Profitability Analysis of Citronella Grass (Cymbopogon winterianus) Cultivation for Herbal Production: The Case of Wondo Genet District, Southern Ethiopia

Guta Bukero  Zeyituna Abe  Mulukén Philipos
Ethiopian Institute of Agricultural Research, WGARc
Agricultural Economics Research Process, P.O.Box, 198, Shashemene, Ethiopia

Abstract
Aromatic plants are plants that possess aromatic compounds, most of which are essential oils which are volatile at room temperature. They can be used as raw materials for extraction of essential oils which, in turn, are used in the flavor and fragrance industries, as well as the sources of spices, herbs, and other natural products such as traditional medicines, pharmaceuticals, cosmetics, botanical pesticides, insect repellents, herbal teas/drinks, etc. Aiming to this, Wondo genet agricultural research center (one of the centers of Ethiopian institute of agricultural research)is responsible in doing research, promoting and coordinating aromatic, medicinal and bio energy plants at national level including other research activities on soil and water, livestock, forestry, and other food crops. In Ethiopia; other than the traditional aspect, the scientific aspect of aromatic and medicinal plants is not well known and little has been done on their economic contribution to households. Therefore Wondo genet agricultural research center has been done cost-benefit analysis for a selected aromatic grass namely Cymbopogon winterianus at wondo genet experimental site. The selected plant was planted based on its recommended spacing at wondo genet experimental site and the required data was collected. For the analysis net return to land (birr/ha) was used as a parameter. The analysis shows that, the selected aromatic grass provides the net return of which is 80417.32 birr/ha at fresh biomass price of 1 birr. The NPV and BCR for Nardos grass was found to be: 76,858.5 and 2.3 respectively.

Keywords: BCR, Benefit, Citronella grass/ Cymbopogon winterianus, Cost and NPV
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1. Introduction
Aromatic plants are plants that possess aromatic compounds, most of which are essential oils which are volatile in room temperature. They have traditionally been used as raw materials for extraction of essential oils which, in turn, are used in the flavor and fragrance industries, as well as the sources of spices, herbs, and other natural products such as traditional medicines, pharmaceuticals, cosmetics, botanical pesticides, insect repellents, herbal teas/drinks, etc. And they are plants that possess odorous volatile substances which occur as essential oil, gum exudates, balsam and oleoresin in one or more parts, namely, root, wood, bark, stem, foliage, flower and fruit.

1.1. Production of Cymbopogon winterianus
1. Cymbopogon Winterianus (Citronella grass): is an aromatic grass belonging to the family Gramineae and genus Cymbopogon. Citronella grass is a tufted perennial grass, the leaves of which on distillation give a yellowish –brown essential oil with citrus odor. Citronella oil serves as a starting material for the extraction of geraniol and citronellal which can be converted into aroma chemicals such as citronellol, hydroxy citronellol, synthetic menthol and esters of geraniol. These find extensive use in soap, perfumery, and flavoring industries throughout the world. Soaps, soap flakes, detergents, household cleansers, insecticides and other technical products are often perfumed exclusively with this oil.

1.2 Medicinal and Aromatic Plants World Market Volume
Generally, in the period 1991-2003, the reported average annual global exports of medicinal and aromatic plant material amounted on average to 467,000 tones, or approximately € 1.06 billion. The international trade was dominated by only a few countries: 80% of the worldwide imports were channeled to just 12 countries. Three international trade centers for botanicals could be recognized: the USA for North and South America, Hong Kong for Asia, and Germany for intra-European trade. Europe was responsible for one third of the annual global imports. Germany accounted for 12% of the total, and four other EU countries (France, Italy, the Unit United Kingdom and Spain) were among the major importers. In these countries, the raw material was mainly processed in each country’s industry, and then sold as finished products either on the domestic market or exported (CBI market survey 2008; FAO, 2004). The leading suppliers were Germany, Poland, China and the USA.
2. Objectives

1. To identify the cost and revenue of Citronella grass (Cymbopogon winterianus).
2. To provide information on cost and revenue of Citronella grass (Cymbopogon winterianus).

2.1 Description of study area

The analysis was conducted at Wondo Genet agricultural Research Center which is one of the centers of Ethiopian institute of agricultural research and is found in SNNPRS, in Sidama zone wondo genet woreda. It is located about 268km south of Addis Ababa and 14 km south east of Shashemene. Its geographical location and altitude ranges from 38° 37'13''-38° 38'20'' East and 7° 52'3''-7° 55'2'' North and 1760-1920 masl respectively. The center has been doing research activities on aromatic & medicinal plants and other crops, soil and water, livestock and forestry with focus on Aromatic and medicinal plants (Adugna et al 2010).

2.2 Methodology of the analysis

The study was conducted at Wondo Genet Agricultural Research Center (WGARC), Southern Nations, Nationalities and peoples region, Ethiopia in the Aromatic and Medicinal plants experimental field. Planting material used in the study was slip of citronella grass. To determine the production cost and benefit that would be obtained; the amount of labor cost for land clearing, plowing, watering and harvesting operations and cost of fertilizer and other material costs were recorded. In addition to this, yields per each harvest and overall total yields were recorded.

2.2.1 Data analysis

The data was analyzed by using simple cost accounting method. This analysis considers costs incurred and returns obtained during the economic life of the plant production. The analysis will help us to examine the economic contribution of Citronella grass (Cymbopogon winterianus). For this analysis net return to land (birr/ha), Net Present Value (NPV) and Benefit- Cost Ratio (BCR) was used for analysis (Guta et al., 2018).

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

\[
\text{Total revenue (TR)} = \text{Q} \times \text{P} \quad (i)
\]

\[
\text{Total cost (TVC)} = \text{PC} + \text{MC} + \text{CP} + \text{LC} \quad (ii)
\]

\[
\text{NR} = \text{TR} - \text{TC} \quad (iii)
\]

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

Net return to land (birr/ha) = Net Present Value (NPV) = Benefit cost ratio (BCR) = Net present value is simply the present worth of the cash flow stream.

3. RESULTS AND DISCUSSION

The fresh biomass yield of Citronella grass per hectare harvested for three (3) years is summarized in table 1 as follows.

| Frequency | 1\text{st} | 2\text{nd} | 3\text{rd} | 4\text{th} | 5\text{th} | 6\text{th} | 7\text{th} | 8\text{th} | 9\text{th} | 10\text{th} | 11\text{th} | 12\text{th} | Total |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------|
|           | 2720      | 14500     | 18400     | 15300     | 16300     | 17200     | 9800      | 7000      | 16450     | 14960     | 6450      | 9700      | 148,780 kg |

Source: experimental field data, 2011-13

As indicated above, the bio mass of Citronella grass fluctuates i.e. it increases till 3rd harvest and decreases in the 4\text{th} harvest and again increases in the 5\text{th} harvest. The first harvesting time after planting for Citronella/Nardos grass was 3 months and the rest consecutive harvests were made after 2 months.
On the other hand, of the different costs of cultivating aromatic grasses weeding and hoeing cost share the largest production cost (on average 30% of the total production cost) in the case of Wondo Genet Agricultural research center. But this may vary from place to place depending on the severity of weed in the area.

Table 2. Returns of citronella grass in its individual economic life

| Item                          | Citronella grass |
|-------------------------------|-----------------|
|                               | Year 1 | Year 2 | Year 3 | Total   |
| Production in (kg)            | 67220  | 65410  | 22150  | 154780  |
| Price/kg (in Birr)            | 1      | 1      | 1      | 1       |
| Total Revenue                 | 67220  | 65410  | 22150  | 154780  |

1 USD = 17.5 ETB

Source: experimental field data, 2011-13
### Table 3: Costs from cultivating Citronella grass

| Particulars | Economic life (in years) | Sub total |
|-------------|--------------------------|-----------|
|             | 1 | 2 | 3 |          |
| **Fixed cost:** | | | |          |
| Rental value of a hectare of land @ 5000 Birr for one year for 3 years | 5000 | 5000 | 5000 | 15000 |
| Rental value of tractor @ 1700 Birr/ha (For Plowing and disk) | 1700 | 1700 | | |
| **Material cost:** | | | |          |
| Seedling cost @ 10 birr/kg @ 90kg/ha | 900 | 900 | | |
| Fertilizer cost @ 8.4 birr/kg @ 50kg/ha for 5 harvest for 1st year, 5 harvest for 2nd year and 5 harvest for 3rd year | 2100 | 2100 | 2100 | 6300 |
| **Labor charge for:** | | | |          |
| Land preparation @ 14.7 birr/man-day @ 62 man-days/ha | 911.4 | 911.4 | | |
| seedling preparation and planting @ 14.7 birr/man-day @ 97 man-days/ha | 1426 | 1426 | | |
| Watering @ 14.7 birr/man-day @ 17 man-days/ha/single round for 15 round in 1st year, 14 man-days/ha/single round for 15 round in 2nd year and 7 man-days/ha/single round for 12 round in 3rd year | 3748.5 | 3087 | 1234.8 | 8070.3 |
| Weeding and hoeing @ 14.7 birr/man-day @ 16 man-days/ha/single round for 22 round in 1st year, 10 man-days/ha/single round for 13 round in 2nd year and 8 man-days/ha/single round for 15 round in 3rd year | 5174.4 | 1911 | 1764 | 8849.4 |
| Harvesting @ 14.7 birr/man-day @ 22 man-days/ha/single round for 5 round in 1st year, 36 man-days/ha/single round for 5 round in 2nd year and 40 man-days/ha/single round for 5 round in 3rd year | 1617 | 2646 | 2940 | 7203 |
| Fertilizer application @ 14.7 birr/man-day @ 14 man-days/ha/single round for 5 round in 1st year, 12 man-days/ha/single round for 5 round in 2nd year and 12 man-days/ha/single round for 5 round in 3rd year | 1029 | 882 | 882 | 2793 |
| Fertilizer application @ 14.7 birr/man-day @ 24 man-days/ha/single round for 5 round in 1st year, 24 man-days/ha/single round for 5 round in 2nd year and 24 man-days/ha/single round for 5 round in 3rd year | 1764 | 1764 | 1764 | 5292 |
| **Total cost of herbage cultivation** | 25370.3 | 17390 | 15684.8 | 58,445.1 |
| **Miscellaneous costs (15%)** | 3805.5 | 2608.5 | 2352.7 | 8,766.8 |
| **Overall cost of herbage cultivation** | 29175.8 | 19998.5 | 18037.5 | 67,211.9 |

### Table 4: The Financial feasibility for Nardos / Citronella Grass

| Items | Economic Life (in Years) | Total |
|-------|--------------------------|-------|
|       | 1 | 2 | 3 | | |
| **Total fresh biomass yield** | 67220 | 65410 | 22150 | 154,780 |
| **Total value** | 67220 | 65410 | 22150 | 154,780 |
| **Overall cost of herbage cultivation** | 29175.8 | 19998.5 | 18037.5 | 67,211.9 |
| **Net return from herbage cultivation** | 38044.1 | 45411.5 | 4112.5 | 87,568.1 |
| **Discounted total value** | 61953.9 | 55562.9 | 17341.4 | 134,858.2 |
| **Discounted overall cost of herbage cultivation** | 21841.9 | 13957.9 | 12083.5 | 57,999.7 |
| **NPV** | | | | **76,858.5** |
| **BCR** | | | | **2.3** |

**NB:** The fresh biomass price of Citronella grass is 1 birr/kg

### 4. CONCLUSIONS

Even if the price of this aromatic grass is not set by the market, at the current price production of aromatic and medicinal plant is profitable. The major production cost for this aromatic grass is weeding and hoeing but it may vary from place to place.
Though this aromatic grass is profitable, it may doesn’t mean that it is economically viable. Because it is too difficult to study profitability comparison between this selected aromatic grass and major crops grown in the surrounding districts (i.e., wondo and wondo genet) because of price dynamism for those major crops due to their market existence.

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