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Original article

# Optimizing coffee cultivation and its impact on economic growth and export earnings of the producing countries: The case of Saudi Arabia

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ABSTRACT

Coffee is one of the historical socioeconomic crops. It has received an increasing attention at the global level, due to its positive interlinkage with the economic growth and on the gross domestic product for most of the producing countries, particularly, developing and least developed countries. Saudi Arabia is one of the coffee producing countries that has a relative comparative advantage of coffee cultivation. Yet, coffee cultivation has not received as much attention in Saudi Arabia as that of producing countries around the world. This study aims to assess the current state of coffee cultivation in Saudi Arabia and to investigate the potential to optimize coffee cultivation in Saudi Arabia that maximizes the net national economic return and export earnings, given limitation of cultivated areas, local market activities, and international trade activities. The study statistically analyzed primary data collected from around (65) coffee farms and traders in the study regions at the south and southwest Saudi Arabia, and optimized coffee cultivation in Saudi Arabia using LINGO optimization software. Empirical results of the study revealed the great potential of Saudi Arabia to expand coffee cultivation at south and southwest regions to meet the escalating local demand and to increase its share at the world market up to 2%. Optimization of coffee cultivation in Saudi Arabia showed a high potential to meet the local demand for coffee by producing 80.07 thousand tons grown over 2861.78 hectares and to generate a net return equivalent to $395.72 million a year, which is equivalent to $138.28 thousand per hectare and $4.94 thousand per ton of coffee. Optimizing coffee cultivation will play a substantial role to increase market share of Saudi Arabia to about 1–2% of the world market by increasing its export volume, respectively, to about 69.66 and 112.56 thousand tons, the national net economic return by about $395.86 and $395.95 million a year, and the export earnings of coffee by about $219.43–354.57 million a year, which in turns, will serve the national strategic trend to diversify the economic base and lower the dependency of incomes generated from oil exportation.



## 1. Introduction

Coffee is one of the historical socioeconomic crops that has received an increasing attention at the global level. The share of coffee in total export earnings has a positive and significant reflection on economic growth (Yifru, 2015), and on the Gross Domestic Product (GDP) for most of the producing countries, particularly, developing and least developed countries (Seudieu, 2015). Fig. 1 shows the estimated share of coffee in GDP and total export earning in some selected producing countries in year 2013.

The sustainable development of coffee sector requires a considerable attention to full spectrum value chain of coffee from production to consumption at local and international markets. Private and public targeted investments are necessary to trigger a quantum increase of quantities produced of coffee and improve quality premiums in international markets (Minten et al., 2014).

According to a number of 2013 estimates, the total produced coffee reached about 8.89 million tons, grown on an area of about 10.60 million hectares (FAO, 2016). South America reserves about 43% of the total world coffee production, followed by Asia and Oceania with 33% (ICO, 2015). Brazil and Vietnam are the two largest producers and exporter of coffee worldwide, reserving about 33.34% and 14.92% in the worldwide production of coffee,

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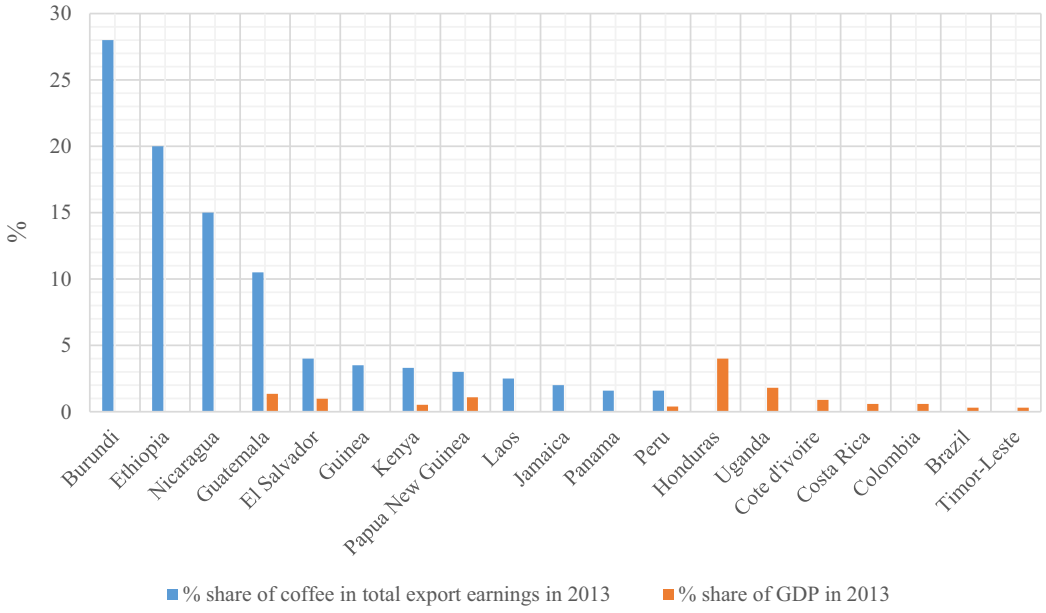



Source: reproduced from Seudieu, 2015.

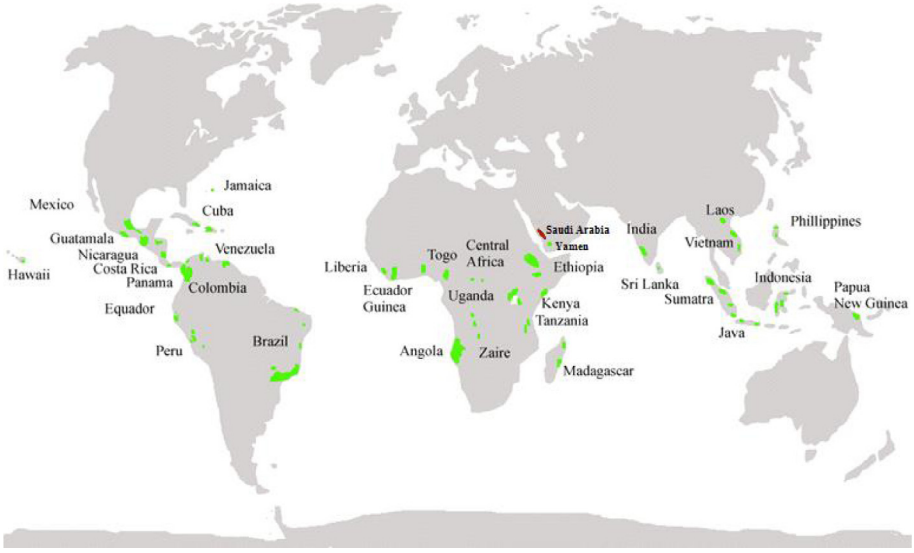
**Fig. 1.** The estimated share of coffee in GDP and total export earning in some selected producing countries in year 2013.

and about 24.39% and 18.76% from the total worldwide exported coffee that reaches about 6.97 million tons in year 2013, respectively (FAO, 2016). Fig. 2 shows the world coffee production map.

Previous economic analysis of coffee showed that positive and negative shocks had different impacts on price return volatility of Arabic coffee. Such impacts were persistence and asymmetrical, and had a reflection on coffee markets. Accordingly, producing countries of coffee should introduce proper strategic instruments of hedging to minimize the persistency and asymmetrical impacts on price return volatility of Arabic coffee, which in turns, would trigger additional investments at Arabic coffee markets (da Silva and Ferreira, 2015).

Many factors, including, application of traditional farming practices, missing of specialized extension institutions, and the existence of competing crops to coffee have impacted production and marketing value chain of coffee from production to final consumption at local and international markets. Thus, improving the value chain of coffee required robust interlinkages between its actors, improvement of standard quality level, and setting a clear coffee value chain governance (Amamo, 2014).

On the other hands, the performance of coffee cooperatives and their economic contributions in developing countries were assessed, showing that their contributions are limit and inefficient. That is, mainly, due to the limited financial resources, untimely




Source: reproduced from Gardfoods, 2016.

**Fig. 2.** World coffee production map, reproduced from Gardfoods, 2016.

credit services available to cooperatives, the dependency of cooperative members on lending agencies, shortage of capital, and physical and technical challenges. Minimizing the financial effects on cooperatives required the establishment of funding institutions that facilitate access to credit (Karunakaran and Mekonnen, 2013; Mengistu, 2015).

The structure and performance of coffee export sector in Ethiopia was studied, showing that export earning of coffee is progressing dramatically due to the increases of coffee prices at the world market, and the export earing could be further enhanced thru increasing produced quantities and improving quality of coffee that comply requirements of the international markets (Bart, et al., 2014). The economics of coffee production in Hawaii was investigated, including, production, costs, sales, profitability, and labor usage in coffee farms. The investigation showed that coffee farming in Hawaii is profitable and efficient in general, and taxes and interest represent major cost components for small farms, while, labor represents the major cost items for large farms (Woodill et. al., 2014).

There are about 124 species of the genus coffee (Davis et al., 2011). However, only three of these species are responsible for all the world production of coffee (*C. arabica* (arabica coffee), *C. canephora* (robusta coffee), and *C. liberica* (Liberica coffee, or excelsa coffee) (Davis et al., 2004, 2006). *Coffea arabica* is the most important species in term of economic production since it is responsible for about (62–75%) of the world coffee production (Anthony et al., 2002; Bertrand et al., 2002; Dias et al., 2007).

Coffee Arabica originates from the rainforests in the highlands of Africa (e.g. Ethiopia), and has been introduced to the south of Arabian Peninsula (e.g. the seaport of Mocca in Yemen) since AD 500s (Anthony et al., 2002; Pohlan and Janssens, 2010). After that, Coffee Arabica spreads over the south part of Arabian Peninsula (Yemen and southwest of Saudi Arabia). The suitable environmental conditions helped coffee to grow in the highland of the southwestern part of Assarawat Mountains in Saudi Arabia (from Jazan province south until Shada mountain- in Al-Baha province north, see Fig. 3).

### 1.1. Study statement

Despite the relative comparative advantage of coffee cultivation in large areas south and southwest of Saudi Arabia and the growing demand for coffee at the local markets, coffee cultivation in Saudi Arabia has not received attention as much as that of the world. Accordingly, Saudi Arabia becomes a net coffee importing country, with an average volume of about 38.25 thousand tons at about US$ 137.29 million in the year 2013 (FAO, 2016).

As a first study in its nature that discusses coffee cultivation in the region from different perspectives, this study is assumed to pave venues for investors to expand coffee cultivation in Saudi Arabia, and to contribute significantly to the national strategic trend to diversify the economic base that has been inspired to lower the dependency of incomes generated from oil exportation as a major driver of development. The main aims of this study are to assess the current state of coffee cultivation in Saudi Arabia and to investigate the potential to optimize coffee cultivation in Saudi Arabia that maximizes the net national economic return and export earnings, given limitation of cultivated areas, local market activities, and international trade activities.

## 2. Material and methods

A field survey was conducted to collect primary data from coffee farmers and traders at regions of coffee farming in Saudi Arabia, namely, Al Baha, Jazan, and Aseer. The field survey covered a total number of (65) coffee farmers and traders from the study regions, Fig. 3.


**Fig. 3.** Coffee cultivation regions in Saudi Arabia.

**Table 1**
Inputs of the coffee cultivation optimization baseline model – Saudi Arabia.

| National average | Average | Study Regions | | | Unit | Description |
|---|---|---|---|---|---|---|
| | | Aseer | Jazan | Al Baha | | |
| | 84.53 | 84.53 | 88.08 | 80.98 | 000$/ha | Operation cost |
| | 3.47 | 4.03 | 3.14 | 3.24 | 000$/ton | Operation cost |
| | 7.45 | 8.09 | 7.33 | 6.93 | 000$/ton | Local market price |
| | 24.67 | 21.00 | 27.98 | 25.02 | ton/ha | Productivity |
| | 4049.57 | 4589.9 | 6884.7 | 674.1 | Ha | Cultivated areas |
| Consumption | | | | | 000 ton | 80.07 |
| Import volume | | | | | 000 ton | 38.25 |
| Import value | | | | | 000$/ton | 3.59 |
| Export volume | | | | | 000 ton | 1.53 |
| Baseline export value | | | | | 000$/ton | 1.98 |

Source: field survey, national averages from FAO 2016.

The field survey used a predetermined questionnaire that contains (4) sections, including, general information about coffee farms and their location coordinates, annual production and productivity of coffee farms, annual production cost of coffee and its structure, and finally marketing information of coffee at the local markets. The collected primary data was analyzed qualitatively to assess the inputs of the coffee cultivation optimization baseline model. Table 1 shows variations among study regions in terms of operation costs of coffee production per hectare, operation costs of coffee production per ton, local market price, productivity, and cultivated areas, respectively, averaging $84.53 thousand per hectare, $3.47 thousand per ton, $7.45 thousand per ton, 24.67 ton per hectare, and 4049.57 hectare. Table 1 shows, also, that Saudi Arabia consumes about 80.07 thousand ton of coffee, imported about 38.25 thousand ton at $3.59 thousand per ton, and export or re-export about 1.53 thousand ton at $1.98 thousand per ton.

A sectorial mathematical model was built to optimize the one-year cropping pattern of coffee cultivation in Saudi Arabia that maximize the national net economic return, subject to cultivated area, local market activities, and international trade using LINGO modeling language and optimizer (LINGO, 2008). The built sectorial mathematical model was formulated in a four building blocks, namely, the objective function, resource constraints, national commodity balance of coffee, and national trade balance of coffee.

The objective function of the sectorial mathematical model was to determine the optimal one-year cropping pattern of coffee cultivation based on the comparative advantage in the major coffee-cultivation regions in the south and southwest of Saudi Arabia that maximize the national net economic return. The model maximized the national net economic return subject to the limited cultivated area, given marketing and trade balance constraints.

$$ER_c^t = -\sum_r PC_{cr}^t X_{cr}^t + \sum_r COSL_r^t - CIF_{cn}^t I_{cn}^t + FOB_{cn}^t E_{cn}^t \qquad for\ all\ r \tag{1}$$

where,

| | | |
|---|---|---|
| $ER_c^t$ | = | estimated net economic return of coffee (c) in Saudi Arabia, measured in US$1000 in year t. |
| $PC_{cr}^t$ | = | average production cost of coffee (c) in study region (r), measured in US$1000 per hectare in year t. |
| $X_{cr}^t$ | = | average production for coffee (c) in study region (r), measured in tons per hectare in year t. |
| $COSL_r^t$ | = | average quantity sold of coffee (c) in study region (r), measured in US$1000 in year t |
| $CIF_{cn}^t$ | = | average national (n) import value of coffee (c) in year (t), measured in US$1000 in year t. |
| $I_{cn}^t$ | = | average national (n) import volume of coffee (c) in year (t), measured in tons. |
| $FOB_{cn}^t$ | = | average national (n) export value of coffee (c) in year (t), measured in US$1000. |
| $E_{cn}^t$ | = | average national (n) export volume for coffee (c) in year (t), measured in tons. |
| $R$ | = | study regions (Al Baha, Jazan, Aseer) |
| $t$ | = | year 2013. |

Limitation of cultivated areas for coffee is the major resource constrain in the south and southwest of Saudi Arabia, thus, modeling the limited cultivated areas will ensure not to allocate more cultivated areas to coffee cultivation than the available level of cultivated area resources in the study regions.

$$\sum_i a_{icr}^t X_{icr}^t \le b_{irMax}^t \qquad for\ all\ i,\ r \tag{2}$$

where,

| | | |
|---|---|---|
| $a_{icr}^t$ | = | Input-output coefficients that state the amount of cultivated area resources (i) required to produce one hectare of coffee (c) in study region (r) in time (t), measured in hectares. |
| $X_{icr}^t$ | = | Annual yield for coffee (c) in study region (r), measured in ton per hectare. |
| $b_{irMax}^t$ | = | maximum amount of cultivated area resources available (i) in study region (r) in time (t), measured in hectares. |
| $t$ | = | time in terms of year. |

The national commodity balance states the annual total quantity sold of coffee at local markets and exported at the world market is less than or equal to the annual total quantities produced at the study regions and imported from world market.

$$\sum_r COSL_r^t + E_{cn}^t \le \sum_r COPR_r^t + I_{cn}^t \tag{3}$$

In addition, the national commodity balance confirms that total quantity sold at the local markets is equal to or less than the total consumption of coffee at national level.

$$\sum_r COSL_r^t \le COSL_{nMax}^t \tag{4}$$

Where,

| | | |
|---|---|---|
| $COSL_r^t$ | = | average quantity sold of coffee (c) in study region (r), measured in tons in year t |
| $E_{cn}^t$ | = | average national (n) export volume for coffee (c), measured in tons in year t. |
| $COPR_r^t$ | = | average production of coffee (c) in study region (r), measured in thousand tons in year t. |
| $I_{cn}^t$ | = | average national (n) import volume of coffee (c) in year (t), measured in tons in year t. |
| $COSL_{nMax}^t$ | = | average quantity consumed of coffee (c) at national level (n), measured in tons in year t |

The *national trade balance* states that the potential national import volume of coffee did not exceed the actual maximum limit for national imports annually, and the potential national export volume of coffee did not exceed the actual maximum limit for national exports annually, formulated mathematically as follows:

$$I_{cn}^t \leq I_{cnMax}^t \quad (5)$$

$$E_{cn}^t \leq E_{cnMax}^t \quad (6)$$

where,

| | | |
|---|---|---|
| $I_{cn}^t$ | = | potential national imports for coffee (c) in year (t), measured in tons. |
| $I_{cnMax}^t$ | = | actual maximum limits for national import volume of coffee (c) in year (t), measured in tons. |
| $E_{cn}^t$ | = | potential national export volume of coffee (c) in year (t), measured in tons. |
| $E_{cnMax}^t$ | = | actual maximum limits for national export volume of coffee (c) in year (t), measured in tons. |

The optimized model estimates the potential national net economic returns of coffee cultivation in Saudi Arabia under two scenarios, namely, the baseline model, and the export based model. The export based model estimates the potential of Saudi Arabia to increase its share in the world coffee export to about 1% and 2%, and the impact of the increased share in the national economy of Saudi Arabia.

## 3. Results and discussions

The field survey revealed a quit informative facts about coffee cultivation in Saudi Arabia that are presented under the following titles.

### 3.1. Current state

Coffee arabica trees are adapted to the tropical highlands habitats above 1000 meters above sea level altitude, and an annual temperature between 15 °C and 30 °C. It requires a prolonged rainy weather (e.g. rain period exceeds 6 months and rainfall ranges between 800 and 3000 mm) with relatively high temperature (Pohlan and Janssens, 2010). The current state of coffee cultivation in Saudi Arabia showed that coffee cultivation is spread over large areas south and southwest of Saudi Arabia. The farms of *coffee arabica* are located between about 17°N latitude (Jazan region) and about 20°N latitude (Shada mountain- in Al Baha region) and at elevations between 1000 and 2000 meters above sea level. The average of annual temperature in these regions range from 18 °C to 30 °C, and the annual rainfall range between 200 mm and 500 mm (Fifa Development Authority, 1993). Indeed, the available amount of rain is insufficient to meet the water needs for the cultivation of coffee. Accordingly, farmers in these regions make up for the shortage of water need through an additional irrigation water during the periods of drought (Hussain, 1990).

Water deficiency and heat stress are the main climatic limitations for coffee production in the regions of coffee cultivation in Saudi Arabia. The consequences of these limitations are expected to increase due to ongoing global warming (DaMatta and Ramalho, 2006). Thus, global warming will threaten the future of coffee crop. Climate changes can cause a significant loss in the suitable areas and productivity of coffee crop (Martins et al., 2016). Therefore, in order to increasing the productivity of coffee crop, the farmers should develop their agricultural terms by using some agricultural techniques. For example, farmers with farms at the low altitudes should use grafting of *C. arabica* on another Coffea species (e.g. *C. robusta* or *C. canephora*) that have greater tolerance abilities to grow at the harsh climate conditions (e.g. high temperature and water deficiency) at this low altitude (see Bertrand et al., 2002; DaMatta and Ramalho, 2006). Moreover, the breeding programs is also one of the techniques that could developed varieties of coffee can tolerate the changes in the climate and increase productivity (Rodrigues et al., 2014). Furthermore, recent studies show that the elevated $Co_2$ can mitigate the negative impacts of heat stress resulted from global warming (see Rodrigues et al., 2016; Gray and Brady, 2016; Martins et al., 2016; Martins et al., 2017). Implementing one or more of such developed agricultural techniques could contribute to improve the cultivation of coffee and increase its production under the environmental conditions of Saudi Arabia.

The estimated arable cultivation areas of coffee vary from region to region ranging from about (6884.7 ha) in Jazan region, followed by Aseer region with about (4589.9 ha), and about (674.1 ha) in Al Baha region. The estimated arable cultivation areas of coffee were assumed to represent about 10% of the total available arable cultivation areas in the study regions (General Authority for Statistics, 2015).

### 3.2. Economic indicators

The cost structure of coffee cultivation in Saudi Arabia comprises two major components, capital cost with an average of about $243.60 thousand per hectare and operational cost with an average of about $84.53 thousand per hectare. The capital cost of coffee cultivation is the highest at Al Baha region at about $307.02 thousand per hectare, followed by Aseer region with about $243.60 thousand per hectare, and Jazan region at about $180.19 thousand per hectare. On the other hands, operation cost at Jazan region is the highest at about $88.08 thousand per hectare, followed by Aseer region at about $84.53 thousand per hectare, and Al Baha region at about $80.98 thousand per hectare.

Per unit cost of coffee cultivation in Saudi Arabia was found comparable with that of world lead coffee producers. It was estimated at $3.80 per kilogram in Saudi Arabia (Al-Turki et al., 2013) compared to $3.67 in Brazil, and $3.06 in Kenya (ICO, 2015).

Profitability and investment measures showed promising net revenues of coffee cultivation in Saudi Arabia that generate about $132.88 thousand per hectare. In addition, the average return on investment was estimated at about 58.14% and 1.9 years payback period. Jazan region was found to be the most promising region for coffee cultivation in Saudi Arabia that generate a net revenue at about $150.96 thousand per hectare, return about 83.78% on investment, and 1.2 years payback period. Aseer region, on the other hand, ranked the second in terms of return on investment at about 48.24% and payback period at about 2.1 years, and ranked the third in terms of net revenue at about $117.50 thousand per hectare. While, Al Baha region ranked the second in terms of net revenue at about $130.18 thousand per hectare, and ranked the

third in terms of return on investment at about 42.40% and payback period at about 2.4 years. Table 2 shows a summary of cost structure, profitability, and investment measures of coffee cultivation in Saudi Arabia.

### 3.3. Optimized model

Optimizing coffee cultivation in Saudi Arabia using different sceneries revealed encouraging results that promote the expansion of coffee cultivation to meet the local demand for coffee and to increase the potential market share of coffee in the world market.

#### 3.3.1. Baseline scenario

The optimized baseline scenario model of coffee cultivation in Saudi Arabia showed a high potential to meet the local demand for coffee by producing about 80.07 thousand tons grown over 2861.78 hectares and to generate a net return equivalent to $395.72 million a year, which is equivalent to about $138.28 thousand per hectare and about $4.94 thousand per ton of coffee. No traded coffee activities were feasible at the optimized baseline model. Coffee producers receive higher prices at the local markets that average $7.45 thousand per ton of coffee compered to the export value that averages $1.98 thousand per ton. Furthermore, importing coffee at the world market rate equivalent to $3.59 thousand per ton is more costly than the production cost of coffee in Saudi Arabia averages at $3.47 thousand per ton. The optimized model showed that importing coffee at world market will be feasible by reducing the cost of import by about $442 per ton from the current import price.

#### 3.3.2. Export based scenario (1% market share)

Empirical results of the baseline model revealed that Saudi Arabia would be better off if focusing on producing coffee that meets the local consumption needs and not to trade any coffee at the world market unless the export price of coffee competes that at the local market price. The baseline model set the minimum competing export price at $3.15 thousand per ton, at which Saudi Arabia has the potential to increase its share to about 1% of the world market by increasing its export volume to about 69.66 thousand tons of coffee compared to about 1.53 thousand tons only. At this scenario, coffee production will reach about 149.73 thousand tons grown over 5.35 thousand hectares in Saudi Arabia. The total coffee production will cover the local consumption at about 80.07 thousand tons and exporting about 69.66 thousand tons. Accordingly, the net return of the coffee cultivation at this scenario is about $395.86 million annually. The generated net return of coffee cultivation would be equivalent to about $73.97 thousand per hectare and about $2.64 thousand per ton of coffee. The optimized model showed that importing coffee at world market will be feasible by reducing the cost of import by about $442 per ton from the current import price.

#### 3.3.3. Export based scenario (2% market share)

At this scenario, the optimized model showed that Saudi Arabia has the potential to increase its share in the world market of coffee up to 2% given the export value was set at $3.15 thousand per ton. Total coffee production in Saudi Arabia will increase to about 192.63 thousand tons grown over 6.88 thousand hectares to cover the local consumption of coffee and export about 112.56 thousand tons annually. Importing coffee at the world market price averages $3.56 thousand per ton is more expensive than the production cost of coffee in Saudi Arabia averages $3.47 thousand per ton. Accordingly, the net return of the coffee cultivation at this scenario is about $395.95 million annually. The generated net return of coffee cultivation would be equivalent to about $57.51 thousand per hectare and about $2.06 thousand per ton of coffee. The optimized model showed that importing coffee at world market will be feasible by reducing the cost of import by about $440 per ton from the current import price.

Under the considered optimization scenario models, Jazan region was found more privileged to produce the full quantity of coffee due to its higher productivity of cultivated area averaging 27.98 tons per hectare compared to about 25.02 tons per hectare in Al Baha region and 21 tons per hectare in Aseer region. On the other hands, Aseer region was found more privileged to be the hub of marketing coffee in Saudi Arabia as the market price of coffee is higher in Aseer compared to that of the other regions averaging $8.09 thousand per ton, compared to about $7.33 thousands per ton in Jazan region and about $6.93 thousands per ton in Al Baha region.

Table 3 shows a summary of the one-year optimized coffee cultivation models in Saudi Arabia under different scenarios.

**Table 2**
Summary of cost structure, profitability, and investment measures of coffee cultivation in Saudi Arabia.

| Study region | Capital costs (000$/ha) | Operation costs (000$/ha) | Revenue (000$/ha) | Net revenue (000$/ha) | Return on investment (%) | Payback period (year) |
|---|---|---|---|---|---|---|
| Al Baha | 307.02 | 80.98 | 211.16 | 130.18 | 42.40 | 2.4 |
| Jazan | 180.19 | 88.08 | 239.03 | 150.96 | 83.78 | 1.2 |
| Aseer | 243.60 | 84.53 | 202.03 | 117.50 | 48.24 | 2.1 |
| Average | 243.60 | 84.53 | 217.41 | 132.88 | 58.14 | 1.9 |

**Table 3**
Summary of the One-year Optimized Coffee Cultivation Models in Saudi Arabia Using Different Scenarios.

| Description | Units | Baseline model | World export share at 1% | World export share at 2% |
|---|---|---|---|---|
| Net revenues | (million $) | 395.72 | 395.86 | 395.95 |
| Per unit return | ($/hectare) | 138278.22 | 73973.65 | 57511.66 |
| Per unit return | ($/ton) | 4942.04 | 2643.80 | 2055.46 |
| Area | (hectare) | 2861.78 | 5351.41 | 6884.70 |
| Production | (ton) | 80072.50 | 149732.40 | 192633.90 |
| Preferable production region | (region) | Jazan | Jazan | Jazan |
| Marketable quantity | (ton) | 80072.50 | 80072.50 | 80072.50 |
| Preferable marketing region | (region) | Aseer | Aseer | Aseer |
| Imports | (ton) | – | – | – |
| Exports | (ton) | – | 69659.89 | 112561.40 |
| Export FOB price | (thousand $/ton) | 1.98 | 3.15 | 3.15 |

## 4. Conclusions and recommendations

Coffee cultivation received an escalating importance in the world economy due to the positive impact of coffee export earnings on economic growth and on the gross domestic product for most of the producing countries, particularly, developing and least developed countries. This study highlighted up-to-date estimates about coffee production, cultivated area, exports, lead producers and exporter countries of coffee worldwide. This study, then, assessed the current state of coffee cultivation in Saudi Arabia and optimized the national net economic return of coffee cultivation using LINGO optimization software. Results of the study revealed the great potential of Saudi Arabia to expand coffee cultivation to meet the growing local demand and to increase its share in the world market up to 2%. Optimization of coffee cultivation in Saudi Arabia showed a high potential to meet the local demand for coffee by producing about 80.07 thousand tons grown over 2861.78 hectares and to generate a net return equivalent to $395.72 million a year, which is equivalent to about $138.28 thousand per hectare and about $4.94 thousand per ton of coffee. Optimizing coffee cultivation in Saudi Arabia will play a substantial role to increase market share of Saudi Arabia to about 1–2% of the world coffee market by increasing its export volume, respectively, to about 69.66 and 112.56 thousand tons of coffee, the national net economic return by about $395.86 and $395.95 million a year, and the export earnings of coffee by about $219.43 to $354.57 million a year, which in turns, will serve the national strategic trend to diversify the economic base that has been inspired to lower the dependency of incomes generated from oil exportation as a major driver of development. Jazan region was found more privileged to produce the full quantity of coffee due to its higher productivity of cultivated area averaging 27.98 tons per hectare. On the other hands, Aseer region was found more privileged to be the hub of marketing coffee in Saudi Arabia as the market price of coffee is the highest averaging $8.09 thousand per ton.

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## Conflict of interest

The authors declare that there are no conflicts of interest.

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