
Natural Farming Practices in India: Its Adoption and Impact on Crop Yield and Farmers' Income

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ABSTRACT

Natural Farming (NF) is contemplated by its protagonist as one of the most potential crop cultivation methods to drastically cut down production costs by reducing dependence on market for purchase of critical inputs. Being considered as an agroecologically diverse farming practice, it brings hosts of ecological and social benefits, although, there are two school of thoughts- opposing each other on the efficacy of its practices. In order to better understand the practice followed in NF as well as the cost saving and income gain by the NF farmers, the study was undertaken in the states of Karnataka and Andhra Pradesh during January-June 2019 covering 55 and 124 NF-adopting farmers and 50 and 61 non-NF farmers in Karnataka and Andhra Pradesh, respectively. Though there are certain practices prescribed in natural farming, the most adopted practice is use of *Jeevamritha*, *Beejamritha* and other plant protection materials. Further, there is always scope for tweaking and innovation in these practices like *Ghanajeevamritha*, use of *Azolla* in paddy field or applying *Jeevamritha* through drip irrigation. Significant reduction in cost of cultivation of all the crops was observed. However, the effect on crop yield is not conclusive. NF-farmers in Karnataka harvested better yield in finger millet, but lower yield in paddy and sugarcane. While in Andhra Pradesh, yield advantage was visible in paddy. It was also observed that the NF-adopted farmers who applied farm yard manure harvested better crop yield than those who did not apply. Thus, natural farming may not look as yield enhancing farming practices, but definitely increases farmers' income through cost reduction and long-term sustainability.

Keywords: Natural farming, ZBNF, *Jeevamritha*, *Beejamritha*, Agro-ecology.

JEL: Q01, Q15, Q16, Q24

I

INTRODUCTION

Agrarian distress is often viewed as a short-term phenomenon in which farmers look for support from various quarters on account of being unable to get a gainful return due to low price realisation, increasing cost of inputs, frequent occurrence of natural calamities, etc. Besides, substantial increase in input costs has led to a decline in crop income over the years (Mishra, 2008). The price of urea, DAP (Diammonium phosphate) and potash has risen by 60 per cent to 600 per cent between 1991-92 and 2013-14 (The Hindu, 2019). Though, per hectare real value of output increased for most crops in recent years, but the rise in input cost was much higher (Businessline, 2019), resulting into reduced farm income. Moreover, green revolution technology is now contemplated to be degrading the agro-ecosystem; and diminishing the

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economic returns for the farmers (Rahman, 2015). Several studies have shown that chemical fertiliser and pesticides affect soil health by killing millions of microbes present in the soil which are important for sustaining plant life (Zafar *et al.*, 2001; Jayashree and Vasudevan, 2007). Decreasing trend in crop yield growth has been observed due to injudicious/overuse of inputs like synthetic fertilisers and pesticides (Lal, 2009; Pingali, 2012).

Natural Farming (NF) is considered to be agroecology based diversified farming system, which integrates crops, trees and livestock, allowing functional biodiversity (LVC, 2010; Rosset and Martinez-Torres, 2012) to drastically cut down production costs by replacing the chemical fertilisers and pesticides with home-grown product like *Jeevamritham*, *Beejamritham*, *Neemastra*, etc., and adopting intercropping and mulching (Palekar, 2005; 2006). Highlighting the predominance of smallholder farmers (68.5 per cent marginal and 17.7 per cent small farmers) in India, *The Economic Survey* (2019) emphasised the importance of Zero Budget Natural Farming (ZBNF)¹ as one of the alternative farming practices for improving the farmers' income, in the backdrop of declining fertiliser response and farm income. Biological sciences (e.g. microbiology, ecology, soil science) with their increasingly symbiotic (Gilbert *et al.*, 2012) and "probiotic" (Lorimer, 2017) understandings of soil and plant life are also an inspiration for the ecological renewal of agriculture.

Initially, a Japanese farmer, Masanobu Fukuoka proposed natural farming, which is based on the philosophy of working with natural cycles and processes of the natural world (Fukuoka, 1987). The movement of promoting ZBNF in India has been championed by Shri Subhash Palekar (has resulted into widespread adoption at varying levels in many states, especially, Andhra Pradesh, Karnataka, Maharashtra, Himachal Pradesh) (Khadse *et al.*, 2017; Mishra, 2018; Niyogi, 2018; Government of India, 2019). However, in recent times, a section of scientific community and critics vehemently oppose this alternative practices condemning it being not based on scientific evidences, promoting certain beliefs system, particularly indigenous cows, a backward-looking and chauvinistic idiom (Shotwell, 2016; Saldanha, 2018; EPW, 2019). After having exhaustive study of the movement, Munster (2018) believes that the prevalent ambivalence makes natural farming a valuable case for the political ecology of agriculture. Moreover, most of these studies lack field level or experimental evidences to support their arguments. With this ambiguous context, the present study is an attempt to understand the practices followed by the farmers under natural farming; examine the adoption of practices by the farmers, and to study the implication on costs of crop cultivation, yield and farmers income for major crops in the study area.

II

DATA AND METHODOLOGY

The study is based on extensive field survey and interaction with adopted and non-adopted farmers in Karnataka and Andhra Pradesh (A.P.) during February- May

2019. It is said that ZBNF started in 2002 in Karnataka and about a lakh farmers may be practicing in the state (Khadse *et al.*, 2017). Similarly, with the support of Government of A.P. through Rythu Sadhikara Samstha (RySS), about 1,38,000 farmers across all districts of A.P. may be practicing it (Tripathi *et al.*, 2018). In both the states, 2-3 districts, viz., Mandya, Ramanagara and Tumakuru districts in Karnataka; and Vizianagaram and Vishakhapatnam in Andhra Pradesh having higher proportion of farmers adopting natural farming were selected through expert consultation. The farmers practicing NF were selected using snowball sampling in the sample districts. For identification of NF adopter farmers, we followed the criteria that any farmer who is using at least *Jeevamritha* and not using any chemicals (fertilisers/pesticides/growth promoters) are NF adopters. To have comparative assessment, the non-NF farmers were also selected from the same villages. In all, 55 and 124 NF-adopter and 50 and 61 non-adopter farmers in Karnataka and Andhra Pradesh, respectively, were surveyed using pre-tested and structured survey schedule. The district-wise sample size is presented in the Table 1. It may be noted that when we started the survey in Karnataka state, we struggled to get NF-adopters in randomly selected villages, therefore, we had to increase the number of villages, where we had done survey of almost all farmers who qualified the criteria of NF-adopters. The descriptive analysis of the field survey data was done for the study.

TABLE 1. DISTRIBUTION OF SAMPLE FARMERS IN THE STUDY

State (1)	District (2)	No. of villages covered (3)	NF-adopted farmers (4)	Non-adopted farmers (5)	Total sample farmers (6)
Andhra Pradesh	Visakhapatnam	5	62	31	93
	Vizianagaram	4	62	30	92
Karnataka	Mandya	9	32	24	56
	Ramanagara	6	7	10	17
	Tumakuru	9	16	16	32
	Total sample size	33	179	111	290

III

RESULTS AND DISCUSSION

Ensuring food security, producing more with less resources and building the resilience of smallholder farmers are important policy agenda towards creating a food-secure future. Natural farming which is based on agroecological principles emphasises on the enhanced biomass recycling; enhanced soil conditions by managing organic matter and soil biological activity; and enhanced beneficial biological interactions. Therefore, NITI Aayog (2018) stressed upon the need of strong push to be given to ZBNF techniques to reduce costs, improve land quality and increase farmers' incomes.

Socio-Economic Profile of Sample Farmers

Table 2 presents the socio-economic characteristics of the sample farmers. The average land holding of sample NF-farmers in Karnataka was much higher than that of non-NF farmers, while in Andhra Pradesh (A.P.), most of the farmers were smallholders. In Karnataka, 20 per cent of the NF-farmers were large farmers. In terms of education, almost all NF farmers in Karnataka were well educated. In A.P., around 70 per cent of NF practicing farmers are literate with varying educational level. More of illiterate farmers are non-NF farmers in both the states. Age-wise, there was no significant difference between the adopted and non-adopted farmers in both the states.

TABLE 2. SOCIO-ECONOMIC CHARACTERISTIC OF NF AND NON-NF FARMERS IN THE STUDY AREA

Particulars (1)	Percentage of farmers			
	Andhra Pradesh		Karnataka	
	NF (n=124) (2)	Non-NF (n=61) (3)	NF (n=55) (4)	Non-NF (n=50) (5)
1. Landholding size				
< 1 ha	61.3	80.0	18.2	40.0
1-2 ha	25.0	12.0	27.3	36.0
2-4 ha	12.1	2.0	34.6	24.0
≥4 ha	1.6	nil	20.0	nil
Average land holding (ha)	1.0	0.7	2.8	1.3
2. Education level				
Illiterate	29.0	45.9	1.8	20.0
Up to 12th	66.1	54.1	54.5	72.0
Graduate and above	4.8	-	43.6	8.0
3. Average family members engaged in farming (no.)	3.0	3.0	3.0	2.0
4. Age				
<30 years	13.7	8.2	1.2	2.0
30-40 years	21.8	19.7	34.5	18.0
40-50 years	28.2	32.8	38.2	40.0
>50 years	36.3	39.3	25.5	40.0
5. Experience in natural farming				
1-3 years	84.6	-	29.1	-
3-6 years	15.3	-	27.2	-
6-10 years	Nil	-	16.3	-
≥10 years	Nil	-	27.3	-

As far as the adoption of natural farming practices is concerned, majority of the NF-adopter farmers in Andhra Pradesh (A.P.) have adopted during last five years, whereas some of these farmers in Karnataka have been practicing NF since more than 15 years. This could be because of the movement that took place in Karnataka in 2002 at the grassroot level due to active involvement of Karnataka Rajya Raitha Sangha (KRRS) (Khadse and Rosset, 2019). The farmers in the two states have different sources of information regarding methods of NF. In Karnataka, NGOs like MHR foundation, Beleva Foundation, KRRS, *Amritha Bhoomi* arrange 2-5 days training and educate the farmers about NF. Few farmers have attended training by

Shri Subhash Palekar as well. In Andhra Pradesh, the state government has taken the initiative named as Climate Resilient Zero Budget Natural Farming (CRZBNF) in the year 2016, by creating an institution called *Rythu Sadhikara Samstha* (RySS). Under this programme, Cluster Resource Persons (CRP) and Natural Farming Fellows (NNF) are posted in each cluster of the villages, who are responsible to train the farmers for preparation and application of ZBNF materials.

Natural Farming Components and Practices Followed in Two States

According to Palekar (2005), one indigenous cow is sufficient for cultivating crops in 30 acres area. Unlike in organic farming, only a small quantity of cow dung and urine are required in natural farming, to prepare the concoction of *Jeevamritha* and *Beejamritha*. Therefore, examining the availability of indigenous cow is important. It was observed that 91 per cent of the NF farmers in Karnataka are having at least one indigenous cow. However, in Andhra Pradesh, the scenario is entirely different as less than 40 per cent of the NF-farmers own indigenous cow (Table 3). The average number of indigenous cows is 2 per household. Those who do not own indigenous cow in Andhra Pradesh are either purchasing from fellow farmers or from nutrient pest management shops (called as village green shop selling NF materials like *jeevamritha*, *beejamritha*, insect traps, drums etc.). *Jeevamritha* is normally sold at Rs.20 per litre in Andhra Pradesh.

TABLE 3. INDIGENOUS COW OWNERSHIP AMONG NF FARMERS

Particulars (1)	Percentage of farmers	
	Andhra Pradesh (2)	Karnataka (3)
Percentage of households owning indigenous cow	39.5	91.0
Average number of indigenous cows per household	2	3

Methods of Preparation of NF Materials and their Application

The study examined the extent of level of adoption of four wheels of natural farming-*jeevamritha*, *beejamritha*, mulching and *wapsa* among the NF-adopted farmers. *Jeevamritha* improves soil fertility by stimulating microbial activity to make nutrients plant-available and increase soil carbon (Devarinti, 2016; Anusha, 2018). *Jeevamritha* is a fermented microbial culture used as an alternative to chemical fertiliser. It is prepared by adding 10 kg of cow dung, 10 litres of cow urine, 2 kg of jaggery, 2 kg of pulse flour, a handful of undisturbed soil added to 200 litres of water. It is fermented for 48 hours by stirring twice in a day. It is prepared in a drum and applied in the fields through flooding along with irrigation and/or by spraying. It is applied in the field 2-3 times during the crop season (Table 4). In Andhra Pradesh, NF-farmers are also preparing *ghanajeevamritha*, which is a solid dried ball. The farmers are mainly preparing *ghanajeevamritha* during the off season and apply in

the field before sowing. It consists of cow dung, cow urine, jaggery, chickpea flour which is dried under shade and stored up to six months. *Beejamritha* is a microbial treatment used for treating the seeds, plant saplings by the farmers. It is prepared by the farmers using 5 kg of cow dung, 5 litres of cow urine, 50 gm of lime and 20 litres of water.

TABLE 4. COMPOSITION OF NATURAL FARMING MATERIALS

S. No. (1)	Ingredients (2)	<i>Jeevamritha</i> (3)	<i>Ghanajeevamritha</i> (4)	<i>Beejamritha</i> (5)
1	Cow dung (kg)	10	100	5
2	Cow urine (lt)	10	20	5
3	Jaggery (kg)	2	5	-
4	Pulse flour (kg)	2	5	-
5	Undistributed soil	Handful	-	-
6	Water (lt)	200	10	20
7	Lime (gm)	-	-	50

Note: The quantity given in the table is used for 0.4 hectare (1 acre) of land.

Apart from the above materials, NF-farmers apply different types of home-made non-chemical plant protection materials. The composition of these materials vary according the locally available raw materials. Mainly three compounds are used in the study area, viz., *Neemastra*, *Bhrahmastra* and *Agniastra*. *Neemastra* is prepared from cow dung (5 kg), cow urine (5 litres), Neem seeds and leaves, *Pongamia* (*Millettia pinnata*), Parthenium, castor, Calotropis, and other bitter tasting leaves available locally. *Bhrahmastra* is prepared from cow urine (5 litres), leaves of neem, guava, *Lantana camara*, custard and papaya. *Agniastra* is prepared from cow urine, *Neem* leaves, tobacco leaves (1 kg), Green chillies (0.5 kg), and Garlic (0.5 kg). These plant protection materials are diluted and sprayed on the crops. Some farmers also mix sour curd.

Though, NF-farmers are growing variety of crops, particularly in Karnataka, however paddy and sugarcane are the major crops in both the states, while finger millet is third important crop in Karnataka. From Table 5, it is evident that *Jeevamritha* is being used by all the sample NF-adopted farmers for all the crops (this was the pre-qualifier to be considered as NF-adopters). Application of *jeevamritha* and mulching in the field has helped in improving the soil ecosystem, as it was evident from Karnataka, where the farmers were using natural farming for more than 4-5 years, soil was light, moist and earthworms were present in the sub-surface. However, use of *Beejamritha* depends on the crops selected for cultivation. Mulching is not so common in case of paddy. Azolla is used by about 50 per cent of the paddy growing NF-farmers. For other crops, leaves of cowpea, horse gram, glyricidia or sugarcane trash are used as mulching material. Mulching with sugarcane trash is a common practice in sugarcane. Wapsa or irrigation at noon is suggested by the proponents of ZBNF. During the survey, it was found that in Andhra Pradesh, only 4 per cent (5 farmers from Visakhapatnam following irrigation at noon in the case of

paddy and sugarcane crops) of the sample farmers are following the principle of *wapsa*. Majority of the farmers gives irrigation as per their convenience and power supply availability. Mainly open channel irrigation is followed in both the states.

TABLE 5. COMPONENTS/ PRACTICES FOLLOWED BY NF ADOPTER FARMERS

(1)	(per cent)				
	Andhra Pradesh		Karnataka		
	Paddy (2)	Sugarcane (3)	Paddy (4)	Finger millet (5)	Sugarcane (6)
<i>Jeevamritha</i>	100	100	100	100	100
<i>Beejamritha</i>	92	95	88	89	89
Mulching	52 (Azolla)	55	12	11	92
<i>Ghanajeevmritha</i> *	62	70	-	-	-

**Ghanajeevmritha* is not mentioned among the four wheels of ZBNF.

Neemastra, *Bhrahmastra* and *Agniastra* are commonly used for protecting plants from pests and diseases. The common ingredient used for all the plant protection solutions in natural farming is *Neem* leaves (*Azadirachtaindica*). Table 6 shows the percentage of farmers using various pest controlling solutions as proposed in NF. In *Neemastra*, farmers use seeds and leaves of neem tree and mix with cow dung and urine. In other compounds, they mix *Neemastra* with different bitter tasting leaves like, *Calotropis*, *Parthenium*, and *Pongamia* depending upon the local availability. Paddy farmers in Andhra Pradesh are found to be using various NF materials for pest control. Farmers are using the control measures only after the appearance of pests as a reactive measure.

TABLE 6. PEST CONTROLLING SOLUTIONS USED BY NF FARMERS IN THE STUDY AREA

S. No. (1)	Pest controlling solutions (2)	Andhra Pradesh		Karnataka	
		Paddy (3)	Sugarcane (4)	Paddy (5)	Sugarcane (6)
1)	<i>Neemastra</i>	47.5	36.8	4.8	-
2)	<i>Bhrahmastra</i>	31.4	-	-	-
3)	<i>Agniastra</i>	13.6	-	-	-
4)	Buttermilk+ Green chilli	12.7	-	-	-

Cropping Pattern followed by NF-Adopted Farmers

Intercropping is an important feature of natural farming. In Kurnool district of Andhra Pradesh, farmers have been reported to grow pearl millet, red gram, foxtail millet, along with chilies and tomatoes (Niyogi, 2018). In the study area, paddy and sugarcane are the two prominent crops cultivated under NF. These two crops together account for more than 40 per cent of the total cropped area under NF among the sample farmers (Table 7). Paddy is grown as a solo crop, whereas sugarcane is found to be grown as a solo crop as well as an intercrop with cowpea, onion or green vegetable. Due to intercropping, the row to row spacing in sugarcane is more than that in solo crop. The space is used for growing other crops/vegetables which is

harvested before the sugarcane leaves grow and canopy covers the space between the rows. In Andhra Pradesh, a mixture of nine millets called as 'Navadhanya' is also grown in the rain fed area before sowing the main crop in summer. Paddy was grown as a monocrop whereas sugarcane was cultivated under mixed crop system at the initial stages only, without any change in the row spacing.

TABLE 7. CROPPING PATTERN FOLLOWED BY SAMPLED NF ADOPTED FARMERS

Andhra Pradesh		Karnataka	
Crops (1)	Per cent of total cropped area (2)	Crops (3)	Per cent of total cropped area (4)
Paddy	43.18	Paddy	20.5
Sugarcane	10.19	Sugarcane	20.6
Black gram	6.27	Finger millet	6.2
Cashew	5.99	Arecanut	3.6
Mango	4.20	Banana	2.6
Sesamum	4.05	Coconut	1.5
Black gram+ Green gram + Sesamum	7.81	Coconut + Arecanut + Black Pepper	5.7
Others	18.31	Coconut + Arecanut + Banana	5.0
		Coconut + Arecanut	2.8
		Others	31.1
Total area under NF among sample farmers	178.69 hectares	Total area under NF among sample farmers	120.59 hectares

Input-Use Pattern followed by NF-Adopted and Non-Adopted Farmers

Among the major critical inputs used by the farmers in the study area, chemical fertilisers and its substitutes as a part of natural farming has been examined carefully and given in Table 8. Use of the rest of the inputs, like irrigation, machines and labours are almost similar for NF-adopted and non-adopted farmers. It may be observed that seed rate in paddy cultivation is the same for both the groups of farmers in Andhra Pradesh. However, in Karnataka, NF farmers are using less seeds than non-NF farmers in paddy as well as in finger millet. In case of sugarcane also, seed rate is less for NF farmers than non-NF. This could be due to cultivation of native seeds in case of paddy and finger millet, whereas, for sugarcane, farmers are using the previous crop for setts (planting material). The most interesting observation from the farmers' fields have been the use of farm yard manure (FYM) by the NF-adopted farmers. It is evident that irrespective of the crops, farmers who have large animals like cows, bullocks or buffalo, apply FYM in the field. Some farmers even apply purchased FYM. Therefore, this may be considered as deviation from the original concept of natural farming advocating use of only *jeevamritha* for supplying nutrients to the crop. As discussed earlier, NF-adopter farmers in A.P. state are also applying *ghanajeevamritha* in paddy and sugarcane crops.

TABLE 8. INPUT-USE PATTERN IN MAJOR CROPS IN THE STUDY AREA

Particulars	Paddy				Sugarcane				Finger Millet	
	Andhra Pradesh		Karnataka		Andhra Pradesh		Karnataka		Karnataka	
	NF	Non-NF	NF	Non-NF	NF	Non-NF	NF	Non-NF	NF	Non-NF
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Number of sample farmers	118	40	42	22	20	6	27	15	18	20
Seeds (kg/ha)*	70.0	70.0	48.3	66.0	5	6	5	6	12.0	26.6
FYM (t/ha)	4	4.5	3	2	5	6	6	6	4	2
	(65.3)	(66.7)	(61.9)	(100)	(85.0)	(83.3)	(81.5)	(100)	(55.5)	(90.1)
<i>Jeevamritha</i> (litres/ha)	1600	nil	2450	nil	3000	nil	240	nil	1600	nil
Fertilisers (kg/ha)	nil	233	nil	308	nil	400	nil	480	nil	209
<i>Ghanaieevamritha</i> (kg/ha)	250	nil	nil	nil	250	nil	nil	nil	nil	nil

Figures within parentheses indicate the percentage of farmers under respective categories applying FYM.

Note: *Seeds in case of sugarcane is sugarcane setts given in tonnes/ha.

IV

ECONOMICS AND IMPACT OF NATURAL FARMING

Khadse *et al.* (2017) highlighted several positive impacts on various agro-ecological indicators from among the ZBNF-adopted farmer households they surveyed in Karnataka. Those include soil conservation, seed autonomy, quality of the produce, household food autonomy, farm income, crop yield, seed diversity, selling price, etc. However, the authors have remained silent about the methods used to measure these indicators. Similarly, Tripathi *et al.* (2018) reported very encouraging results stating that farmers practising ZBNF in Andhra Pradesh earn considerably more than the control group of conventional farmers and ZBNF farmlands may be able to withstand droughts, high-speed winds and flooding better than non-ZBNF plots. They also reported that the yields of five crops (paddy, groundnut, blackgram, maize and chillies) have increased by 8-32 per cent for ZBNF farmers.

The present study has examined the use of various inputs in cultivation of different crops and estimated the paid-out cost and return for NF-adopted and non-adopted farms. Table 8 details the various costs incurred in cultivation of major crops in Andhra Pradesh and Karnataka. The values correspond to the year 2018 based on survey conducted during February - May 2019. The percentage of corresponding cost with respect to non-NF crops is also presented alongside. Material cost includes costs incurred in seed, *jeevamritha*, *beejamritha*, FYM, pest controlling solution for NF farmers, whereas for non-NF farmers, it is mainly seed, fertiliser, FYM and pesticide. Operational cost includes cost on land preparation, labour including harvesting. These two are added to arrive at the total paid-out cost in both the cases.

In the case of paddy cultivation, wide difference in the material cost exists between two states (Table 9). NF-farmers in Karnataka have mostly home-made

Jeevamritha and *Beejamritha*, while in case of Andhra Pradesh, since only 40 per cent of NF-farmers have indigenous cows, they depend on purchased materials. The material costs in A.P. is high also due to large number of farmers are applying purchased FYM and *Ghanajeevamritha* in their field. Therefore, total variable cost of paddy cultivation is lower by only 5 per cent in A.P. state, while it is about 30 per cent in Karnataka as compared to non-NF farms. However, NF-farmers of A.P. harvested 12 per cent better paddy yield than those of non-adopters, while in Karnataka, paddy yield of NF-farmers was lower by 15 per cent as compared to that of non-adopters. Further, there was marginal improvement in the market price of paddy for A.P. NF-farmers, while Karnataka NF-farmers realised more than double price as compared to the non-adopters.

TABLE 9. COMPARISON OF COST, YIELD AND BENEFIT: COST RATIO BETWEEN MAJOR NF AND NON-NF CROPS

Particulars (1)	Andhra Pradesh		Karnataka	
	NF-adopted farmers (2)	As per cent of Non-NF farmers (3)	NF-adopted farmers (4)	As per cent of Non-NF farmers (5)
Paddy				
a) Material costs (Rs./ha)	9,050	84.8	4,038	28.3
b) Operational costs (Rs./ha)	25,960	98.5	19,260	99.4
c) Total variable cost (Rs./ha)	35,011	94.6	23,298	69.3
d) Yield (q/ha)	52	111.8	48	85.7
e) Market price (Rs./q)	1,525	109.5	3,900	288.8
f) Benefit:Cost ratio	2.29	129.4	8.03	356.8
Sugarcane				
a) Material costs (Rs./ha)	26,780	95.5	18,598	63.4
b) Operational costs (Rs./ha)	39,473	89.4	21,351	94.3
c) Total variable cost (Rs./ha)	66,253	91.8	39,949	76.9
d) Yield (q/ha)	70.98	97.9	105	82.0
e) Market price (Rs./q)	2505	103.7	5,200	198.7
f) Benefit:Cost ratio	2.68	110.6	13.66	212.1
Finger millet				
a) Material costs (Rs./ha)	-	-	5,852	87.1
b) Operational costs (Rs./ha)	-	-	18,551	102.9
c) Total variable cost (Rs./ha)	-	-	24,403	98.6
d) Yield (q/ha)	-	-	35	134.6
e) Market price (Rs./q)	-	-	3,700	150.0
f) Benefit:Cost ratio	-	-	5.30	204.6

In the case of sugarcane, the pattern in material costs and total variable costs were the same as in the case of paddy. In other words, cost saving was more vivid in Karnataka state than that in A.P. Moreover, sugarcane yield in NF was less than that in non-NF in both the states. However, market price of sugarcane was significantly higher for NF-adopters in Karnataka as compared to non-adopters or even adopters in A.P. But in both the states, benefit: cost ratio was favourable to NF-adopters for sugarcane crops as well. Finger millet is one of the important crops in Karnataka state. When we compare the cost of cultivation, being low input crop, the difference in material costs or total variable costs was not significant. However, in terms of crop

yield and price realisation, there was significant boost to the NF-adopted farmers as compared to non-adopted farmers. The yield was higher by 35 per cent, while market price was higher by almost 50 per cent.

Natural Farming Produce as Niche Product

From consumers' point of view, the middle and high income consumers have become more conscious about the quality of food, that's why demand for organic/naturally grown foods has been increasing in India. Nandini *et al.* (2009) in her study found that heavy metals like chromium (86mg/kg), iron (14620 mg/kg) and copper (52mg/kg) were found in soil sample under chemical farming, which are beyond the permissible limit and hazardous to plants. In the present study, it was evident that market in Karnataka treats the natural farming produce as niche product, which was not apparent in Andhra Pradesh. Being new introduction in Andhra Pradesh, the NF-farmers are not able to differentiate their produce from the non-NF produce. Hence, there is not much difference in the price. In Karnataka, the NF-farmers are projecting their produce as chemical free produce. Though there is no certification available for such produce, farmers have created good network through social media like Whatsapp and Facebook through which customers contact them for buying the produce. Many urban customers basically from Bengaluru and Mysuru visit the farmers field directly at the time of harvesting for purchasing the required quantity. Some farmers are selling their produce through informal groups namely '*Bhoomithayi Belegarara Sangha*' and '*Savayava Belegarara Sangha*' on every Sunday in central parts of the city like bus stands, railway stations etc. Even sugarcane farmers are able to sell the NF sugarcane at nearly double the price of non-NF. Some farmers also sell jaggery to the companies which are retailing organic jaggery, like '*Organic Mandya*' in the study area.

V

CONCLUSION AND WAY FORWARD

Natural farming is found to be widespread in Andhra Pradesh with majority joining the bandwagon during the last 5 years, whereas in Karnataka, adoption of NF though started more than 15 years back, is very much sporadic. Though there are certain practices prescribed in natural farming, the most adopted practice is the use of *Jeevamritha*, *Beejamritha* and other plant protection materials. Mulching and different irrigation techniques (*Wapasa*) are not popular practice. There is always scope for tweaking and innovation in these practices like *Ghanajeevamritha* and use of Azolla in the paddy field in A.P. It was also evident that there is significant reduction in the cost of cultivation of all the crops, although crop yield may/may not be higher as compared to conventional farming. We also observed better soil health in terms of light texture, presence of earthworms, moisture retention, etc. in the NF-

adopted farms. Moreover, necessity of owning an indigenous cow is not valid, as the requirement of cow dung and urine is very low for the preparation of *jeevamritha* or *beejamritha*. There may be community level preparation or small business opportunities at the village level are already emerging for these products. It was also observed that the NF-adopted farmers who applied FYM, made up of all kind of dungs (bullocks, buffaloes, etc.) harvested better crop yield than those who did not apply. Secondly, the essentiality of indigenous cow is also beyond the purview of the current study, as it requires lab research to examine the presence of different types of micro-organisms as compared to dung and urines of different species. Thirdly, different certification system may be developed for such products to create different markets for those consumers who are willing to pay premium price for the chemical-free produce. Thus, natural farming may not look as yield enhancing farming practices, but would definitely increase farmers' income through cost reduction and long-term sustainability.

NOTE

1) Though the proponent claims it to be 'Zero Budget Natural Farming' assuming no purchase of any input from market, we believe that every resource has opportunity cost. Therefore, we considered the practice as 'Natural Farming'. Therefore, the terms ZBNF and NF have been used interchangeably.

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