, ghanajeevamrit, jeevamrit, stale seedbed, agniastra, neemastra, and dashparni. These practices involve natural formulations prepared from cow manure, cow urine, compost, kitchen waste, and leaf extracts. They are cost-effective methods that enhance soil fertility, structure, and water-holding capacity, ultimately improving soil health and promoting plant growth. However, some practices are less popular among farmers, indicating a gap in the promotion of sustainable agricultural practices. Effective dissemination of information and techniques related to these practices by extension agents and government organizations through training programs, workshops, and encouraging active farmer participation can play a vital role in bridging this gap. Documentation of these practices is very important for directing research priorities towards developing standardized packages of practices tailored to specific crops and formulating policies to facilitate their wider adoption. It would help policymakers to develop supportive policies that promote sustainable agriculture, enhancing food security, environmental conservation and rural development.

Funding: The first author has received Institute fellowship during the research study.

Declaration of conflicit of interest: The authors have no conflicts of interests.

Acknowledgement: Authors of the paper are thankful to the Director & Head of Dairy Ext. Divi., NDRI, Karnal, Haryana, for necessary support during the study.

Data availability: Data would be made available on request.

Author's Contibution: The authors conceptualized, operationalized, collected and analyzed the data and interpreted the data, participated in contributing to the text and the content of the manuscript, including revisions and edits. All authors approve the content of the manuscript.

REFERENCES

APEDA. (2023). Organic products: National Programme for Organic Production (NPOP). Agricultural & Processed Food Products Export Development Authority (APEDA). Retrived https://apeda.gov.in/Retrived on April 4, 2023.

Aulakh, C. S.; Sidhu, A. S.; Singh, S. and Singh, D. (2022). Organic and natural farming in north west India: Farmers' perspective. *Agril.Res. J.*, **59** (6):1078-1085.

Bajaj, K. K., Chavhan, V. Raut, N.A. and Gurav,s (2022). Panchgavya: A precious gift to humankind. *J. Ayurveda and Integr. Medi.*, **13** (2):100525.

Bandanaa, J.; Asante, I. K.; Egyir, I. S.; Schader, C.; Annang, T. Y.; Blockeel, J.; Kadzere, I. and Heidenreich, A. (2021). Sustainability performance of organic and conventional cocoa farming systems in Atwima Mponua District of Ghana. *Envir. and Sustai.*

Indicators, **11**, 100121.

Bhattacharjee, U.; Saha, A.; Tiwari, P. K.; Dhakre D.S. and Gupta, R.K. (2020). Adoption level of farmers practicing organic farming in Birbhum District of West Bengal. *Indian Res. J. of Ext. Edu.,* **24**(3):12-15.

Das, S.; Chatterjee, A. and Pal, T. K. (2021). Organic farming in India: A vision towards a healthy nation. *Food Quality and Safety.***4**(2): 69–76.

Economic Survey (2019). Retrieved at: https://www.indiabudget.gov.in/budget2020-21/ Retrieved on 25 September 2024.

FAO (2017). The Future of Food and Agriculture – Trends and Challenges. FAO, Rome, Italy. 163 p. Retrieved at: https://www.fao.org/3/i6583e/i6583e.pdf. Retrieved on 26 September 2024.

HLPE (2017). Nutrition and Food Systems. A Report by the high-level panel of experts on food security and nutrition of the committee on world food security, Rome. Retrieved at: https://www.fao.org/3/i7846e/i7846e.Retrieved on 26 Sept. 2024.

Homulle, Z.; George, T.S. and Karley, A.J. (2022). Root traits with team benefits: Understanding belowground interactions in intercropping systems. *Plant and Soil*, **471**(1–2), 1–26.

Kumar, A.; Avasthe, R.; Babu, S.; Singh, R.; Verma, G.; Gudade, B.; Bhupenchandra, I. and Devi, E. (2021). Jeevamrut: A low-cost organic liquid manure in organic farming for sustainable crop production. *Kerala Karshakan E J.*, **9**: 32-34.

Kumar, S.; Nagal, G.; Kar, P. and Lal, B. (2024). Impact of organic farming training on the knowledge of farm women: A pre-post analysis. *Indian Res. J. of Ext. Edu.,***24**(2):73-79.

Mahajan, G.; Sharda, R.; Kumar, A. and Singh, K. G. (2007). Effect of plastic mulch on economizing irrigation water and weed control in baby corn sown by different methods. *African J. Agril.Res.,* **2** (1):19-26.

Mishra, M. (2013). Role of eco-friendly agricultural practices in Indian agriculture development. *Int. J. Agri. and Food Sci. Tech.*, **4**(2):11-15.

Narain, S.; Kalpana, K.; Kumar, H. and Shukla, A.N. (2024). Organic farming of Tulsi (Ocimum species): Motives and satisfaction level of certified organic Tulsi growers in the Bundelkhand region of UP. *Indian Res. J. of Ext. Edu.,* **24** (2): 66-72.

Panagos, P.; Borrelli, P.; Meusburger, K.; Alewell, C.; Lugato, E. and Montanarella, L. (2015). Estimating the soil erosion cover-management factor at the European scale. *Land Use Policy*, **48**:38-50.

Patel, V.B.; Prajapati, M.R. and Joshi, S.G. (2018). Practice-wise adoption of organic farming by the organic farmers of North Gujarat.*Guj. J. Ext. Edu. Special Issue*, 104-106.

Raghuwanshi, V. (2018). Study on adoption of organic farming practices in soybean crop in Guna district of Madhya Pradesh. *Indian Res. J. of Ext. Edu.,***18**(4):18-22.

Sangeetha, K. G.; Sherief, A.K.; Thomas, A. and Seema, B. (2018). Comparison of organic and conventional farmers based on integrated climate change adaptive capacity. *Indian Res. J. of Ext. Edu.,* **18**(2):1-6.

Sathya, S.; Akila, N. and Velmurugan, K. (2024). Popularization organic farming practice in tomato cultivation through front line demonstration. *Indian Res. J. of Ext. Edu.,***24**(3):78-81.

Shanthy, T.R.; Subhash, P.K. and Chauhan, J.K. (2023). Intercropping in sugarcane by growers of Kolhapur district, Maharashtra: A performance analysis. *Indian Res. J. of Ext. Edu.,* **23**(4): 126-133.

Sindhu, P.V.; George Thomas, C. and Abraham, C.T. (2011). Stale seedbed and green manuring as an effective weed management strategy in dry-seeded rice (Oryza sativa). *Indian J. Agro.*, **56** (2):109.

Singh, S. K.; Chauhan, J.; Singh, G. and Singh, R. (2012). Adoption of neem as a pesticide in agriculture: An experimental study. *Indian Res. J. of Ext. Edu.,* **12**(3): 97-101.

Subrahmaniyan, K.; Zhou, W. and Veeramani, P. (2011). Weed control through degradable, herbicidal plastics and organic mulches and their effect on crop growth and yield of winter rapeseed (Brassica napus). *Indian J. Agril. Sci.*, **81**(4):348.

Swarnam, T. P.; Velmurugan; Jaisankar, A.I. and Roy, N. (2016). Effect of foliar application of panchagavya on yield and quality characteristics of eggplant (Solanum melongena L). *Adva. in Life Sci.*, **5**(7): 2636.

Zala, P.H. and Kalsariya, B.N. (2022). A scale to measure the attitude of farmers towards natural farming. *Indian Res. J. of Ext. Edu.,* **22**(1): 13-18.

• • • • •