Planning The Highest Income-Generating Labor Use in The Agriculture Sector According to Production Activities

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> **HIGHLIGHTS**
>
> - Lack of labor can cause economic losses.
> - Insufficient labor reduces production efficiency.
> - Labor planning is important for agricultural production.

Abstract

In all production processes, making detailed analyses and thinking about using the resources at an optimal level is defined as planning. For this reason, it is crucial to analyze and plan the external effects during the production process and the constraints that occur due to the use of inputs, especially in the agricultural sector, compared to other sectors. The main purpose of enterprises is to reach maximum profit with optimal resource use or to achieve optimal production by using minimum input. Therefore, planning should be done to ensure the optimization of limited resources and to realize the best distribution among various options to achieve a specific purpose. The factor of production that prevents capital and natural resources from being passive and contributes to using resources with their qualifications and abilities is human. For this reason, the planning of human resources in agricultural production will directly influence the use of other factors. Within the scope of this study, production patterns in Konya's agroecological regions were designated, and optimal use of the labor was planned to achieve maximum income. It has been determined that economic losses are due to underemployment in the agroecological third, fourth, and fifth regions. Policy recommendations have been developed to solve the problems identified in the study.

Keywords: Agriculture; Agricultural Employment; Linear Planning; Labor Force; Agroecology.

1. Introduction

The macro- and micro-scale interaction between economies is bidirectional. While the policies implemented at the macro scale affect the production and marketing processes of the enterprises, they are important in maintaining production and increasing competitive power at the international level. On the micro-scale, enterprises need to plan production, use their resources efficiently and effectively, and create new employment areas with the production income. The success of both economic structures at the scale level will contribute to price stability in the long run.

Price changes at a predictable level predicate the enhancement of consumer welfare and, thus, success in the development process. The most important element representing a country's competitiveness and welfare level on a global scale is "access to adequate secure food." In order to achieve this global success, it is necessary to use resources more effectively and to develop production models that can provide sufficient food for the growing population (Godfray et al. 2010; Smith et al. 2018; Güler and Saner 2021).

As part of economic activities, every business organization works to produce and market goods and services and obtain the highest profit with the lowest input costs. In order to achieve this goal, the factors of production must be operated continuously and effectively. To use the resources effectively, the buildings, machinery, equipment, inputs, labor, etc., must be analyzed accurately. Production planning judgments include decisions such as determining the labor force level, determining the priorities in the production phase, and making the division of labor (Graves 1999; Demirdöğen and Güzel 2009). Concisely, production planning refers to the decision-making processes regarding the resources of the enterprise and the use of resources for producing products of desired quality and quantity in the future (Magee 1967; Bilici 2010). Labor planning is the organization of the amount and quality of labor needed in business activities in line with future expectations, depending on time. Businesses have to perform a systematic study and manage resources properly in terms of labor planning. It is essential to work systematically, particularly in plant production processes carried out in limited times due to natural resources and climatic changes. For this reason, planning and properly managing the labor in agricultural enterprises ensure efficient and effective work.

"Linear programming method" is preferred to plan the labor per the production pattern in agricultural enterprises. The program has been used frequently in planning studies for the agricultural sector. Heady and Chandler (1958) adapted the planning methods to the agricultural sector. They examined both the solution to the problems in the enterprises with the method of maximization and minimization and the methods to obtain optimum results in the face of changing prices. Meijaard (1972) aimed to determine the most profitable production method for agricultural enterprises using the budgeting method. Aksöz (1971) contributed to optimal planning for agricultural enterprises in Nebraska. In the study, the contributions of the working capital at different levels to the business processes were determined, and the optimal operating capacities were calculated according to the scales. Tekeli and Ergün (1983) carried out a study covering the provinces of Ankara, Konya, Şanlıurfa, Tokat, Eskişehir, Mersin, Samsun, and İzmir. Data were collected on input usage, input-product and price relationship, optimum product component, and the adequacy of inputs for optimum production. Özçelik (1985) used the linear program method by comparing the existing technology and advanced technology within the scope of the study carried out in Eskişehir, optimum enterprises were specified, and their success levels were determined. Akay (1996) identified the problems related to the full and effective use of business resources in the study conducted in Tokat. Tatlıdil (1992) determined the optimum size of farms in the Beyşehir and Ereğli districts of Konya, considering the labor force, revenue assets, and tractor capacity of agricultural enterprises in irrigated and dry lands. Aksoyak (2004) worked on the economic analysis and planning of agricultural enterprises in Konya, Sarayönü district, and calculated the optimum product component and the size of the enterprise with sufficient income. Within the scope of the study, the enterprise size that will provide sufficient income for the family, which is an agricultural enterprise, was determined as 134.38 da. Çevik (2006) completed a labor plan that will provide minimum cost for a company operating as a family business in Tokat province. Within the model's scope prepared for business activities, a shift system and the number of workers were determined to minimize personnel costs by preventing insufficient or idle personnel. Khan et al. (2005) analyzed crop cultivation areas, production quantities, and income by establishing a linear programming model. With the planning made in agricultural enterprises, the cultivation areas decreased by 1.76%, while the optimum income increased by 3.28%. Şahin and Miran (2008) determined that within the scope of the planned labor study, labor costs can be minimized in conjunction with optimum planning, labor can be used more effectively, and open and disguised unemployment can be directed to production through support policies. Uysal (2008) aimed to determine agricultural enterprises' economic structures and annual activity results in the Dikbıyık town of Samsun. According to the planned production pattern, it has been determined that the production of forage crops will increase depending on the increase in livestock activities. By extension, the gross profit will increase by 218.00%.

2. Materials and Methods

Agroecological regions refer to sub-fields with similar characteristics, such as the environmental characteristics of the land, potential yield, and land suitability (Soylu 2011).

Table 1. Agro-Ecological Regions of Konya Province

Regions	Province in the Region	Field (hectare)	Rate (%)	Yearly Precipitation (mm)
Region 1	Çumra, Karatay, Meram, Selçuklu	704.649	16,9	<400
Region 2	Akören, Ahırlı, Bozkır, Güneysınır, Hadim, Taşkent, Yalıhüyük	525.234	12,6	>400
Region 3	Akşehir, Ereğli, Halkapınar, Ilgın, Tuzlukçu	597.982	14,3	>400
Region 4	Beyşehir, Derbent, Derebucak, Doğanhisar, Hüyük, Seydişehir	589.385	14,2	<400
Region 5	Altınekin, Cihanbeyli, Çeltik, Emirgazi, Kadınhanı, Karapınar, Kulu, Sarayönü, Yunak	1.752.150	42,0	<400
Total	31 District	4.169.400	100	-

Source: Çelik et al. 2015.

Konya is among the provinces of Türkiye well-known for its high agricultural production potential. The province comes to the fore in terms of its product diversity and its agricultural employment diversity. It is known that more than 120,000 agricultural workers are employed only in Konya's livestock sector. This study was carried out to determine the perspective on the permanently and seasonally employed labor in various jobs. A stratified random sampling method was used to determine the number of enterprises to be surveyed, and it was studied with 5% error and 90% confidence limits. Yamane's (1967) formula was used in determining the strata distribution and the number of questionnaires. In line with the results obtained, 375 surveys were conducted in 2022. Questionnaires were obtained from face-to-face data. Accordingly, the distribution of the number of enterprises to be surveyed according to districts and strata was determined by proportioning the number of enterprises in each district and the "k" value of the strata (number of establishments/k).

The linear programming method was used in labor planning in agricultural enterprises. The linear programming method is a mathematical method used to determine the optimum business plan by evaluating various constraints for agricultural enterprises (Uysal 2008). The linear programming model has three basic elements. These are the determined decision variables, the goal to be optimized, and the business constraints. Within the scope of this study, gross profit in agricultural enterprises was determined as the decision variable. The purpose of planning is to use the labor at an optimal level.

As linear programming deals with allocating limited resources among alternatives, it is impossible to refer to negative activities or resource use. The last part of linear programming models consists of the boundary that ensures that the decision variables are not negative (Büyükkeklik 2007). For any problem to be the subject of linear programming, it must meet certain conditions (Cinemre 2011). Within the scope of work;

- The decision-maker must have a goal that he or she wants to achieve.

- At least one must have alternative strategies to achieve the goal.

- Resources should be limited.

- The purpose should be explained mathematically, and the resources' limits should be shown in equality and inequalities. All of these equations or inequalities must be linear.

Provided that these conditions are met, the problem can be expressed mathematically. As in all other numerical decision-making methods, establishing linear programming models begins with defining the problem. Then, the defined problem is observed in the system, and the parameters affecting the problem are determined. Using these parameters establishes a linear programming model consisting of the problem's objective function and constraints set. By solving this model, the values of the decision variables that satisfy all boundary conditions and make the value of the objective function optimum are obtained (Ekmekçi 2015).

In agricultural enterprises, the need for labor is intensified according to the type of work and seasonal characteristics. In order to determine the labor need, a production season was divided into periods and

analyzed by region. There is continuity in animal production processes due to living materials, and activities continue for 365 days. For this reason, plant production was taken as a basis while classifying working periods and hours.

Table 2. Working Periods Used for Businesses

Period	Date	Work Type
Term 1	February 1 - April 15	Spring tillage and planting
Term 2	April 16 - June 30	Care for anchor plants
Term 3	July 1 - September 15	Harvesting and care
Term 4	September 16 - November 30	Harvesting and sowing winter cereals

Source: Bayramoğlu et al., 2006.

3. Results

The values of production activities determined as a result of planning include fractional results. Values are fractional due to the divisibility condition of the linear programming method used to determine the optimal business organization. Fractional expressions are converted into integers and included in the planning process, considering the capacity levels and limitations in the implementation process (Bayramoğlu et al. 2006).

It is observed that there are changes between the current situation and the post-planning situation in terms of the products examined in Table 3. For the enterprises in the first region to succeed using their limited resources, they must halt the irrigated farming of barley, oats, sugar beet, potatoes, dried beans, and chickpeas. Moreover, cattle and sheep and goat farming activities should be halted to increase the gross profit in the region. As a result of the focus on profit maximization and optimal use of resources, the production of dry wheat and confectionary sunflowers also needs to be reduced. Due to the reduction of dry wheat areas by 5.40 da and confectionary sunflower by 2.68 decares per enterprise, the resources acquired will be used in other areas planned for production, thus increasing the gross profit. The products expected to increase production areas after planning are irrigated wheat, grain maize, dry barley, silage maize, clow, Hungarian vetch, sunflower for oil, zucchini for snacks, and onions. With this production pattern, the business enterprises in the first region, which continue their agricultural activities, will be able to increase their gross profits from 443,775.21 TL to 764,269.30 TL.

In line with the results obtained with the linear program method, marginal revenue for each product included in the production plan and marginal loss for products not included in production were calculated. Marginal losses represent the decreases in earnings due to the inclusion of these products in the production activities of the enterprise. For certain products included in the planning, the value of marginal revenues is calculated as zero and therefore is not indicated in the table. The marginal income for the existing land assets of the enterprises is calculated as 230.86 TL. This value represents that if the enterprises continue their activities without changing their production areas, a contribution of 230.86 TL will be made to the gross profit of the enterprise. When all effective products in marginal income are examined, it is determined that the product that makes the most substantial contribution to profit is an onion with 1,962.84 TL. Dry onions, which are included in the production pattern of enterprises, make an important contribution to ensuring economic sustainability. The intensive labor requirement of onion production during harvest periods is important in terms of the employment of the rural labor and the creation of alternative income sources. When an evaluation is made, including the enterprises located in the first region for the working hours of the labor, it is possible to say that the resources are used sufficiently for the first period. However, the same is not the case for other employment periods. Wages are important in increasing the labor's motivation, creating social and economic welfare conditions, and maintaining the workflow. Determining an optimal wage for workers and agricultural operators (employers) is necessary to sustain employment and production. In order to increase the gross profits of agricultural business managers in the first region, it was determined that the wages for the second period should not exceed 35.78 TL per hour. Labor fees for the third term are determined as 56.16 TL/hour and for the fourth term as 98.48 hours. Wages also increase when packaging/sacking operations intensify during the harvest period.

Once the business structures in the first region are examined in terms of marginal losses, it has been determined that irrigated barley, oats, potatoes, dried beans, and chickpeas should not be produced. The production of irrigated barley in one decare for the enterprises will cause a loss of 373,76 TL in the total gross profit. This value is 695.95 TL for oats, 843.74 TL for potatoes, 798.76 TL for dried beans, and 667.31 TL for chickpeas. Potato is the product that causes the greatest loss due to production activities in the region. The main reason for this situation is that using pesticides and fertilizers increases input costs. When the enterprises in the first region for livestock activities are examined, it has been determined that the cattle stock is 8.95 heads, and sheep and goats are 5.54 heads per enterprise. Under the current circumstances, the protection of animal existence is important for businesses. Therefore, it has been determined that reducing or not including livestock activities within the business planning will increase the gross profit of the business enterprises. The gross profit, which was calculated as 443,775.21 TL under the current conditions, will increase to 764,269.30 TL as a result of the continuation of the activities.

Table 3. First Region Production Plan

Products	Unit	Available Status	Planning Result
Wheat (irrigable land)	Decare	30,76	35,01
Barley (irrigable land)	Decare	17,11	0,00
Oats	Decare	9,84	0,00
Grain Maize	Decare	33,51	34,44
Dry Wheat	Decare	29,69	24,29
Dry Barley	Decare	28,91	30,37
Silage Maize	Decare	5,40	17,23
Clover	Decare	7,56	17,23
Hungarian Vetch	Decare	1,36	6,07
Oil Sunflower	Decare	6,43	24,15
Sunflower for Snack	Decare	21,03	18,35
Sugar Beet	Decare	34,49	0,00
Potato	Decare	0,68	0,00
Dry Beans	Decare	2,78	0,00
Zucchini for Snack	Decare	0,65	8,61
Dried Onion	Decare	0,65	17,23
Chickpea	Decare	2,14	0,00
Fallow	Decare	4,55	4,55
Bovine Animal	Head	8,95	0,00
Small Bovine Animal	Head	5,54	0,00
Total Gross Profit	TL	443.775,21	764.269,30

Table 4 demonstrates the enterprises' production activities and planning results in the second region. According to the planning results, the use of marginal lands in agricultural production will increase enterprise profitability. As a result of the planning, it was determined that dry wheat and zucchini for snacks cultivation areas, which are included in the production pattern of the enterprises, should be reduced. Before the planning, the business planning did not include irrigated wheat, irrigated barley, peach, walnut, cherry, pear, apple, strawberry, and lavender. Due to the limited resources in the production processes of agricultural enterprises, the distribution of existing resources should be carried out at an optimal level to reach the highest profit. Therefore, only products that will contribute to the optimal use of resources should be included in business planning. It has been recommended to increase the fields of grain maize, dry barley, oats, grapes, silage maize, Hungarian vetch, dried beans, and zucchini for snacks among crops for businesses in the second region. Increasing livestock activities in the region is one of the activities planned for the planning process. The cattle stock in agricultural enterprises is 7.29 heads, and the stock of sheep and goats is 30.87. As a result of the implementation of the planning made by considering the enterprises' economic and technical conditions, the gross profit from 232,955.41 TL is expected to increase to 473,963.20 TL. Gross profit growth is expected to be 49.15% in businesses in the region. Suppose these enterprises produce with the planned production pattern and maintain their existing business sizes for their irrigated lands. In that case, gross profit will increase by 2,490.90 TL, and dry land assets will increase by 307.15 TL. The product that will contribute the most to the

enterprises' gross profit within the planned production pattern is pumpkin for snacks with 2,139,80 TL. In order to use the resources effectively and increase the business's profitability, according to the planned production pattern, there should be 1.94 decares of confectionary squash. While diversifying the production pattern and creating alternative sources of income for businesses will contribute to the distribution of economic risks, it will also improve business management. Among the products included in the production planning, the product that is expected to have the largest land asset is oat with 31.02 da. The marginal income that oats will provide for each decare within the planned business model is 505.61 TL. In the second region, the marginal value of the labor force for the fourth period has been determined as 172.10 TL/hour, and it is expected that the wage value of the labor to be hired will not exceed 172.10 hours. Otherwise, there will be decreases in gross profit. According to the planning results, the use of marginal lands in agricultural production will increase enterprise profitability.

Table 4. Second Region Production Plan

Products	Unit	Available Status	Planning Result
Wheat (irrigable land)	Decare	3,70	0,00
Barley (irrigable land)	Decare	2,94	0,00
Grain Maize	Decare	4,00	7,76
Dry Wheat	Decare	26,71	24,81
Dry Barley	Decare	24,30	31,02
Oats	Decare	0,60	6,20
Grape	Decare	2,91	3,88
Peach	Decare	0,30	0,00
Walnut	Decare	0,49	0,00
Cherry	Decare	11,46	0,00
Pear	Decare	0,28	0,00
Apple	Decare	1,64	0,00
Strawberry	Decare	0,30	0,00
Silage Maize	Decare	2,30	3,88
Hungarian Vetch	Decare	0,24	3,88
Dry Beans	Decare	1,54	1,94
Zucchini for Snack	Decare	1,89	1,94
Chickpea	Decare	8,29	3,88
Sunflower for Snack	Decare	1,28	11,64
Lavender	Decare	0,66	0,00
Fallow	Decare	11,11	11,11
Bovine Animal	Head	5,84	13,13
Small Bovine Animal	Head	4,32	35,19
Total Gross Profit	TL	232.955,41	473.963,20

Table 5 presents the enterprises' current production activities and planned production patterns in the third region. It has been determined that reducing the number of silage maize and cattle in planning within the planned business activities will contribute to the resource use of the enterprises. Since silage maize is generally used for feeding in cattle breeding, a parallel decrease in both factors is an admissible result. Irrigated wheat, irrigated barley, dry wheat, cherry, apple, sour cherry, plum, Hungarian vetch, sugar beet, and poppy are the products that are not included in the planned new production activities of the enterprises. The products whose production is planned to be increased are grain maize, dry barley, rye, tomatoes, alfalfa, sunflower for oil and confectionary sunflower, confectionary pumpkin, and small cattle. It is seen that the gross profit can rise to 645,146,20 TL with the new production pattern as a result of changing the operating plan while maintaining the technical and economic conditions in the enterprises. The business profitability in the third region will increase by 53.32% due to the new business plan. When the production potential and labor needs in the third region are evaluated, it has been determined that there is a labor shortage in terms of periods. In this context, the labor force needed in the enterprises has been scripted and included in the planning. Working times in one decare area for all products produced were calculated within the scope of the study. In the current situation, a study includes 748.23 hours in the first period, 55.42 hours in the second period, 544.80 hours in the third

period, and 419.77 hours in the fourth period. Based on these working hours, the cultivated land in the enterprises is calculated as 105.64 decares. In the region, which has a total operating area of 155.65 decares, the current working hours cause the land to remain idle at 50.01 decares. Agricultural lands may remain inactive due to legal, environmental, technical, social, and economic reasons. As a result of assumptions such as the seasonal labor force in the region is not sufficient, the demand for employment in agriculture decreases, the income of agricultural workers is not sufficient by the workers, the labor costs are perceived as high by the agricultural operators, the labor force is decreasing, and the labor capacity in the enterprises is insufficient for production. This situation is reflected in the working hours and results in the idleness of the lands. Business planning and employment planning should be done to transform idle lands into cultivated lands due to economic and social reasons. If only family labor remains in the production processes in the region, the presence of idle land will increase.

Table 5. Third Region Production Plan

Products	Unit	Available Status	Planning Result
Wheat (irrigable land)	Decare	24,34	0,00
Barley (irrigable land)	Decare	11,68	0,00
Grain Maize	Decare	6,78	20,40
Dry Wheat	Decare	24,89	0,00
Dry Barley	Decare	25,25	25,06
Rye	Decare	0,48	25,06
Cherry	Decare	4,94	0,00
Apple	Decare	0,24	0,00
Cherry	Decare	1,95	0,00
Plum	Decare	0,85	0,00
Tomato	Decare	0,97	8,06
Silage Maize	Decare	11,45	10,20
Hungarian Vetch	Decare	0,68	0,00
Clover	Decare	3,69	10,20
Oil Sunflower	Decare	5,15	30,60
Sunflower for Snack	Decare	11,10	17,45
Sugar Beet	Decare	9,69	0,00
Potato	Decare	0,45	0,00
Poppy	Decare	6,39	0,00
Zucchini for Snack	Decare	0,68	5,10
Fallow	Decare	3,52	3,52
Bovine Animal	Head	13,69	5,14
Small Bovine Animal	Head	11,51	35,29
Total Gross Profit	TL	301.130,89	645.146,20

The production planning results for the fourth region are analyzed in Table 6. As a result of the planning, it was foreseen that the presence of irrigated wheat, dry wheat, zucchini, sheep, and goats produced in the region should be reduced. Irrigated barley, dry barley, safflower, sugar beet, potatoes, dried beans, and chickpeas grown in the region should be excluded from the production plan. To increase the total gross profit of the enterprise, the plant production pattern of the enterprise should include grain maize, oats, grapes, strawberries, melons, silage maize, clover, Hungarian vetch, poppy, lentils, and lavender. Increasing the stock of cattle in enterprises will also contribute to profit maximization. The products included in the planning will contribute to the region's more effective use of scarce production factors. Fallow areas are included in the planning, provided that their widths remain constant. The reason why the fallow areas remain stable is to create a strategy for the preservation of soil fertility in dry agricultural lands. If the businesses continue to produce using their existing land assets, the gain will be 267.55 TL for each unit of land width. In return for the continuation of production on irrigated agricultural lands, a contribution of 1,207,64 TL will be made to the gross operating profit for each decare of land. Silage maize provides the most profitable production activity for businesses in the fourth region with 2,111,35 TL. Other products included in the business planning are grain maize, clover, Hungarian vetch, poppy, strawberries, and dried wheat. Similar to the fact that grapes are

included in the production pattern in the second region, the presence of strawberries in the fourth region is important for research. Because Hüyük, one of the districts in the fourth region, stands out with its strawberry production and adds value to agricultural production activities by creating brand value in the region. The marginal income to be obtained for each decade of strawberries in the enterprises operating in the fourth region is 1,495.53 TL. The product included in the production planning but with the lowest marginal income is dry wheat, with 103.89 TL. Production activities in dry lands are important to prevent unirrigated agricultural lands from remaining idle.

When the current situation and the result of the planning are compared, it is planned to increase the number of cattle to 18.68 heads and to decrease the number of sheep and goats in the enterprises to reach 9.08 heads. The main reason for the decrease in the presence of sheep and goats is to ensure the effective use of scarce production factors in cattle breeding activities. Depending on the increase in cattle stock for the planned business activities, a marginal income increase of 102.22 TL will be achieved due to each unit change in the enterprises. The gross profit of cattle breeding activities is greater than the gross profit of small cattle breeding activities. As a result of the implementation of the planning results by the businesses in the region, it is expected that the gross profit, which was 98,389.86 TL, will increase more than three times and reach 312,815.90 TL.

As a result of the production activities in the fourth region, the working hours required by the enterprises for each unit were calculated. Similar problems were detected in the fourth region as in the third region. The existing labor prevents the full-capacity use of agricultural lands in enterprises. In the current situation, the labor need of the enterprises in the first period is 793.68 hours; in the second period, it is 583.13 hours; in the third period, it is 594.21 hours and in the fourth period, it is 563.99 hours. With the current working hours, businesses can only cultivate 87.17 decares of land, considering their total land assets. The total farm widths in the region are 91.44 decares, and in the current situation, 4.27 decares of land remains idle for each farm. The working hours needed according to the periods were calculated to include the uncultivated lands in the region in the business planning. Calculated values were used to increase the efficiency of the planning process. According to the calculation results, the required working hours are the same for the first and second semesters. According to the planned production activities, the labor need of the enterprises is 844.81 hours for the third period and 1.063.99 hours for the fourth period. There are marginal losses for sugar beet, potato, and dried beans due to labor shortages in production activities in the third and fourth periods. As a result of meeting the seasonal labor needs in the region, the marginal losses of the enterprises will be transformed into marginal revenues, and the enterprises' gross profits will increase.

The products that cause the highest marginal losses per decare in agricultural enterprises are sugar beet with 1.049.58 TL and dried beans with 1.082.82 TL. Meeting the seasonal labor needs during periods when the need for labor in agricultural enterprises is intensified will increase the areas of activity that increase workers' income and the gross profitability for the agricultural enterprises. However, due to the seasonality of production in agricultural enterprises, the periods when labor demand is concentrated in each geographical region will be different. In particular, the mobile seasonal labor is present in the areas where the workload is concentrated for a short time (3-7 days) in line with the work routes they have determined in May and June, and they fulfil the requirements of the job during this period. Therefore, the business operator creates a demand for every production activity that requires labor during the production period and experiences losses in terms of product yield and income, particularly during periods when it cannot meet the labor demand that is concentrated during the harvest period. To minimize these losses, the resident labor in the region should take an active role in agricultural production activities.

Table 6. Fourth Region Production Plan

Products	Unit	Available Status	Planning Result
Wheat (irrigable land)	Decare	6,54	3,13
Barley (irrigable land)	Decare	2,61	0,00
Grain Maize	Decare	0,48	4,74
Dry Wheat	Decare	35,55	29,30
Dry Barley	Decare	21,93	0,00
Oats	Decare	0,28	30,40
Safflower	Decare	0,05	0,00
Grape	Decare	0,05	1,20
Strawberry	Decare	0,19	0,42
Melon	Decare	0,05	0,36
Silage Maize	Decare	0,93	2,37
Clover	Decare	0,49	2,37
Hungarian Vetch	Decare	0,36	2,37
Sugar beet	Decare	5,78	0,00
Potato	Decare	2,73	0,00
Zucchini for Snack	Decare	3,46	1,82
Dry Beans	Decare	0,08	0,00
Poppy	Decare	0,31	2,37
Lentil	Decare	0,84	1,20
Chickpea	Decare	1,88	0,00
Lavender	Decare	0,02	2,37
Fallow	Decare	7,02	7,02
Bovine Animal	Head	7,66	18,68
Small Bovine Animal	Head	11,14	9,08
Total Gross Profit	TL	98.389,86	312.815,90

The production planning of the fifth region is examined in Table 7. According to the obtained planning results, it was determined that irrigated barley and dry wheat production areas should be reduced to use the resources more effectively. The production of irrigated wheat, oats, canary grass seed, dry barley, oil sunflower, sugar beet, canola, dry beans, lentils, and sheep and goats is not included in the planning result. Production of grain maize, rye, silage maize, clover, Hungarian vetch, sunflower for snacks, pumpkin for snacks, onions, chickpeas, cumin, poppy, and grass and cattle breeding activities are planned. In order to reach the highest gross profit of the enterprises, it is necessary to produce confectionary sunflowers on 50.95 decares for the planned production activities. Among the planned business activities, the product with the highest land width is the confectionary sunflower. This is followed by grain maize with 33.97 decares and rye with 20.13 decares. For the region, the ovine stock should be removed from the operation plan, the bovine stock should be increased, and the 5.39 headstock should be increased to 30. As a result of the implementation of the planning, the gross profit of the enterprises will increase from 383,479.81 TL to 934,785.10 TL, increasing approximately three times.

The average land width of the enterprises in the region is 231.90 decares, and as a result of continuing the production activities with the same land size, a contribution of 755.14 TL will be provided to the marginal income of the enterprises for each decade. The marginal income for the irrigated agricultural lands in the region is 1,083.30, and the fact that the enterprises have one more decare of irrigated lands will contribute to the increase in gross profit. Plant products included in the operation plan are grain maize, silage maize, clover, Hungarian vetch, confectionary sunflower, onion, grass, rye, chickpea, and cumin. The product with the highest marginal revenue in business planning is onion, with 3,277,83 TL. Dry onions are followed by grass with 2,321.42 TL and grain maize with 2,273.84 TL.

In the agricultural enterprises located in the fifth region, the marginal return of labor is equal to zero in the first and fourth periods. In these periods, an inactive labor force is accumulated in enterprises. In the second and third periods, the marginal value of the labor force increases due to the increase in working hours. The

labor requirement for the current business activity is 1,622.92 hours in the first period, 1,129.71 hours in the second period, and 1183.20 hours in the third and fourth periods. With the current labor working hours, production can only be made for an area of 144.58 decares. The land width of the enterprises in the region is 231.9 decares on average, and 87.32 decares of land remain idle in the current situation. When the working hours needed in the region are increased to 1,583.20 hours in the third region, all of the idle lands can be included in production. In this period, the cost for one labor unit employed as outsourcing will be 7.49 TL per hour.

Table 7. Fifth Region Production Plan

Products	Unit	Available Status	Planning Result
Wheat (irrigable land)	Decare	35,77	0,00
Barley (irrigable land)	Decare	23,77	8,49
Oats	Decare	0,28	0,00
Bird Feed	Decare	1,05	0,00
Grain Maize	Decare	20,19	33,97
Dry Wheat	Decare	21,75	15,10
Dry Barley	Decare	23,75	0,00
Rye	Decare	0,60	20,13
Silage Maize	Decare	7,87	16,98
Clover	Decare	5,60	16,98
Hungarian Vetch	Decare	0,12	16,98
Oil Sunflower	Decare	10,60	0,00
Sunflower for Snack	Decare	16,59	50,95
Sugar Beet	Decare	27,69	0,00
Canola	Decare	4,70	0,00
Zucchini for Snack	Decare	0,51	5,33
Dry Beans	Decare	6,07	0,00
Dried Onion	Decare	0,80	8,49
Chickpea	Decare	2,55	5,03
Lentil	Decare	0,60	0,00
Cumin	Decare	2,11	10,06
Poppy	Decare	1,13	3,15
Grass	Decare	2,11	8,49
Fallow	Decare	11,75	11,75
Bovine Animal	Head	5,39	30,00
Small Bovine Animal	Head	37,84	0,00
Total Gross Profit	TL	383.479,81	934.785,10

4. Discussion

When an evaluation is made in terms of labor presence, it has been determined that there are losses in production areas and processes due to missing labor in the third, fourth, and fifth regions. Agricultural operators cannot make effective production decisions because they cannot access the labor to employ, especially during the harvest periods when labor intensity increases. For this reason, production areas remain idle. In order to evaluate the use of resources and production capacity, the need for labor in agricultural enterprises should be determined by taking into account the working hours and production patterns. For this reason, there is a need for production planning to be done throughout Türkiye. Furthermore, an organizational model that will contribute to the supply of seasonal labor in times of increased labor force needs to be established in the agricultural sector and to play a facilitating role in terms of employment during the implementation phase. In the organizational process, it should be encouraged to determine the type of labor force according to production activities, to provide specialization for the job, to determine the labor needs of the operators, and develop the communication network between the worker and the employer. While organizing activities represent a system that facilitates access to personal rights for workers, it will also make

a significant contribution to the reduction of unregistered employment in the agricultural sector. The organized employment structure in agriculture will also create value on a macroeconomic scale by reducing problems such as disguised unemployment and structural unemployment.

Meeting the seasonal labor needs during periods when the need for labor in agricultural enterprises increases provides income-increasing activity areas for workers and increases the gross profitability for agricultural operators. Due to the seasonality of production activities in agricultural enterprises, the periods when labor demand is concentrated in each geographical region are different. In particular, the mobile seasonal labor is in certain periods, mainly in the months of May and June, in the areas where the work is concentrated in line with the work routes they have determined for a short time (3-7 days) and they leave the region by fulfilling the requirements of the job during this period. Therefore, the operator demands labor for every production activity that requires labor during the production period, and losses occur in the product and income, especially during the periods when the labor force cannot be met, which is concentrated during the harvest period. In order to minimize these losses, the resident labor in the region should take an active role in agricultural production activities. For this, a special working system should be established to encourage the participation of local labor in production. Within this system, a monitoring and follow-up system should be established, job notifications should be made, and a special insurance system should be applied to the people registered in the system.

There are problems arising from both working methods and time in agricultural enterprises. For this reason, the distribution and division of labor according to the production activity in the enterprises become difficult. Especially for the seasonal mobile labor, the short working hours cause the problem of specialization. In the evaluations made on sustainability, it was determined that personal factors affect labor productivity. Therefore, to achieve success in the production processes, it is necessary to implement training activities for specialization and to create a notification system that will contribute to the employment of the labor in the enterprises in the region. This system, which can be integrated into the organizational model, can be expanded through agricultural chambers operating in the region.

References

Akay M (1996). Tokat ili Niksar ovası tarım işletmelerinin yapısal analizi işletme sonuçlarını etkileyen faktörlerin değerlendirilmesi ve doğrusal programlama yöntemiyle planlanması üzerine bir araştırma. PhD Thesis, Gazi Osman Paşa University, Türkiye.

Aksoyak Ş (2004). Konya ili Sarayönü ilçesi tarım işletmelerinin ekonomik analizi ve planlanması. PhD Thesis, Ankara University, Türkiye.

Aksöz İ (1971). Linear Programlama Metodunun Nebraska'da Bir Bölgeye Tatbiki. Atatürk Üniversitesi Ziraat Fakültesi Yayınları, Yayın No:110, Erzurum.

Bayramoğlu Z, Göktolga ZG ve Gündüz O (2006). Tokat ili Zile ilçesi sol sahil sulama alanlarında yer alan tarım işletmelerinin ekonomik analizi ve planlaması. *Gaziosmanpaşa Üniversitesi Ziraat Fakültesi Yayınları*, No:69, Araştırma Serisi No:24, Tokat.

Bilici AG (2010). Sanayi işletmelerinde üretim planlaması ve sezersan matbaacılık ve ambalaj san. tic. a.ş.'de örnek uygulama. Master Thesis, Selçuk University, Türkiye.

Büyükkeklik M (2007). Üretim planlama problemlerinde doğrusal programlama modellerinin kullanımı: bir üretim işletmesinde uygulama. Yüksek Lisans Tezi. Niğde Üniversitesi Sosyal Bilimler Enstitüsü, Niğde.

Cinemre N (2011). Yöneylem araştırması. İstanbul: Evrim Yayınevi.

Çelik Y, Bayramoğlu Z, Gündüz O. ve Karakayacı Z (2015). Konya ilinde farklı işletme tipleri ve agro-ekolojik bölgelere göre çiftçilerin sosyal güvenlik durumu. *Türk Tarım ve Doğa Bilimleri Dergisi*, 2: 60-68.

Çevik O (2006). Tam sayılı doğrusal programlama ile işgücü planlaması ve bir uygulama. *Afyon Kocatepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi* 8: 157-171.

Demirdöğen O, Güzel D (2009). Üretim planlama ve iş yükleme metotları. *Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi* 23: 43-67.

Godfray HCJ, Beddington JR, Crute IR, Haddad L, Lawrence D, Muir JF, Pretty J, Robinson S, Thomas SM and Toulmin C (2010). Food security: the challenge of feeding 9 billion people. *Science* 327: 812-818.

Graves CS (1999). Manufacturing Planning And Control. Massachusetts Institute of Technology.

Güler D, Saner G (2021). Süt sığırcılığı işletmelerinde üretim planlaması: İzmir ve Manisa örneği. *Ege Üniversitesi Ziraat Fakültesi Dergisi* 58: 75-85.

Heady EO, Chandler W (1958). Linear programming methods. The Lowa State University Press, Ames, 597 pp.

Khan A, Khan MA, Hassan I, Cheema N, Maryam R (2005). Use of linear programming model to determine optimum cropping pattern in Bahawalpur, Punjab, Pakistan. *Pakistan Journal of Life and Social Sciences* 3: 21-23.

Magee J (1967). Production Planning and Inventory Control. New York, McGraw Gill Book.

Meijaard D (1972). Economic butgeting methods and their practical application. *WAERSA*, 14.

Özçelik A (1985). Samsun ilinde çalışma dönemleri ver tarla çalışma günlerinin tespiti üzerine bir araştırma. *Ziraat Mühendisliği Dergisi*, 174.

Smith LG, Jones PJ, Kirk GJD, Pearce BD, Williams AG (2018). Modelling the production impacts of a widespread conversion to organic agriculture in England and Wales. *Land Use Policy* 76: 391-404.

Soylu S (2011) Konya ilinin bitkisel üretimdeki yeri ve önemi. *I. Konya Kent Sempozyumu*, 26-27 Kasım, 385-395.

Şahin A, Miran B (2008). Tarım işletmelerinde üretim dallarına göre işgücü kullanımının çok boyutlu analizi: bayındır ilçesi örneği. *Ege Üniversitesi Ziraat Fakültesi Dergisi* 45: 37-47.

Tatlıdil F (1992). Konya ili sulu ve kuru koşullardaki tarım işletmelerinde işgücü, döner sermaye ve traktör güçlerine göre optimal işletme büyüklüğünün tespiti. PhD Thesis, Ankara University, Türkiye.

Tekeli S, Ergün N (1983). Girdi Fiyatlarının Bitkisel Üretim Düzeyi ve Bileşimi Üzerine Etkileri. Milli Prodüktivite Merkezi Yayınları, No:290, Ankara.

Uysal O (2008). Tarım işletmelerinin doğrusal programlama yöntemi ile planlanması: Dıkbıyık beldesi örneği. Master Thesis, Ondokuz Mayıs University, Türkiye.

Yamane T (1967). Statistics: an introductory analysis. New York: Harper and Row.