

Zero budget natural farming:

A promising model in Indian agriculture

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On the basis of initial investigations and observations at 180 acres of Gurukul Farm Kurukshetra, it appears that Zero Budget Natural Farming (ZBNF) may be a promising model in Indian Agriculture. The analytical results from different institutions (CCS HAU, Hisar; PAU Ludhiana, IIFSR Modipuram and Kurukshetra University Kurukshetra) have reflected that there was incredible enrichment of soils in terms of organic carbon (OC), available phosphorus, available potash, micronutrients and biological health. The results indicated that the average OC in the soil samples collected from Gurukul farm in June 2017 and analyzed at CCS HAU, Hisar and IIFSR, Modipuram was 0.61 and 0.62%, respectively. Around 19 and 30% soil samples in the analysis of IIFSR and CCS HAU were found sufficient/rich in OC (>0.75%). After one year of cropping i.e. in June 2018, soil samples were again collected and analysed at CCS HAU Hisar. It was observed that 95% soil samples were rich in OC with average OC value of 0.91% in the range of 0.82-1.12%. For confirmation of results, soil samples were further drawn in October 2018 after kharif and analyzed at CCS HAU, Hisar and PAU, Ludhiana. These results indicated that the average OC was 0.84 and 0.78% in the soil analysis reports from the respective institutes. The increase in OC by 49% (from 0.61 to 0.91%) in a period of only one year and the maintenance of average OC at the level of more than 0.75% across the season on a farm of 180 acres exhibit the impact of ZBNF practices. Seasonal variation and crop management practices may exert influence on OC content of soil.

Key words: Indian Agriculture, Natural farming, Tubewell Zero budget

THE pronounced impact of ZBNF practices on OC might be attributed to the exuberant multiplication of microbes in the soils of Gurukul farm which was evident from the microbial studies conducted in the Department of Microbiology, Kurukshetra University, Kurukshetra. These studies revealed that there were 528 times more colony forming units of bacteria per gram soil in the soil samples of Gurukul farm as compared to that recorded in the soils from farmers' fields.

The increase in the mean values of available P was 89 and 32% detected in the soil samples collected in June 2018 and October 2018, respectively, over that recorded in the soil samples collected in June 2017. Likewise,

mean available potassium increased by 7 and 17% in the samples collected in June 2018 and October 2018, respectively, over those collected in June 2017. The extent of increase in micronutrients was 32, 27, 31 and 114% in zinc, iron, copper and manganese, respectively, during a period of one year from June 2017 to June 2018.

The crop yields obtained at Gurukul farm were highly comparable to the level achieved by the farmers. Average yields of non-scented high yielding cultivars of rice (including hybrids) were in the range of 70-80 q/ha during previous 5 years. Average wheat yields of Bansi, a desi variety, was 31.25 q/ha. Production of sugarcane achieved a

level of 1,300 q/ha with average cane yield of 860-100 q/ha during the previous years. In vegetables, average tuber yield of potato ranged between 250-300 q/ha.

The present analytical studies do not quantify the contribution of earthworms which needs to be considered in future investigations. There is considerable multiplication of earthworms in the soils nurtured by organic and natural farming practices. The impact of earthworms in building soil health and improving crop yields is well known and established fact.

Detailed Report

Gurukul Kurukshetra owns 220 acres of land, out of which 180 acres



is situated 5 km away from its main premises where Zero Budget Natural Farming (ZBNF) is practised since 2015. Earlier, some part of this farm was managed by adopting organic farming practices for the last 12 years. After 2015, by the inspiration of *Padam Shree Awardee* Sh. Subhash Palekar, Arharya Dev Vrat, the Hon'ble Governor, Himachal Pradesh decided to adopt ZBNF on the whole farm of 180 acres. The crops which are primarily grown at the farm are rice, wheat, sugarcane, fodder, potato and other vegetables.

Scientific measures adopted to evaluate the impact of ZBNF

The scientific studies to evaluate the impact of ZBNF practices was initiated from the *kharif* of 2017. Soil samples of *Gurukul* farm were collected in June 2017, June 2018 and October 2018 and analyzed in the Department of Soil Sciences, CCS HAU, Hisar. Similar exercise was done in June 2017 by the scientists of Indian Institute of Farming System Research, Modipuram (IIFSR). Soil samples were drawn in June 2018 for analysis at PAU, Ludhiana. Underground water samples of 15 tubewells installed at *Gurukul* farm were taken for analyzing the quality of water. The analysis of water samples was done at CCS HAU Hisar. For assessing the nutritional status of different herbal formulations used in ZBNF for crop production and crop protection, samples were taken from these formulations and analyzed at IIFSR, Modipuram. For microbial studies, soil samples from the *Gurukul* farm and farmers' fields were taken and analyzed in the department of Microbiology, Kurukshetra University, Kurukshetra.

The results on Organic Carbon, macro and micronutrients and

microbial status of the soil of '*Gurukul* farm' Kurukshetra and the nutritional status of different herbal formulations used in ZBNF for crop production/crop protection are discussed in the present report.

Formulations/Products used as inputs in ZBNF at the farm

There are two types of formulations prepared in the laboratory of *Gurukul* Kurukshetra and used as inputs in the crops grown at the farm.

- Those formulations which fulfil the nutritional requirement of the crops and promote growth and development of the crops.
- Those formulations which control or help in the repulsion of pests and diseases in the crop.

Mainly there are two formulations viz. *Jivamrit* and *Ghan Jivamrit* which help in the fulfilment of nutritional requirement of the crops and enhance manifold multiplication of microbial population, earthworms and natural beneficial bio-agents like frogs etc. The formulations which are used for insect control are mainly *Neemastra*, *Brahmastra* and *Agnistra*. It has been observed that crops like rice and wheat and for the control of mild insects as hoppers, aphids, white fly, Jassid etc., *Neemastra* alone gives excellent results and there is no need of applying insecticides. For the insects like borers and caterpillar, *Brahmastra* and under extreme conditions, *Agnistra* plays vital role in insect control. In ZBNF, it has been observed that there is natural control of most of the pests and diseases. Spray of *Jeevamrit*, *Lassi* and *Desi-Cow* urine remain effective for the control of diseases. These are sprayed as precautionary measures on the crops. For root and seedling diseases, seed treatment with *Beejamrit* is done as remedial measure.

For the fulfilment of nutritional requirement of crops, besides *Jivamrit* and *Ghan Jivamrit*, other formulations which are used for insect-pest control like *Neemastra*, *Brahmastra*, *Agriastra*, *Khatti Lassi* and Cow Urine also have nutritional and growth promoting values (Table 1 and 2). A perusal of data revealed that these formulations support the growth and development of the crops.

Underground water quality of tubewells at Gurukul farm

The quality of water of the tubewells at *Gurukul* farm was analyzed in the soil and water testing lab of department of Soil Science, CCS HAU, Hisar. Generally underground quality of water of all the tubewells installed at *Gurukul* farm was found good (Table 3). Only one tubewell (No.3) was having RSC 1.5 meq/litre which require 50 kg gypsum per irrigation to neutralize the insoluble salts. The EC of all the tubewells was below critical level. Hence, it can be said that the underground water quality of the farm is not harmful for the growth and development of the crops.

Impact of ZBNF practices on soil chemical properties: Random soil samples were taken from 180 acres farm of *Gurukul* Kurukshetra starting from June 2017 to October 2018. These samples were analyzed at CCS HAU, Hisar; PAU, Ludhiana and Indian Institute of Farming Systems Research (IIFSR), Modipuram at different times for chemical composition.

Table 2. Nutrient composition in different formulations prepared at *Gurukul* Kurukshetra

Formulations	N (%)	P (ppm)	K (ppm)	Zn (ppm)
<i>Jivamrit</i>	0.896	2.976	884	138
<i>Neemastra</i>	0.672	2.193	1584	3.88
<i>Agnistra</i>	1.176	0.379	709	1.09
<i>Dashparni Ark</i>	2.184	0.339	602	1.83
<i>Khatti Lassi</i>	2.80	25.835	430	2.24
Cow Urine	1.50	6.788	9000	-
Buffalo Urine	0.90	7.963	5130	-
<i>Saptdhanya Ankur</i>	1.42	3.916	852	-

Source: Report, IIFSR Modipuram (2018)

Table 1. Nutrient composition in different formulations prepared at *Gurukul* Kurukshetra

Formulation	Macronutrients			Micronutrients		
	N	P	K	Zn	Fe	Cu
Vermicompost	0.49	0.42	1.94	296.0	8,154	47.0
<i>Ghan Jivamrit*</i>	0.99	0.49	4.51	229.0	6,002	45.6

**Ghan Jivamrit* is prepared in 3-5 days, whereas vermicompost takes 2.5 to 3 months in this process.

Source: Report, IIFSR Modipuram (2018)



Table 3. Water quality of tubewells installed at *Gurukul* farm Kurukshetra

Tubewell No.	EC × 10 ⁶ CO ₃ ²⁻	Contents (meq/litre)							Gypsum required (kg/irri.)
		HCO ₃ ⁻	Cl ⁻	Ca ⁺⁺	Ca ⁺⁺⁺	Mg ⁺⁺	RSC		
1.	980	Nil	6.0	4.5	-	-	8.0	-	-
2.	600	Nil	5.2	3.0	-	-	6.5	-	-
3.	1,300	Nil	8.5	6.0	-	-	7.0	1.5	50
4.	630	Nil	4.0	3.0	-	-	7.0	-	-
5.	860	Nil	4.0	3.8	-	-	8.5	-	-
6.	690	1.2	2.8	6.0	-	-	4.5	-	-
7.	520	0.5	4.0	3.0	-	-	5.5	-	-
8.	770	Nil	5.5	4.0	-	-	6.0	-	-
9.	350	Nil	5.5	3.5	-	-	6.0	-	-
10.	640	Nil	5.0	4.0	-	-	6.5	-	-
11.	590	Nil	7.5	3.0	-	-	6.5	-	-
12.	1,060	Nil	6.0	4.0	-	-	9.0	-	-
13.	750	Nil	6.5	3.5	-	-	6.5	-	-
14.	840	Nil	5.0	4.0	-	-	6.5	-	-
15.	760	0.5	6.0	3.0	-	-	6.5	-	-

Organic carbon content: In *kharif* of 2017, 10 soil samples were drawn at random from *Gurukul* farm and got analyzed at CCS HAU, Hisar. Likewise 16 soil samples were taken by the scientists of IIFSR, Modipuram for analysis of organic carbon, macro and micronutrients. These analytical results (Tables 4 and 5) revealed that 30% soil samples analyzed at CCS HAU, Hisar and 19% of those analyzed at IIFSR were in rich category (>0.75%) with respect to organic carbon. Similarly, 10 and 12% soil samples represented poor status of organic carbon (<0.40%) in the results registered by the respective institutions. Rest of the samples were categorised in the medium range of OC content. The average OC from both of the institutions was 0.61%.

After one year in June 2018, nineteen samples were again drawn randomly from 180 acres of *Gurukul* farm and got analyzed in the soil testing laboratory of CCS HAU, Hisar. The results were incredible which depicted that 95% soil samples represented in rich category with average OC of 0.91% in the range of 0.82 to 1.12% (Table 4). Soil samples (16%) had OC more than 1.0%. Only one sample was in medium category with OC of 0.45%.

Again in October 2018, the soil samples were drawn at random from the farm and got analyzed in soil testing labs of CCS HAU, Hisar and PAU, Ludhiana. These results again

confirmed the OC status of *Gurukul* farmland, although at somewhat lesser scale might be due to seasonal variations (Tables 4 and 6). The average OC was 0.84 and 0.78% in the samples tested at CCS HAU Hisar and PAU, Ludhiana, respectively. The figures of the samples representing rich category (>0.75%) were 90% (CCS HAU) and 70% (PAU, Ludhiana). Only one sample out of 20 samples tested at CCS HAU and PAU fall under poor category (<0.40%) whereas 30%

samples analyzed by both institutions had OC more than 0.90%.

Status of macronutrients: The samples collected at 3 times in June 2017, 2018 and October 2018 were analyzed in Soil Testing Lab in CCS HAU, Hisar. The data on mean available phosphorus reveal that there was increase of 89% in available P in the samples collected in June 2018 over that recorded in 2017 (19 kg/ha), but this increase was 32% in the samples collected in October 2018 (Table 4). This increase might be attributed to the possible increase in phosphorus solubilizing microbes (PSM/PSB) due to addition of natural formulations of *Jivamrit* and *Ghan Jivamrit*. The decrease in available P from 89% in June 2018 to 32% in the samples drawn in October 2018 could be due to the impact of seasonal variation which needs further studies for proper evaluation. The available P detected (Table 6) in the analysis done in the Soil Testing Lab of PAU, Ludhiana was almost similar (27.7 kg/ha) to that recorded in CCS HAU, Hisar (25.0 kg/ha) in October 2018.

Variation in available potash was not pronounced (Table 4) in the soil samples collected in June 2017 (186 kg/ha) and June 2018 (199 kg/ha).

Table 4. Organic carbon and macronutrient, status of *Gurukul* farm

Sr. No.	Organic carbon (%)			Phosphorus (Kg/ha)			Potash (Kg/ha)		
	June 2017	June 2018	October 2018	June 2017	June 2018	October 2018	June 2017	June 2018	October 2018
1.	0.82	1.12	0.82	25	40	40	-	431	238
2.	0.82	1.05	0.52	17	40	17	181	170	133
3.	0.75	1.05	0.82	20	32	20	275	152	143
4.	0.67	0.97	0.82	40	32	27	275	200	181
5.	0.60	0.97	0.75	29	34	17	190	133	133
6.	0.60	0.97	1.12	13	32	22	133	133	569
7.	0.52	0.97	0.82	10	40	29	112	133	162
8.	0.52	0.97	0.82	8	34	25	133	190	250
9.	0.45	0.97	0.97	8	37	25	133	200	238
10.	0.37	0.97	0.97	17	42	29	238	162	124
11.	-	0.90	-	-	42	-	-	300	-
12.	-	0.90	-	-	34	-	-	250	-
13.	-	0.90	-	-	29	-	-	170	-
14.	-	0.90	-	-	40	-	-	190	-
15.	-	0.82	-	-	42	-	-	325	-
16.	-	0.82	-	-	37	-	-	143	-
17.	-	0.82	-	-	34	-	-	152	-
18.	-	0.82	-	-	34	-	-	152	-
19.	-	0.45	-	-	27	-	-	190	-
Average	0.61	0.91	0.84	19	36	25	186	199	217

Source: Samples analyzed at CCS HAU, Hisar, Haryana

Table 5. Status of organic carbon and micronutrients at *Gurukul* farm

Sr. No.	Organic Carbon (%)	Micronutrients (ppm)			
		Zn	Fe	Cu	Mn
1.	1.08	2.47	44.29	2.44	17.94
2.	0.93	1.14	12.36	1.56	6.06
3.	0.915	2.12	37.07	3.37	11.84
4.	0.72	1.28	40.42	3.27	12.01
5.	0.705	1.88	48.09	2.83	10.11
6.	0.645	1.12	16.76	1.13	2.29
7.	0.57	0.99	4.50	0.99	2.84
8.	0.555	1.00	9.89	1.28	2.49
9.	0.525	1.05	13.44	1.02	2.25
10.	0.525	1.61	25.76	1.94	8.26
11.	0.525	0.99	16.04	1.78	4.83
12.	0.495	0.98	15.21	1.48	6.24
13.	0.495	2.67	30.42	2.67	8.85
14.	0.48	1.03	21.12	1.05	2.37
15.	0.375	1.26	9.90	1.40	4.34
16.	0.33	1.15	2.90	1.18	3.38
Average	0.617	1.42	21.76	1.84	6.63

Source: Samples collected in June 2017 analyzed at IIFSR Modipuram

But there was considerable increase of 17% in mean available potash (217 kg/ha) in the soil samples collected in October 2018 over that found in June 2017. The respective increase was 9% in soil samples of October 2018 over that of June 2018.

A reverse trend was observed in the variation of mean available P and K in the samples collected in June 2018 and October 2018 (Table 4). Mean available K increased by 8% from June 2018 to October 2018, but mean available P decreased by 31% in the same scale of time. This variation and the reason of reverse trend of variation in the behaviour of available P and K needs to be confirmed in the future studies. This reverse trend in the availability of P and K from June 2018 to October

2018 indicates a possibility of decrease in the mobility and activity of P-solubilizing bacteria and increase in the activity of K-solubilizing bacteria during the *kharif* season which needs to be verified with respect to the different aerobic and non-aerobic crop environment. The similar studies need to be undertaken during the cropping situations in *rabi*.

Studies on micronutrients: There was no deficiency of micronutrients (Zn, Fe, Cu and Mn) in any of the samples analyzed at IIFSR, CCS HAU, Hisar and PAU, Ludhiana at different times. The soil samples collected from *Gurukul* farm and analysed in Soil Testing Lab of CCS HAU, Hisar reflected that on an average there was 32, 27, 31 and 114% increase in zinc, iron, copper

and manganese content in the samples collected in June 2018 as compared to those collected in June 2017 (Table 7). Although, in the present studies, there was positive effect of ZBNF practices on the availability of micronutrients, but long-term experimentation is required to evaluate their sustainable impact on the availability of trace elements in the soil and their influence on crop yields.

Impact on microbial population:

Eleven soil samples, 7 from the fields of *Gurukul* farm and 4 from farmers' fields, were drawn from upper 0-10 cm layer to assess the microbial load in the soil. The samples were collected from different cropping systems and analyzed in the deptt. of Microbiology of Kurukshetra University, Kurukshetra. The results revealed that the soils of *Gurukul* farm where ZBNF practices were adopted, were exuberantly loaded with bacterial population in comparison to that recorded in the samples collected from farmers' fields. On an average, irrespective of cropping systems, the total bacterial count in the soils of *Gurukul* farm was 528 times more than that recorded in the soil from farmers' fields (Table 8). The respective colony forming units (cfu) per gram soil in *Gurukul* fields were 1,610 millions as compared to 3.05 million in the soil from farmers' fields. These results indicate the efficiency of ZBNF practices in manifold multiplication of microbes in the soil which might have contributed in enriching the nutritional status of the soil as reflected in the data on organic carbon and macro and micronutrients described earlier. Besides the role of microbes in improving physico-chemical properties of soil under ZBNF, the contribution through incredible enhancement in the activity of earthworms needs to be quantified for proper budgeting of soil nutrition and evaluating soil health. Hence, the future investigations with respect to ZBNF need to be directed towards generating information on the contribution of earthworms, besides microbes, in enriching the soil health and improving crop yields.

Table 6. Chemical status of soil of *Gurukul* farm

Sr. no.	Organic carbon (%)	Phosphorus (Kg/ha)	Potash (Kg/ha)	Micronutrients (ppm)			
				Zn	Fe	Cu	Mn
1.	1.17	43.3	231	1.38	44.78	3.08	9.0
2.	0.36	17.5	93	1.08	48.34	2.18	10.06
3.	0.66	24.8	114	1.76	46.74	2.10	7.78
4.	0.75	14.6	126	1.18	35.52	1.88	6.58
5.	0.60	21.6	111	1.80	29.80	1.50	4.92
6.	1.05	44.7	363	2.88	50.24	2.80	8.96
7.	0.75	19.5	129	2.74	52.68	2.88	7.14
8.	0.90	35.4	195	3.14	54.52	3.02	8.88
9.	0.81	28.2	180	2.70	53.30	4.04	7.74
10.	0.81	27.1	123	3.30	49.86	3.26	6.80
Average	0.78	27.7	166	2.20	46.58	2.67	7.79

Source: Samples collected in October 2018 and analyzed at PAU, Ludhiana



Table 7. Status of micronutrients at *Gurukul* farm Kurukshetra under zero budget natural farming

Sr. No.	Micronutrients (ppm)							
	Zn		Fe		Cu		Mn	
	June 2017	June 2018	June 2017	June 2018	June 2017	June 2018	June 2017	June 2018
1.	3.20	2.10	21.45	25.32	1.50	2.64	10.42	12.38
2.	2.20	2.41	20.83	25.67	1.90	2.34	3.94	12.11
3.	1.94	1.56	20.92	25.21	2.08	2.48	4.14	11.46
4.	1.68	1.79	22.08	18.34	2.50	2.25	4.62	12.31
5.	2.13	2.17	20.83	24.89	2.30	2.23	7.66	11.58
6.	1.34	2.35	21.25	24.77	1.70	2.49	4.44	11.83
7.	1.12	1.90	19.36	25.21	1.60	2.49	3.98	12.01
8.	1.10	1.88	19.32	24.50	2.02	2.41	7.36	11.50
9.	0.90	2.45	15.58	25.05	1.26	1.26	5.08	11.75
10.	0.74	2.75	10.42	25.05	0.94	2.74	5.36	11.98
11.	-	2.68	-	26.11	-	2.68	-	12.98
12.	-	2.44	-	24.24	-	2.31	-	12.68
13.	-	2.23	-	24.96	-	2.16	-	11.83
14.	-	1.90	-	25.81	-	2.34	-	11.92
15.	-	2.62	-	25.30	-	2.94	-	13.24
16.	-	1.47	-	24.86	-	1.78	-	12.81
17.	-	2.38	-	24.99	-	2.35	-	11.83
18.	-	2.30	-	25.48	-	2.67	-	12.13
19.	-	1.64	-	19.27	-	2.00	-	13.15
Average	1.64	2.16	19.21	24.48	1.78	2.34	5.70	12.18

Source: Samples analysed at CCS HAU, Hisar

Effect of ZBNF practices on crop yields: Level of crop yields seems to be excellent at *Gurukul* farm. Rice, wheat, sugarcane, potato and fodder are the predominant crops grown at the farm under ZBNF. Besides using

natural formulations prepared from the dung and urine of *Desi*-cow, green manuring, *in-situ* incorporation of crop residues, mulching, crop rotation are some other practices which are followed for taking desirable results.

In rice, scented as well as non-scented varieties are grown. In scented group, CSR 30, HBC19 and PB1121 and in non-scented group, hybrids and inbred varieties like HKR47, PR126 and PR114 are the main cultivars grown at the farm. In wheat, *Bansi*, WH1105, WH1124 are some of the cultivated varieties. *Bansi*, a desi variety of wheat is the predominant variety at the farm which attracts lucrative prices. In Sugarcane, COJ85, CO118, CO238 and COH160 represent major varietal composition.

Rice, wheat and sugarcane are the most exhaustive crops and require high doses of fertilizers. The average yield level of non-scented rice varieties generally ranges between 70-80 q/ha (Table 9). The rice variety PR114 which is non-scented high yielding variety of rice gave an average yield 65 q/ha when grown in 15 acres for the first time on newly

Table 9. Average paddy yields of last five years at *Gurukul* farm

Year	Non-scented Varieties (Average yield q/ha)	Scented Varieties (Average yield q/ha)
2014	76.0 (18 ha)	40.0 (10 ha)
2015	72.0 (16 ha)	41.0 (6.5 ha)
2016	80.0 (16 ha)	25.0 (10 ha)
2017	65.0-80.0 (34 ha)	32.5-40.0 (22 ha)
2018	70.0-80.0 (36 ha)	30.0-38.0 (25 ha)

acquired area under ZBNF in *kharif* 2017. This area where PR114 was grown for the first time was having organic carbon in the range of 0.31 to 0.45%, poor to medium in available P and medium in available K content. After completing one year of cropping sequence, there was tremendous increase in the level of organic carbon, available P and micronutrients as mentioned earlier in the document. Hence, the speculation and fear of farmers and scientists about the reduction in yield during the first 3-4 years under ZBNF as expressed in organic farming does not seem to hold true.

There is basic difference in organic farming and ZBNF. In organic farming, there is need of bulky organic manures like FYM, vermicompost and other organic materials for the fulfilment of nutritional requirement of the crops. It is slow process of building soil health and hence, crop yields are likely to decrease during the initial few years. In ZBNF, not the manures in the form of FYM or vermicompost, but microbial inoculum in the form of *Jivamrit* and *Ghan Jivamrit* are applied in the field which promote the multiplication of earthworms and microbes in the soil. However, green manuring, residue incorporation, mulching, minimum tillage, crop rotation etc. are other complementary practices which form a composite package in ZBNF.

Jivamrit is the backbone of ZBNF. ZBNF is desi-cow based farming. For the preparation of *Jivamrit*, only one day dung and urine of desi-cow are required besides other minor constituents as *Gur* (jaggery) and pulse flour. It takes 4 days for final preparation and applied 4-6 times in

Table 8. Microbial Count of the soil samples collected from *Gurukul* farm Kurukshetra and adjoining farmers fields

Sr. No.	Name of sample	No. of colonies (cfu/g soil)
A. Samples from <i>Gurukul</i> farm		
1.	<i>Basmati</i> Rice	17 x 10 ⁷
2.	Hybrid Rice	37 x 10 ⁷
3.	<i>Berseem</i> -Rice	17 x 10 ⁷
4.	<i>Moong</i> -sugarcane (1st year)	76 x 10 ⁷
5.	Sugarcane (2 nd year)	66 x 10 ⁸
6.	Sugarcane (4 th year)	21 x 10 ⁸
7.	<i>Gurukul Jowar</i>	11 x 10 ⁸
B. Samples from farmers fields		
8.	<i>Sorghum</i> (fodder)- <i>Jaswinder Kainthla khurd</i>	12 x 10 ⁵
9.	Rice - <i>Jagir Singh Kainthla</i>	10 x 10 ⁵
10.	Rice- <i>Karam Chand Kainthla</i>	88 x 10 ⁵
11.	Rice - <i>Farmer Kainthla</i>	12 x 10 ⁵

Average bacterial count at farmers' fields - 3.05 million/g soil; average bacterial count at *Gurukul* farm - 1,610 million/gram soil



Table 10. Average yield of last years of potato at *Gurukul* farm

Year	Production (q)	Total area (ha)	Average yield (q/ha)
2013-14	810	4.0	202
2014-15	1000	4.0	250
2015-16	1199	4.0	300
2016-17	510	3.6	142
2017-18	1250	4.0	312

a crop through irrigation water. One day (24 hour) desi-cow dung and urine is sufficient for single dose of one acre at a time. Second important input is *Ghan Jivamrit* which can be prepared in 3-5 days from decomposed manure of desi-cow or in 10-12 days from fresh desi-cow dung. For plant protection, herbal formulations like *Neemastra*, *Brahmastra* and *Agristra* can easily be prepared with the help of desi-cow dung and urine. *Beejamrit*, *Khatti Lassi*, cow-urine, *Dashparni Ark*, *Saptdhanya Ankur* are the other natural formulations used in ZBNF.

The average yield of *Bansi* of wheat variety 25-35 q/ha. The grain of this variety fetches more than ₹ 4,000 per quintal with a consistent demand from the consumers.

The sugarcane yield has crossed 1300 q/ha with an average productivity of 850-1100 q/ha. The mean productivity of potato excels in the range of 200-300 q/ha (Table 10). The better part of crop production in ZBNF is that there is very less incidence of pests and diseases in all the crops. In cereals like crop, it is the *Neemastra* which controls insects efficiently and *Khatti Lassi* remains effective in controlling diseases. In the crops like sugarcane,

Table 11. Economics of rice and wheat crops at *Gurukul* farm during 2017-18

Crop/Variety	Yield (q/ha)	Cost of cultivation (₹/ha)	Total return (₹/ha)	Net return (₹/ha)	Benefit-cost ratio
<i>Non scented rice varieties</i>					
<i>Gurukul</i> farm	72.50	29,412	12,6875	97,463	4.31
Farmers field	65.25	42,802	108,937	66,135	2.54
<i>Scented rice variety (CSR30)</i>					
<i>Gurukul</i> farm	32.00	34,780	140,800	106,020	4.05
Farmers field	30.75	47,680	101,475	53,795	2.13
<i>Wheat varieties</i>					
<i>Gurukul</i> farm (var. <i>Bansi</i>)	31.25	26,255	125,000	98,745	4.76
Farmers field (var. HD2967)	47.50	33,835	82,412	48,577	2.44

besides *Neemastra*, *Brahmastra* may be used for the control of insects, whereas in vegetables like brinjal, Okra and tomato, *Agristra* may be required for the control of seriously damaging insects like borers. In fruits like guava, spray of *Neemastra* remains effective in controlling fruit borer in needed. Spray of 10% *Jivamrit* is also used for the control of pests and diseases in the crops.

Economics of crops grown at *Gurukul* farm

Economics of rice and wheat crops grown at *Gurukul* farm and Farmers' fields is given in Table 11. Total cost of cultivation of the crops grown at farmers' fields is taken from the package of practices of *kharif* and *rabi* crops (2017) published from CCS Haryana, Agricultural University, Hisar. In ZBNF, no money is spent for the purchase of pesticides and chemical fertilizers. Due to the change in physico-chemical and biological properties of soil, there is considerable saving in the expenditure incurred on field preparation and some other

requirements like irrigation. After considering all the aspects including weed control in rice and wheat crops grown at *Gurukul* farm during 2017-18, it has been observed that the net return was 1.47 to 2.03 times more in comparison to the farmers. In non-scented high yielding rice varieties, this increase was the minimum i.e. 1.47 times as the produce was sold at minimum support price. The benefit cost ratio was 2.54 and 4.31 for non-scented rice varieties, 2.13 and 4.05 for scented rice variety (CSR 30), and 2.44 and 4.76 for wheat crop (variety *Bansi* at *Gurukul* farm and HD 2967 at Farmers field) for crop grown by farmers and *Gurukul* farm, respectively. The produce variety of CSR 30 (rice) and *Bansi* (Wheat) was sold at premium price due to the increased demand of consumers for natural products grown at *Gurukul* farm.

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ICAR New Portals

The Council has created the following portals for effective governance by utilizing the information and communication technology.

ICAR Data Centre and Unified Communication portals to secure institute information and information transmission.

- ICAR-Enterprise resource planning (ERP) System to this manage the human resource in information of the council including pay roll, finance and budgeting.
- KVK Knowledge Network Portal (<http://kvk.icar.gov.in>) to share basic information and facilities of KVKs with contingency plans, demonstration schedule, and advisories.
- Management System for Post-Graduate Education (MSPGE) enabling academic and e-learning modules while also being a repository of academic records
- E-Samvad, an online interface of the Council to answer citizens queries.
- KRISHI –A knowledge repository portal of digital information pertaining to research experiments, outputs, publications, etc.
- E-Krishi Manch, a dedicated portal for farmer-scientist interaction.