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Research Article

Research Article: Profitability of Producing Early Generation Rice Seed Under Pawe Districts: Northwestern Ethiopia

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Abstract

This research was conducted on the profitability of producing early-generation rice seeds under pawe districts in northwestern parts of Ethiopia. Early-generation seed production is a promising business that can be a solution to increase rice productivity and farmers' income. However, limited technology use, soil preference of commodity, and limited rice seed multiplier companies and human resources often become obstacles to addressing improved seed for farmers, especially smallholder farmers. The main purpose of early-generation seed production is to maintain the genetic potential and identity of a variety and regular provision of high-quality breeder seed which is the basis for subsequent seed production. Variety maintenance, production, and distribution of the breeder, pre-basic, and basic seed are carried out by the public breeding institutions or private seed sector. Samples were taken f r o m rice seed farmers within two production seasons. This research aims to understand the economics of current seed production in the case of rice crops and provide basic information cost structure of EGS production for private and public enterprises. The analysis carried out includes cost analysis, income, and profitability analysis. The results showed that rice seed farmers were profitable with a 1.381 benefit-cost ratio and 27.58 profit margins. The total profit of one-hectare pre-basic seed production of rice was 47,433.565 which is the difference between total revenue (Price*Quantity =171939.39) and total cost (124,505.825).

Keywords

Profitability, Price, Cost, Production, Pre-basic Seed, Pawe

1. Introduction

Ethiopia's agriculture is the main driver of the country's economy, accounting for 79% of employment possibilities for the working-age population, more than 34.1% of GDP, 79% of foreign exchange revenues, and the majority of raw materials and capital used in market and investment [1]. Approximately 82% of Ethiopians are rural dwellers who depend on farming for their living. Ethiopia's large population necessitates a large amount of rice. The need for rice must be met by expanding the farming area and advancing technology, not just by imports. Given the progressively smaller amount of land, it is challenging to increase the farming area. [2]. The primary source of reliable feed and food factories, breweries, and oil

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manufacturers is agriculture. Notwithstanding its significance, the industry has encountered various obstacles in its efforts to augment its economic impact on the country.

Thus, employing superior technology in conjunction with premium seed can boost rice yield. One crucial component of farming that has a big impact on output is high-quality seed. With a few minor modifications, Ethiopia adopted the nomenclature for seed production and certification from the Organization for Economic Cooperation and Development (OECD): breeder seed, pre-basic seed, basic seed, and certified seed [3].

Ethiopia has a large population, which makes a large amount of rice necessary. Imports cannot be the only means of meeting the world's rice needs; broadening (growing the production area) and intensification (technical advancements) are also necessary. However, with the amount of available land growing more and more scarce, expansion is a challenging task. The most converted land type is agricultural land, particularly paddy fields [12]. As a result, there are relatively few opportunities to expand the area of land and the proportion of landowners who own land is decreasing [13].

Thus, employing high-quality seed and intensifying are two ways to increase the cultivation of rice. One vital component of farming that has a big impact on output is high-quality seed. In farms that are now in operation, the cost of seed is relatively inexpensive, accounting for just between one and three percent of total farming costs [14-16]. When growing rice, using high-quality seeds usually has a good effect and significantly increases output. [17-18]. Therefore, the use of high quality can support the increased national rice production.

Breeder seed, then, is a first-generation seed that is grown under the guidance of a plant breeder. The offspring of breeder seed, known as pre-basic seed, is specifically utilized for crops with low multiplication factors. Pre-basic seed's offspring, basic seed, is often only supplied to accredited seed sellers and companies. The offspring of basic seed, certified seed is created for the farmer's benefit. Although certified seed (C1) can be multiplied for an additional generation (Certified 2), Ethiopia recognizes C3 and C4, which differs from the OECD seed program.

Pre-basic seed can be created by further multiplying the breeder seed generated during the maintenance procedure. To produce certified seed on a wide scale, pre-basic seed can be multiplied into basic seed. Official seed quality assurance is applied to these two generations; seed lots are recognized by the seed certification agency after being tested against national field and seed standards and seed fields are inspected. Thus, early-generation seeds (EGS) include breeder seeds, pre-basic seeds, and basic seeds.

The majority of the time, public or commercial seed companies as well as research centers generate early-generation seeds. There has not yet been any research done on the economics of producing EGS in research centers. Every year, there was a noticeable rise in the demand for these pre-basic seeds, although it is unknown how much they cost. The agricultural research wing of the Ethiopian Institute of Agriculture decided to investigate the economics of EGS production using priority crops in the relevant centers.

Ethiopia only recently began to introduce rice; the country's efforts to do so were perhaps sparked by the discovery of wild rice in the marshy, flooded regions of the Gambella Plains and Fogera [4].

Given that the country's rice area under cultivation, production, and productivity have increased by 88%, 92%, and 34%, respectively, during the past 20 years, it is widely acknowledged that rice is important [6]. After maize, it is the second most productive cereal crop in terms of productivity [7]. It has demonstrated potential as one of the main crops that can significantly help to guarantee Ethiopia's food security.

Every region of Ethiopia is home to rice cultivation [5]. Amhara produced the most rice of any region that produced rice, accounting for almost 86% of the total.

Rice production was given appropriate consideration in the current five-year plan, GTP II. To guarantee food security, rice is regarded as a priority crop. This can be achieved by raising average productivity from 2.7 tons per ha in 2015 to 4.1 tons per ha in 2020 and by increasing total production from 1300 tons in 2015 to 2030 tons by 2020. In addition to rising rice yield and output, the nation has been importing a significant amount of rice to meet its domestic needs because domestic production only accounts for 30% of the total [5].

So, understanding the production economics and EGS of rice became crucial to illustrate potential technological investment planning paths that would boost output, encourage revenue generation, and assist new business ventures in realizing their full potential and closing the enormous demand gap.

Thus, under the Pawe Agricultural Research Center farm land stations, the study was developed to evaluate the profitability of EGS rice growing and to determine the expenses of production. As a result, the study would offer insightful information about the enterprise's input-output relationships and production cost components.

2. Objectives

2.1. General Objectives of the Study

To assess the economics of the Early Generation of rice Seed production.

2.2. The Specific Objectives of the Study

1) To understand the economics of current seed production in the study area.
2) To generate basic information on the cost structure of early-generation rice seed production for private and/or public seed growers.

3. Research Methodology

3.1. Description of the Study Area

One of the EIAR institutes, Pawe Agricultural Research Centre (PARC), was established in 1986 with a focus on oil crops. The center is situated in the Metekel zone of Benishangul Gumuz regional the state's Pawe district—578 kilometers distance Pawe, located northwest of Ethiopia, from Addis Ababa. The district has 643,000 acres of total surface area and 60,206 people are displayed to live here (50.06% male and 49.94% female). It is characterized as warm, humid lowland that gets a lot of rain from mid-May through October [8].

Because of its extreme demographic diversity large people mix and peaceful coexistence, it is a model distinctive woreda in the nation. Metekel neighbors Pawe in the south and west, and also on east and north by the Amhara region.

The annual mean rainfall was 1580mm, annual mean temperature ranges from 16.7 ℃ to 32.7 ℃ [9]. The farming system of the district is characterized as mixed crop-livestock farming system dominated by cereal and pulses crops. Major crops are soybean, rice, maize, ground nut, sesame, sorghum, finger millet and etc are cultivated in the district. Perennial fruit crops like mango and papaya are widely grown in Pawe district [10].

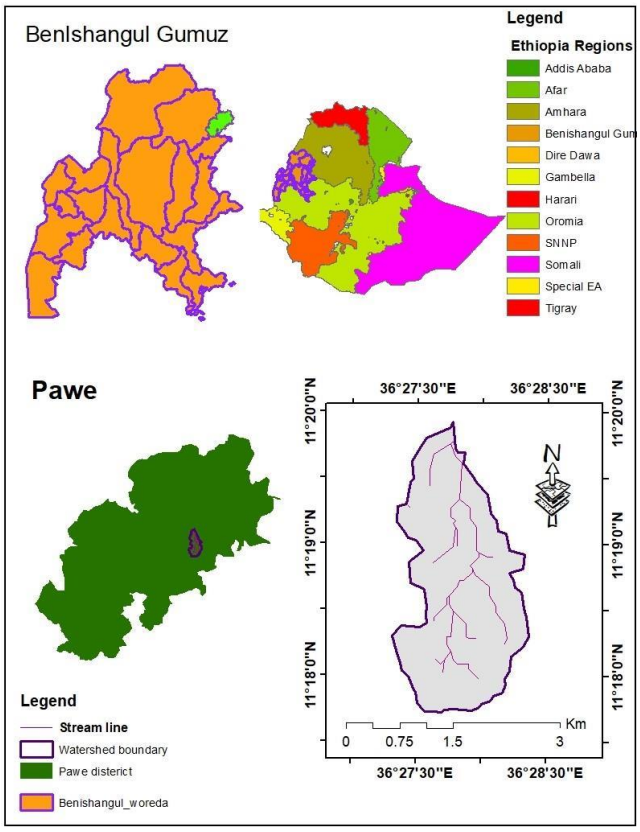

Figure 1. *Study area.*

3.2. Data Collection and Analysis

Both primary and secondary data were used in the course of the study. Using a predefined input-output recording format created by the researchers, the primary data were gathered from the on-station and each farming action along with the related expenses were recorded. Clearing the land, plow work, planting, harvesting, threshing, weeding, planting, applying fertilizer, and other tasks are included. In addition, input expenses were documented, including labor, fertilizer, seed, and the opportunity cost of the land. With the aid of a recording sheet which was routinely monitored by researchers, these data were gathered. The required expenses associated with seed production were recorded with the utmost care.

Secondary data comes from a variety of publications, notably reports provided by the Pawe Woreda Agriculture Office and magazines.

3.3. Gross Margin Analysis

To gain a greater awareness of the connection between sales revenue and cost structures, gross margin analysis was employed [11] and used to evaluate the viability of rice production enterprises to enable better decision-making.

Mathematically it is expressed as;

$$GM = TR - TVC \quad (1)$$

Where GM is gross margin per hectare, TR is total revenue calculated as the product of the prevailing market price per unit output and the amount of paddy and straw produced per hectare and TVC is total variable cost that varies with the level of production and includes expenditure on inputs like seeds, fertilizer and labor etc.

3.4. Sensitivity Analysis

To evaluate the risk-bearing capacity of rice production under various price and yield scenarios, a sensitivity analysis was conducted.

3.5. Break Even Analysis

Whether or not a business maximizes profits, it is frequently helpful to know the price (or output level) at which its total earnings must equal total cost. An analysis of break-even points may be used for this. The goal of this analysis is to identify the lowest production required for the business to break even.

Mathematically it is expressed as follows;

$$\text{Break} - \text{even sale price} = \frac{\text{Totalcost}}{\text{Total production (yield)}} \quad (2)$$

If unit farm-gate prices are higher than the break-even price, the farm operation makes an economic profit.

$$\text{Break} - \text{even yield} = \frac{\text{Totalcost}}{\text{Sale price}} \quad (3)$$

If per-hectare yields are higher than the break-even yield, the farm operation makes an economic profit.

4. Result and Discussion

On the station, Early Generation rice Seed production of pre-basic rice crops covered a total land of 1ha in the production year of 2013/14E.C.

4.1. Cost of Rice Production

The total amount of money spent on buying the various fixed and/or variable inputs needed for the production process is known as the cost of production. Therefore, the sum of money needed to buy the various constant and variable inputs used in the rice manufacturing processes is the cost of producing rice.

Because the cost of production in any given period includes the value of the resource services converted into a product in that single period rather than the value of the resource itself, the costs of production are typically calculated about a specific amount of product (per unit of output) in that particular period.

Among the materials employed in the creation were:

Resources classified as poly-period are those for which only a portion of their services are converted into goods during each unique production cycle. Tractor services, labor, and land are poly-period resources in our scenario.

Resources classified as "mono-period" are those that, like seeds or fertilizer, are a stock of services that are converted into production entirely during a single period. Fertilizers and seeds are resources within a single period.

Let's quickly go over the following topics before getting into the specifics of the cost of production principle: a) Explicit and implicit costs; and b) economic (opportunity cost).

A) Explicit and Indirect Expenses

Costs incurred by producers for the acquisition of various inputs are referred to as explicit costs.

Implicit Cost: The term implicit cost refers to the earnings of those employed resources, which belong to the owner him/herself in the production process. The value of self-owned inputs (implicit costs) should be inputted or estimated from what they could earn in their alternative use which is called the opportunity cost of that input.

Examples of these costs are:

1) The salary of the owner-manager,
2) Depreciation cost of a building that belongs to the owner of the farm,
3) Depreciation cost of a tractor or other fixed farm equipment, which belongs to the owner of the farm,
4) Interest forgone when the owner uses his capital in his farm, etc.

The total cost of production is the sum of explicit cost and implicit cost.

Economic (opportunity) cost =Explicit Cost +Implicit Cost

Opportunity cost means the value forgone because the resource was used for another purpose. In other words, it is the return that must be given up in the next best alternative use.

Labor: rice land preparation usually starts in mid-May of the production season. In our research center, the first plowing was done soon after the yield was harvested for easy plowing purposes. Land preparation (plowing, leveling, and row-making) was done by the operators.

The operator spent 6.09 hours on land preparations. According to Pawe's wage rate for the operator (100 Birr/day (8 hr)), he received 76 ETB.

The number of labor participated in planting was 48 (35 women and 13 men) for 188.57 hours. According to Pawe wage rate (50 Birr/day or 50 Birr for 8hr), they received 34,571.43 ETB.

The number of labor participated in fertilizer application (DAP and urea) was 6 (4 women and 2 men) for 20hr. As mentioned, the wage rate above them was 428.60ETB.

Usually, rice was recommended to weed two to three times. The EGS field was well prepared following the weeding done twice. The number of laborers was 554 (71 men, 483 women) for 51.3hr, with a total cost of 45,223.165ETB.

Harvesting (mowing, pile up) and threshing costs total birr of 3960.63 and 243.125 respectively. The number of laborers who participated in harvesting for 12.45hr and threshing for 19.45 hr was 98 (17 men, 81 women) and 1 man (thresher) respectively. Winnowing required 18 female daily laborers with a total birr of 2188.125. Women are good enough for winnowing operations.

Transportation from the field (collect for threshing purposes) and the seed to the store costs 1750 Birr.

Guarding of the rice field starting from planting up to storage, was one of the important farming operations. Four persons were employed for guarding (for field monitoring) starting from the date of sowing (17/10/2013) up to harvesting (15/3/2013) two for a day and the other for a night. They worked for 1800hr and each was paid 6,750 Birr.

The number of labor participated in bird guarding was 5 women for 132 hours. According to Pawe's wage rate for guarding (45 Birr/day or 45 Birr for 8hr), they received 2475 ETB.

Four persons for four months were contracted for guarding purposes one for a day and the other for a night. Each was paid 1500 Birr.

Input costs:

Seed is the most important input for agricultural operations. The seed class used for this activity was pre-basic with a variety named Pawe-1. The seed rate recommended for rice production is 80kg/ha. Following this rate 0.8qt was used. The price at the time of sowing was 21 Birr/kg (the price was fixed at the EIAR level). Hence, the seed costs 1680ETB.

Fertilizer is another input for agricultural operations. Both DAP and urea were applied for rice production. 100 kg/ha

DAP and 100 kg/ha urea were used for rice production. Following this rate 1qt DAP and 1qt urea were used. The price at the time of sowing was 18 Birr/Kg. Hence, the fertilizer costs 3600 (1800+1800) ETB.

Finally, we summarized the cost structure of rice production in the following table below.

Seed class: Pre-basic

Variety: Pawe-1

Area: 1ha

Table 1. Per hectare costs of EGS rice production.

No	Cost of items	Cost in ETB
1	Material cost	
	Seed	1680
	Fertilizer (DAP)	1800
	Fertilizer (Urea)	1800
	Fuel and lubricant	589.75
	Packing materials (sack)	600
	Chemicals used (Herbicide)	120
	Total material cost	6,589.75
2	Cost of Cultural Practices	
	Ploughing (operator)	31.25
	Leveling (operator)	22.375
	Row making (operator)	22.375
	Planting	34571.43
	Labor for Fertilizer application	428.60
	Weeding (round1+ round2)	45223.165
	Harvesting (mowing and Pileup)	3960.63
	Threshing and winnowing	2431.250
	Transporting	1750
	Guarding (field monitoring and bird guarding)	29,475
	Total cultural practice cost	117,916.075
	Total variable cost (TVC) =1+2	124,505.825

Source: own calculation

Table 2. Per Hectare Returns of EGS Rice Production.

No	Items	Output in Kg
1	Total yield (Paddy)	2997
2	Price per kg in Birr	56.87
3	Return (1*2)	170439.39
4	Straw	500
5	Price per qt	30
6	Return (4*5)	1500
7	Total Revenue (3+6)	171939.39

Source: own calculation

Table 3. Gross margin Analysis and profitability analysis.

No	Variables	Amount (estimated value)
1	Total Return (TR)	171939.39
2	Total Variable cost (TVC)	117,916.075
3	Total fixed cost (TFC)	6,589.75
4	Total cost (TC)(TVC+TFC)	124,505.825
5	Profit (TR-TC)	47,433.565
6	Gross Margin (TR-TVC)	54023.315
7	Benefit Cost Ratio (BCR) =1/4	1.381
8	Profit margin (%) =5/1*100	27.58
9	Break-even Yield (kg) =4/sale price	2189.31
10	Breakeven price (ETB) =4/yield	41.54

Source: own calculation

5. Conclusion and Recommendation

The study was designed to estimate the cost of production of EGS rice and assess its profitability in Pawe research center farm on-stations. The major cost component of rice was labor cost which took the maximum cost of the total variable cost of 117,916 in addition the highest total variable cost was operational costs of which the weeding cost was 45,223.165. This indicates that the sector lacks appropriate labor-saving technologies.

The total yield of pre-basic rice production in one hectare was 29.97 quintals i.e. 2997 kilograms. The total revenue of pre-basic rice seed was 171,939.39 birr with a seed price of 56.87 birr per kilogram and 30 birrs of straw per quintal out of 500 quintals.

The total profit of one-hectare pre-basic seed production of rice was 47,433.565 which is the difference between total revenue (P*Q =171939.39) and total cost (124,505.825). This result shows the production of rice pre-basic seed was prof-

itable with a 1.381 benefit-cost ratio and 27.58 profit margin.

6. Recommendation

1) The breakeven price and breakeven yield were 41.54 birrs and 21.8931 quintals respectively, so the sales price below 41.54 birrs was a loss and the yield below 21.89 quintals was a loss benefit-cost ratio less than 1.
2) The sale price of pre-basic rice seed should be greater than 41.54ETB to cover production cost.

Abbreviations

CSA	Central Statistics Agency
EAIR	Ethiopian Institute of Agricultural Research
EGS	Early Generation of Seed
FAO	Food and Agricultural Organization
MOA	Ministry of Agriculture
PARC	Pawe Agricultural Research Center
PDAO	Pawe District Agricultural Office

Author Contributions

Feleke Shitu Mekonnen: Formal Analysis, Investigation, Data curation, Methodology, Writing – original draft, Writing – review & editing

Belete Woundefiraw: Conceptualization, Resources, Supervision, Project administration

Data Availability Statement

The data is available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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