Cost benefits Analysis of lemongrass (Cymbopogon citratus (DC) Stapf.) variety: WG-Lomisar-Java for herbal production at Wondogenet

*Melkamu Tilaye¹, Tamirat Girma², Muluken Philipose³

1,2,3Ethiopian Institute of Agricultural Research, Wondogenet Agricultural Research Center, P.O. Box. 198, Shashemene, Ethiopia

The study was conducted at Wondogenet Agricultural Research Center experimental field from the beginning 2015 to the beginning of 2018. This study was conducted with the aim of examining the financial feasibility of WG-Lomisar-Java lemongrass (Cymbopogon citratus (DC) Stapf.) variety: WG-Lomisar-Java for its herbal production. For this study WG-lomisar-Java lemongrass was planted on 100m² area of land with an intra and inter row spacing of 60cm. During the study all cost and benefit data were collected throughout the cultivation period. To examine the feasibility of its cultivation the study employed financial analysis methods such as Net Present Value (NPV) and Benefit Cost Ratio (BCR). The result of the study revealed that; the herbal production WG-lomisar-Java lemongrass required a total cost of 78,016.77 birr/ha, and provided total revenue of 247,250 birr/ha, resulted net return of 169,233.23 birr/ha in overall three years of production. Moreover, net present value and benefit cost ratio was found 140,579.80 birr/ha and 3.04 birr/ha respectively indicating that production of WG-lomisar-Java lemongrass is financially feasible. The sensitivity analysis in the fluctuation of selected scenarios revealed that production of the plant is still financially feasible.

Keywords: Cost benefit Analysis, feasibility, Lemongrass, Sensitivity Analysis

INTRODUCTION

Lemongrass (Cymbopogon citratus (DC) Stapf.) belongs to family Poaceae, is a perennial growing aromatic grass native to West Indian. It is a plant cultured in almost all tropical and subtropical countries (Paranagama et al., 2003; Cheel et al., 2005). It is a tall, aromatic perennial grass that can grow up to 90 cm in height and 5 mm wide. Fresh lemongrass contains volatile oil and non-volatile components and nutritious such as calcium, iron, magnesium, manganese, phosphorus, potassium, selenium and zinc. The main chemical components of lemongrass oil are myrcene, citronellal, geranyl acetate, nerol, geraniol, neral and traces of limonene and citral (Abdurahman et al., 2013).

Lemongrass extracts and their essential oils used in the food flavoring, perfume and cosmetics industries. In Brazil, the tea, infusion and extracts of lemongrass which are prepared with fresh or dry leaves, are often used in the popular medicine as a restorative, digestive, effective drug against colds, with an analgesic, anti-hermetic, anti-inflammatory of urinary ducts, diuretic, antispasmodic and diaphoretic (Sousa et al., 2010). Lemongrass is widely used as an essential ingredient in Asian cuisines because of its sharp lemon flavor. Its herbal tea is used as sedatives, febrifuge and immune stimulant in India. Lemongrass essential oil is applied for its medicinal value to cure acne, oily skin, scabies, flatulence, headaches, blood circulation problems (Singh et al., 2011). Lemongrass extract and its polyphenols inhibited the cytokine production on human macrophages. This supports the anti-inflammatory activity of cells (Francisco et al., 2016).

*Corresponding author: Melkamu Tilaye, Ethiopian Institute of Agricultural Research, Wondogenet Agricultural Research Center, P.O. Box. 198, Shashemene, Ethiopia. Email: melkamutw@gmail.com, Tel: +251929336305 Co-Author Email: tamirat.grma@yahoo.com, natinard.philip1@gmail.com
Even though lemongrass has a lot of uses in the forms of fresh herb, dry herb and in its essential oil; the production and utilization of lemongrass is in a very infant stage in Ethiopia. In line with this there is limited information on feasibility of lemongrass production. Thus, this study was conducted to examine the feasibility of WG-Lomisar-Java lemongrass for its herbal production to provide information about feasibility of its production. This information will encourage the producers to cultivate this plant.

MATERIALS AND METHODS

The study was conducted at Wondogenet Agricultural Research Center experimental site for three years (from the beginning of 2015 to the binging 2018). Wondogenet is located at 7° 192' North, latitude and 38° 382' East, longitude with an altitude of 1780 m.a.s.l. (Beemnet et al., 2011). In this study lemongrass (Cymbopogon citratus (DC) Stapf.) variety: WG-Lomisar-Java planted on the experimental field area of 100m² and with inter and intra row spacing of 60cm. For this study all the cost and benefit data were collected from experimental site accordingly. To study the costs of WG-Lomisar-Java lemongrass production: the planting material and plowing costs, the amount of labor in terms of man-days for land preparation, planting, watering, weeding and hoeing and harvesting operations were recorded accordingly by preparing data collection sheets. To calculate the total amount of labor, cost of cultivation, current wage rate that was fixed by Wondogenet Agricultural Research Center was used. The total cost of production was obtained through adding all these costs. On the other hand, to calculate total revenue, farm gate price which was used to purchase fresh herb of lemongrass from farmers was used. Total annual fresh herb yields were recorded and multiplied by price to calculate the total annual revenues of WG-Lomisar-Java lemongrass production. All the cost and benefit data were recorded in Ethiopian Birr. Finally, all the information was converted to a per hectare basis for the final analysis. The collected data from experimental site has been analyzed by using Microsoft excel 2010. To examine the feasibility WG-Lomisar-Java lemongrass cultivation for its fresh herb production, financial analysis methods were followed. For this study the two discounted measures, net present value (NPV) and benefit cost ratio (BCR) methods was employed for analyzing financial feasibility.

To calculate total revenue (TR), total cost (TC), net present value (NPV), and Benefit cost ratio (BCR) the following formulas were used:

Total revenue (TR)

\[ TR = QT \times P \]  
(1)

Where:

TR: Total Revenue
Q: Total quantity of fresh herb in kg
P: Selling price per kg

Total cost (TC)

\[ TC = PC + MC + CP + LC \]  
(2)

Where:

TC= Total cost
PC= first cost of plowing and harrowing
MC= Planting material cost
CP= Land cleaning and leveling, and cost of planting
LC= Labor cost of operation (watering, weeding and hoeing and harvesting costs)

Total cost (TC)

\[ TC = Bn + Cn \]  

Net Return/profit

\[ NR = TR - TC \]  
(3)

Where:

NR: Net return
TR and TC are total revenue and total cost of production

Net Present Value (NPV)

Net present value is computed by finding the difference between the present worth of benefit stream less the present worth of cost stream. Or it is simply the present worth of the cash flow stream.

\[ NPV = \sum_{t=0}^{n} \left( \frac{Bn - Cn}{(1+r)^t} \right) \]  
(4)

Where:

NPV: Net Present Value
Bn: Benefits in each year
Cn: Costs in each year
n: number of years
r: discount rate.

Then after having the value of NPV, the decision is if NPV is positive indicates that investing on WG-Lomisar-Java lemongrass for herbal production is feasible; if NPV is negative indicates that it is not feasible.

Benefit Cost Ratio (BCR)

It is the ratio of present worth of benefit stream to present worth of cost stream, that is:

\[ BCR = \frac{\sum_{t=0}^{n} Bn}{\sum_{t=0}^{n} Cn} \]  
(5)

Where:

BCR: Benefit cost ratio
Bn = Benefit in each year
Cn = Cost in each year
n = number of years
r = discount rate.

According to BCR, herbal production of WG-Lomisar-Java lemongrass is feasible if BCR is greater than 1. If it is less than one, it indicates that the production not feasible.
RESULTS AND DISCUSSION

In this section results on yield, costs and returns, financial feasibility and sensitivity analysis associated with cultivation of WG-lomisar-Java lemongrass is presented.

Yield of WG-Lomisar-Java lemongrass production

The per hectare fresh yield of WG-Lomisar-Java lemongrass was 83,600 Kilogram in the first year, 115,200 kilograms for second year and 48,450 kilograms in third year of its production. Which showed that herbal yield of WG-lomisar-Java lemongrass reached maximum in its second year of production; then it gradually declined in its third year of production. This is because of plants died due to ageing. The result showed that fresh herbal yield in the second year increased by 37.8% from the first year of production. On the other hand, fresh herbal yield in the third year of production was decrease by 57.94% and 42.05% from the second and first year of production respectively. In three years of production WG-Lomisar-Java lemongrass yielded a total fresh herb of 247,250 kilogram per hectare and an average of 82,416.67 kilogram per hectare as it is presented in Table 1 and chart 1 below.

Table 1: Herbal production of WG-Lomisar-Java lemongrass in (kg/ha).

<table>
<thead>
<tr>
<th>Plant name</th>
<th>Years of production</th>
<th>Fresh herb yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WG-WG-Lomisar-Java lemongrass</td>
<td>I</td>
<td>83,600</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>115,200</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>48,450</td>
</tr>
<tr>
<td>Total production (kg/ha)</td>
<td></td>
<td>247,250</td>
</tr>
<tr>
<td>Average yield per Year (kg/ha)</td>
<td></td>
<td>82,416.67</td>
</tr>
</tbody>
</table>


Costs and Returns of WG-lomisar-Java lemongrass production

The annual costs and returns of WG-lomisar-Java lemongrass were calculated based on specified wage rate for labor, input prices for inputs and revenues based on selling price of fresh herb lemongrass. The costs, returns and the share of costs per year are presented in Table 2 and chart 2 below.

As presented in table 2, the first-year cost of production of WG-lomisar-Java lemongrass for its herbal production was Birr 55,873.84, the second-year cost of production was Birr 11,827.96 per hectare and the third-year cost of production was Birr 10,314.97 per hectare. In terms of percentage the first year cost of cultivation accounts 71.62% of the overall cost, the second year cost of cultivation accounts 15.16% of the overall cost and the third year cost of cultivation accounts 13.22% of the overall cost in three years of WG-lomisar-Java production. This showed that the cost of production of WG-Lomisar-Java lemongrass was maximum in the first year, due to the existence of initial establishment costs, such as cost of plowing, planting material, land labeling and cleaning, and labor cost for planting, then it diminishes in the second and third and years of production as result of the absence of these costs. This result is in agreement with the study, Mittal and Singh (2007) reported that per hectare cost of cultivation of lemon grass (Cymbopogon flexuosus) is maximum in the first year, as compared to subsequent years due to high cost of planting material. This result is also comparable to the current study of Roy (2016) reported that the cost of cultivation of lemon grass (Cymbopogon flexuosus) is maximum during the initial year but declined substantially due to the absence of planting material cost. In a total of three years life of its production the maximum cost of production was planting material cost which was estimated to Birr 20,916.75 accounts 26.81% of the overall three years total cost and the minimum cost was first plowing cost which was Birr 3,130 which accounts 4.01% of the overall three years total cost of production. Moreover, the overall production cost of WG-lomisar-Java lemongrass for herbal production over three years of economic production life was Birr 78,016.77.

As presented in table 2, the first-year total revenue of WG-Lomisar-Java lemongrass was 83,600 birr/ha, which accounts 33.81% of the overall total revenue. In the second-year total revenue was 115,200 birr/ha, which is 46.59% of the overall total revenue. In the third-year total revenue was 48,450 birr/ha, this accounts 19.6% of the overall total revenue. The second-year total revenue was increase by 37.8% from the first-year total revenue. The third-year total revenue was decrease by 57.94% and 42.05% from the second and first year’s total revenues of WG-lomisar-Java lemongrass production respectively. The revenue diminished in third year because of the yield of fresh herb WG-lomisar-Java lemongrass decreased in its third years of production. The total revenue of the WG-
lomisar-Java in three years of its production was Birr 247,250. The net return from the production of WG-lomisar-Java lemongrass was 27,726.16 birr/ha in the first year, 103,372.04 birr/ha in its second year and 38,135.03 birr/ha in the third year. In line with this, the overall net return obtained from production of WG-lomisar-Java lemongrass was 169,233.23 birr/ha indicating that investing in production of WG-lomisar-Java lemongrass generates a positive net return. This indicates that investing in the cultivation of this plant is profitable.

**Table 2:** Per hectare costs and returns of WG-lomisar-Java production.

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Years</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>A. Fixed cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rent of tractor for first plowing (birr/ha)</td>
<td>3,130.00 (5.60)</td>
<td>3,130.00 (4.01)</td>
</tr>
<tr>
<td>B. Variable costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planting material/seedling cost</td>
<td>20,916.75 (37.44)</td>
<td>20,916.75 (26.81)</td>
</tr>
<tr>
<td>land labeling and cleaning</td>
<td>7,512.00 (13.44)</td>
<td>7,512.00 (9.63)</td>
</tr>
<tr>
<td>Planting (birr/ha)</td>
<td>5,164.50 (9.24)</td>
<td>5,164.50 (6.62)</td>
</tr>
<tr>
<td>Labor cost for watering (birr/ha)</td>
<td>2,851.43 (5.10)</td>
<td>2,851.43 (14.44)</td>
</tr>
<tr>
<td>Weeding and hoeing (birr/ha)</td>
<td>7,239.69 (12.96)</td>
<td>7,239.69 (27.96)</td>
</tr>
<tr>
<td>Harvesting cost (birr/ha)</td>
<td>1,771.58 (3.17)</td>
<td>1,771.58 (27.96)</td>
</tr>
<tr>
<td>Miscellaneous expenses (birr/ha)</td>
<td>7,287.89 (13.04)</td>
<td>7,287.89 (13.04)</td>
</tr>
<tr>
<td>Total costs (birr/ha)</td>
<td>55,873.84 (100)</td>
<td>55,873.84 (100)</td>
</tr>
<tr>
<td>Herbal Yield (Kg/ha)</td>
<td>83,600</td>
<td>115,200</td>
</tr>
<tr>
<td>Gross return at (1birr/kg)</td>
<td>83,600</td>
<td>115,200</td>
</tr>
<tr>
<td>Net return (birr/ha)</td>
<td>27,726.16</td>
<td>103,372.04</td>
</tr>
</tbody>
</table>

**Source:** field data, 2015-2018

**In this table:** numbers in brackets shows the share of each cost.
- **Total fixed cost (birr/ha)**
- **Total variable cost (birr/ha)**
- **Total cost (birr/ha)**

**Chart: 1 Cost of production of W. lomisar-Java lemongrass**

*Source: field data, 2015-2018*

*In this chart, the costs beyond year three (to the right year three) show the overall total cost of W. lomisar-Java Cultivation.*

**Financial Feasibility**

The financial feasibility of WG-lomisar-Java lemongrass was investigated by using of investment analysis criteria. Among the criteria, the Net present value (NPV) and benefit cost ratio (BCR) was applied to analyze the feasibility of the WG-lomisar-Java lemongrass for its herbal production. Market interest rate which is 9.5% was used to calculate the discount factor. Based on this, as presented in Table 3, the NPV was Birr 140,579.80, which is a positive number, indicating that investing on WG-lomisar-Java lemongrass production for fresh herbal production is financially feasible. Similarly, the BCR was Birr 3.04 which is greater than 1; indicates that a 1-birr investment in WG-lomisar-Java lemongrass production yielded a net benefit of Birr 2.04. The result revealed that in both measures investing in WG-lomisar-Java lemongrass cultivation for herbal production is financially feasible.

**Table 3: financial feasibility analysis of WG-lomisar-Java lemongrass**

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Years</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total revenue (birr/ha)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>83,600</td>
<td>115,200</td>
</tr>
<tr>
<td>Total costs (birr/ha)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>55,873.84</td>
<td>11,827.96</td>
</tr>
<tr>
<td>Discounted total revenue</td>
<td>76,347.03</td>
<td>96,078.06</td>
</tr>
<tr>
<td>Discounted total costs</td>
<td>51,026.34</td>
<td>9,864.65</td>
</tr>
<tr>
<td>NPV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** field data, 2015-2018

Cost benefits Analysis of lemongrass (*Cymbopogon citratus* (DC) Stapf.) variety: WG-Lomisar-Java for herbal production at Wondogenet
Sensitivity Analysis

In this section the sensitivity of WG-lomisar-Java lemongrass production is presented. The sensitivity analysis is used to examine how sensitive is the production of WG-lomisar-Java lemongrass to the fluctuations of selected variables. The sensitivity of production was tested in the following scenarios of WG-lomisar-Java lemongrass production assuming other variable constant.

1. When herbal yield of WG-lomisar-Java lemongrass decreased by 10%.
2. When the price of WG-lomisar-Java lemongrass decreased by 10%
3. When costs of production of WG-lomisar-Java lemongrass increased by 10%.
4. When costs of production increased by 10% and herbal yield of WG-lomisar-Java lemongrass decreased by 10%.
5. When costs of production increased by 10% and price of WG-lomisar-Java lemongrass decreased by 10%.
6. When both herbal yield and price of WG-lomisar-Java lemongrass decrease by 10%.
7. When herbal yield and price of WG-lomisar-Java lemongrass decreased by 10%, and costs of production increased by 10%.

Applying the above listed scenarios, the effect of variables to the net present value (NPV) and benefit cost ratio (BCR) of WG-lomisar-Java lemongrass production were examined as presented in the table 4 below.

As presented in the table 4, keeping other things constant;
1. When yield decreased by 10% and
2. Price decreased by 10% separately,

In a total of three years of production, when herbal yield WG-Lomisar-Java lemongrass decreased by 10% and price decreased by 10% separately, the Net present value (NPV) was Birr 119,647.08, which is a positive number. It indicates that investing in WG-lomisar-Java lemongrass is financially feasible regardless these changes. On the other hand, benefit cost ratio (BCR) was Birr 2.74. It shows that if 1 birr is invested in the production of WG-lomisar-Java lemongrass yielded a net benefit of birr 1.74. This indicates that production is financially feasible as BCR was greater than one in these two scenarios.

3. When costs of production WG-lomisar-Java increased by 10%

In this case the Net present value (NPV) was Birr 105,445.01, which is a positive number. It indicates that with this change investing in WG-lomisar-Java lemongrass is financially feasible. On the other hand, benefit cost ratio (BCR) was Birr 2.57. It shows that if 1 birr is invested in the production of WG-lomisar-Java lemongrass yielded a net benefit of birr 1.57. Thus, the result BCR indicates that production is financially feasible, as it was greater than one.

4. When Costs increased by 10% and yield decreased by 10%
5. When Costs increased by 10% and price decreased by 10%

When costs increased by 10% and yield decreased by 10% and when costs increased by 10% and price decreased by 10% separately, production of WG-lomisar-Java lemongrass provided a Net present value (NPV) of Birr 88,202.50, which is a positive number. It indicates that investing in WG-lomisar-Java lemongrass is still financially feasible. On the other hand benefit cost ratio (BCR) was Birr 2.32. It shows that if 1 birr is invested in the production of WG-lomisar-Java lemongrass yielded a net benefit of birr 1.32. Thus the result indicates that production is financially feasible as BCR was greater than one.

6. When price and Yield decreased by 10%

When price and yield of WG-lomisar-Java decreased by 10% it provided a Net present value (NPV) of Birr 100,807.63, which is a positive number. It shows that even though these changes occur, investing in WG-lomisar-Java lemongrass is financially feasible. On the other hand, benefit cost ratio (BCR) was Birr 2.47. This shows that if 1 birr is invested in the production of WG-lomisar-Java lemongrass it yielded a net benefit of birr 1.47. Thus, the BCR suggest that production is financially feasible as it was greater than one. This shows that production is still financially feasible.

7. When Yield and price decreased by 10%, and costs increased by 10%

When both price and yield of WG-lomisar-Java lemongrass decrease by 10% and costs of production increased by 10% it provided a Net present value (NPV) of Birr 72,684.24 which is a positive number. It indicates that even though these changes occur, investing in WG-lomisar-Java lemongrass is still financially feasible. On the other hand, benefit cost ratio (BCR) was 2.09. It shows that if 1 birr is invested in the production of WG-lomisar-Java lemongrass it yielded a net benefit of birr 1.09. indicates that production is still financially feasible as BCR was greater than one. This shows that production is still financially feasible despite the occurrence of this worst scenario changes.

Generally, the sensitivity analysis in all selected scenarios revealed that the production of WG-lomisar-Java is still financially feasible.
CONCLUSION AND RECOMMENDATION

The study on cost benefit analysis of WG-lomisar-Java lemongrass has been conducted at Wondogenet Agricultural Research Center for three years. During the life of the experiment data were collected accordingly from the experimental site. Based on this the costs, benefits and financial feasibility of its production is examined. Thus, the study revealed that herbal production of WG-lomisar-Java lemongrass is financially feasible. The sensitivity analysis on selected scenarios also revealed that the herbal production of the plant is still financially feasible. So the herbal production of this plant can be used as one alternative to generate additional income.

Although lemongrass has a lot of uses in food, herbal remedies, cosmetics and pharmaceutical industries, in Ethiopia the production, processing and utilization of this plant is at its infancy. In line with this the market and market linkage is poor and is not sustainable. So it needs to create awareness about the plant for farming community and stake holders to involve in the sustainable production and processing of the plant. To strengthen sustainable production this plant; many processors of this plant should be created. In addition to this it needs to strengthen the market linkage between producer and processors of this plant.

ACKNOWLEDGEMENT

We would like to Acknowledge Wondogenet Agricultural Research Center Aromatic and Medicinal Research Program for its financial support. We would also like to thank our field assistant Sofonias Admasu and Gezahegn Erkeno for their unreserved contribution during data collection and recording.

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