Introduction

Worldwide, specific agricultural systems and landscapes have been created, shaped and maintained by generations of farmers and herders based on diverse natural resources, using locally adapted management practices. As we all know agriculture is a practice by which, farmer produces various types of commodities by using various types of farm inputs like seeds, fertilizer, pesticide and water. Farmer uses different practices for it, and on the basis of various practices and inputs agriculture is differentiated in various types as follows: 1) Natural Farming or Zero/Low Budget Natural Farming, 2) Organic Farming and 3) Conventional Farming. In order to maintain soil fertility and ecological balance and reduce pollution and waste, organic farming uses biological components instead of synthetic ones. It is based on agricultural practices that are ecologically balanced, such as crop rotation, the use of green manure, organic waste, biological pest management and the addition of minerals and rocks. Use local resources to supply nutrients and control pests and diseases and use external inputs as little as possible. The main goal of organic farming is to maintain soil life through processes for soil-building. In organic farming soil is fed not the crops.

Conventional farming or inorganic farming is highly resource and energy intensive production system which includes the use of synthetic fertilizers, pesticides, agrochemicals, heavy irrigation and mechanization to get the highest possible yield of crops. In conventional farming, chemical fertilizers promote plant growth, insecticides are sprayed to reduce pests and diseases and herbicides are used to manage weeds. This type of farming method is mostly used by farmers all over the world because it will give them good crop production.

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Economic assessment of different farming systems under sesame-groundnut-chickpea cropping sequence

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Abstract

An experiment conducted during summer 2022, kharif 2022 and rabi 2022-23 at Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat) to study the economic assessment of different farming systems under sesame-groundnut-chickpea cropping sequence. The experiment was laid out on non-organic and fixed plot with large plot technique having three treatments of different farming system viz., Low Budget Natural Farming (LBNF), Organic Farming (OF) and Conventional Farming (CF). The results revealed that, conventional farming system comprised recommend dose of chemical fertilizers, FYM and inorganic pesticides recorded maximum gross returns, net returns and B:C ratio, while, under the consideration of premium price i.e. 25% higher than normal market price, higher net returns was recorded under the organic farming system in all three season viz., summer 2022, kharif 2022 and rabi 2022-23.

Keywords: Natural farming, organic farming, conventional farming, sesame, groundnut, chickpea
Materials and Methods
A field experiment was conducted during summer 2022, kharif 2022 and rabi 2022-23, at the Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat. The soil of experimental plot was clayey in texture, which was medium in soil organic carbon (0.58%), slightly alkaline in reaction (pH 8.18) with EC 0.53 dS/m. The soil was low in available nitrogen (242.87 kg/ha), medium in available phosphorus (31.94 kg/ha), medium in available potassium content (246.60 kg/ha) and medium in available sulphur (19.75 mg/kg) in summer 2022 when experiment was started. The overall soil conditions at the time of sowing were found to be favourable for good germination as revealed from the better plant stand. The experiment was laid out on non-organic and fixed plot with large plot technique with eight samples (4.2 m x 3.6 m) from each of 24.4 m x 10.8 m module i.e Low Budget Natural Farming Module (LBNF), Organic Farming Module (OF) and Conventional Farming Module (CF). The treatments were as follows.

A. Summer Season
1. Module-I: Low Budget Natural Farming (LBNF)
   - Mixed cropping of sesame (Var. GJT 5) and pearl millet (Var. GHB 1129) with 90:10 seed ratio
   - Seed treatment with Beejamrut @ 300 ml/kg seed by spraying on sesame and pearl millet seed, mix it well and dry before sowing
   - Ghan Jeevamrut 250 kg/ha + FYM 250 kg/ha at sowing and Jeevamrut @ 500 l/ha with each irrigation
   - Achhadan: Soil/organic/weed mulch
   - Plant protection: Agniasta, Brahmastra and Neemastra, if required

2. Module-II: Organic Farming (OF)
   - Sole cropping of sesame (Var. GJT 5)
   - Seed treatment with Azospirillum @ 20 g/kg of seed
   - Vermicompost 2 t/ha, FYM 5 t/ha and Panchagavya @ 3% three spray at 30, 45 and 60 DAS
   - Plant protection: Pheromone trap, Trichoderma, Beauveria, Metarhizium, NPV, etc., if required

3. Module-III: Conventional Farming (CF)
   - Sole cropping of sesame (Var. GJT 5)
   - Seed treatment with thiram @ 4 g/kg of seed
   - Recommended dose of chemical fertilizer (50-25-40 kg N-P_2O_5-K_2O/ha) and manure (FYM 5 t/ha)
   - Plant protection: Recommended fungicides, insecticides and herbicides, if required

B. Kharif Season
1. Module-I: Low Budget Natural Farming (LBNF)
   - Mixed cropping of groundnut (Var. GJG 20) and sweet corn (Var. Madhuram) with 90:10 seed ratio
   - Seed treatment with Beejamrut @ 300 ml/kg seed by spraying on groundnut and sweet corn seed, mix it well and dry before sowing
   - Ghan Jeevamrut 250 kg/ha + FYM 250 kg/ha at sowing and Jeevamrut @ 500 l/ha either by each irrigation or by soil sprinkling at sowing, 30, 60 and 90 DAS
   - Achhadan: Soil/organic/weed mulch
   - Plant protection: Agniasta, Brahmastra and Neemastra, if required

2. Module-II: Organic Farming (OF)
   - Sole cropping of groundnut (Var. GJG 20)
   - Seed treatment with Rhizobium @ 20 g/kg of seed
   - Vermicompost 2 t/ha, FYM 7.5 t/ha and Panchagavya @ 3% three spray at 30, 45 and 60 DAS
   - Plant protection: Pheromone trap, Trichoderma, Beauveria, Metarhizium, NPV, etc., if required

3. Module-III: Conventional Farming (CF)
   - Sole cropping of groundnut (Var. GJG 20)
   - Seed treatment with thiram @ 4 g/kg of seed
   - Recommended dose of chemical fertilizer (12.5-25-25 kg N-P_2O_5-K_2O/ha) and manure (FYM 7.5 t/ha)
   - Plant protection: Recommended fungicides, insecticides and herbicides, if required

C. Rabi Season
1. Module-I: Low Budget Natural Farming (LBNF)
   - Mixed cropping of chickpea (Var. GJG 6) and mustard (Var. GDM 4) with 90:10 seed ratio
   - Seed treatment with Beejamrut @ 300 ml/kg seed by spraying on chickpea and mustard seed, mix it well and dry before sowing
   - Ghan Jeevamrut 250 kg/ha + FYM 250 kg/ha at sowing and Jeevamrut @ 500 l/ha with each irrigation
   - Achhadan: Soil/organic/weed mulch
   - Plant protection: Agniasta, Brahmastra and Neemastra, if required

2. Module-II: Organic Farming (OF)
   - Sole cropping of chickpea (Var. GJG 6)
   - Seed treatment with Rhizobium @ 20 g/kg of seed
   - Vermicompost 2 t/ha, FYM 5 t/ha and Panchagavya @ 3% three spray at 30, 45 and 60 DAS
   - Plant protection: Pheromone trap, Trichoderma, Beauveria, Metarhizium, NPV, etc., if required

3. Module-III: Conventional Farming (CF)
   - Sole cropping of chickpea (Var. GJG 6)
   - Seed treatment with thiram @ 4 g/kg of seed
   - Recommended dose of chemical fertilizer (20-40-00 kg N-P_2O_5-K_2O/ha) and manure (FYM 5 t/ha)
   - Plant protection: Recommended fungicides, insecticides and herbicides, if required

Results and Discussion
Economics (Summer Season)
The data (Table 1) revealed that the maximum gross returns (₹ 1,11,823/ha) and net returns (₹ 69,684/ha) were obtained under conventional farming (CF), followed by organic farming (OF) and minimum gross returns (₹ 88,112/ha) as well as net returns (₹ 49,406/ha) were found under the natural farming (LBNF). Whereas, higher B:C ratio (2.65) was found under conventional farming (CF), followed by the natural farming (LBNF) and organic farming (OF) to the tune of 2.28 and 1.96, respectively. If we see according to premium prices of naturally and organically produced crop, maximum gross returns (₹ 1,27,158/ha) and net returns (₹ 75,365/ha) were obtained under organic farming (OF). Whereas, higher B:C ratio (2.85) was found under natural farming (LBNF).
An examination of the data (Table 3) indicated that maximum gross returns (₹ 1,01,458/ha) and net returns (₹ 55,480/ha) were recorded under conventional farming (CF), followed by organic farming (OF) and low budget natural farming (LBNF). Conventional farming (CF) recorded higher B:C ratio (2.21), followed by natural farming (LBNF) and organic farming (OF) with an average B:C of 1.65 and 1.58, respectively.

If we see according to premium prices of naturally and organically produced crop, maximum gross returns (₹ 1,14,378/ha) and net returns (₹ 56,593/ha) were obtained under organic farming (OF). Higher B:C ratio (2.21) was recorded under conventional farming (CF), followed by low budget natural farming (LBNF) and organic farming (OF).

**Economics (Kharif Season)**

**Table 2:** Economics of groundnut under low budget natural farming, organic farming and conventional farming (Kharif)

<table>
<thead>
<tr>
<th>Particular</th>
<th>I</th>
<th>I*</th>
<th>II</th>
<th>II*</th>
<th>III</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>LBNF</td>
<td>LBNF</td>
<td>OF</td>
<td>OF</td>
<td>CF</td>
</tr>
<tr>
<td>Gross returns (₹/ha)</td>
<td>98917</td>
<td>123646</td>
<td>116220</td>
<td>145274</td>
<td>127509</td>
</tr>
<tr>
<td>Cost of cultivation (₹/ha)</td>
<td>48519</td>
<td>48519</td>
<td>62725</td>
<td>62725</td>
<td>51171</td>
</tr>
<tr>
<td>Net returns (₹/ha)</td>
<td>50398</td>
<td>75127</td>
<td>53495</td>
<td>82549</td>
<td>76338</td>
</tr>
<tr>
<td>B:C ratio</td>
<td>2.04</td>
<td>2.55</td>
<td>1.85</td>
<td>2.32</td>
<td>2.49</td>
</tr>
</tbody>
</table>

*Economics with premium price (25% higher than normal market price)

Note: LBNF (groundnut + sweet corn (90:10) as a mix cropping)

Conventional farming (CF) registered significantly the maximum gross returns (₹ 1,27,509/ha) and net returns (₹ 76,338/ha), followed by the organic (OF) and natural farming (Table 2). The natural farming (LBNF) reported minimum gross returns (₹ 98,917/ha) and net returns (₹ 50,398/ha). Higher B:C ratio (2.49) was recorded under conventional farming (CF), followed by low budget natural farming (LBNF) and organic farming (OF).

If we see according to premium prices of naturally and organically produced crop, maximum gross returns (₹ 1,45,275/ha) and net returns (₹ 82,549/ha) were obtained under organic farming (OF). Higher B:C ratio (2.49) was recorded under conventional farming (CF), followed by low budget natural farming (LBNF) and organic farming (OF).

**Economics (Rabi Season)**

**Table 3:** Economics of chickpea under low budget natural farming, organic farming and conventional farming (Rabi)

<table>
<thead>
<tr>
<th>Particular</th>
<th>I</th>
<th>I*</th>
<th>II</th>
<th>II*</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LBNF</td>
<td>LBNF</td>
<td>OF</td>
<td>OF</td>
<td>CF</td>
</tr>
<tr>
<td>Gross returns (₹/ha)</td>
<td>71444</td>
<td>89305</td>
<td>91503</td>
<td>114378</td>
<td>101458</td>
</tr>
<tr>
<td>Cost of cultivation (₹/ha)</td>
<td>43182</td>
<td>43182</td>
<td>57785</td>
<td>57785</td>
<td>45978</td>
</tr>
<tr>
<td>Net returns (₹/ha)</td>
<td>28262</td>
<td>46123</td>
<td>33718</td>
<td>56593</td>
<td>55480</td>
</tr>
<tr>
<td>B:C ratio</td>
<td>1.65</td>
<td>2.07</td>
<td>1.58</td>
<td>1.98</td>
<td>2.21</td>
</tr>
</tbody>
</table>

*Economics with premium price (25% higher than normal market price)

Note: LBNF (chickpea + mustard (90:10) as a mix cropping)

Based on the data presented in Table 4 significantly, maximum gross returns (340790 ₹/ha) and net returns (201502 ₹/ha) were obtained under conventional farming (CF) over organic farming (OF) and natural farming (LBNF) with 309449 ₹/ha & 137146 ₹/ha and 258473 ₹/ha & 128066 ₹/ha, respectively. This might be attributed to higher economical yield and biological yield of crops with comparatively less cost than additional income under this module. The minimum gross returns and net returns were achieved under low budget natural farming (LBNF) which might be due to variation in the economical and biological yields of crops. Maximum B:C ratio 2.45 was found under conventional farming (CF). Lower B:C ratio 1.80 of the organic module might be due to higher cost of organics as well as comparatively lower yield. Further, organic farming module recorded maximum gross returns (386811 ₹/ha) and net returns (214508 ₹/ha) under consideration of premium price (25% higher than normal market price). These results are in accordance with findings of Kavya and Singh (2018) [3], Suja et al. (2018) [10], Upendra Naik et al. (2018) [11], Singh et al. (2018) [9], Galab et al. (2019) [2], Lyngdoh et al. (2019) [6], Vinay et al. (2020) [12], Behera and Chandrashekar (2023) [1], Korat et al. (2023) [4], Kumari et al. (2023) [3], Monica et al. (2023) [8] and Mallikarjun et al. (2024) [7].

**Conclusion**

On the basis of the results obtained from three season (summer-sesame, kharif-groundnut and rabi-chickpea) of sequential experiment, it can be concluded that conventional farming system comprised recommend dose of chemical fertilizers, FYM and inorganic pesticides offers short term higher productivity and profitability than natural and organic farming system. However, organic farming found more viable compared to natural and conventional farming under consideration of...
premium price (25% higher than normal market price) of crop produces on the basis of net return.

References