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Technological interventions in natural farming for upliftment of natural farming in Sonitpur district of Assam, India

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Abstract

In Assam, Natural Farming now-a-days is becoming increasingly popular among the smallholder farmers of Sonitpur district of Assam. The state has 272 lakhs farming households out of which 85.59 farming households are small and marginal having operational land holding of less than 1-2 hectares (Agricultural Census, 2010-11). So to obtain desirable changes in socio-economic life of its esteemed farming population, there must be adoption of all sustainable and profit earning technologies for boosting production and productivity in due space and time (Sarmah *et.al.*, 2023). Natural farming practices are cost savings from not using chemical fertilizers and pesticides, as well as higher benefit from intercrops. Under natural farming system, three to four crops are cultivated or grown together on the same area, along with leguminous crops as intercrop in order to ensure that no piece of land is wasted and utilized properly (Laishram *et. al.*, 2022). This article highlighted the activities of Mrs. Dipali Mandal, a lady farmer engaged with vegetable and flower cultivation since last fifteen years. By converting her entire farm (less than 1ha) under natural farming system since last three years, she could able to increase production by 30.55% over traditional farming by focusing mainly on the different cropping systems of natural farming and comparing the economics of natural farming (NF) with traditional farming (TF) systems. It is found in study that intercropping with leguminous crops is considered as one of the most important components of natural farming as it increases crop productivity and soil fertility through the atmospheric nitrogen fixation. The analytical results from soil samples collected from different locations of her farm reflected that there was incredible enrichment of soil in terms of organic carbon (0.86-0.89), available nitrogen (279.4 -288.5 kg/ha) and available potash (323.5-239.8 kg/ha). These studies revealed that the farm soils where natural farming practices were adopted, were exuberantly loaded with bacterial population (45×10^7 CFU/ml) in comparison to traditional farming (18.6×10^7 CFU/ml). The increase in soil organic carbon content might be attributed to the exuberant multiplication of microbes in the soil under natural farming system (Debabrata, 2019) [6].

Keywords: Natural farming, sustainability, traditional farming, intercropping, Sonitpur, Assam

Introduction

Assam is naturally blessed with fertile lands and diversified agro climatic conditions. Hence agriculture forms the backbone of socio economy of Assam. The state is mostly organic by default as out of net cultivable area of 4.3 million hectares, about 30.92 lakh hectare area have not seen the use of inorganic fertilizers and pesticides (Das, 2020) [5]. Rice is the staple crop in Assam producing food to more than 25 million people. Main kharif crops are autumn rice, winter rice, maize, pulses, kharif oilseeds, kharif vegetables etc. In rabi season, fields are occupied by summer rice, wheat, gram, rape and mustard, various rabi oilseeds, rabi vegetables, potato etc. Except a few like wheat, onion and potato, rest of the crops are grown under traditional methods of farming using cow dung. On the other hand, it becomes difficult to change the mind of farmers to adopt a fully organic method in the pockets of commercial production due to the risk of yield reduction.

So to bring maximum area under organic cultivation where there is little or no use of fertilizers, organic farming movement was promoted in Assam during the 1st half of 20th century with implementation of Central Sector Organic Schemes like Paramparagat Krishi Vikash Yojna (PKVY), Rashtriya Krishi Vikash Yojana for Organic Farming (RKVY) and

Mission Organic Value Chain Development (MOVCD). But these schemes could not flourish properly due to the reasons like high input cost and lower yield of crops under commercial cultivation. In the mean time, many researchers and scientists are claiming Natural Farming as a good alternative to chemical as well as organic farming that directly or indirectly impacts sustainable development positively (Tripathy and Tauseef, 2018) [16].

Natural farming is a special form of Agriculture that does not require any financial expenditure to purchase chemical fertilizers or organic manure and agrochemicals from outside farm (Palekar, 2021) [4]. With very limited investments, these inputs can be prepared in farm itself with deshi cow dung, urine and plant extracts etc. It is even cited by farmers that labour and production costs has drastically reduced by 14-45% (Chandel *et al.*, 2021) [4]. Thus natural farming though in its preliminary stages, is showing increased positive results and is being adopted by farmers in good faith in Assam also.

Sonitpur district comes under North Bank Plain Zone of Assam. It is the second largest district in Assam with a population of 19,25,975 (as of 2011 census). The economy of Sonitpur district is underdeveloped and approximately 80% of the population depends on Agriculture allied (primary sector) activities for their livelihood. Cropping intensity of the district is 185% and fertilizer consumption rate of 40%. Besides the areas where intensive cultivation of vegetables is practicing, rest of the cultivable land of the district is organic by default. So these areas can be easily brought under natural farming system in near future. Due to simplicity, adaptiveness and huge reduction in cost of cultivation, a few farmers of the district are adopting natural farming practices in cropping system mode. So to know the impact of cropping systems of natural farming on crop productivity and soil health, this study was conducted in the farm of Mrs. Dipali Mandal, a lady farmer of Teenmile village of Sonitpur District holding 6 bigha of farm land where she is practicing natural farming since 2019. The objectives of the study was:

- To study the economics of natural farming with traditional farming system.
- To study the soil conditions under natural farming system.

Materials and Methods

Study area

Deepali mandal is a marginal farmer of Sonitpur district with land holding of <1 ha (6 bighas) where she is practicing Low Budget Natural Farming (LBNF) since 2019. Earlier some part of the farm was managed by adopting traditional farming system with cowdung and little amount of chemical fertilizers and pesticides for last 15 years. After 2019, by the inspiration of Padam Sree Awardee Sree Subhash Palekar, she decided to adopt LBNF practices to a part of her farm. The crops which were primarily grown at the farm are cabbage, cauliflower, pea, gerbera, tuberose and marigold.

Analytical framework

Soil samples of the farm were collected in May 2022. Five composite soil samples were collected from both plots under natural farming (NF) (3years of conversion plot) and traditional farming (TF) plot which sums up to a total of ten number of composite representative soil samples. The soil

samples were collected from 0-15cm depth to assess soil properties viz soil reaction (pH), soil organic carbon (OC), available N, P and K at the Soil Testing Laboratory of KVK, Sonitpur, Napam, Assam. Soil samples were collected from the identified sites, thereafter dried under shade, grounded, mixed thoroughly and passed through 2mm sieve. The processed samples were then kept in plastic bags and used for subsequent laboratory analysis.

Soil reaction was determined through glass electrode pH meter method (Jackson, 1973) [10], soil organic carbon was determined by Walkley and Black method (Jackson, 1973) [10]. Alkaline KMnO_4 method given by Subbiah and Asija (1956) [15] was used for determination of soil available nitrogen while available phosphorus was determined by sodium bicarbonate (NaHCO_3) extraction and subsequent colorimetric analysis (Olsen *et al.* 1954) [13] method. Exchangeable K was determined by extracting the soil samples with neutral normal ammonium acetate solution and thereafter through flame photometer (Barrows and Simpson, 1962) [3].

The enumeration of the total microbes in soil samples was done following "Serial dilution plate technique" using nutrient agar medium for bacterial and potato dextrose agar (PDA) medium for fungi." The population of microbes was examined in various treatments and expressed as CFU/ml. Sterilized test tubes were taken and the first test tube was taken 10 ml of distilled water, and remaining test tubes were with 9 ml distilled water. 1 g of sample was dissolved in a first test tube with distilled water (10 ml) and its dilution factor 10-1. Then, 1 ml of sample was transferred from first tubes (10-1) and second test tubes and its dilution factor is 10-2, similarly samples were transferred to remaining test tubes, and dilution factor obtained as 10-3, 10-4, 10-5, 10-6, 10-7, 10-8, 10-9, and 10-10. From these diluted samples, 1 ml of sample from 10-7, 10-8 was taken and transferred to nutrient agar media and 10-3, 10-4 was taken in PDA plates and incubated 24 hrs for bacterial culture and 72 hrs for fungal culture.

Crop equivalent yield: In Natural Farming system, since many crops are growing in multiple or mixed cropping system, so it is very difficult to compare multiple crops with a single crop. By applying a technique given by Francis (1986), crops equivalent yield can be calculated by using formula:

$$\text{CEY} = C_Y + C_{Y1} \cdot P_1 / P_0 + C_{Y2} \cdot P_2 / P_1 + \dots$$

Where,

C_Y = Yields of the main crop

P_0 = Price of the main crop

(C_{Y1} , C_{Y2} , C_{Y3} ,..... C_{Yn}) = Yields of intercrop, which are to be converted to equivalent of main crop yield

(P_1 , P_2 , P_3 ,..... P_n) = Price of the respective intercrops

Relative Economic Efficiency: Relative Economic Efficiency given by Farrell (1957) [8] was used to calculate the comparative economic gain of the two farming systems, calculated by the following formula:

$$\text{REE} = \frac{(\text{Net Returns in Natural Farming} - \text{Net Returns in Traditional Farming}) \times 100}{\text{Net Returns in Traditional Farming}}$$

Formulations/products used as input at farm

After conversion to Natural Farming system, Dipali mandal used to cultivate her crops by using natural formulations prepared at her own farm with the products which are easily available at farm. Earlier she used mostly FYM and very little amount of chemical fertilizers like Urea and DAP along with insecticides and fungicides under traditional method of farming which raised the cost of cultivation and lowering the farm income. The natural formulations and practices used in the farm includes:

- Minimum ploughing with power tiller as initial soil preparation work
- Tranches making along with the crop rows for application of mulches, irrigation water and jeevamrit.
- The formulations which improve crop growth and development by adding microbial inoculums to soil includes Jeevamrit and Ghanjeevamrit
- Inter-cropping and mixed cropping with leguminous crops and follow crop rotation
- The formulations which help to reduce insect-pest-disease infestation in crop fields includes Beejamrit and Dashparni ark

Natural farming is a desi-cow based farming system and Jeevamrit is the backbone of Natural farming. Jeevamrit and Ghanjeevamrit besides fulfil the nutritional requirement of crops also enhance manifold multiplication of microbial population, earthworms and natural beneficial bioagents (Debabrata, 2019) ^[6]. Seed treatment with Beejamrit was done as remedial measure which helps to reduce root and seed born diseases besides speeding the germination process and increase percentage of germination. In Natural Farming system, it was observed that there was a natural control of pest and diseases in farm as compared to traditional farming system. But as a precautionary measure, herbal formulations like Dashparni ark (mixing of ten to twelve leaves of plants which cow does not eat with cow urine) and spray of Jeevamrit were practiced in farm. However, incorporation of crop residues, mulching, minimum tillage with power tiller, inter cropping and inclusion of legumes in crop rotation are the other practices followed in the natural farming farm.

Table 1: Formulations used under Natural Farming System at Farm

Sl. No.	Name of formulation	Inputs used for preparation	Preparation time and method of application
1.	Jeevamrit	Cowdung 10 kg, Cow urine 10 lit, Jaggery 2 kg, Besan 2kg, Soil 500 gm, Water 180 lit (for one acre land)	4 days for preparation, application at 15 days interval
2.	Beejamrit	Cowdung 5 kg, Cow urine 5lit, Lime 250 gm, Water 20lit	Ready in 24 hrs, sprinkled over seed and shade dry before sowing
3.	Ghanjeevamrit	Cowdung 100 kg, Jaggery 1 kg, Besan 2 kg, soil half kg, cow urine 7-10lit	Ready in 15-20 days, broadcasted during final land preparation
4.	Dashparni Ark	10-12 types leaves (10 kg), Cow urine 10 lit, Cow dung 2 kg	Ready in one month, applied upto 6 month @ 5 lit/200 lit water at 7 days interval

Major crop combinations under natural farming vs traditional farming

Crops were grown according to their season following intercropping model and leguminous crop was incorporate with other crops (Table.2) in order to ensure that no piece of land is wasted and utilized properly. Intercropping with leguminous crops is considered as one of the most important components of natural farming as it increases crop

productivity and soil fertility through the atmospheric nitrogen fixation. Growing multiple crops in the same unit of land maximizes land use and reduces the chance of crop yield loss (Laishram *et al.*, 2022) ^[11]. Major crop combination adopted under Natural Farming was Flower-vegetable crops. However, in Traditional Farming, as opposed to Natural Farming, solo cropping was practiced.

Table 2: Season-wise major crop combinations followed under NF and TF system

Particulars	Kharif	Rabi
NF		
Flower-vegetable	Marigold+ Tuberose	Cabbage+ Cauliflower+ Pea+ Gerbera
TF		
Flower-vegetable	Marigold, Tuberose	Cabbage, Cauliflower, Pea, Gerbera

Results and Discussion

Comparative analysis of crop yield under natural and traditional farming system

Under Natural Farming, two or more crops are grown in the same piece of land in multiple/mixed cropping system. So it is very difficult to compare the economic produce of

natural farming system with that of traditional farming produce. So to compare the yield, Crop Equivalent Yield (CEY) concept was used for a mixed cropping system (Francis, 1986). In our study, main crop was marigold and other crop yields were calculated as CEY of marigold crop.

Table 3: Before Conversion (Traditional Farming)

Component Description		Before Natural Farming (2018-19)				
Component	Names	Area (Bigha)	CEY (q/no)	Total Cost (Rs)	Gross Income (Rs)	Net Income (Rs)
Vegetables	Cabbage	0.3	8.80q	3600.00	7280.00	3680.00
	Cauliflower	0.3	10.20q	4135.14	8725.40	4590.26
	Pea	0.3	1.4q	3440.00	6200.00	2760.00
Flowers	Gerbera	0.07	18000no	34320.00	74200.00	39,880.00

	Marigold	1.0	24.00q	23870.70	48560.70	24690.00
	Tuberoose	1.0	8.60q	22020.20	32350.20	10330.00

Table 4: After Conversion (Natural Farming)

Component Description		Three years after Natural Farming (2021-22)					REE (%)
Component	Names	Area (Bigha)	CEY (q/No)	Total Cost (Rs)	Gross Income (Rs)	Net Income (Rs)	
Vegetables	Cabbage	0.3	11.26q	2737.00	6760.00	4023.00	9.32
	Cauliflower	0.3	15.50q	3130.00	8280.30	5150.30	12.21
	Pea	0.3	1.6q	2799.00	6343.20	3544.20	28.41
Flowers	Gerbera	0.07	23000no	22640.00	75513.90	52873.90	32.58
	Marigold	1.0	32.00q	17860.00	52130.20	34270.20	38.80
	Tuberoose	1.0	12.26q	17260.00	33991.02	1731.02	61.96

Effect of Natural Farming practices on crop yields

Level of crop yields seems to be excellent under NF system. From Table.3 and Table.4, it was observed that the yield in NF system was found to be higher than in TF system and REE varied from 9.32% to 61.96% in all crop combinations with an average of 30.55% during both the seasons. The above results were supported by Tripathi and Tauseef (2018) ^[16], which stated that the average of zero budget natural farming (ZBNF) groundnut farmers was 23% higher than their counterparts outside the NF. On average ZBNF, paddy farmers had a 6% higher yield. These increments are the result of sustainable farming practices, which also improve farmers' capacity to adapt to climate change. Also, another study observed an increase in CEY under cereals-pulses combination (17.22%). This higher increase can be attributed to the comparative remunerative prices of pulses and symbiotic effect of pulses on cereal crop yield (Chandel *et al.*, 2021) ^[4].

Economics of crop grown under NF system

The economics of crop grown under conventional and Natural Farming system is presented in Table3 and Table4. It is evident from the tables that substantial decrease in the cost of growing these crops has occurred with the use of NF technology. It has been observed that the total cost of all the crop combinations in NF systems during the cultivation process was substantially reduced. The percentage reduction in NF cultivation costs over the TF system was 37.58% in present study. It indicates that the NF method lowers the costs of farmers as it uses non-synthetic inputs available locally in contrast to TF capital intensive inputs. Similar findings were reported by Mishra, 2018, which revealed that, after converting into NF, farmers had a decreased cost of cultivation for all the crops and, most significantly, farmers were able to increase their income from natural agricultural practices by increasing the number of crops. The total expenditure in fruit-based cropping sequences showed a marked decline from Rs. 2,40,638 to Rs. 1,31,023 per ha, which indicate that the Subhash Palekar Natural Farming (SPNF) system reduces farmers' direct costs, boosting yields, and promotes the use of locally sourced nonsynthetic inputs, compared to capital intensive conventional farming (CF) (Chandel *et al.*, 2021) ^[4].

Impact of NF practices on soil chemical properties

Samples from both plots exhibited a strongly acidic reaction. Soil pH of the samples under natural farming (NF) ranged from 5.0 to 5.3 and samples from traditional farming (TF) ranged from 5.0 to 5.2 (Table.5). Organic carbon values in the NF plots ranged from 0.86 to 0.89 percent with a mean of 0.86%. On the other hand samples from TF plots

ranged from 0.56 to 0.58 percent with a mean of 0.57 percent. The samples from NF plots showed a high range of organic carbon content. This could be due to incorporation of organic mulches and uses of jeevamrita in the plots. According to findings of Bajorienė *et al* (2013), organic mulch is a source of soil micro organism, incorporation of which organic residues used in mulching are decomposed and this shoot up the content of soil organic carbon.

Available nitrogen in NF plots ranged from 279.4 to 288.5 kg/ha while TF plots has a range of 261.5 to 269.3 kg/ha. It was found that available phosphorus in the soil samples of both the plots does not show any striking difference. Its range was found to be 20.2 to 21.5 kg/ha in NF plots and 21.3 to 21.8 kg/ha in TF plots. Available potassium values however showed an increasing pattern in NF plots in comparison to TF plots. The soil samples from NF plots has available potassium value ranging 232.3 to 239.8 kg/ha while TF plots has a range of 213.4 to 225.3 kg/ha. Hence, it can be said that, some soil chemical properties has been improved in the plots under natural farming.

Table5: Status of soil pH, Organic carbon (OC), available nitrogen, phosphorus and potassium under natural farming (NF) and traditional farming (TF) system

Samples	pH	OC (%)	N P K		
			Kg/ha		
NF1	5.30	0.89	288.50	21.30	235.80
NF2	5.20	0.88	284.60	20.20	239.80
NF3	5.30	0.87	281.00	20.60	232.30
NF4	5.30	0.83	279.40	20.80	235.60
NF5	5.20	0.86	283.20	21.50	236.20
sum	26.30	4.33	1416.70	104.40	1179.70
Mean (average)	5.26	0.866	283.34	20.88	235.94
SD	0.05	0.02	3.51	0.53	2.66
CV	0.01	0.03	0.01	0.03	0.01
TF1	5.00	0.56	265.50	21.60	217.60
TF2	5.10	0.57	269.30	21.60	213.40
TF3	5.00	0.58	266.40	21.50	220.50
TF4	5.00	0.55	268.40	21.80	225.30
TF5	5.20	0.58	265.50	21.30	223.00
sum	25.30	2.84	1335.10	107.80	1099.80
Mean (average)	5.06	0.57	267.02	21.56	219.96
SD	0.09	0.01	1.74	0.18	4.65
CV	0.02	0.02	0.01	0.01	0.02

Impact on Soil Microbial Population

Notable change in bacterial population was recorded in both the systems. Bacterial population increased from 16 CFU/ml to 45 CFU/ml in NF system, while in TF system, it increased from 12.1 CFU/ml to 18.6 CFU/ml. The percent change in bacterial population was 181.25% in NF system, as compared to 53.72% in TF (Table.6). Similar results were

also found in case of fungi population. Fungal population increased from 2 CFU/ml to 4 CFU/ml in NF system, while in TF system, it increased from 1.2 CFU/ml to 1.6 CFU/ml. The percent change in fungal population was 100% in NF system, as compared to 33.33% in TF system. These results indicate the efficiency of NF practices in manifold multiplication of microbes in the soil which might have contributed in enhancing the nutritional status of the soil as

reflected in the data of organic carbon and macro nutrients described earlier. Devakumar *et al.*, (2018) [7] also recorded higher bacteria and fungi population i.e. 40.33×10^5 CFU/ml and 20.33×10^4 CFU/ml respectively with application of Jeevamrit in soil. Our results are in line with the reported studies and shows the beneficial effects of NF in increasing the microbial population and biodiversity, which are important indicators of soil quality.

Table 6: Variable microbial count under NF and TF

Variable microbes	Farming systems					
	NF		Change (%)	TF		Change (%)
	Before sowing	After harvest		Before sowing	After harvest	
Bacteria (x10 ⁷ CFU/ml)	16	45	181.25	12.1	18.6	53.72
Fungi (x10 ⁴ CFU/ml)	2	4	100	1.2	1.6	33.33

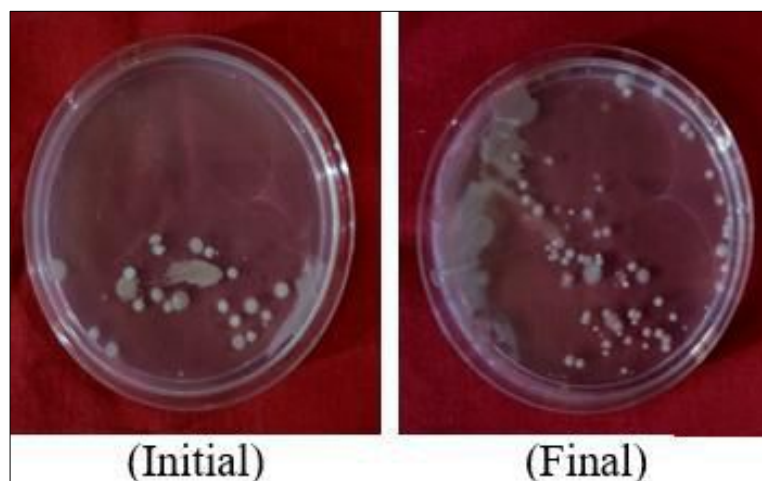


Fig 1: Bacterial count under NF

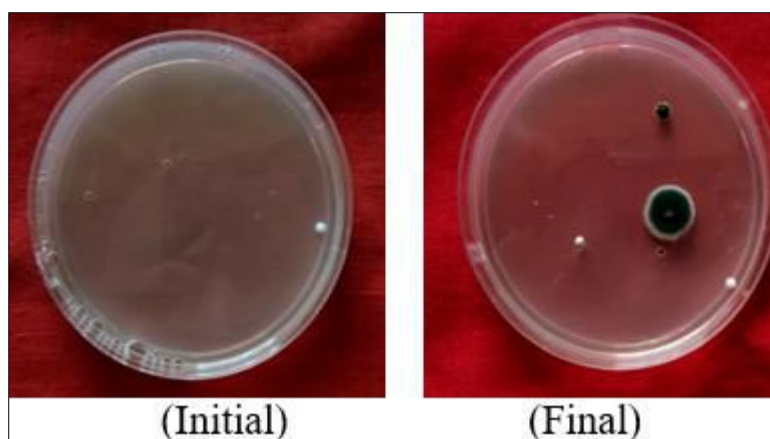


Fig 2: Fungal count under NF

Conclusion

On the basis of initial investigation and observations recorded under the study, it appears that Natural Farming may be a promising model in sustainable Agriculture. Considering the hazards of fertilizers and pesticides, farmers can employ these environmentally beneficial traditional inputs and practices as a production alternative. Application of jeevamrit and ghanajeevamrit in the fields promotes the multiplication of microbes in the field. However, incorporation of green manuring crops, mulching, minimum tillage and crop rotation etc. are other complementary practices which form a composite package for improving soil health under Assam condition.

References

1. Directorate of Economics and Statistics, Government of Assam. Agricultural Census 2010-11. Guwahati: Directorate of Economics and Statistics, Government of Assam; 2011. p. 5.
2. Bajorienė K, Jodaugienė D, Pupalienė R, Sinkevičienė A. The study of organic farming practices in Lithuania and Estonia. *Estonian J Ecol*. 2013;62(2):100-106.
3. Barrows HL, Simpson EC. An EDTA method for direct routine determination of calcium and magnesium in soils and plant tissue. *Soil Sci Soc Am Proc*. 1962;26:443-445.
4. Chandel RS, Gupta M, Sharma S, Sharma PL, Verma S, Chandel A. Impact of Palekar's natural farming on

- farmers' economy in Himachal Pradesh. *Indian J Eco.* 2021;48:873-878.
5. Das P. Organic Agriculture in Assam. *J Emerg Technol Innov Res.* 2020;7(2):444-448.
 6. Debabrata A. Kam lagot prakritik krishi. New Delhi: Pushpak Press Pvt. Ltd.; 2019.
 7. Devakumar N, Shubha S, Gouder SB, Rao GGE. Microbial analytical studies of traditional organic preparations beejamrutha and jeevamrutha. 2014.
 8. Farrell MJ. The measurement of productivity efficiency. *J R Stat Soc Ser.* 1957;120:153–290. doi: 10.2307/2343100.
 9. Francis CA. Distribution and importance of multiple cropping. *Agric Syst.* 1986;25:238–240. doi: 10.1016/0308-521X(87)90024-2.
 10. Jackson ML. Soil Chemical Analysis. New Delhi: Prentice Hall India Ltd.; c1973.
 11. Laishram C, Vashishat RK, Sharma S, *et al.* Impact of natural farming cropping system on rural households: evidence from Solan district of Himachal Pradesh, India. *Front Sustain Food Syst.* 2022;6:878015.
 12. Mishra S. Zero Budget Natural Farming: Are These and Similar Practices The Answers? Bhubaneswar: Nabakrushna Choudhury Centre for Development Studies; c2018.
 13. Olsen SR, Cole CU, Watanabe FS, Deen LA. Estimation of Available Phosphorus in Soil by Extracting with Sodium Bicarbonate. Washington, DC: U.S. Government Printing Office; 1954. USDA Circ. 939.
 14. Sarmah A, Deka PC. Zero budget natural farming in Assam. *The Pharma Innovation.* 2023;12(1):1208-1210.
 15. Subbaiah BV, Asija GC. A rapid procedure for determination of available nitrogen in soils. *Curr Sci.* 1956;25:259–260.
 16. Tripathi S, Tauseef S. Zero Budget Natural Farming, for the Sustainable Development Goals. Andhra Pradesh: c2018.