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Cost benefit Analysis of lemongrass (cymbopogon citratus) variety: WG-Lomisar-UA for herbal production

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The study was conducted at Wondogenet Agricultural Research Center experimental field from August 2014 to September 2017. The study was undertaken with the aim of examining the financial feasibility of WG-lomisar-UA lemongrass (Cymbopogon citratus) variety: WG-lomisar-UA for its herbal production. For this study WG-lomisar-UA lemongrass was planted on 100m^2 area of land with an intra and inter row spacing of 60cm. All cost and benefit data were collected during the production period by preparing data collection sheets. The study employed financial analysis methods such as Net Present Value (NPV) and Benefit Cost Ratio (BCR) to analyze feasibility of its production. The result revealed that, the herbal production WG-lomisar-UA lemongrass required a total cost of 60,172.78 birr/ha, and provided total revenue of 152,750 birr/ha, resulted net return of 92,577.22 birr/ha in its three years of cultivation. Moreover, net present value and benefit cost ratio was found 76,454.03 and 2.44 respectively indicating that production of WG-lomisar-UA lemongrass is financially feasible. Sensitivity analysis in selected scenarios revealed that production the plant is still financially feasible. These indicate that the herbal production of this plant was profitable.

Key Words: Feasibility study, WG-lomisar-UA, Wondognenet

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INTRODUCTION

The history of medicinal and aromatic plant (MAPs) utilization is as old as the beginnings of mankind (Mathe, 2014). Our forefathers used natural substances they could find in nature to ease and cure their sufferings and illnesses and to heal their wounds. This approach has survived in the traditional medicinal uses until today. Nearly 80% of the world population still relies on MAPs in their medications *(ibid)*. Medicinal and aromatic plants get attention across the world, because they offer a wide range of safe and cost effective, preventive and corrective therapies, which is useful for health (Suresh *et al.,* 2012).

Lemongrass (*Cymbopogon citratus*) belongs to family Poaceae or Gramineae, is a perennial growing aromatic grass native to West Indian (Paranagama, *et al.* 2003). Lemongrass (Cymbopogon citratus) is cultivated in Argentina, Brazil, Guatemala, Honduras, Haiti and other Caribbean islands, Java, Vietnam, Malaysia, Sri Lanka, Madagascar, Comoros; to a lesser extent in the Philippines, China, India, Bangladesh, Burma, Thailand and Africa (Wiss, 1997). Lemongrass widely cultured in tropical and subtropical countries as a source of essential

oil. In Peru it is used for preparing soft drinks and is used as an aromatic, pleasant tasting herbal tea all around its distribution area. The infusion or decoction of its aerial parts has widespread use for medicine. Lemongrass is recommended to treat digestive disorders, inflammation, diabetes, nervous disorders, and fever as well as other health problems. Its extracts have free radical scavenging effect; inhibit lipid peroxidation and anti-oxidant activity (Cheel, *et al.,* 2005).

Lemongrass is commonly used in Asian cooking. In Thailand and Indonesia, freshly ground lemongrass is added to spice pastes. The Vietnamese prepare their food at the dinner table, mixing meat with fresh herbs, and it is an essential herb at the table. Vietnamese add the fresh grass to broth in which mutton and beef are cooked. They also smoke meats with chopped grass. Dried lemongrass leaves are widely used as a lemon flavor ingredient in herbal teas, prepared either by decoction or infusion. Tea obtained from leaves of lemon grass is used for its anxiolytic, hypnotic and anticonvulsant properties. Lemongrass oil is used in culinary flavoring. It is used in most of the major categories of food including alcoholic and nonalcoholic beverages, frozen dairy desserts, candy baked foods, gelatins and puddings, meat and meat products and fat and oils. It is used to improve the flavor of some fish and can be used for sauces and to flavor wines (Joy, *et al,* 2006; Balanco *et al,* 2009). A tea of lemongrass leaves is used in Brazil and other Third World Countries as a popular remedy for various nervous and gastrointestinal disturbances (Lorenzetti, *et al.,* 1991).

Lemongrass is usually ingested as an infusion made by pouring boiling water on fresh or dried leaves and is one of the most widely used traditional plants in South American folk of medicine. It is used as an antispasmodic, antiemetic, and analgesic, as well as for the management of nervous and gastrointestinal disorders and for treatment of fevers (Zaman, et al., 2014). Lemongrass is used in the treatment of headaches, stomach aches, abdominal pain, and rheumatic pain (Giron et al., 1991). Lemongrass essential oil is an innovative and useful tool as alternative to the use of synthetic fungicides or other sanitation techniques in storage or packaging. Lemon grass oil with highest concentration inhabits fungal colony development for all the pathogens (Tzortzakis, and Economakis, 2007). Its oil also have been used both internally for alleviating colds and fever symptoms; and externally to treat skin eruptions, wound and bruises. The plants essential oils in general have been recognized as an important natural source of pesticides and insecticides. Liquid paraffin solutions of lemongrass oil exhibited concentration-dependent repellency of Mosquito. High concentrations (20%-25%) provided complete (100%) protection lasting 1h. Lower concentrations (1–15%) also exhibited total repellency that was short-lived immediately following application of the respective solutions (Oyedele, *et al*., 2002).

Even though lemongrass has many use as culinary, medicinal and industrial inputs, the production and utilization of this plant is in infant stage in Ethiopia. On the other side there is limited information on feasibility of lemongrass production. Thus this study was designed to study feasibility of WG-lomisar-UA lemongrass herbal production. Thus this will provide information that helps and encourages the production the plant.

METHODOLOGY

The study was conducted at Wondogenet Agricultural Research Center, Southern Nations Nationalities, and peoples region of Ethiopia. The study was undertaken at wondogenet Agricultural Research Center experimental field for three years (August 2014 to September 2017). Geographical location of the study area ranges from 38^{o} 37'13"-38^{o} 38'20" East and 7^{o} 5'23"-7^{o} 5'52" North with an altitude range of 1760-1920 masl. Planting material used in the study was tillers of lemongrass *(Cymbopogon citrutus*) variety: WG-lomisar-UA*;* Thus planting materials were planted on the experimental field area of $100m^2$ and with inter and intra raw spacing of 60cm. To study the costs of WG-lomisar-UA lemongrass production: 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. All the necessary data were collected from Wondogenet Agricultural Research Center experimental field. The total amount of labor cost was calculated by using wage rates that were fixed by Wondogenet Agricultural Research Center. In addition to this, planting material and plowing costs was recorded. The total cost of production was obtained through adding all these costs. To calculate the revenue of production, 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 its price to calculate the total revenue. Finally, all the information was converted to a per hectare basis for the final analysis. All cost and benefit data were recorded in Ethiopian Birr. To examine the feasibility WG-lomisar-UA 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 to analyze 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=Q*P …… **(1)**

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

Total cost (TC)

TC= PC+MC+ CP+LC…… **(2)**

Where:

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

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 = Present worth of Benefit Stream - Present Worth of Cost Stream.

Mathematically, it can be shown as:

$$\mathrm{NPV} = \sum_{t=0}^{n} \frac{(\mathrm{Bn}-\mathrm{Cn})}{(1+\mathrm{r})^{\mathrm{n}}} \quad \text{(4)}$$

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-UA 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=Sum of the present worth of benefit **/** Sum of the present worth of costs

Mathematically, it can be shown as:

$$\mathrm{BCR}=\frac{\sum_{t=0}^{n} \frac{Bn}{(1+r)^{n}}}{\sum_{t=0}^{n} \frac{Cn}{(1+r)^{n}}} \quad \text{(5)}$$

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-UA lemongrass is feasible if **BCR** is greater than 1. If it is less than one, it indicates that the production of WG-lomisar-UA lemon grass is not feasible.

RESULTS AND DISCUSSION

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

Yield of WG-Lomisar-UA lemongrass production.

As it is presented in Table 1, the fresh herb yield of WG-Lomisar-UA lemongrass was **62,350** Kilogram per hectare in the first year of cultivation, 52,450 kilogram per hectare for second year and **37,950** kilogram per hectare in third year's cultivation. Which shows yields of WG-lomisar-UA lemongrass had decreasing trends in subsequent years of cultivation; this is because of the plants of WG-lomisar-UA lemongrass died due ageing and other related natural factors though the life time of the cultivation. It shows that herbal yield in the second year decreased by 15.88% from the first year, and the herbal yield in third year decreased by 27.65% and 39.13% from the second and first year of cultivation respectively. In three years of Cultivation WG-Lomisar-UA lemongrass yielded a total fresh biomass of **152,750** kilogram per hectare, and an average of 50,916.67 kilogram per hectare per year.

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

Plant name	Years of cultivation	Fresh herb yield (kg/ha)
WG-Lomisar-UA lemongrass	I	62,350.00
	II	52,450.00
	III	37,950.00
Total production (kg/ha)		152,750.00
Average yield per Year (kg/ha)		50,916.67

Source: *field data, 2014-2017*.

Table 2: costs and returns of WG-lomisar-UA lemongrass production.

Particulars	Years of cultivation			Total
	1	2	3	
Fixed cost				
Rent of tractor for first plowing and harrowing (birr/ha)	1,840 (4.18)			1,840 (3.06)
Variable costs				
Planting material/tillers cost (birr/ha)	26,010 (59.07)			26,010 (43.23)
Land labeling and cleaning (birr/ha)	677.12 (1.54)			677.12 (1.13)
Planting cost (birr/ha.)	1,656 (3.76)			1,656 (2.75)
Watering cost of labor (birr/ha)	1,577.28 (3.58)	1,577.28 (18.14)	903.55 (12.14)	4,058.11 (6.74)
Weeding and hoeing (birr/ha.)	4,811.20 (10.93)	3,306.67 (38.02)	1,930.27 (25.94)	10,048.13 (16.70)
Harvesting per (birr/ha.)	1,719.47 (3.90)	2,678.40 (30.80)	3,636.93 (48.87)	8,034.80 (13.35)
Miscellaneous costs (15%)	5,743.66 (13.04)	1,134.35 (13.04)	970.61 (13.04)	7,848.62 (13.04)
Total costs (birr/ha)	44,034.73 (100)	8,696.70 (100)	7,441.36 (100)	60,172.78 (100)
Herbal Yield (Kg/ha)	62,350.00	52,450.00	37,950.00	152,750.00
Gross return at (1birr/kg)	62,350.00	52,450.00	37,950.00	152,750.00
Net return (birr/ha)	18,315.27	43,753.30	30,508.64	92,577.22

Source*: field data: 2014-2017*

(In this table: numbers in brackets shows the share of each cost)

Costs and Returns of WG-lomisar-UA lemon grass production

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

As it is presented in table 2, the first year cost of cultivation of WG-lomisar-UA lemongrass for herbal production was Birr 44,034.73 which accounts 73.18% of the overall total cost. The second year cost of cultivation

was Birr 8,696.70 which accounts 14.45% of the overall total cost of cultivation. The third year cost of cultivation was Birr 7,441.36 which accounts 12.37% of the overall total cost of cultivation. This showed that the cost of cultivation of WG-Lomisar-UA lemongrass was maximum in the first year and it diminished in the second and third and years of cultivation. In overall three years life of its cultivation the maximum cost of cultivation was planting material cost which was estimated to Birr 26,010 accounts 43.23% of the overall cost and the minimum cost was land leveling and cleaning cost which was Birr 677.12 accounts 1.13% of the overall cost of production.

The per hectare cost of cultivation of WG-Lomisar-UA lemongrass was maximum during the first year, because of the presence of initial costs such as cost of plowing, planting material, land labeling and cleaning, and labor cost for planting; but declined substantially in the second and third years of cultivation due to the reduction of those initial costs. Moreover, the overall cultivation cost of WG-lomisar-UA lemongrass for herbal production over the three years of production life was Birr 60,172.78.

On the other hand, the first year total revenue of WG-Lomisar-UA lemongrass was Birr 62,350 Which accounts 40.82% of the overall total revenue. In the second year total revenue was Birr 52,450 which is 34.34% of the overall total revenue. In the third year total revenue was Birr 37,950 this accounts 24.84% the overall total revenue. The second year total revenue decrease by 15.88% from the first year total revenue. The third year total revenue decreased by 27.65% and 39.13% from the second and first year total revenues of WG-lomisar-UA lemongrass cultivation respectively. This decreasing trend of revenues occurs due to the diminishing yield trends of the WG-lomisar-UA lemongrass cultivation. Thus total revenue in three years of the cultivation was Birr 152,750.

The net return in the cultivation WG-lomisar-UA lemongrass was **18,315.27** birr/ha for the first year, **43,753.30** birr/ha in its second year of cultivation and **30,508.64** birr/ha in the third years of cultivation. In addition to this, the overall net return obtained from cultivation of WG-lomisar-UA lemongrass was **92,577.22** birr/ha indicating that investing in production of WG-lomisar-UA lemongrass generates a positive net return.

Financial Feasibility

The financial feasibility of WG-lomisar-UA 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-UA lemongrass for its herbal production. Market interest rate which was **9.5%** used to calculate the discount factor. Based on this, as presented in Table 3, the NPV was **76,454.03** which is a positive number**,** indicating that investing on WG-lomisar-UA lemongrass cultivation for herbal production is financially feasible. Similarly, the BCR was 2.44 which is greater than **1;** indicates that a 1 birr investment in WG-lomisar-UA lemongrass cultivation yielded a net benefit of Birr 1.44. The result revealed that in both measures investing in WG-Lomisar-UA lemongrass Cultivation for herbal production is financially feasible.

Sensitivity Analysis

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

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

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

As presented in the table 4, keeping other things constant;

1. When yield decreased by 10% and
2. Price decreased by 10% separately,

The production of WG-Lomisar-UA lemongrass, in a total of three years of production provided a net return of **77,302.22 birr/ha.** This shows in these two cases i.e. when yield decreased by 10% and price decreased by 10% independently, investing in WG-lomisar-UA lemongrass production is still profitable. Net present

Table 3: financial feasibility analysis of WG-lomisar-UA lemongrass

Particulars	**Cultivation Years**			**Total**
	1	2	3	
Total revenue	62,350	52,450	37,950	152,750
Total costs	44,034.73	8,696.70	7,441.36	60,172.78
Discounted total revenue	56,940.64	43,743.88	28,904.76	129,589.28
Discounted total costs	40,214.36	7,253.14	5,667.74	53,135.24
		NPV		76,454.03
		BCR		2.44

Source: *field data 2014-2017*

Table 4: Sensitivity Analysis of WG-lomisar UA lemongrass production

No	Scenarios change	Net return (birr/ha)	Net present value (NPV)	Benefit cost ratio (BCR)
1	Yield decreased by 10%	77,302.22	63,495.11	2.19
2	Price decreased by 10%	77,302.22	63,495.11	2.19
3	Costs of increased by 10%	86,559.94	71,140.51	2.22
4	Costs increased by 10% and yield decreased by 10%	71,284.94	58,181.58	2.00
5	Costs increased by 10% and price decreased by 10%	71,284.94	58,181.58	2.00
6	When price and Yield decreased by 10%	63,554.72	51,832.07	1.98
7	Yield and price decreased by 10%, and costs increased by 10%	57,537.44	46,518.55	1.80

Source: *field data 2014-2017*

value (NPV) was **63,495.11** which is a positive number. It indicates that investing in WG-lomisar-UA lemongrass is financially feasible regardless these changes. Similarly benefit cost ratio (BCR) was 2.19. This indicates that production is financially feasible as BCR was greater than one. It shows that if 1 birr is invested in the production of WG-lomisar-UA lemongrass yielded a net benefit of birr 1.19 in this scenario.

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

Net returns of production was **86,559.94** birr/ha**.** This shows that even though all costs of production increased by 10%, production of WG-lomisar-UA lemongrass is still profitable. The Net present value (NPV) was **71,140.51** which is a positive number. It indicates that with this change investing in WG-lomisar-UA lemongrass is financially feasible. Similarly benefit cost ratio (BCR) is **2.22**. This indicates that production is financially feasible, as BCR was greater than one. It shows that if 1 birr is invested in the production of WG-lomisar-UA lemongrass

yielded a net benefit of birr 1.22.

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

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

The production of WG-lomisar-UA lemongrass had net return **71,284.94** birr/ha. It indicates that despite those changes its production were profitable. Net present value (NPV) was **58,181.58** which is a positive number. It indicates that investing in WG-lomisar-UA lemongrass is still financially feasible. Similarly benefit cost ratio (BCR) was **2.00**. This indicates that production is financially feasible as BCR was greater than one. It shows that if 1 birr is invested in the production of WG-lomisar-UA lemongrass yielded a net benefit of birr **1.00.**

6. When price and Yield decreased by 10%

Production of WG-lomisar-UA lemongrass had net return **63,554.72** birr/ha. It indicates that even though yield and price decreased by 10% production is still profitable. Net present value (NPV) is **51,832.07** which is a positive number. It shows that even though these changes occur, investing in WG-lomisar-UA lemongrass is financially feasible. Similarly benefit cost ratio (BCR) was **1.98**. This indicates that production of lemongrass is financially feasible as BCR was greater than one. It shows that if 1 birr is invested in the production of WG-lomisar-UA lemongrass yielded a net benefit of birr **0.89.**

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

The production of WG-lomisar-UA lemongrass had net return **57,537.44** birr/ha. It indicates that even though yield and price of WG-lomisar-UA lemongrass production decreased by 10% and its cost of production increased by 10%, production still profitable. Net present value (NPV) was **46,518.55** which is a positive number. It indicates that even though these changes occur, investing in WG-lomisar-UA lemongrass is still financially feasible. Similarly benefit cost ratio (BCR) was **1.80**. This also indicates that production of lemongrass is still financially feasible as BCR was greater than one. It shows that if 1 birr is invested in the cultivation of WG-lomisar-UA lemongrass yielded a net benefit of birr **0.80.**

CONCLUSION AND RECOMMENDATION

The feasibility WG-lomisar-UA lemongrass has been conducted at Wondogenet Agricultural Research Center for three years. During the period of the cultivation data were collected accordingly from the experimental site. Based on this the costs, benefits and financial feasibility of its production is examined. The study revealed that herbal production of WG-lomisar-UA lemon grass is financially feasible and every stake holders should be made aware about this fact. Accordingly the plant can be taken as one alternative to generate additional income.

Even though lemongrass has many uses in food, cosmetics and pharmaceutical industries, in Ethiopia awareness about the plant, the market condition and market linkage is limited. So it needs to create awareness for stake holders to improve the production and processing of the plant. Especially processes of the plant should be involved to encourage the production and marketing WG-lomisar-UA lemongrass. In addition to this all stake holders should play their part to create and strengthen sustainable production and utilization of the plant.

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