

Comparative Economic Analysis of Zero Budget Natural Farming for *Kharif* Groundnut under Central Dry Zone of Karnataka, India

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Authors' contributions

This work was carried out in collaboration among all authors. Authors AHKN designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SB and GMC managed the analyses of the study. Author SB managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This research work is mainly focused on comparative economic analysis of Zero Budget Natural Farming (ZBNF) for *Kharif* Groundnut under Central Dry Zone of Karnataka. The purpose of conducting the study is to examine the cost of cultivation for ZBNF with other treatments. This is mainly due to farmers are facing high cost of cultivation by practicing conventional farming as it is highly depends on external inputs. ZBNF is low cost technology where, farming is practiced by using jeevamrutha, beejamrutha, mulching and whapsa etc. The Groundnut experiment was conducted at ZAHRS, Babbur Farm, Hiriyyur during *Kharif* 2019-20 in order to estimate economics for different treatments. Each treatment was having different input usage. For calculating economics of each treatment, conventional cost of cultivation method was followed (*i.e.* calculation of Variable cost, Fixed cost, Gross returns, Net returns and B:C). The results of economic analysis revealed that the per hectare yield (17.46 q/ha) total cost (₹ 53,019), gross returns (₹ 88,871), net

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returns (₹ 35,852) and B:C (1.68) were found to be highest in RPP among all treatments i.e. ZBNF, OPS and Control. The cost of cultivation of ZBNF 22.55 per cent lesser than RPP. The B:C ratio was found to be more in ZBNF (1.66) than OPS (1.58). This is due to highest cost for purchase of excess quantity of FYM in case of OPS. It is concluded from the study that RPP was best treatment among all treatments. This is due to highest yield, net returns and B:C was found in RPP treatment as compared to all treatments. In the economic point of view, there was reduction in total cost in case of ZBNF with fewer yields as compared to RPP.

Keywords: ZBNF; OPS; RPP; control; gross returns; net returns; B:C.

1. INTRODUCTION

Agriculture has been the mainstay of the Indian economy for centuries. Over half the country's population today depends on agriculture and allied services for their livelihoods. Agriculture constitutes 17.4 per cent of the gross value added (GVA) to the national economy [1]. Since the Green revolution of the 1960s, agriculture in India has relied heavily on chemical fertilizers and pesticides. Over the years, their excessive use has resulted in their diminishing marginal utility leading to declining net incomes and growing debts for farmers. Their excessive application also poses threat to soil health, ground water purity, local biodiversity and human health. The inherent unsustainability of chemical-based agriculture and its contribution to the ecological and agrarian crisis has resulted in growing demand for alternative agro ecological farming practices that promise a most of ecological and social benefits [2].

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 realization, 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 [3]. 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 [4]. Though, per hectare real value of output increased for most crops in recent years, but these rise in input cost was much higher [5], resulting into reduced farm income. Moreover, green revolution technology is now contemplated to be degrading the agro-ecosystem; and diminishing the economic returns for the farmers [6]. Several studies have shown that chemical fertilizer and pesticides affect soil health by killing millions of microbes present in the soil which are important for sustaining plant life [7]. Decreasing trend in crop yield growth has been observed due to

injudicious or overuse of inputs like synthetic fertilizers and pesticides [8].

Zero budget natural farming (ZBNF) a sustainable agricultural system is one such alternative to chemical fertilizer based agriculture and high input cost agriculture. It exemplifies agro ecological principles where the emphasis is on "enhanced soil conditions by managing organic matter and soil biological activity; diversification of genetic resources; enhanced biomass recycling; and enhanced biological interactions" [9]. The practice advocates 100 per cent elimination of synthetic chemical inputs (fertilizer and pesticides) and encourages the application of natural mixtures made using cow dung, cow urine, jaggery, pulse flour etc., mulching practices, and symbiotic intercropping. The practice could potentially reinvigorate rural economies and reduce credit risks for farmers caused by high-input resource-intensive chemical farming. It will also help agricultural families retain greater resources to spend on their well-being for needs such as education, health, and financial security [1]. At the same time, the practice holds promise for improving biological soil health and local biodiversity, enhancing the climate resilience for crops, contributing towards the Sustainable Development Goals, and supporting the achievement of the Global Nutrition Targets 2025 of access to affordable and safe food.

Groundnut (*Arachis hypogaea*), is an important leguminous crop belong to family fabaceae. It is known by many other local names such as earthnuts, ground nuts, goober peas, monkey nuts, pygmy nuts and pig nuts. Its history is a journey from South America to East Asia, across the Atlantic Ocean and back again to North America. The groundnut plant probably originated in Peru or Brazil in South America. Dr. George Washington Carver is considered by many to be the father of the groundnut industry. He suggested to farmers that they rotate their cotton plants and cultivate groundnuts.

Groundnut oil has a very important position in the Indian diet. The oil content of the seed varies from 44.00 to 50.00 per cent depending upon the varieties and agro-climatic condition. It contributes 67.00 per cent to the total edible oils used in India. Groundnut contains protein, vitamin, amino acid, calcium, iron, Zinc and Boron. Kernels are also eaten, roasted or sweetened. It is an important protein supplement in cattle and poultry ration. It is also consumed as confectionary product. The cake can be used for manufacturing artificial fiber. The haulms (Plant stalk) are fed (green, dry or silage) to livestock. All parts of this plant can be commercially used. Being a leguminous crop, groundnut is also valuable rotation crop with root nodules. It maintains the soil fertility and help in reducing soil erosion.

Groundnut occupies first position in terms of area and second position in terms of production. China is the largest producer as well as consumer of groundnut in the world with 171.50 lakh tonnes in 2017-18 followed by India (91.79 lakh tonnes), United States (32.81 lakh tonnes), Nigeria (24.20 lakh tonnes) and Sudan (16.41 lakh tonnes). According to the all India *kharif* crop coverage report, Government of India, as on 26th September 2019, groundnut was sown in around 39.31 lakh hectares as compared to last year (40.19 lakh ha). Among the states, Gujarat stood first in area coverage with 15.52 lakh ha followed by Rajasthan (5.73 lakh ha), Andhra Pradesh (5.37 lakh ha), Karnataka (3.88 lakh ha) and Madhya Pradesh (2.21 lakh ha) [10].

In the state of Karnataka, Dharwad, Belgaum, Bijapur, Raichur, Bellari and Bidar are the major districts where groundnuts are grown in abundance.

2. MATERIALS AND METHODS

The field experiment was conducted at ZAHRS, Babbur farm, Hiriyur (Zone-04) during *Kharif* 2019-20 in order to estimate the economics of Zero Budget Natural Farming. The experimental plot was laid out in Randomized Block design (RBD) with five replications and four treatments. The treatments imposed were T₁-Zero Budget Natural Farming (ZBNF), T₂-Recommended package of practice (RPP), T₃-Organic production system (OPS), and T₄-Control.

The purpose of estimating the economics of Zero Budget Natural Farming to what extent this farming reduce the expenditure on purchased

inputs by comparing the economics of ZBNF with other treatments. Each treatment was having different input usage. In case of Zero budget natural farming extracts of naturally available low cost materials (Jeevamrutha, Beejamrutha, Brahmastra, Neemastra and Agniastra etc) were used for plant protection and production and mulching material used for moisture conservation. No Farm Yard manure (FYM) was used in case of ZBNF. Bio-fertilizer, Bio-pesticides and FYM were used for plant protection and production in case of OPS with no usage of inorganic fertilizers and plant protection chemicals (PPCs). In case of RPP, PPCs and inorganic fertilizers were used with other recommended inputs. No inputs (except seeds) were used in case of control.

The data for the study was obtained by maintaining records on labour cost and number of labour used for each operation and cost and quantity of inputs used in different treatments in *Kharif* groundnut experiment since from land preparation up to harvesting. Further, recorded data on cost of cultivation for different treatments of *Kharif* groundnut experiment was analyzed by using following formulas.

2.1 Estimation of Costs

Total cost = Variable cost+ Fixed cost

Annual depreciation = (Original value-junk value)/Expected life of asset (years.)

2.2 Estimation of Returns

Gross returns=Yield*Price of product

Net returns = Gross returns –Total cost

Cost-benefit ratio ((B:C)= Gross returns/ Total cost

Following procedure was followed while estimating cost of cultivation for different treatments.

2.3 Estimation of Costs and Returns

The costs were classified into variable and fixed costs. Variable cost includes cost of inputs (Seeds, farm yard manure, bio-fertilizer, bio-pesticide, jeevamrutha, beejamrutha, neemastra, brahmastra, agniastra, neem leaf extract, inorganic fertilizer, plant protection chemicals etc), labour cost and interest on working capital. Fixed costs include land revenue, depreciation

on farm implements, rental value of land and interest on fixed cost. The measurement and definitions of various cost components are as follows.

Total cost was divided into two broad categories:

- a) Variable cost viz., Labour cost, Material cost
- b). Fixed cost
- c) Variable costs

This comprise of following cost items

2.4 Labour Cost

The expenditure incurred on human labour (Men and women) and machine labour constituted the labour costs. In case of human labour, the total labour employed for each activity was recorded. The women labour was converted into man days by multiplying each women day with 0.6 being the ratio of wages of women to wages of man.

2.5 Material Cost

Material costs covered expenditure on seeds, manures, fertilizers, plant protection chemicals, bio-fertilizer, bio-pesticide, jeevamrutha, beejamrutha, agniastra, brahmastra, neemashtra, neem leaf extract and miscellaneous. These costs were computed based on actual prices paid by the growers and prices prevailing in the locality for owned inputs.

1. Farm yard manure (FYM) cost

Farm yard manure was charged as per the prevailing market rates during the period of study in the study area.

2. Fertilizers cost

The fertilizer cost was calculated at the actual price paid by farmers.

3. Plant protection chemicals cost

The cost of different insecticides and fungicides used for control of pest and diseases was determined on the basis of actual price paid by the farmers.

4. Seeds cost

Seeds purchased from market at the rate prevailing in the study area were treated as seeds cost.

5. Beejamrutha

The cost for materials used in preparation of beejamrutha such as desi cow dung, cow urine, lime and water was estimated for one acre. This was treated as cost for preparation of beejamrutha.

6. Jeevamrutha

The cost for materials used in preparation of jeevamrutha such as desi cow dung, desi cow urine, jaggery, gram flour and water was estimated for acre. This was treated as cost for preparation of jeevamrutha.

7. Brahmastra

The cost for materials used in preparation of brahmastra such as leaves of different plants (Neem, Guava, Custard apple, Lantana camera and Datura) and desi cow urine was estimated for acre. This would be treated as cost for preparation of brahmastra.

8. Neemastra

The cost for materials used in preparation of neemastra such as desi cow dung, desi cow urine, neem leaves and water was estimated for acre. This could be treated as cost for preparation of neemastra.

9. Agniastra

The cost for materials used in preparation of agniastra such as desi cow urine, garlic, green chilli, tobacco and neem leaves was estimated for acre. This could be treated as cost for preparation of agniastra.

10. Neem leaf extract

The cost for materials used in preparation of neem leaf extract such as desi cow urine, desi cow dung, neem leaf and neem seeds were estimated for acre. This could be treated as cost for preparation of neem leaf extract.

11. Mulch material

The cost for purchase of crop residue such as maize stalk was determined. This was treated as cost for mulch material in this study.

12. Miscellaneous cost

This item includes the cost incurred for miscellaneous expenditure during farming

operations like building maintenance and machinery repair expenses and incidental charges.

2.6 Interest on Working Capital

This was calculated on the variable cost of establishment at the prevailing bank rate of 7 per cent per annum.

b. Fixed costs

These include rental value of land, land revenue, depreciation on farm implements and machinery and interest on fixed capital.

1. Land revenue: These were charged according to the actual payments incurred by the cultivators.

2. Depreciation: Depreciation on each capital equipment and machinery used in groundnut cultivation was calculated by using straight line method. The average life of the asset was considered in computation of the depreciation. The depreciation was worked out by using following formula.

3. Rental value of land: Rental value of land was calculated as per the rate prevailing for dry land in the study area. It varies with the type of crops, duration and water requirement of crops.

4. Interest on fixed capital: Interest on fixed capital was calculated at the rate of 12 per cent per annum as the fixed deposits in commercial banks would fetch this rate of interest.

6. Total cost: Total cost is the summation of total variable cost (labour cost, total material cost) and total fixed cost.

7. Cost-benefit ratio (B:C): To judge the profitability of groundnut production B:C ratio was worked out with the help of following formula.

3. RESULTS AND DISCUSSION

The details of per hectare total cost incurred on variable inputs and fixed inputs in cultivation of *Kharif* groundnut (TMV-2 variety) for different treatments has been presented in Table 1 and Fig. 1.

It is clear from table that highest cost was found to be in RPP (₹ 53,019) followed by OPS (₹ 50,425), ZBNF (₹ 43,262) and control (₹ 35,654). Which was higher by 5.11 per cent, 22.50 per cent and 48.70 per cent than OPS,

ZBNF and control treatments respectively. This was reported by [2] in their study that ZBNF farmers cultivating rice and maize in the *Kharif* season reported lower input costs per acre as compared to their non-ZBNF peers. Variable cost accounted major share in total cost for different treatments in groundnut experiment. Labour cost was found to be highest in case of RPP (₹ 24,063) followed by OPS (₹ 22,338), ZBNF (₹ 21,993) and control (₹ 21,159). This was due to more number of women labour and men labour were required for weeding (no mulch material used) and application of PPCs (more number of sprays) respectively in case of RPP. Labour cost for bullock pair (₹ 5,625) and machine labour (₹ 4,063) was found to be same for all treatments. Bullock pair and machine labour were mainly used for intercultivation and land preparation respectively among all treatments. Less labour cost in case of ZBNF was due to use of mulch material which could reduce number of weedings and intercultivation operations. This was reported by [11] that the cost of cultivation for food crops was less for ZBNF farmers than Non-ZBNF farmers.

Similarly, lowest input cost (₹ 8,436) was observed in case of control treatment as no inputs were used in that treatment except for purchase of seeds. Input cost (₹ 22,897) in case of RPP was 50.53 percent more than ZBNF (₹ 15,210). This was mainly due to reduction in the cost for purchase of inorganic fertilizers and PPCs in case of ZBNF. Natural growth promoters (Jeevamrutha, Agni astra, Brahmastra, Neematra, Ulimajjige etc) were used for plant production and protection in ZBNF which could save an increased cost of ₹ 2,550 for purchase of fertilizers and chemicals per hectare. Similar results were reported by [2] in their study, they showed that a chemical farmer spent ₹ 1,187 per acre as against ₹ 780 per acre by a complete ZBNF farmer in cultivation of groundnut. No FYM used in case of ZBNF which could save an expenditure of ₹ 11,650 and ₹ 6,120 on purchase of FYM in OPS and RPP respectively. The cost incurred towards purchase of mulch material in case ZBNF was found to be ₹ 2,500, the highest cost (₹ 11,650) was incurred on purchase of FYM in OPS. This was mainly due to scarcity of FYM and also high quantity of FYM was used in that treatment compared to RPP. For seed treatment, Beejamrutha was used in ZBNF which could reduce increased cost of about ₹ 879 both in OPS and RPP. Total variable cost was found to be highest in case of RPP (₹ 46,960) followed

by OPS (₹ 44,365), ZBNF (₹ 37,203) and Control (₹ 29,595). This was mainly due to increased expenditure towards purchase of FYM, PPCs and inorganic fertilizers. Land rent (₹ 4,500) was accounted for major share in fixed cost followed by depreciation (₹ 850) interest on fixed capital (₹ 649) and land revenue (₹ 60) among all treatments.

Table 1. Economic analysis (₹/ha) of *Kharif* Groundnut per hectare at ZAHRS, Babbur Farm, Hiriyyur during 2019-20

Sl. no.	Particulars	ZBNF	OPS	RPP	Control
I	Labour cost				
1	Men labour	3680	3450	4025	3421
2	Women labour	8625	9200	10350	8050
3	Machine labour	4063	4063	4063	4063
4	Bullock pair	5625	5625	5625	5625
II	Total labour cost	21993	22338	24063	21159
III	Input cost				
1	Seeds	6500	6500	6500	6500
2	Seed treatment	96	975	975	-
3	FYM	-	11650	6120	-
4	Chemical fertilizers	-	-	4250	-
5	Growth promoters(naturals)	3680	-	-	-
6	PPCs	-	-	1980	-
7	Mulch material	2500	-	-	-
8	Interest on working capital@7%	2434	2902	3072	1936
IV	Total variable cost(II+III)	37203	44365	46960	29595
V	Fixed cost				
1	Depreciation	850	850	850	850
2	Land revenue	60	60	60	60
3	Land rent	4500	4500	4500	4500
4	Interest on fixed capital@12%	649	649	649	649
5	Total Fixed cost	6059	6059	6059	6059
VI	Total cost(IV+V)	43262	50425	53019	35654
Returns structure					
1	Yield	14.13	15.18	17.46	8.40
2	Gross returns	71922	77266	88871	42756
3	Net returns	28660	26842	35852	7102
4	Returns per rupee spent(B:C)	1.66	1.53	1.68	1.20

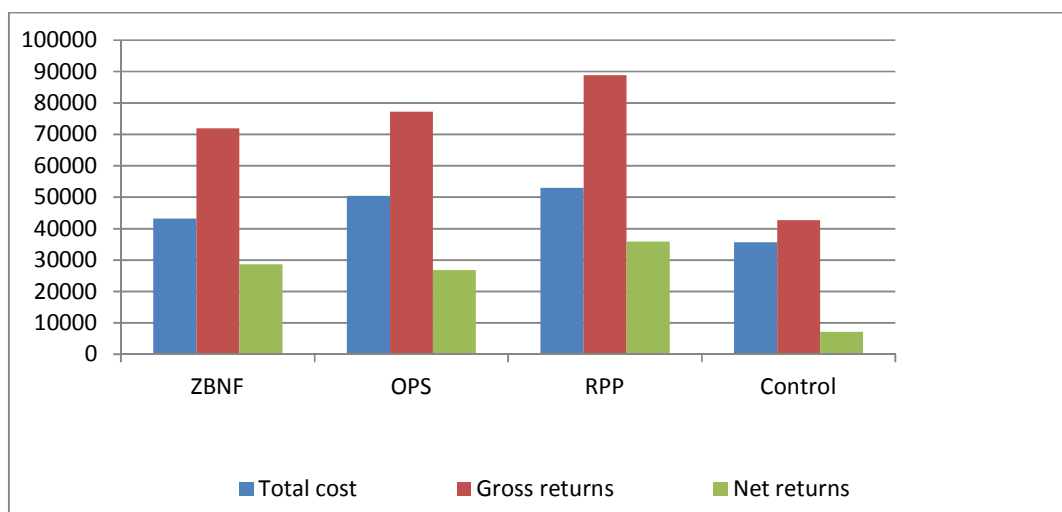


Fig. 1. Cost and returns for different treatments of *Kharif* Groundnut experiment

It is also observed from the table that there was difference in yield among ZBNF (14.13 q/ha), OPS (15.18 q/ha), RPP (17.46 q/ha) and control (8.40 q/ha) treatments. The yield obtained in ZBNF was lesser than RPP and OPS. This was also reported by [12] in their study that sugarcane yield in natural farming (NF) was less than in non-natural farming in both Karnataka and Andhra Pradesh states. The gross returns was found to be highest in RPP (₹ 88,871) followed by OPS (₹ 77,266), ZBNF (₹ 71,922) and control (₹ 42,756). This was mainly due to usage of recommended inorganic fertilizers and PPCs in RPP. The gross returns in RPP were found to be 15.01 per cent, 23.56 per cent and 107.85 per cent more than OPS, ZBNF and Control respectively. The net returns was found to be highest in RPP (₹ 35,852) followed by ZBNF (₹ 28,660), OPS (₹ 26,842) and control (₹ 7,102). The highest cost-benefit ratio was recorded in RPP (1.68) followed by ZBNF (1.66), OPS (1.53) and control (1.20).

4. CONCLUSION

Results of the economic analysis for different treatments of *Kharif* groundnut indicated that the highest total cost (₹ 53,019), gross returns (₹ 88,871), net returns (₹ 35,852) and cost-benefit ratio (1.68) were found to be more in RPP treatment among all treatments. Hence, the RPP was the best treatment among all treatments. In economic point of view, there was reduction in total cost (22.55%) in ZBNF treatment with less yield (14.13 q/ha) as compared to RPP (17.46 q/ha). Due to use of excessive quantity of FYM in case of OPS resulted in high cost of cultivation (₹ 50,425) which further led to decrease in net returns (₹ 26,842) and cost-benefit ratio (1.53). There were less yield (8.40 q/ha), less net returns (₹ 7,102) and least cost-benefit ratio (1.20) found to be in case of control treatment among all treatments. This is due to no inputs were used in case of control treatment except for seeds.

5. POLICY IMPLICATIONS

It was concluded from above study that there was highest cost obtained in case of RPP treatment among all treatments. But Majority of farmers in India are having marginal and small holdings with less resource base. Most of them practicing conventional farming which requires huge investment for purchase of external inputs. Hence, they are facing high cost of cultivation by practicing conventional farming. Because of high

investment in conventional farming farmers have to depend on money lenders to borrow money due to lack of capital to invest in agriculture. Due to excessive use of inorganic fertilizers and PPCs in conventional farming there is decrease in soil fertility which further led to reduction in crop yield. Hence, in order to protect the farmers from high debt and to sustain their interest in the farming there is need to develop low cost technology with less dependence on external inputs. So, ZBNF is one of the farming practices in which there is no use of external inputs. This was led to decrease in cost of cultivation with improvement in soil fertility status and gradual increase in Crop yield.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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