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Production techniques in natural farming

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Natural farming (NF) is an ecological farming approach which relies on environment friendly agricultural inputs and practices for improving soil health, agro-biodiversity, and self-sustaining production system. NF, an indigenous cow-based farming is based on the five components, viz. Beejamrit, Jivamrit, Acchadana, Whapasa and plant protection measures using cow dung and urine as the main ingredient in all its bio-formulations. Considering the nationwide promotional activities on NF, various comparative experimental trials were conducted in ICAR Research Complex for NEH Region, Umiam on NF with organic farming and integrated crop management practices for acidic soils of hill region. Three different case studies on NF field trials on different crops are presented here addressing its impact on soil, crop yield, and profitability in the region.

Keywords: Acid soil, Natural bio-formulations, Sustainable soil management, Traditional farming

NATURAL farming (NF) is a traditional and cow-based farming approach which encourage utilizing of natural locally available resources within the farm by cutting down the dependence on external inputs. It is a chemical free farming method rooted in Indian tradition enriched with modern understanding of ecology, resource recycling and on-farm resource optimization which protects the biodiversity and friendly with nature. It is considered as agro-ecology based diversified farming system which integrates crops, trees and livestock with functional biodiversity. NF is considered as regenerative agriculture, by reassessing the agriculture system into sustainable management practices that has the ability to conserve soil nutrients, moisture and sequester carbon in the soil, with a prominent strategy to save the planet. The main purpose of this farming method is to practice the pre-green revolution system with a cost of production to almost zero.

The principal ingredient of NF is "indigenous cow dung and cow urine" and all the formulations are prepared by mixing dung and urine in different concentrations. NF is based on five pillars,viz.

- *Beejamrit* is usually formulated by combining fresh cow dung (200 g), cow urine (200 ml), lime (2 g), water (800 ml), and soil (8 g). It is mainly used for seed treatment at the rate of 25 L/kg of seed. Seeds of any crop are soaked in the *beejamrit* solution for about one hour, dried in shade, and then used for sowing. In the case of transplanted crops, seedlings should be dipped in the solution for 1–2 h before transplanting in the main field. Thus, seed treatment and root dipping with *beejamrit* offer multiple benefits, such as enhanced seed germination, better crop establishment, increased populations of beneficial rhizospheric micro-organisms, and suppression of soil- and seed-borne pathogens, thereby promoting healthy plant growth.
- *Jivamrit* is prepared by fermenting a mixture of

Components of natural farming

water (200 L), fresh cow dung (10 kg), cow urine (5–10 L), jaggery (2 kg), pulse flour (2 kg), and a handful of soil for 48 hours. The solution can be stored for up to 15 days without any loss of efficacy. In field crops, *jivamrit* is basically applied in soil with irrigation water and foliar feeding @200 L/acre at fortnightly intervals, but in fruit trees, the solution is applied directly to individual plants. The major functions of *Jivamrit* are providing essential plant nutrients, improving earthworm and microbial activities for nutrient cycling, and preventing different plant diseases.

Preparation of natural farming bio-formulations

- *Acchadana* (Mulching) is covering the soil surface or the area around plant roots with either live vegetation or crop residues to conserve soil moisture, maintain soil temperature, reduce runoff and prevent soil loss and suppression of weed growth.
- *Whapasa* is the combination of air and water vapour (50% each) for improving total porosity in the soil particles. It moderates the micro-climate and provides soil moisture to the plant roots, and microbes for better nutrient recycling. Further, it significantly reduces the net irrigation requirement by forming soil aeration with air and water molecules in the soil.
- **Plant protection**

Agniastra: Pour 200 L of cow urine into a container and mix in 2 kg of neem leaf paste, 500 g of tobacco powder, 500 g of green chili paste, 250 g of garlic paste, and 200 g of turmeric powder. Stir the mixture in a clockwise direction, cover it with a lid, and boil until foam appears. After boiling, remove it from the heat and place the vessel in a shaded area, away from direct sunlight, to cool and ferment for up to 48 h stirring the contents twice daily. After 48 h filter with a thin muslin cloth and store it. It can be stored for 3 months. Insecticidal and effective against the pests like leaf roller, stem borer, fruit borer, pod borer. It is used as a foliar spray at 2% concentration, applied at the rate of 200 L/acre. For spraying, 6–8 L of agniastra is diluted in 200 L of water. The dilution ratio may be adjusted depending on the intensity of pest infestation.

- 100 L of water 3 L of *agniastra*
- 15 Lof water 500 L of *agniastra*
- 10 Lof water 300 L of *agniastra*

Neemastra: Fill a drum with 200 L of water and add 10 L of cow urine, followed by 2 kg of local cow dung. Then mix in either 10 kg of finely ground neem leaf paste or 10 kg of neem seed pulp. Then stir it clockwise with a long stick and cover it with a gunny bag. Store the mixture in a shaded place, ensuring it is protected from sunlight and rain. Stir it in a clockwise direction twice daily, in the morning and evening. The solution will be ready for use after 48 h and may be stored for use up to 6 months but it should not be diluted with water. Strain the prepared solution through a muslin cloth and apply it directly to crops as a foliar spray at 3% concentration. It is effective against sucking pests such as jassids, aphids, whiteflies, small caterpillars, and mealybugs.

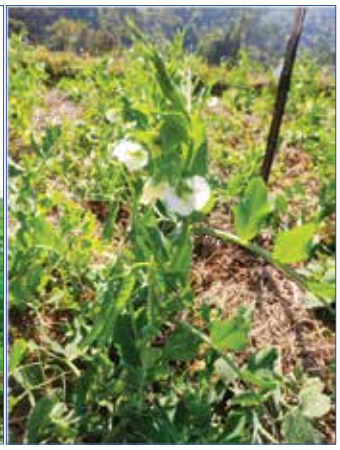
Brahmastra: Pour 20 L of cow urine into a vessel and add 2 kg each of neem leaf paste, karanj leaf paste, custard apple leaf paste, castor leaf paste, and datura leaf paste. Heat the mixture on a low flame until it begins to foam and slightly overflows once or twice. Stir in clockwise direction, then cover the vessel with a lid and keep on boiling it. Once the second foam appears, stop boiling and let the mixture cool for 48 h allowing the alkaloids from the leaves to infuse into the urine. After 48 h, strain the solution through a muslin cloth and store it in earthen pots or plastic drums kept in the shade. The preparation can be preserved for up to six months. It is used to control the sucking pests, viz. pod borer, fruit borer, etc. and caterpillar. For application, use it as a foliar spray at 3% concentration by diluting 6–8 L of *Brahmastra* in 200 L of water and spraying it on standing crops. This ratio may be changed depending upon the severity of pest attack as follows:

- 100 L of water + 3 L of *Brahmastra*
- 15 L of water + 500 ml of *Brahmastra*
- 10 L of water + 300 ml of *Brahmastra*

Practice of natural farming in acidic hill soils

Since traditional farming has been practiced by the farming communities for ages in North Eastern Hill (NEH) Region, therefore practicing zero budget natural farming (ZBNF) in this region provide wide scope for the small and marginal farmers. At present, the ICAR Research Complex for NEH region, various agricultural state departments and agricultural universities have recently initiated different projects and studies related to natural farming. Most of them have not come out with conclusive information for recommendation. Area and production survey is also not yet carried out for natural farming in northeast, India. From 2023, majority of the campaigns and capacity building programmes have been started by various organizations to sensitized the farmers on NF. Under the project "Outscaling

Finger millet + Cowpea



Field pea

Crops under natural farming

of Natural Farming through KVKs" many trainings, demonstrations and awareness programmes have been given to the farmers regarding the benefits and adoption of natural farming. Recently, Indian Council of agricultural Research (ICAR) launched a B.Sc. (Hons) Natural Farming as part of degree programme in Agricultural colleges in various parts of India. The main focus is to highlight the utilization and practices of indigenous knowledge in agreement with agro-ecological principles. ICAR has also initiated a research study on the assessment of NF on different crops.

Evaluation and validation of natural farming practices

Case study I: Considering the nationwide promotional activities on NF, a field trial was also conducted on NF at experimental field of ICAR-Research Complex for NEH Region, Umiam, Meghalaya to analyse the effect of nutrient management practices of natural farming comparing with organic farming (OF) practices in different crops. The treatments of NF and OF are: T_1- Traditional/farmers' practice (organic-FYM); T_2- Natural farming; T_3- Packages of practices (POP) organic (FYM+ Biofertilizer (specific to crop+Lime); T_4- NF+Lime; and T_5- NF+Vermiwash/Compost wash (foliar spray).

Table 1. Effect of different nutrient management practices of NF compared with OF on soil and crop yield

Treatment	Millet + Cowpea (soil data)				Field Pea (soil data)				Yield (t/ha)		
	pH	SOC (%)	Avail. N (kg/ ha)	Avail. P (kg/ha)	pH	SOC (%)	Avail. N (kg/ ha)	Avail. P (kg/ha)	Millet (t/ ha)	Cowpea (t/ ha)	Pea (t/ha)
Initial	4.45 -5.31	1.10 -1.39	125.4 -263.4	17.8 -26.3	4.90-5.56	1.18-1.35	213.3-263.4	29.4-36.2	-	-	-
T_1	5.07	1.35	263.4	31.4	5.52	2.08	468.0	70.1	1.88	3.69	1.52
T_2	5.56	1.21	225.8	36.2	5.30	1.36	306.0	20.0	1.58	5.43	2.22
T_3	4.97	1.18	213.3	29.4	5.25	1.64	369.0	26.5	1.44	5.41	1.61
T_4	5.00	1.32	250.9	35.8	5.21	1.50	337.5	22.7	1.64	5.98	2.67
T_5	4.90	1.35	263.4	33.8	5.23	1.44	324.0	25.0	1.97	5.84	1.83

These experiments were conducted in the existing terrace land of ICAR Research Complex for NEH Region. The soils are acidic in nature with pH range of 4.45–5.31 and SOC of 1.10–1.39% before starting of the experiment. The post-harvest soil analysis of millet *(Eleusine coracana)* and cowpea *(Vigna unguiculata)* showed that soil pH in T_2 was observed highest with higher available P comparing to the other treatments. Millet yield was highest (1.97 t/ha) in T_5 and cowpea in T_4 (5.98 t/ha) and T_5 (5.84 t/ha) treatments. During 2nd year, field pea *(Pisum sativum)* crop was raised as second crop to analyse the effect of NF nutrient management comparing to organic farming practices.The results showed that pH ranged from 5.21–5.52, and SOC 1.36–2.08%. The yield was observed highest in T_4 (2.67 t/ha) followed by T_2 (2.22 t/ ha) treatment.

Case study II: A field experiment on natural farming, organic and Integrated Crop Management (ICM) practices was established in 2021–22 to evaluate the impact on turmeric yield, and profitability. The experiment was laid out in a randomized block design with three replications. The treatment consists of T_1: Control, T_2: Complete natural farming, T_3: All India-organic farming package, T_4: Integrated Crop Management (50 % organic and 50% sources with *Neemastra, Dashparni* ark, *Brahmastra,* Neem seed kernel extract and T_5: Integrated Crop Management (50 % organic + 50% inorganic with need-based pesticides). The results showed that the significantly highest yield of turmeric was reported in the AI-NPOF package (21970 kg/ha), which was 5.09 to 56.7% higher than the remaining treatments. While the natural farming plot registered a turmeric yield of 11600 kg/ha but it was 20.2% higher than the control plots. Further, the minimum cost of cultivation was incurred in control plots (₹ 53468/ha) followed by natural farming (₹ 60397/ha) but maximum in AI-NPOF package

Pictorial view of experiment on natural farming at the ICAR Research Complex for NEH, Umiam, Meghalaya

(₹ 53468/ha) followed by ICM practices. Though, the cost of cultivation was higher in the AI-NPOF package, it registered a maximum net return (₹ 60397/ha), which was 55.0%, 58.8%, and 21.0% higher than natural farming, control and ICM practices, respectively.

Table 2. Impact of natural farming, organic and ICM practices on turmeric yield and economics

Treatments	Cost of cultivation (₹/ha)	Yield of Turmeric (kg/ha)	Net returns (₹/ha)
T_1: Control	53468	9500	65231
T_2: Complete Natural Farming *(Beejamrit + Ghanjeevamrit + Jeevamrit;* Crop residue mulching; Intercropping; and *Whapasa*)	60397	11600	71365
T_3: AI-NPOF package	75529	21970	158610
T_4: Integrated Crop Management (50 % organic and 50% sources with *Neemastra, Dashparni ark, Brahmastra,* Neem seed kernel extract	84094	20850	125300
T_5: Integrated Crop Management (50 % organic+50% inorganic with need-based pesticides)	73899	20180	116760

Case study III-Natural farming based-agro-pastoral (FSW-4) and agri-horti-silvi-pastoral (FSW-5) farming system models: The experiment on natural farming for sustainable system productivity in the mid-hills of acid soils was initiated on July 2023. The study aimed to assess the long-term effect of natural farming on system productivity, economic viability and soil health. Two existing micro-watershed farming system models (FSW-4 and FSW-5) that were established in 1983 were taken in the study, wherein ~70 % of the land is assigned to natural farming practices and 30% to conventional practices. Further to align with the mandate of natural farming, slight modifications in the crops and cropping system were made before the sowing of different crops. As per the guidelines of NITI Aayog, the desi cow breed 'Lakmi' (Assam) is reared for the preparations of various formulations and concoctions. Further, all other principles of natural farming, and management practices were followed as per the plan of the experiment. The results revealed that the natural farming practice produced a greater seed yield of mustard i.e. 706.0, 590.6 and 442.6 kg per unit area in lower, middle and upper, respectively which was 16.5%, 18.3% and 44.3% higher than the control plots. Further, the pod yield of peas was also higher under natural farming (4.63 t/ha) than the control (1.68 t/ha). However, the crop yield of maize, black gram, and tomato showed a lower value in natural farming practices as compared to control treatments. Additionally, the baseline soil samples were taken to assess the yearly and long-term impact of natural farming on the soil properties.

Table 3. Baseline description of the different soil properties under natural farming

Terraces	Depth	SOC (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)	pH
Lower	0–15 cm	1.71	282.24	27.17	241.36	5.25
	15–30 cm	1.01	172.48	12.83	169.68	5.15
Middle	0–15 cm	1.50	297.92	26.98	240.24	5.19
	15–30 cm	1.24	227.36	10.76	132.72	5.10
Upper	0–15 cm	1.21	261.33	21.01	188.91	5.15
	15–30 cm	0.98	188.16	9.81	133.65	5.03

SUMMARY

In north eastern India, indigenous farming practices like natural, organic, and bio-dynamic farming have been widely practiced for centuries. The suitable agro-climatic conditions, vast bio-diversity, and low use of synthetic chemicals make the region apposite to adopt natural farming (NF) practices. The NF practices integrate an ecological principle, resource recycling, and biodiversity conservation to create a regenerative system thereby reducing dependence on external inputs. The studies conducted at ICAR-Research Complex for NEH Region,

Agro-pastoral–based system (FW-4) | Concoctions preparation | Agri-horti-silvi-pastoral system (FSW-5)

View of natural farming based IFS models

Meghalaya showed an improved yield of millet under NF with vermi wash applications (1.97 t/ha). Further, it also had more stable soil organic carbon (SOC), and nitrogen (N) levels than the other practices. Similarly, the NF practices enhanced the rhizome yield of turmeric by 20.2%; and incurred the minimum production costs as compared to control, and other treatments, respectively. Moreover in terms of crop yield, mustard, and pea crops exhibited a positive response, while maize and tomato crops showed a negative response to NF practices. Nevertheless to harness the long-term benefits of NF practices, emphasis must be given on access to different NF bio-formulations, skill development programmes, premium prices or incentives to farmers, and infrastructure development in the NE region.

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