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# Evaluation of Agricultural Policy in the Dairy Sector in Kosovo and Efficiency Analysis at the Farm Level

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Evaluation of Agricultural Policy in the Dairy Sector in Kosovo and Efficiency Analysis at the Farm Level

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**ABSTRACT**

This thesis consists of two studies on the dairy sector in Kosovo. The first study evaluates the effect of the Subsidy per Head Scheme (SPHS) on increasing production, land use, gross income and number of dairy cows on dairy farms in Kosovo. Results from the Propensity Score Matching (PSM) approach using four alternative matching algorithms revealed that SPHS has not had any impact on increasing land use, gross income or the number of dairy cows per farm. Furthermore, SPHS had a negative impact on decreasing land use and number of cows for the participating dairy farmers in the program. In terms of milk production, SPHS has not had any meaningful effect on increasing milk productivity when compared to farms that did not participate in the program. Improvement in milk production per cow was found to be a statistically significant effect for two matching algorithms. However, two other algorithms revealed insignificant effect of SPHS on improving milk productivity.

The second study provides estimates of the technical efficiency level for a random sample of 243 dairy farms in Kosovo over the 2014 farming season. Statistically significant determinants of technical efficiency are identified. A stochastic frontier production function was estimated using a two stage procedure. Results revealed that feeding rates (specifically of concentrates and silage), land use per cow, and the number of days that cows had been kept on pastures have statistically significant impacts on milk productivity per cow. The mean technical efficiency of dairy farms was estimated at 0.72. The major determinants that help to improve the efficiency are breed improvement, intensification of corn production on the farm, improving feeding rates,

and using free range production systems. Given the results from the SPHS impact assessment and technical efficiency analysis, it is crucial for the Government of Kosovo to redesign their dairy policy, specifically their direct payment schemes and target technical assistance and investment support based on regional potentials.

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**DEDICATION**

To my parents; for all their sacrifice, education and most importantly their unconditional love throughout all these years. Every success is attributed to them. It is their merit for who I am and what I have today.

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## Chapter I. Introduction

### 1.1 Overview of the dairy sector in Kosovo

The livestock sector in Kosovo suffered severe damages during the 1998-99 war, with more than half of livestock killed or stolen, and about 40% of infrastructure and machinery were destroyed (MAFRD, 2003). However, over the post war period, the livestock sector, specifically dairy, has emerged as one of the most important sectors of agriculture, contributing about 10 percent to the total national GDP (Bytyqi et al., 2014).

In 2014, there were 63,874 households that had dairy cows in their farms (MAFRD, 2015). From a total of 261,689 cattle, 51% were dairy cows, 42% were calves and the other part were heifers, bulls and other cattle (MAFRD, 2015). The largest numbers of cattle were located in the region of Prishtina (20%) and Prizren (17%), while Gjilan and Ferizaj had the lowest number of cattle inventory (9%) and (8%), respectively (Table 1).

**Table 1. Kosovo number of cattle by cow herd size, by region, 2014**

| | Total | Prishtina | Mitrovica | Peja | Prizren | Ferizaj | Gjilan | Gjakova |
|---|---|---|---|---|---|---|---|---|
| Herd size | 261,689 | 52,475 | 31,414 | 44,490 | 46,772 | 22,607 | 23,615 | 40,316 |
| (1 - 2) | 58,727 | 14,525 | 7,615 | 6,840 | 12,223 | 6,389 | 4,353 | 6,782 |
| (3 -9) | 111,003 | 19,963 | 13,764 | 18,859 | 20,827 | 9,950 | 8,748 | 18,892 |
| (10 - 19) | 46,379 | 8,981 | 5,505 | 9,075 | 6,613 | 3,448 | 4,810 | 7,947 |
| (20 - 29) | 19,919 | 4,053 | 2,180 | 3,829 | 3,167 | 1,562 | 2,380 | 2,748 |
| (30 - 49) | 16,165 | 3,076 | 1,913 | 3,564 | 2,172 | 987 | 2,174 | 2,279 |
| (>50) | 9,496 | 1,877 | 437 | 2,323 | 1,770 | 271 | 1,150 | 1,668 |

Source: MAFRD (2015).

Most of the dairy farms are small, producing primarily for self-consumption. As reported in Table 1, the largest share of cow inventory is on farms with 3 to 9 cows (42%). In general, the structure of dairy farms in the post-war period has been changing slowly. The average herd size in 2014 was 4 cows (MAFRD, 2015). MAFRD (2015) estimated that in 2014 total milk production in Kosovo was 279 MT. This production met only about 80% of domestic consumption needs. The deficit of 20% was satisfied by imports (MAFRD, 2015). Kosovo still imports a large amount of dairy products, mainly from neighboring and EU countries. In 2014 the value of dairy product imports decreased by 2.9% compared to 2013, reaching a value of over €37 million. However, in 2014 the trade deficit for dairy products originating from cow milk reached a value of €25.5 million.

**Table 2. Export and import data for Kosovo dairy and all agricultural products in €1000**

| | | | | | | 0,000€ |
|---|---|---|---|---|---|---|
| Year | Export (1-98)[1] | Import (1-98) | Export (1-24)[2] | Import (1-24) | Dairy export | Dairy import |
| 2007 | 165,112 | 1,576,186 | 18,134 | 383,789 | 112 | 26,394 |
| 2008 | 198,463 | 1,928,236 | 20,763 | 473,666 | 314 | 36,714 |
| 2009 | 165,328 | 1,935,541 | 19,993 | 434,810 | 520 | 35,622 |
| 2010 | 295,957 | 2,157,725 | 24,749 | 482,649 | 344 | 36,554 |
| 2011 | 319,165 | 2,492,348 | 26,185 | 561,428 | 365 | 39,402 |
| 2012 | 276,100 | 2,507,609 | 30,807 | 574,974 | 293 | 43,889 |
| 2013 | 293,919 | 2,450,363 | 34,947 | 583,704 | 1000 | 38,243 |
| 2014 | 324,554 | 2,583,231 | 39,372 | 616,051 | 361 | 37,115 |

Source: MAFRD (2015) & KAS (2015).

[1] (1-98) includes all agricultural products.
[2] (1-24) includes mainly products by the livestock sector.

Most Kosovo dairy farms are characterized by low milk productivity, poor infrastructure, and inefficient land use (Miftari et al., 2014). Milk yields per cow are low compared to other European countries. In 2014, the estimated average milk yield per cow in Kosovo was 2,075 liters per year (MAFRD, 2015), while this average in EU-28 was 6,727 liters (European Commission, 2015).

The dairy sector in Kosovo has been facing the same problems of low milk productivity, small structure, fragmented land use and low efficiency over the post-war period. This is in spite that over the last six years (2009-16), the dairy sector has been heavily subsidized, mainly with direct payments schemes from the Government.

### 1.2 Problem Statement

To help Kosovo dairy farmers increase their income, increase their milk production and quality, intensify the use of currently unused land and pastures, improve the quality of inputs, improve food safety and food quality standards, and develop a management capacity that is in line with EU requirements, the Ministry of Agriculture, Forestry and Rural Development (MAFRD) has been implementing the Direct Payments Program (DP) since 2009. This policy involves several direct payment schemes, such us the subsidy per head, subsidy per hectare of planted cereals and subsidy on milk quality (MAFRD, 2010).

Over the period 2009-14, MAFRD has spent over €50 million to implement all (crop and livestock) schemes of the DP program. For the subsidy per head scheme (SPHS), MAFRD has spent over €8.8 million during this period, and in 2014 alone, €2.2 million were provided for this scheme.

Although, millions have been allocated to implement the SPHS, to date there has not been any scientific evaluation of the actual impact of this scheme on the dairy sector in Kosovo, particularly on improving production, increasing land use, income and changing farm structure.

### 1.3 Objectives

This thesis investigates the effects of the SPHS policy in the dairy sector of Kosovo and measures of the technical efficiency level of dairy farms in Kosovo.

Given that to date there has not been any impact assessment studies of the SPHS, the goals of this two-study thesis are to first investigate and provide quantitative evidence of the impact of the subsidy per head scheme (SPHS) and second to use a parametric approach to estimate and evaluate the production efficiency of dairy farms in Kosovo.

The specific objectives of the first study are:

1. Develop a propensity score matching (PSM) model to econometrically estimate the effects of SPHS on its main three objectives: increase milk production, intensify land use, and improve farm income and its specific objective to increase herd size (farm structure).
2. Use farm level survey data collected randomly from 323 dairy farmers to evaluate the impact of SPHS on the four objectives specified above.

3. Assess the robustness of the estimated results by using four alternative matching algorithms.

The null hypothesis of this study is that the SPHS has had no effect on any of the intended outcomes.

The specific objectives of the second study are:

1. Develop a production function model for dairy farms in Kosovo.
2. Use primary farm level data collected from a random sample to estimate the mean technical efficiency (TE) of each individual dairy farm by utilizing a two stage stochastic production function model (SFA).
3. Examine the effect of farm size on technical efficiency.
4. Identify the major determinants (factors) that affect the variation in the technical efficiency scores of the sampled dairy farms.

The null hypothesis of this study is that the specified determinants have no effect on the variation in technical efficiency of Kosovo dairy farms.

These two studies represent the first of their kind using the PSM and SFA models to evaluate a governmental program impact and estimate technical efficiency of dairy farms in Kosovo. Therefore they provide an important contribution to the literature. Even though in the recent years several studies have been conducted in the dairy sector in Kosovo (Bytyqi et al., 2005; Musliu et al., 2009; Miftari et al., 2010; Bytyqi et al., 2011; Kokko et al., 2014; Haas et al., 2016; GAP, 2016), to date none in the available literature has provided estimates of the impact of SPHS or estimates of the technical efficiency level of dairy farms in Kosovo. The first study in this thesis evaluates progress on meeting four key objectives of the SPHS and provides recommendations for the government and policymakers in Kosovo. The second study estimates the technical efficiency and identifies the factors that affect the efficiency level of dairy farms in Kosovo. Furthermore, it provides recommendations for dairy farmers and policymakers where to allocate their investments to improve efficiency in the future.

### 1.4 Organization

Following the introduction, chapter II provides background information on agricultural policy for the dairy sector in Kosovo, and reviews literature where the PSM or SFA approach are employed. Chapter III describes the methodology used for both studies. Chapter IV presents and discusses the study results while the last chapter, Chapter V provides concluding remarks and recommendations.

## Chapter II. Background Information and Literature Review

### 2.1 Governmental programs for the agricultural sector in Kosovo

The Ministry of Agriculture, Forestry and Rural Development (MAFRD) is the implementing institution and the managing authority of the government`s agricultural programs. This ministry applies its strategy for agriculture and rural development through the Agriculture and Rural Development Plan (ARDP), which is revised every four years. The ARDP incorporates a complementary policy framework for the development of the agricultural sector based on the National Agriculture Program (NAP). This plan includes detailed sub-sector strategies, divided into eight main support measures for the key commodities aiming to restructure the agricultural sector and fulfill the requirements of Kosovo as a pre-candidate, candidate and finally as a member state of the European Union (EU).

The first ARDP 2007-2013[3] was prepared and approved by the government of Kosovo in April, 2007, and it was updated in September 2010. This document outlined the general objectives for the agri-rural development in Kosovo. These objectives were:

- to generate additional income for farmers and rural dwellers, leading to improved living standards and working conditions in rural areas;
- to improve competitiveness and efficiency of primary agricultural production, in order to achieve import substitution and take advantage of export markets;

[3] Even though the ARDP was named for the years 2007-13, it was revised in 2010 to a newer version 2010-13.

- to improve processing and marketing of agricultural and forestry products, through increased efficiency and competitiveness;
- to improve on-farm/in-factory quality and hygiene standards;
- to achieve sustainable rural development and improved quality of life (including infrastructure) through promotion of farming and other economic activities that are in harmony with the environment;
- to create employment opportunities in rural areas, particularly through rural diversification; and
- to align Kosovo’s agriculture with that of the EU.

In order to achieve these objectives, MAFRD developed eight sustainable agri-development measures which are directly aligned to the four axis of EU`s rural development strategy (Table 3), within the two pillars of Common Agricultural Policy (CAP):

- Pillar 1: market support measures and direct subsidies to EU producers;
- Pillar 2: rural development programs.

**Table 3. ARDP alignment to the four main axis of EU`s CAP**

| Axis no. | EU CAP (Axis) | MAFRD Measures |
|---|---|---|
| Axis 1 | Competitiveness | • Development of vocational training to meet rural needs (Measure 1)<br>• Restructuring physical potential in the agri-rural sector (Measure 2)<br>• Managing water resources for agriculture (Measure 3)<br>• Improving the processing and marketing of agricultural products (Measure 4) |
| Axis 2 | Environment and improved land use | • Improving natural resource management (Measure 5) |
| Axis 3 | Rural diversification and quality of rural life | • Farm diversification and alternative activities in rural areas (Measure 6)<br>• Improvement of rural infrastructure and maintenance of rural heritage (Measure 7) |
| Axis 4 | Community-based local development strategies | • Support for local community development strategies (Measure 8) |

As can be seen from the table above, each axis of EU`s CAP corresponds to a particular or several measures of the ARDP Program. According to the MAFRD (2010), this alignment is made in order to be ready to fulfill the obligations in the agricultural sector when Kosovo becomes a member state of the EU and also restructures its agri-rural sector in line with the EU[4].

[4] On July 25, 2014 the EU and Kosovo chief negotiators initiated the Stabilization and Association Agreement between the EU and Kosovo in Brussels. For more details see the 2015 Kosovo Report on Member Accession at: http://ec.europa.eu/enlargement/pdf/key_documents/2015/20151110_report_kosovo.pdf

In 2010, MAFRD prepared the ARDP 2010-13, which was mainly built on the previous ARDP, but this document included a broader set of support measures. An important change in this ARDP is the inclusion of the direct payments (DP). This broader set of measures correspond with the first and second pillars of the EU`s CAP[5]. Currently, the ARDP 2014-2020 is being implemented.

### 2.1.1 Direct Payments (DP) Program

MAFRD started the implementation of the direct payments program (DP) in 2009, even though a direct payment scheme for heifers and for fuel (wheat harvesting) was initiated a year earlier, in 2008. A Mid-Term Evaluation of the ARDP 2007-13 conducted by Kastner International and the Federal Institute of Agricultural Economics in Wien (AWI) emphasized that the aim of direct payments is to increase production of agricultural products. The general objectives of DP commonly defined by (Kastner International and AWI, 2012) were:

- increasing and stabilizing farm incomes,
- increasing production,
- increasing the use of currently unused land and pastures,
- improving the quality of inputs,
- improving food safety and food quality standards, and

[5] For more information regarding the dairy policy in EU, read the section in the Appendix "The dairy policy in the European Union (EU)" and "Dairy policy in Germany, Sweden and Denmark".

- building up of an administrative capacity that is in line with EU requirements.

In addition to general objectives that are listed above, the ARDP through the DP implementation intends to achieve some specific objectives such as reducing the average size of small farms from 1.5 to 1.0 ha and increasing the size of large farms from 19.3 to 30.0 ha. Regarding the livestock sector, the specific objective was to increase the average number of dairy cows on large farms from 5.45 to 20 head. As an ultimate overall specific objective was to make farm revenue twice as high as farm expenditure (Kastner International and AWI, 2012).

Kastner International and AWI (2012) also highlighted two arguments in favor of direct payments implementation, firstly direct payments are a major component of the CAP to which Kosovo wants to align its agricultural policies and secondly they create a bond between farmers and the administration that encourages farmers to stay in business and to engage in politics.

Direct Payments (DP) were first offered for livestock and crop farmers. The subsidy per head scheme (SPHS) and the subsidy per hectare of planted cereals (SHPC) constitute the first direct support measures that were initiated by MAFRD. Livestock farmers were supported with premiums per head of milking cows, heifers, sheep and goats, while grain farmers were supported with area payments for wheat and fuel subsidies for harvesting cereals. In 2012, this form of support through direct payments was extended to cover more crops and also the beekeeping sector was included for the first time. Area payments for maize, wheat seed, sunflower and a premium for beehives were added. In

2013, premiums per head for chickens, area payments for the existing vineyards, rape and direct payments for planting materials were the last direct support measures added to this scheme of support. Fuel subsidies for harvesting cereals were terminated in that year. The participation of farmers in all these programs is voluntary, however they have to meet a given set of requirements in order to be eligible for support. This set of requirements are primarily coupled to production such us to number of cows, planting area, number of beehives and others.

**2.1.2 The Subsidy per Head Scheme (SPHS)**

The “subsidy per head scheme” (SPHS) was initiated in 2009, representing one of the first direct payment measures to be implemented by MAFRD. This scheme supports the dairy farmers with a minimum of five (5) cows and supports payments up to as many as fifty (50) dairy cows per farm. SPHS is coupled to the current number of cows and the farmer receives a specific amount of money per head (€50), while payments are made at the end of each year.

As outlined in the “Direct Payments (DP) Program” chapter, the objectives of this scheme are to increase and stabilize farm incomes, increase production, increase the use of currently unused land and pastures, improve the quality of inputs, improve food safety and food quality standards, and buildup of an administrative capacity that is in line with EU requirements.

It is estimated that a range of 41,000 to 45,000 head of dairy cows are being consistently subsidized on an annual basis (AAD, 2014). In 2014, there were in total 5,472 dairy farmers supported, amounting to a total of 44,235 subsidized dairy cows, while in 2013 respectively, 5,075 were supported amounting to a total of 42,119 dairy cows. Table 4 provides the number of supported farmers in both years and the number of subsidized cattle (dairy cows) by region.

**Table 4: Number of supported farmers with the SPHS and the total number of subsidized dairy cows by region in 2013 and 2014**

| | 2013 | | 2014 | |
|---|---|---|---|---|
| Region | No. of supported farmers | Subsidized dairy cows (No.) | No. of supported farmers | Subsidized dairy cows (No.) |
| Prishtina | 860 | 7047 | 947 | 7863 |
| Mitrovica | 724 | 5449 | 856 | 6029 |
| Peja | 935 | 8298 | 992 | 8485 |
| Prizren | 746 | 6537 | 897 | 7489 |
| Ferizaj | 428 | 3414 | 466 | 3607 |
| Gjilan | 728 | 6225 | 685 | 5906 |
| Gjakova | 654 | 5149 | 629 | 4856 |
| Total | 5075 | 42119 | 5472 | 44235 |

Source: AAD-Annual Report 2013/2014.

In 2014 and 2013, in order to implement the SPHS, MAFRD spent €2,211,750, and €2,105,950, respectively. As it can be seen on Table 4, the farmers from Peja and Prishtina region have the largest number of subsidized dairy cows, followed by Prizren and Mitrovica. The region with the lowest number of supported farmers and subsidized dairy cows is Ferizaj. In 2014, the number of supported farmers increased by 7 percent compared to 2013.

### 2.2 Previous research on the dairy sector in Kosovo

The lack of empirical analysis is noted in most of the agricultural policy issues in Kosovo. This is predominantly caused by the lack of data.

However, a Mid Term Evaluation (MTE) was conducted on the first ARDP 2007-13 in 2012[6]. The main purpose of this MTE was to provide essential information on possible revisions of the ARDP 2007-13 in order to improve the efficiency of the proposed interventions (Kastner International and AWI, 2012). This assessment used primary data collected from the interviews with the MAFRD staff responsible for the measure development and implementation. Also primary data were collected from beneficiaries of direct payments and measure two (2) (Kastner International and AWI, 2012). Even though this evaluation included six (6) measures, this literature review will focus only on their findings for the Direct Payment (DP) program. In comparison to investment support, direct payments are noted to be less efficient means to promote growth because their effect hardly plays out over many years. In addition, the selection of particular crops or livestock types as targets of direct payments discriminates against other non-targeted crops and products, which may be more profitable to produce. Furthermore, the application of thresholds as eligibility criteria creates an incentive for farmers who operate below this threshold to surpass it.  The MTE suggests to eliminate

[6] This document was supported with EU funds by Kastner International and the Austrian Federal Institute of Agricultural Economics together with the support of MAFRD on behalf of the EU Twinning Project KS/10/IB/AG/01 "Support to the Ministry of Agriculture, Forestry and Rural Development (MAFRD) in legislative and policy development and in implementing the Agricultural and Rural Development Program (ARDP)".

eligibility criteria which firstly won`t discriminate against small farms and furthermore, the next ARDP should consider including the large scale agricultural holdings in order to achieve the targets of growth and cost reduction more efficiently. At the sector level, the MTE suggested to consider supporting other crops besides wheat, while for the dairy sector, taking into consideration that Kosovo imports about a third of its consumption, mostly in the form of value added products, supporting cows, sheep and goats has the additional benefit that it provides a source of income in more remote and disadvantaged rural areas. A limitation of this MTE regarding the assessment of direct payment effects is that the selected farm sample for analysis were supported with different direct payments schemes (wheat, milk cows, sheep and goats), so the MTE could not isolate the effect of a specific measure due to the unavailability of the data. The MTE suggested that in the future more emphasis on financial terms should be given to investment grant support rather than direct payments since investments deliver higher returns that accumulate over a long period in the future. In addition, the prioritization of certain sectors should be reconsidered in a future program design (Kastner International and AWI, 2012). Similarly Gjokaj & Ortner (2014) assessed the likely improvements of efficiency of support over the previous period as a consequence of better targeting of measures and changes in their composition. Their study was based on the MTE of ARDP 2007-2013, and other studies on rural development programs in

EU member states[7]. The authors emphasized that in terms of trade, Kosovo's agriculture is not competitive in comparison to its trading partners and strongly reliant on EU support to maintain a limited share in its internal market. They recommended that a price support policy would be the most efficient policy to boost production and the quality of products, because the efficiency of direct payments to increase production is much lower. Furthermore, Gjokaj & Ortner argued that the combined effect of the measures applied by the ARDP is not known in detail, hence it is important to address this gap of knowledge in order to identify those measures that are the main levers on development and whose timely and properly funded implementation is crucial to the success of the program. In addition, direct payments based on area or livestock numbers are not the most efficient choice of measures but the introduction of price premiums for products with low self-sufficiency levels may run into opposition from international competitors. In addition to the whole ARDP evaluation, two other studies have evaluated the impact of direct payments schemes in the dairy sector in Kosovo. Their findings revealed that this policy is not achieving its objectives to increase milk production and milk quality (GAP, 2016; INDEP, 2015). GAP (2016) recommended to substitute the SPHS to direct payments based on the quantity of milk produced by the farm and also increase the payments for milk quality. Similarly INDEP (2015)

[7] For more information regarding the studies that assessed the impact of dairy policy in EU, read the section on Appendix "Previous studies that assessed the impact of dairy policy in EU".

recommends to develop a new subsidy policy that would support dairy farmers based on the quantity and quality of produced milk.

Besides these assessments, other empirical studies on the dairy sector in Kosovo have focused primarily on the profitability of commercial dairy farms, milk quality and productivity. Bytyqi et al. (2014) provided an economic overview of 63 dairy farms in Kosovo by using a spreadsheet-based decision support tool. Their findings revealed that the main source of farm income are milk sales, which represent about 69.11 percent of total farm revenue. The authors suggest that enhancing the milk productivity is an opportunity to improve the farm net margin. Bytyqi et al. conclude that insufficient and poor quality of the feed is the primary reason for low productivity.

Besides low productivity, milk quality is a major concern among dairy farms in Kosovo. Musliu et al. (2009) studied the impact of somatic cell counts (SCC) on the profitability of commercial dairy farms in Kosovo. A linear regression model was used to study the impact of several parameters on the profitability of 50 dairy farms. Their results showed that using good milking practices has positive impact on decreasing SCC. They also confirmed that based on existing standards, the quality of fresh milk produced in Kosovo is still low and requires immediate improvement. A similar study conducted by Bytyqi et al. (2010), examined the effect of SCC in raw milk of dairy cattle farms by using a sample of 2203 individual milk laboratory analyses over the period of August 2007-February 2008. Their results revealed that herd, breed, month of the year and lactation number had a significant effect on the presence of SCC. The study also found that the present level of SCC on raw milk was relatively low. However Bytyqi et al. concluded that SCC levels should not be underestimated, considering that a high rate of SCC in raw milk is negatively correlated with farmers' profit, consumer food safety and overall animal health.

In addition to profitability and milk quality, the productivity of the dairy sector in Kosovo has been the focus of several studies. Nushi & Selimi (2009) conducted an assessment of the dairy sector in Kosovo, analyzing its performance after the 1999 war and its potential for future development. They projected that annual milk yields vary from 1,500–6,000 liters per cow, however production is highly dependent on the farm production system and breed. At the country level, they estimated that average milk yield is about 2,200 liters per cow. The study also found that Simmental and Holstein breeds are usually located on bigger farms and can produce 5,000 and more liters of milk while local breeds like Busha can produce only between 1,500–2,500 liters annually.

In general, the genetic structure of cattle farms in Kosovo is mainly dominated by local breeds, cross breeds and Simmentals. There are significant differences in milk productivity among these breeds. Krasniqi et al. (2013) estimated the milk productivity levels of the Busha cows that are kept on pastures using the data from four localities in Prizren region. For the purposes of their study, the authors conducted an assessment of the chemical composition of pasture grass, type of ration to feed the Busha cows and gathered data on milk production over three lactations. Their results revealed that Busha cattle feeding is mainly based on the use of pastures (250 days/year), while the rest of the year these cows are kept in stables for about 115 days per year. Divided by lactation periods, 1st, 2nd, and 3rd, Busha produced about 1143.9, 1306.5 and 1515.9 kg of milk respectively.

### 2.3 Impact assessments in the dairy sector using the Propensity Score Matching (PSM) approach

Agricultural policy analysis represents a complex field of study. The overall aim is to conduct an evaluation of a policy based on the available data. The complexity of policy analysis is mainly a result of the causal and indirect effects that an agricultural policy might have and furthermore, the heterogeneity of farms being affected. This is a major concern among researchers; therefore selecting appropriate methods for policy evaluation is a challenging task.

Matching methods, specifically Propensity Score Matching (PSM) is a widely used approach in impact assessment studies in the agricultural sector. Among different agricultural sectors, dairy has been the focus of several impact assessment studies using the PSM approach. For example, Kabunga (2014) assessed the impact of adopting improved dairy cow breeds on enterprise, household, and individual child-level nutrition outcomes in Uganda. He found that adopting improved dairy cows significantly increases milk yield, household’s orientation to milk markets, and food expenditure. In addition, improved technology adoption substantially reduces household poverty and stunting for children younger than age five. In another study, Smale et al. (2012) estimated the impact of an USAID project aiming to promote maize, dairy and horticulture enterprises among smallholder farmers in Kenya. Their findings showed that USAID programs significantly improved off-farm incomes of targeted households in 2010, suggesting that the programs may have improved the capacity of program participants to generate income from non-farm sources. A similar study by Rawlins et al. (2014) evaluated the impact of Heifer International's dairy cow and meat goat donation programs in Rwanda. They found that the program substantially increased dairy and meat consumption among Rwandan households who were given either a dairy cow or a meat goat. Furthermore, their results provide confirmatory evidence on wasting and stunting reductions among children in households that received dairy cows.

Technology adoption has been the focus of several researchers. A study by Dehinenet et al. (2014) used propensity score matching to assess the impact of dairy technology adoption on small holder dairy farmers in selected zones of Ethiopia. On a matched sample of 163 adopters and 167 non-adopters, their results showed that both milk consumed per day at the farm level and destined to the market were higher in dairy technology adopter households than non-adopters. Moreover, adopter smallholder farmers also could get more income from milk production on average than the non-adopters.

**2.4 The application of Stochastic Production Frontier in the dairy sector**

Farm level efficiency analysis is widely used among researchers. Within this context, several studies have examined the efficiency level of dairy farms using the stochastic frontier analysis (SFA).

The stochastic frontier production approach was firstly proposed and developed by Aigner et al. (1977) and Meeusen van den Broeck (1977). The application of the production function in the dairy sector is used to estimate the efficiency scores of dairy farms and identify the inefficiency determinants. For example, Taurer and Belbase (1987) used a frontier production function to measure the technical efficiency of 432 dairy farms in New York. Using corrected ordinary least squares, the authors found an average of 69 percent of technical efficiency of sampled farms. Furthermore, being located in the more fertile crop growing region of the state and having more cows positively affected efficiency. In another study, Mugambi et al. (2015) used a Cobb-Douglas production function form to estimate the technical and cost efficiency of 135 smallholder dairy farms in Kenya. Results revealed that farms underfed their dairy cows, leading to low milk yields compared to their genetic potential. The average level of efficiency was estimated at 83.7%, while the number of milking cows, quantities of feeds and mineral supplements were the major determinants of the amount of milk a farm produced (Mugambi et al., 2015). In a similar study, Masunda and Chiweshe (2015) investigated the farm level technical efficiency of production of 27 smallholder farmers in Zimbabwe. Using a stochastic production frontier model and a two-step estimation approach, the authors found that dairy farmers are operating far below their production potential. Their results showed a significant relationship between technical efficiency and explanatory variables such as age, veterinary service, extension, gender, farming experience, and market performance. Kompas and Nhu Che (2006) used a stochastic production function and technical efficiency model to determine the importance of each input in dairy production and investigated the effects of key technology variables on farm efficiency on 252 farms in Australia. Their findings showed that the key determinants of production efficiency are the type of dairy shed and the proportion of irrigated farm area. The average technical efficiency was estimated at 87 per cent, ranging from 69 to 99 percent. Similarly Hazneci and Ceyhan (2015) applied a Cobb-Douglas production function on 67 randomly selected dairy farms in Turkey to estimate the production efficiency and identify the inefficiency determinants. Their findings revealed that on average, the amount of milk produced by sampled farms could be increased by 22%, based on the average technical efficiency measure of 0.78. Education level of farmers, feeding frequency, the ratio of Holstein stock to total stock and land allocated to fodder crops were associated with higher efficiency.

## Chapter III. Data and Methodology

This chapter describes the data and methodology used for the purposes of the study. Survey design, sampling strategy, sample size, data collection, data transformation, and the specification of PSM and SFA models are described in the following sections.

### 3.1 Survey

A survey was developed to collect the primary data that were necessary to conduct the studies. The survey instrument contains questions that collected information about the socio-economic characteristics of farmers such as age, gender, household size, formal education in years, experience in milk production, farm size, farm composition, capital, milk production per year, milk sales per year, milk quality, cost of inputs such as labor, feeding cost, transportation and depreciation costs. In total, the survey contains 41 questions, excluding the questions organized in table formats. Some questions were skipped due to answers obtained on previous questions.

Prior to distribution for data collection, the survey was submitted for approval by the Institutional Review Board (IRB) of the University of Arkansas. Following approval, the survey was pre-tested before being used as a final version. The final version of the survey can be found in the Appendix.

### 3.2 Sampling Strategy and Sample Size

To estimate the impact of SPHS on milk productivity, land use and net income, two groups of dairy farmers (participants and non-participants in the SPHS) were randomly selected for the study. The survey observations from these two groups are matched for analysis.

Determining the sample size was the first step on the sampling strategy. Taking into consideration the funds allocated for the study, a maximum of four hundred (400) dairy farmers could be visited and interviewed face-to-face; therefore the primarily objective was to sample 400 dairy farmers. The second step was to determine the group size of participants and non-participant farmers. Regarding the group size, to date and to the best of our knowledge, there is no clear rule that specifies the sample size for the participants and non-participants groups. However, in most of the reviewed studies (Pufahl & Weiss, 2009; Birol et al., 2011; Kabunga, 2014; Becerril & Abdulai, 2010), specifically on impact assessments using the Propensity Score Matching approach, the non-participants group is at least twice as large in comparison with the participants group, mainly due to better chances to obtain more matched observations with members of the participant`s group. Therefore, for this study, a proportion size of 1:3 was used in order to increase the chances of having more matched observations. Taking into consideration this proportion, the objective sample would contain a minimum of one hundred (100) participant farmers and a maximum of three hundred (300) non-participant farmers (respondents).

Subsequently the following step was to determine the number of farmers per region, specifically the number of participants and non-participant farmers throughout the seven regions of Kosovo. Since this study aimed to have countrywide scope, all the regions were sampled.

In order to reduce the geographic bias and have a representative sample across the regions, a weighting technique was used. A population list of participant farmers in the

SPHS in 2014 was used to estimate the weights per region. This was the only official document to which we had access regarding the number of dairy farmers throughout the regions. The following equation describes the weight estimation per region:

$$W_{ij} = \frac{Y_{ij}}{X_{ij}}, \quad (1)$$

where $W_{ij}$ denotes the estimated weight for the farmers $i$ from a specific region $j$, $Y_{ij}$ denotes the number of participant farmers $i$ in a specific region $j$ and $X_{ij}$ is the sum of all participant farmers throughout the country. Based on the estimated weights, the number of participants and non-participant respondents (farmers) per region were calculated. The table below represents the estimated sample size per region based on the estimated weights and the received respondents from the field interviews per region in 2014.

**Table 5: Estimated sample size (weights) and targeted and received number of respondents per region in 2014**

| Region | Estimated weights | | Targeted respondents | | Received respondents | |
|---|---|---|---|---|---|---|
| No. | P.* | Non-p.* | P.* | Non-p.* | P.* 2014 | Non-p.* 2014 |
| 1 | 18.71 | 56.15 | 19 | 56 | 25 | 48 |
| 2 | 15.63 | 46.92 | 16 | 47 | 17 | 23 |
| 3 | 18.14 | 54.45 | 18 | 55 | 20 | 36 |
| 4 | 16.38 | 49.17 | 16 | 49 | 26 | 31 |
| 5 | 8.45 | 25.35 | 8 | 25 | 12 | 17 |
| 6 | 11.18 | 33.56 | 11 | 34 | 17 | 24 |
| 7 | 11.48 | 34.42 | 12 | 34 | 13 | 16 |
| Total | 99.97 | 300.02 | 100 | 300 | 130 | 195 |

Source: author.
*P. - Participants; Non-p.* - non-participants.
*Region No. indicates 1-Prishtina, 2-Mitrovica, 3-Peja, 4-Prizren, 5-Ferizaj, 6-Gjilan, 7-Gjakova.
*Due to random selection, participants may be supported with other direct payment schemes, besides SPHS.

All the farmers in Table 5 were listed on the MAFRD records as having five (5)[8] or more dairy cows in 2014, which is also the SPHS support eligibility criteria that MAFRD applies. So to receive government support, specifically to receive the benefits from the subsidy per head scheme, a cattle farm should have had at least five and a maximum of fifty cows. In addition, this criteria was also used to select the respondents from the non-participant group due to the assumption of common support in the PSM approach

[8] Due to random selection, some of the visited farmers had less or more cows compared to the number of cows they had on the list. Between the period that they were registered in the program and our visit, they decreased or increased their number of cows.

which states that "Households being compared have a common probability of both being adopter and non-adopter" (Kabunga, 2014).

Accordingly, after calculating the target number of respondents per region, the same list was used to generate a random sample that selected the individual respondents per each region.

This sample has a relatively good representation among the regions of Kosovo. In comparison with census data of 2014, the sample has a similar distribution of farmers and dairy cows throughout the seven regions. Table 6 presents this comparison.

**Table 6: A comparison of regional distribution of agricultural dairy households between the Agricultural Census and research sample**

| | AGRICULTURAL CENSUS 2014 | | | | RESEARCH SAMPLE (2014 Observations) | | | |
|---|---|---|---|---|---|---|---|---|
| Region | H.holds | No. of D.cows | % D.cows | % H.holds | H.holds | No. of D.cows | % D.cows | % H.holds |
| 1 | 14592 | 28834 | 21.45 | 22.84 | 73 | 593 | 22.01 | 22.46 |
| 2 | 8159 | 16740 | 12.46 | 12.77 | 40 | 314 | 11.66 | 12.31 |
| 3 | 8889 | 21856 | 16.26 | 13.92 | 56 | 388 | 14.40 | 17.23 |
| 4 | 12252 | 22862 | 17.01 | 19.18 | 57 | 517 | 19.19 | 17.54 |
| 5 | 6359 | 11673 | 8.69 | 9.96 | 29 | 183 | 6.79 | 8.92 |
| 6 | 5005 | 12623 | 9.39 | 7.84 | 41 | 390 | 14.48 | 12.62 |
| 7 | 8618 | 19805 | 14.74 | 13.49 | 29 | 309 | 11.47 | 8.92 |
| Total | 63874 | 134393 | 100 | 100 | 325 | 2694 | 100 | 100 |

*H.holds – households.
*D.cows - dairy cows.
*Region No. indicates 1-Prishtina, 2-Mitrovica, 3-Peja, 4-Prizren, 5-Ferizaj, 6-Gjilan, 7-Gjakova.

The data on dairy production are compared to the official MAFRD reports and relevant studies on the Results chapter.

### 3.3 Data Collection and Final Database

The data collection process was conducted in all the seven regions of the country, during a period of two months, specifically from mid-July to mid-September 2015. This process was managed by two graduate students, a student of the University of Arkansas, Department of Agricultural Economics and Agribusiness, and a student from the University of Prishtina, Faculty of Agriculture and Veterinary. The data were collected using the structured questionnaires, administered by a total of six enumerators in face-to-face interviews. A total of three hundred twenty seven (327) randomly selected households were surveyed. However, this was not a perfect random sample. Due to several refusals, similar farmers on the surrounding area were selected to replace the farmers that refused to take part in the study.

For both approaches, PSM and SFA, several farmer observations were dropped, since they were not eligible to be incorporated in those analyses. For the PSM approach, due to random selection, many dairy farmers were supported by more than one scheme, therefore all these observations (90) were dropped from impact assessment analysis. In order to isolate the effect of SPHS, only the observations from farmers receiving support exclusively from SPHS were kept for analysis. For the efficiency analysis, 243 dairy farmers out of 325 were used, the other observations were dropped, mainly due to missing data.

The collected, specific observations rely heavily on the farmer`s recall, since a large percentage of farmers do not keep records on their daily economic activity. As a final step, the data were entered, stored and then utilized for estimation using the statistical software Stata and R Studio platform.

### 3.3.1 Data cleaning and transformations

Several outlier observations were removed from the final database, due to the "large" differences with the rest of the sample. A specific example is a large dairy farm, which had a significantly larger number of dairy cows, used extremely high feeding amounts and their milk productivity was considerably higher relative to the rest of the sample; therefore it was removed so that those records would not excessively influence the rest of the analysis. Other sources of outliers were the declared milk productivity per cow, grains yields, milk sales and others. These respondents were contacted twice to correct the possible "mistakes". In general, those observations that had a value twice the standard deviation (higher/ lower) compared to the mean, were checked twice or removed from the final database.

In addition, there were several respondents (surveys) with missing data for specific variables, such us the annual milk production per cow, quantity and income from milk sales, milk consumption per household, capital assets, and others. Therefore, these variables were synthesized using the observations from the other variables. For example, in case of missing data for the annual milk productivity per cow, the milk productivity per day was multiplied by 305 days of lactation. In cases of missing data for the milk consumption per household, the official consumption per capita was used, and then multiplied by the size of household.

### 3.4 Construction of Outcome, Impact and Efficiency Variables

The primary outcome variables are: milk productivity, land use, gross income and farm size (structure). All these outcomes correspond to the objectives of the DP/SPHS program. Milk production per cow per day is used to measure the objective of increasing production, the area of meadows, pastures and planted area with other crops is used to measure the objective of increasing the use of unused land and pastures, gross income from the dairy operation is used to measure the objective of improving income and lastly, the number of dairy cows per farm is used to measure the objective of increasing the average of dairy cows per farm.

For the efficiency analysis, a larger number of variables is used. These variables are related to feeding amounts per cow, feeding cost, genetic structure (breeds) and production quantities. Construction, measurement and units of each variable used either in PSM or SFA are presented in Table 7.

**Table 7: Variables used in PSM and SFA approach**

| Variable | Description | Unit | Used |
|---|---|---|---|
| mcowday | Daily milk production per cow | (liters) | PSM & SFA |
| Nocows | Number of dairy cows per dairy farm | (count) | PSM & SFA |
| Corn | Corn planted area | (ha) | PSM |
| Meadpast | Area with meadows and pastures | (ha) | PSM |
| tlanduse | Total land use (ha) | (ha) | SFA |
| Dayspat | The annual amount of days in pastures per cow | (count) | SFA |
| haykgday | The daily given amount of hay in barn per cow | (kg) | SFA |
| congkgday | The daily given amount of concentrate in barn per cow | (kg) | SFA |
| silkgday | The daily given amount of silage in barn per cow | (kg) | SFA |
| Totalfeedday | The daily total amount of feed per cow | (kg) | SFA |
| hayratio | The ratio of hay to total amount of feed per cow | (ratio) | SFA |
| wheatratio | The ratio of wheat planted area to total grains area | (ratio) | SFA |
| cornratio | The ratio of corn planted area to total grains area | (ratio) | SFA |
| Holsteinratio | The ratio of Holstein stock in the barn | (ratio) | SFA |
| Simentalratio | The ratio of Simental stock in the barn | (ratio) | SFA |
| dairyincome | Annual gross income from the dairy operation | (€) | PSM |
| exp | Experience in years in dairy operation | (count) | PSM |
| edu | Formal education in years | (count) | PSM |
| age | Age of the dairy farm manager in years | (count) | PSM |
| Barn | If the farm keep the cows tied in the barn (yes=1) | (1/0) | SFA |
| Grazing | If the farmer uses grazing (yes=1) | (1/0) | PSM |
| frecords | If the farmer keeps farm records (yes=1) | (1/0) | PSM & SFA |
| PrishtinaR | If the farmer is located in Prishtina region (yes=1) | (1/0) | SFA |
| MitrovicaR | If the farmer is located in Mitrovica region (yes=1) | (1/0) | SFA |
| GjilanR | If the farmer is located in Gjilan region (yes=1) | (1/0) | SFA |

### 3.5 Measuring treatment/ participation effects using Propensity Score Matching (PSM). Specification of the PSM Impact Evaluation Model for the SPHS

Estimating the effect of participating in a specific program is the main goal of evaluation studies. According to Pufahl and Weiss (2009), evaluation studies try to estimate the mean effect of participating in a program. Therefore, the purpose of this

PSM Impact Evaluation Model is to estimate the mean effect (impact) of subsidy per head scheme (SPHS) on milk productivity improvement, land use and net income. This impact is measured as the Average Treatment Effect on the Treated (ATT), an effect as a result of participating in the SPHS program.

However, missing data in the counterfactual is a major issue in evaluation studies, since we cannot observe the outcomes of participating farmers (treated) without participating in the program (treatment). Hence, the mean effect of participating in the program is estimated by constructing a control group similar to the treated group, which enables measuring the outcome that would have been observed for the treated if they had not been treated. Subsequently, the next step is to simply compare the mean outcomes between treated and non-treated farmers, however, this leads to biased results. The first potential source of bias is that treated and non-treated farmers may differ in terms of observed characteristics such as experience in milk production, formal education, and age of the farm manager, corn planted area, whether the farmer uses grazing or not and whether they keep farm records. A second bias source is that these two groups can differ with respect to unobserved characteristics such as motivation, managerial skills and others. Therefore, the PSM approach, introduced by Rosenbaum and Rubin (1983), is used to control for the observed characteristics and subsequently estimate the mean outcomes of SPHS participants and non-participants, respectively. Prior to conducting the matching procedures, and constructing comparison groups, a set of observable covariates are chosen for the purposes of matching. Caliendo and Kopeinig (2008) emphasize that only variables that simultaneously influence the participation decision and the outcome variable should be included, while variables that might be affected by the treatment should not be included. Economic theory and the previous knowledge of the researcher regarding the program and observed units should be used in specifying the model (Smith and Todd, 2005). Experience in milk production, corn planted area, formal years of education, and age of the farm manager, a binary variable whether the farm manager keeps farm records or not, and a binary variable for grazing or non-grazing production system were used as observed covariates to conduct matching. It is assumed that these variables simultaneously can affect the outcome and the participation decision.

Following Kabunga (2014), the observable impact of SPHS was measured in two stages. In the first stage, propensity scores $P(x_1)$ for each individual farmer were generated using a probit model. The propensity score indicates the probability of a household, (dairy farmer) to join the SPHS program given the observed characteristics, $x_1$:

$$\Pr(P_i = 1|x_i) = p(x_i) \ . \tag{2}$$

The control (non-participants) group was constructed by matching the participants with non-participant farmers based on their propensity scores. Observations without an appropriate match were dropped from further analysis.

In the second stage, the ATT of SPHS was estimated. Impact of this scheme was measured on these outcome variables, $(y_i)$: $(y_1)$ milk productivity per cow per day, $(y_2)$ land use, $(y_3)$ gross income and $(y_4)$ farm size in number of cows. Impact was measured separately for each of these four outcome variables using matched observations of treated and non-treated dairy farmers. ATT was estimated as follows:

$$ATT = E[y_{1i}|D_i = 1, p(x_i)] - \mathrm{E}[y_{0i}|D_i = 0, p(x_i)], \tag{3}$$

where ATT basically measures the mean difference of the outcome of interest (e.g. milk productivity per cow) between the participants and non-participant farmers with similar propensity scores, $p(x_i)$. The $D_i = 1/0$ denotes whether the farmer was a participant in the program or not, $y_{1i}$ is the outcome of the participant farm $i$, while $y_{0i}$ represents the outcome of the non-participant farm $i$. The variable of $p(x_i)$ denotes the estimated propensity score for the farmer $x_i$. These observations are balanced on their propensity score and lie within the region of common support (Kabunga, 2014).[9]

Prior to moving to the next step, two conditions must be satisfied, the assumption of Conditional Independence and the assumption of Common Support. Following Rosenbaum and Rubin (1983), the Conditional Independence Assumption (CIA) can be specified as follows:

$$(y_1, y_0) \perp \mathrm{D} \,|\, \mathrm{X}\,, \tag{4}$$

[9] Region of common support refers to investigating the validity of the propensity score-matching estimation. It is assumed that the probability of participation in an intervention, conditional on observed characteristics, lies between 0 and 1, implying that participation is not perfectly predicted. This assumption is critical to estimation, as it ensures that units with the same X values have a positive probability of both being participants and non-participants. Checking the region of common support between treatment and comparison groups can be done with relatively straightforward strategies. One obvious approach is through visual inspection of the propensity score distributions for both the treatment and comparison groups (Heinrich et al., 2010);

stating that a given set of observable covariates X are not affected by treatment, and potential outcomes $y$ are independent of treatment assignment D (Khandler et al. 2010). As noted in Khandler et al. (2010), Rosenbaum and Rubin (1983) called this assumption un-confoundedness, implying that uptake of the program is based entirely on observed characteristics. This assumption reduces bias when the untreated units are constructed.

Following Khandler et al. (2010), the Common Support assumption, which can be specified as follows:

$$0 < P(D = 1|\mathrm{X}) < 1 , \tag{5}$$

allows that treatment observations have comparison observations "nearby" in the propensity score distribution (Heckman, Lalonde, and Smith, 1999). Basically this assumption ensures that participants and non-participants have an equal chance of being both adopter and non-adopter; therefore participation in the evaluated program is not strictly controlled by an unobservable variable (covariate). When these two assumptions are satisfied, the treatment assignment is said to be strongly ignorable (Rosenbaum and Rubin, 1983).

The last step prior of estimating the ATT, is to match the treated farmers with farmers in the non-treated group (control). Treated units (observations) have to be similar to non-treated units in terms of observed characteristics unaffected by participation. Therefore some non-treated units are dropped to ensure comparability (Khandler et al., 2010).

Treated units are matched with non-treated units based on the estimated propensity scores, constructed by the selected observed covariates that were mentioned above. In total, four matching methods were used to match the treated with non-treated farmers. The different methods of matching were used in order to compare the outcome results among them. As noted by Kabunga (2014), using different matching algorithms can be considered as an approach to test the robustness of impact results.  The matching methods that were used are the Nearest Neighbor Matching (NNM), Caliper or Radius Matching, Stratification and Interval Matching and Kernel-based Matching method (KBM).

In the Nearest Neighbor Matching method (NNM), each treatment unit is matched to a comparison unit with the closest propensity score. The number of matched units $(n)$ is set up prior to matching (usually $n = 5$ is used). NNM can be conducted with or without replacement, where with replacement approach indicates that the same non-participants (non-treated farmers) can be used as a match for different participants (treated farmers). Following Khandker et al. (2010), NNM can be specified as follows:

$$\left|p_i - p_j\right| = \min_{k \in \{D=0\}} \{|p_i - p_k|\}\,, \tag{6}$$

where  $p_i$ denotes the treated farmer $i$, and $p_j$ denotes the non-treated farmer. The next matching method is Caliper or Radius Matching and it addresses one of the NNM method issues. The difference in propensity scores for a participant and its closest non-participant neighbor may be very high on NNM. Therefore, this situation results in poor matches and can be avoided by imposing a threshold “tolerance” on the maximum propensity distance known as "caliper"[10]. Therefore, caliper provides a certain range where treated units can be matched (with replacement) with non-treated units (Khandker et al., 2010). Caliper or Radius Matching can be specified as follows (Heinrich et al., 2010):

$$E(\Delta Y) = \frac{1}{N}\sum_{i=1}^{N}\left[Y_{1i} - \overline{Y}_{0\,j(i)}\right], \quad (7)$$

where $\overline{Y}_{0\,j(i)}$ denotes the average outcome for all comparison units who are matched with case $i$, $Y_{1i}$ is the outcome for case $i$, and $N$ is the number of treated cases. Therefore, this approach does not limit the number of matches with a given dairy farmer, as long as the units are "close" enough (Heinrich et al., 2010).

Stratification and Interval Matching divide the common support of the propensity score into a set of intervals (strata) and afterwards, the mean outcome difference (impact) between treated and non-treated group within each interval is calculated. One of the main issues with this approach is to select the number of strata to use. As cited in (Caliendo & Kopeinig, 2005), Cochrane and Chambers (1965) demonstrated that five subclasses are often enough to remove 95% of the bias associated with one single covariate. According to Aakvik (2001), one of the ways to justify the number of strata used is to check the balance of the propensity score or the covariates within each

[10] Caliper represents the maximum tolerance level or maximum propensity score distance by which a match can be made (Heinrich et al., 2010). As noted by Smith and Todd (2005), a possible drawback of caliper matching is that it is difficult to know a priori what choice for the tolerance level is reasonable.

stratum, implying that the estimated propensity score is appropriate only if it balances covariates.

Kernel Based Matching (KBM) uses a weighted average of the propensity scores of all non-participants to construct the counterfactual match for each participant. KBM assigns weights to each farmer and subsequently farmers are matched based on these weights. Following Khandker et al. (2010), KBM can be specified as follows:

$$\omega(i, j)_{KM} = \frac{K\left(\frac{P_j - P_i}{a_n}\right)}{\sum_{k \in C} K\left(\frac{P_k - P_i}{a_n}\right)}, \tag{8}$$

where $\omega$ denotes the estimated weight, $P_i$ denotes the propensity score for participant $i$, $P_j$ is the propensity score for the non-participant $j$, $K$ denotes the Kernel function and lastly $\alpha_n$ denotes the bandwidth parameter.

These matching procedures need to be checked for balance within the distribution of the observed variables (characteristics) in both treated and non-treated groups (Kabunga, 2014). Basically this procedure compares the covariates that are used for matching, before and after matching. For example, formal education in years is compared prior to matching and after matching. A summary of descriptive statistics of matching covariates can be found in the "Results from Propensity Score Matching (PSM)" chapter in Table 9.

### 3.6 Specification of the Stochastic Frontier Model

When modelling the impact of technical inefficiency of production, it is assumed that inputs are exogenously given and the objective is to maximize output; therefore only quantities are modeled and no price information is included in the modeling (Kumbahar et al., 2014). Following Kumbhakar et al. (2015), a stochastic production frontier model with output-oriented technical inefficiency can be specified as

$$ln\gamma_i = ln\gamma_i^* - \mu_i, \quad \mu_i \geq 0, \tag{9}$$

$$ln\gamma_i^* = f(x_i; \beta) + v_i\ , \tag{10}$$

where $i$ denotes the observations (dairy farms), $\gamma_i$ is a scalar of the observed output, $\gamma_i^*$ is the maximum output in the frontier (daily milk output per cow per farm), $x_i$ is a $Jx1$ vector of input variables (feed, land use, etc), $\beta$ is $Jx1$ vector of corresponding coefficients, $v_i$ denotes a zero-mean random error, and $\mu_i \geq 0$ is production inefficiency. The term $\mu_i$ is the log difference between the maximum and the actual output ($\mu_i = ln\gamma_i^* - ln\gamma_i$), therefore $\mu_i x100\%$ is the percentage by which the milk production per farm can be increased using the same inputs if production is fully efficient. In other words, it gives the percentage of milk production that is lost due to technical inefficiency (Kumbhakar et al., 2015). Rearranging equation (9)

$$\exp(-\mu_i) = \frac{\gamma_i}{\gamma_i^*}\ , \tag{11}$$

$\exp(-\mu_i)$ gives the ratio of actual output (milk production per farm) to the maximum possible output. This ratio is referred to as the technical efficiency of dairy farm $i$. Since

$\mu_i \geq 0$, the ratio can obtain a value between 0 and 1, with a value equal to 1 implying that the dairy farm is fully technically efficient (Kumbhakar et al., 2015). The value that is obtained from equation (11) multiplied by 100 represents the percentage of the maximum output (milk production) that is produced by dairy farm $i$.

In order to estimate the technical efficiency of dairy farms in Kosovo, a stochastic production frontier, first proposed by Aigner, Lovel and Schmidt (1977) and Meesusen and van den Broeck (1977) was used. The aim of this production frontier model is to identify the dairy farms that are more productive and those that are less productive, how much more milk could be produced given the amounts of feed, pasture days and land use, and whether the efficiency level is affected by the feeding amounts, hay ratio, barn production system, wheat and corn ratio, the ratio of Holstein and Simental stock, farm records, and farm location by region.

Therefore, the technical efficiency is estimated within the production frontier using cross-sectional data in 2014 from 243 dairy farmers in Kosovo. A Cobb-Douglas production function was used to determine the production efficiency level of dairy farms in Kosovo. A two stage procedure was used for this study. In the first stage, technical efficiency scores were estimated, while on the second stage, the efficiency estimates were regressed against a set of variables (factors), in order to explain the inefficiency (Battese and Coelli., 1995). Following Kumbhakar et al. (2015), the original specification was specified for cross-sectional data with an error term with two components, one accounting for random effects and the other for technical inefficiency. The model was specified as follows:

$$Y_i = x_i\beta + (V_i - U_i) \qquad ,i = 1, \ldots., N, \qquad (12)$$

where $Y_i$ is the milk production per cow per day for dairy farm $i$, $x_i$ a kx1 vector of input quantities for the farm $i$, $\beta$ denotes the vector of the respective estimated parameters, $V_i$ are random variables assumed to be independently and identically distributed (IID) $N(0, \sigma_v^2)$ and independent of the $U_i$, which are non-negative random variables assumed to account for technical inefficiency in production. The $V_i$ are assumed to capture random variation in output due to factors beyond the control of farms, such as variations in weather (Kompas and Che, 2006). According to Coelli (1996), the $V_i$ are also often assumed to be IID, $N(0, \sigma_v^2)$. Following Coelli (1996), $V_i$ and $U_i$ are assumed normally and half-normally distributed, respectively. This specification was based also on the Skewness test results, which indicate that the distribution of residuals skews to the left, which is consistent with a production frontier specification (Kumbhakar et al., 2015).

As noted by Kompas and Che (2006), the estimated values of $\beta$ indicate the relative importance of each input to production. The specified model allows for a non-negative random component in $u_i$, in order to generate a measure of technical inefficiency, or the ratio of actual to expected maximum output given inputs and the existing technology.

Since the approach used in this study is a two-step approach, the stochastic production function is estimated in the log-linear form. Subsequently, the estimated efficiency scores in log form are estimated in the inefficiency model as follows:

$$\ln(efficiency) = \beta_0 + \beta_1(x_1) + \beta_2(x_2) + \ldots + \beta_{11}(x_{11}) + \varepsilon_i, \quad (13)$$

where $\ln(efficiency)$ is the logarithm of technical inefficiency, $\beta_1$ denotes the total feed per cow per day measured in kg, $\beta_2$ denotes the hay ratio to the total amount of feed, $\beta_3$ denotes the estimated coefficient of Barn measured as a dummy variable for the production system in the barn, $\beta_4$ and $\beta_5$denote the wheat and corn ratio respectively, to the total grains planted area. $\beta_6$ and $\beta_7$ denote the Holstein and Simental stock to the total stock in the barn, $\beta_8$ is farm records, while $\beta_9$, $\beta_{10}$ and $\beta_{11}$ denote whether the farm is located in Prishtina, Mitrovica and Gjilan region, respectively.

The maximum likelihood estimation approach which includes the specification of the distribution of the errors terms is surely the most common approach used in the estimation of stochastic frontiers (Battese and Tessema, 1997). The package frontier in STATA was used to obtain maximum likelihood estimates of the stochastic production frontier with a half normal distribution for the technical inefficiency error term $U_i$.

## Chapter IV. Results

This chapter presents the results from the PSM and SFA studies on Kosovo dairy farms.

### 4.1 Descriptive Statistics

The descriptive statistics for the key variables used in PSM or SFA analyses for the whole sample are presented in Table 17 in appendix, as supplemental material of the study. As noted in chapter 3, a weighting technique was applied to have a proportionate representation of farmers per region, therefore these statistics reflect the characteristics in aggregate of dairy farmers in all the regions of Kosovo.

The demographic variables such as age, education, household and gender were relatively similar among the famers in the seven regions of Kosovo. The mean age of the sampled farmers in 2014 was 45 years with a standard deviation of 12.67. In terms of years of formal education, farmers in Gjilan (12.07) and Mitrovica (11.75) had slightly higher averages, while the regions of Gjakova (10.55) and Prizren (10.73) had the lowest averages. The most experienced farmers were found in Gjakova, with an average of 11.76 years of experience in dairy operation, followed by Gjilan (10.27) and Peja (9.46), while Mitrovica (5.93) and Prizren (7.81) had the least experienced farmers. On average in 2014, household size was 9.3 members. From the sampled farmers, over 98 percent (321) were male farmers, while only 1.23 percent (4) were female dairy farmers.

In addition to demographics, this section presents the descriptive statistics for some of the dairy operation variables such as farm production system, barn characteristics, milking and insemination method, number of dairy cows, daily and annual milk yield, and others such as milk sales, cheese sales and milk consumption per household. In

2014, 90.15 percent of farmers kept the dairy cows tied in the barn, while 9.85 percent of them used a free range production system. Two hundred and sixty one (261) dairy farmers (80.31%) used grazing, while 64 of them (19.69%) kept the cows only inside the barn (non-grazing). The largest percentage of farmers (80.92%) used milking machines to milk the cows, 18.15 percent used hands while only 0.92 percent used the pipeline as a milking system. In terms of insemination, more than half of the sampled farmers (52.62%) used artificial insemination, 16 percent used only bull breeding (natural method), while 31.38 percent used both methods.

Across the seven regions, the average number of dairy cows per farm in 2014 was 8.29 with a standard deviation of 5.54. The largest farms were recorded in Gjakova region at 10.62 dairy cows, followed by Gjilan (9.51) and Prizren (9.07). Average daily milk yield per cow aggregating both production systems was estimated at 12.06 l/day, equivalent to 3678.86 liters of annual production per cow. In terms of dairy products sales, raw milk sales constitute the highest percentage. In 2014, annual raw milk sales are estimated at 20930.83 liters per farm, combining together the raw milk sales at the unregulated markets known as "green markets" and also those sales at the formal market, mainly to collection milk centers of dairy plants. Similarly, average farm cheese sales are estimated at 117.88 kg of cheese. From the farm production, 6.76 percent of milk on average was consumed by the household. On average, a dairy household consumed 2149 liters of dairy products annually, or 0.6 on daily basis per capita.

Dairy farmers plant a significant amount of grains for their dairy operation. Among several grains, wheat and corn constituted 97 percent of the planted grains in 2014. On average, dairy farmers planted 4 ha of wheat and 2.30 ha of corn.

In terms of program participation, forty percent of the 2014 sampled farmers were supported by SPHS or other direct payment schemes that are part of the Direct Payment (DP) program. There is a slight variability of support distribution among regions; 46%, 45%, 43, and 41%, were the percent of supported dairy farmers in Prizren, Gjakova, Mitrovica and in Gjilan, respectively. The lowest percentages of program participants were in Prishtina (34%) and Peja (36%). Table 8 shows the number and percentage of the sampled dairy farmers participating in each scheme of support by region in 2014 and 2013.

**Table 8. Number of supported dairy farmers by each scheme of support by region**

| | 2014 | | | | 2013 | | | |
|---|---|---|---|---|---|---|---|---|
| Region | SPHS | Scereals | Smilk | Grant | SPHS | Scereals | Smilk | Grant |
| Prishtina | 25 | 23 | 3 | 1 | 42 | 34 | 0 | 3 |
| Mitrovica | 17 | 16 | 3 | 1 | 21 | 18 | 0 | 2 |
| Peja | 20 | 25 | 6 | 0 | 26 | 28 | 0 | 0 |
| Prizren | 26 | 12 | 2 | 2 | 25 | 22 | 0 | 1 |
| Ferizaj | 12 | 21 | 0 | 0 | 19 | 22 | 0 | 0 |
| Gjilan | 17 | 13 | 4 | 3 | 21 | 11 | 0 | 0 |
| Gjakova | 13 | 11 | 0 | 0 | 15 | 19 | 0 | 1 |
| Total | 130 | 121 | 18 | 7 | 169 | 154 | 0 | 7 |

SPHS-Subsidy per head scheme;
Scereals-subsidy for planted cereals, mainly for wheat and corn;
Smilk-subsidy for milk quality;
Grant-an investment grant scheme.

### 4.2 Results from Propensity Score Matching (PSM)

This section presents the results obtained from the Propensity Score Matching (PSM). The observations from 2014 were used for this estimation. Considering that SPHS was implemented in both years 2013-14, two groups of farmers (participants and non-participants) were constructed for the purposes of the study. Participants were supported only in 2014, while non-participants were not supported in both years, 2013 and 2014.

Table 9 reports the summary statistics for the farm and household characteristics of sampled dairy farmers.

**Table 9. Summary Statistics: Farm and Household characteristics**

| Variable | Description | N | Mean | S.D. |
|---|---|---|---|---|
| Nocows | Number of dairy cows per dairy farm | 149 | 7.06 | 3.51 |
| mcowday | Daily milk production per cow (liters/cow) | 149 | 11.88 | 1.98 |
| mcowyear | Annual milk production per cow (liters/cow) | 149 | 3623.97 | 604.90 |
| dailycons | Annual milk consumption per person (kg/person) | 149 | 0.61 | 0.13 |
| Grains | Total grains planted area (hectares) | 149 | 3.78 | 4.41 |
| Wheat | Wheat planted area (hectares) | 149 | 2.36 | 3.14 |
| Corn | Corn planted area (hectares) | 149 | 1.36 | 1.81 |
| landuse | Total land use (ha) | 126 | 3.16 | 3.86 |
| dairyincome | Annual gross dairy income in euro | 149 | 8135.96 | 5020.11 |
| Experience | Experience in years in dairy operation | 149 | 9.10 | 6.06 |
| Education | Formal education in years | 149 | 11.09 | 2.83 |
| Age | Age in years | 149 | 43.03 | 17.85 |
| Household | Household size | 149 | 9.10 | 4.84 |
| Grazing | If the farm uses grazing (yes=1) | 149 | 0.87 | 0.33 |
| Barn | If the farm keep the cows tied in the barn (yes=1) | 149 | 0.97 | 0.16 |
| frecords | If the farmer keeps farm records (yes=1) | 149 | 0.40 | 0.49 |

S.D. - Standard Deviation

The average daily milk production per cow is estimated at 11.88 liters per cow, amounting to 3623 liters of annual production for 305 days of lactation. This average is relatively different from the MAFRD (2014), which estimated that the average annual milk production per cow in Kosovo to be at 2066 liters per cow. However this difference is expected since the MAFRD estimation included all the cattle farms in Kosovo, while our sample selected only the farms that are or could potentially be participants of SPHS. These farms are considered to be commercial and semi-commercial, indicating that their production levels might be higher due to market participation. Nushi and Selimi (2009) stated that milk yields in Kosovo vary from 1,500-6000 liters per cow, depending on the farm and breed. Number of dairy cows owned is a condition for participating in the SPHS program, and a dairy farmer in the selected sample has on average 7.06 dairy cows[11]. According to MAFRD (2015), the average number of cattle in the agricultural households in Kosovo is four (4).

Table 9 further shows that the dairy operations on average generate €8135 annually as gross income. This income is relatively similar to the average annual gross income for all the agricultural household types in Kosovo estimated by MAFRD (2015) which is estimated at €8466. Correspondingly, MAFRD (2015) estimated that dairy farms generate an average of €9693 as annual gross income.

[11] PSM sample was truncated at four (4) cows per farm, since MAFRD supported also farmers with four cows in 2014.

In terms of experience, dairy farmers on this sample had on average 9 years of experience in dairy operations. Further, these households have on average 11 years of formal education. In 2014, the daily milk consumption per capita including secondary dairy products from the farm was estimated at 0.6 liters, which is quite consistent to the estimated value of MAFRD (2015), 0.5 kg.

As noted earlier, participants are classified as dairy farmers that were supported with the SPHS in 2014, while non-participants are dairy farmers that were not supported with the SPHS over the two years, 2013 and 2014.  From the seven regions, farmers were proportionally distributed between the regions, based on the number of dairy farmers per region. The number of surveyed dairy farmers (participants and non-participants) and their SPHS status per region are reported in Table 10.

**Table 10. Number of sampled participants and non-participants dairy farmers by region**

| Region | Ferizaj | Gjakova | Gjilan | Mitrovica | Peja | Prishtina | Prizren | Total |
|---|---|---|---|---|---|---|---|---|
| Participants | 1 | 3 | 1 | 2 | 14 | 12 | 7 | 40 |
| Non-participants | 2 | 4 | 15 | 8 | 24 | 34 | 22 | 109 |
| Total | 3 | 7 | 16 | 10 | 38 | 46 | 29 | 149 |

Source: Author calculations.

Twenty-six percent of these dairy farmers were participants, while the majority, more than seventy-three percent were not participants in SPHS. At the regional level, farmers from Prishtina and Peja constitute the highest share of the sample, while Ferizaj and Gjakova constitute the lowest participation. From the total sample of 149 dairy farmers, a sample of 135 were used for matching purposes.

This sample is created based on several variables (experience, education, age, corn planted area, farm records and grazing) that help to increase the balance between the two groups (participants and non-participants). After matching, there should be no statistical differences for the selected covariates between these groups. Therefore, to examine differences in observed characteristics between participants and non-participants, significance tests (t-test) were performed (see Table 11).

Dairy farmers (participants and non-participants of SPHS) differed in terms of number of dairy cows, grains planted area, age and gross dairy income (see Table 11). On average, participants had 0.10 percent more dairy cows and 1.95 percent more planted area with grains compared to non-participants. In contrast, non-participants had on average 1.08 more years of experience in dairy operation and were on average 10 years older compared to participants. Significance differences were found for daily milk yield per cow, wheat and corn planted area, total grains planted area, age of the farm manager and grazing.

These initial descriptive results support the assumption that there is no statistical difference between the groups in terms of observed characteristics. However, participant dairy farmers were better off in terms of several characteristics. Participants had on average higher years of education, higher annual gross dairy income and were younger compared to non-participants. Most importantly, even for the four variables that were used to measure the net impact (daily milk yield per cow, land use, gross income and number of dairy cows) participants were better off.

**Table 11. Difference in mean for the matching and outcome variables for potential and selected participants and non-participants (controls)**

| Variable | Potential participants | Potential controls* | Difference | Selected participants | Selected controls* | Difference |
|---|---|---|---|---|---|---|
| No. of observations | 40 | 109 | / | 40 | 92 | / |
| Number of dairy cows (log) | 1.92 | 1.82 | 0.10 | 1.92 | 1.88 | 0.04 |
| Daily milk yield per cow in liters (log) | 2.52 | 2.44 | 0.09*** | 2.52 | 2.38 | 0.15*** |
| Wheat planted area (ha) | 3.03 | 1.92 | 1.11* | 3.03 | 1.79 | 1.23 |
| Corn planted area (ha) | 1.91 | 1.10 | 0.82* | 1.91 | 1.63 | 0.28 |
| Barley planted area (ha) | 0.03 | 0.00 | 0.03 | 0.03 | 0.00 | 0.03 |
| Oat planted area (ha) | 0.06 | 0.06 | 0.00 | 0.06 | 0.09 | 0.03 |
| Area under grain cultivation (ha) | 5.03 | 3.07 | 1.95* | 5.03 | 3.51 | 1.52 |
| Total land use (ha) | 3.74 | 2.94 | 0.80 | 3.74 | 3.29 | 0.45 |
| Annual gross dairy income in euro (log) | 9.00 | 8.82 | 0.18 | 9.00 | 8.84 | 0.15 |
| Years of experience in dairy operation | 8.29 | 9.36 | 1.08 | 8.29 | 7.03 | 1.26 |
| Formal education in years | 11.46 | 11.13 | 0.33 | 11.46 | 11.03 | 0.43 |
| Age of the dairy farm manager | 36.03 | 46.11 | 10.08** | 36.03 | 36.94 | 0.91 |
| Household size | 8.91 | 9.00 | 0.09 | 8.91 | 8.03 | 0.89 |
| Dummy for Grazing/ Non-grazing | 1.00 | 0.87 | 0.13* | 1 | 0.91 | 0.09 |
| Dummy for farm records | 0.37 | 0.42 | 0.05 | 0.37 | 0.37 | 0.00 |

Significance levels: * p<0.05, ** p<0.01, *** p<0.001;
Potential controls – Potential non-participants;
Selected controls – Selected non-participants;
Source: Author.

Daily milk yield per cow at the participants group was estimated at 12.5 liters on average, their farms were generating €8870 gross income on average annually from the dairy operation and were using on average 3.7 ha of meadows, pastures and other crops. On the other hand, demographics such as education, household size and gender showed statistical similarities across participants and non-participants.

These descriptive results are important due to the fact that these initial differences among these two groups are a potential source of bias in estimates of program impact. By eliminating the initial statistical differences implies that better-off farmers are not more likely to participate in the program, therefore, all the dairy farmers in the selected sample have an equal chance of being an adopter or non-adopter. As noted in Kabunga (2014), this suggest that there is no positive selection bias in adoption behavior. The summary statistics from Table 11 reflect that there is no statistical difference between potential participants and potential non-participants (controls).

The propensity score matching was used to remove the selection bias and observe any systematic differences between participants and non-participants. As noted in the methodology chapter, PSM is used to match covariates that are related to treatment assignment and outcomes, but are not affected by the treatment assignment (Rubin and Thomas, 1996; Heckman, Ichimura and Todd, 1998; Glazerman, Levy and Myers, 2003).

*Results from PSM for daily milk production, land use, number of cows and gross income*

The selection of matching covariates was based on the previous studies in the dairy sector in Kosovo (Bytyqi et al., 2005; Miftari et al., 2010; Musliu et al., 2009; Bytyqi et al., 2011), previous studies of impact assessments using PSM in the dairy sector (Kabunga, 2014; Alemu & Adesina, 2015; Rawlins et al., 2014; Kirchweger & Kantelhardt, 2012; Smale et al., 2012) and the previous knowledge of the author on relevant theory and institutional settings following Smith and Todd (2005). In addition, the selected variables were tested for correlation with the treatment variable (SPHS participation).

As a first step, propensity scores for each observation were generated by utilizing a probit model. The dependent variable is the subsidy per head scheme (SPHS), which is estimated as the treatment variable, it equals to 1 for participants and 0 otherwise (see Equation 2, page 40). Results of the probit model are reported in Table 12 below.

**Table 12. Probit regression results**

| *Dependent variables is SPHS 1/0* | Coefficient | S.E. |
|---|---|---|
| Experience | -0.003 | 0.023 |
| Corn | 0.16* | 0.08 |
| frecords | -0.22 | 0.25 |
| Education | -0.02 | 0.04 |
| Grazing | 0.79 | 0.45 |
| Age | -0.03** | 0.01 |
| Constant | -0.12 | 0.70 |
| N | 149 | |
| LR $\chi 2$ ($p>\chi 2$ ) | 24.95 | |
| Pseudo- R^2 | 0.14 | |
| Log likelihood | -74.19 | |
| S.E. - Standard Error | | |
| Significance levels: * p<0.05, ** p<0.01, *** p<0.001. | | |

This probit model was used to assess the impact of the SPHS on daily cow milk productivity, as well as its effect on land use, gross income from dairy operation and farm size on dairy cows. From the probit model presented above, the pseudo-$R^2$ is above 0.14, indicating a good model fit (Kabunga, 2014). Caliendo and Kopeinig (2005) argue that the pseudo-$R^2$ indicates how well the regressors explain the participation probability and its value should be fairly low. Secondly, most of the variables included in the model have the expected signs. Farmers with more experience, more years of education, older farmers and those that keep farm records are less likely to join the SPHS program. Contrary, farmers that use grazing and plant corn are more likely to join this scheme of support. Among these variables, age is highly significant ($p<0.01$). Corn is statistically significant ($p<0.05$), implying that farmers that plant more areas with corn are more likely to join the program. However, there was no significant relationship between SPHS participation and experience, education, grazing and farm records.

The impact of the SPHS program on milk productivity per cow, land use, gross income and number of dairy cows was estimated by first imposing the common support condition by matching participants with non-participants in the region of common support (Sianesi, 2004). As outlined in the methodology chapter, four matching algorithms (NNM, Stratification matching, Radius matching, and KBM) were utilized. Those observations that were not matched were dropped from further analysis.

The PSM framework matches participants with non-participants on a single dimension – propensity score – that represents a function of all covariates included in the model (Kabunga, 2014). Similar propensity scores were generated from similar characteristics.

This was proven with balancing tests after the matching process, and there were no statistical differences on the observed covariates between the two groups. As noted in Kabunga (2014), the overall matching quality before and after propensity score estimation is shown also by the relatively low pseudo-$R^2$, implying that there is no systematic differences in the distribution of covariates.

After the matching procedures, the net impact (ATT) of the SPHS on daily milk productivity, land use, number of dairy cows and gross income is estimated following Equation 3. The results of this estimation based on NNM, Stratification matching, Radius matching and KBM are presented in Table 13.

**Table 13. Average treatment effects on treated (ATT) from four matching algorithms**

| Nearest neighbor matching (NNM) | | | | |
|---|---|---|---|---|
| Outcome | ATT | t-value | Treated | Control |
| Milk yield (log) | 0.107<br>(0.07) | 1.534 | 40 | 23 |
| Land use (log) | -0.285<br>(0.30) | -0.942 | 35 | 21 |
| Gross income (log) | 0.282<br>(0.24) | 1.199 | 40 | 23 |
| Farm size in cows (log) | 0.12<br>(0.19) | 0.656 | 40 | 23 |
| Stratification matching | | | | |
| Milk yield (log) | 0.116***<br>(0.03) | 3.827 | 30 | 102 |

**Table 13. Average treatment effects on treated (ATT) from four matching algorithms (Cont.)**

| Outcome | ATT | t-value | Treated | Control |
|---|---|---|---|---|
| Land use (log) | -0.387** | -2.146 | 27 | 86 |
| | (0.18) | | | |
| Gross income (log) | 0.142 | 1.542 | 30 | 102 |
| | (0.09) | | | |
| Farm size in cows (log) | 0.03 | 0.362 | 30 | 102 |
| | (0.07) | | | |
| Radius matching | | | | |
| Milk yield (log) | 0.051 | 0.779 | 12 | 12 |
| | (0.07) | | | |
| Land use (log) | -1.026*** | -2.878 | 9 | 8 |
| | (0.36) | | | |
| Gross income (log) | -0.059 | -0.289 | 12 | 12 |
| | (0.20) | | | |
| Farm size in cows (log) | -0.19* | -1.813 | 12 | 12 |
| | (0.10) | | | |
| Kernel based matching (KBM) | | | | |
| Milk yield (log) | 0.114** | 2.441 | 40 | 92 |
| | (0.05) | | | |
| Land use (log) | -0.162 | -0.773 | 35 | 78 |
| | (0.21) | | | |
| Gross income (log) | 0.247 | 1.390 | 40 | 92 |
| | (0.18) | | | |
| Farm size in cows (log) | 0.15 | 1.178 | 40 | 92 |
| | (0.13) | | | |

*Milk yield (log) = milk productivity per cow per day

*Land use = meadows, pastures and planted area with other crops besides grains.

*Gross income (log) = gross income from milk sales, cheese and other dairy products, animal sales and SPHS payments.

*Farm size in cows (log) = Number of dairy cows in the barn.

Standard errors are in parentheses.
Source: author.

The impact of SPHS was estimated at the farm level for milk productivity, land use, gross income and number of dairy cows. The results for each of these four outcomes are described below separately.

*Daily milk productivity per cow*

Milk productivity outcome represents the daily milk production per farm per cow and it was estimated as a natural log. NNM estimates that dairy farmers that were participants of SPHS program increased their milk productivity per cow per day by 10.7%, subsequently the ATT from Stratification, Radius and KBM was estimated at 11.6%, 5.1% and 11.4% respectively. However, results revealed a partially significant impact of SPHS on improving milk productivity. Partially because two matching algorithms showed significant estimates, while two others were not significant. ATT is significant only using Stratification and KBM algorithm. This result is not consistent, considering that the two other matching algorithms were statistically insignificant. The results from NNM and Radius Matching showed that ATT is not significant, implying that SPHS did not have any effect on improving milk productivity (see Table 13). Generally, there is no strong evidence in favor of a significant ATT, even when the difference is significant, the difference in productivity is not large in an empirical sense. The findings from NNM and Radius Matching are consistent with INDEP (2015) and GAP (2016), who concluded that subsidies of MAFRD did not show any positive effect on increasing production or improving milk quality.

*Land use*

One of the main objectives of the DP/SPHS program is to increase the use of currently unused land and pastures. Therefore the land use outcome is measured correspondingly to this objective, as the total area used for meadows, pastures and other planted crops, estimated as a natural log. As it can be seen on table 13, the sample size for land use is smaller due to lack of information for meadows and pastures and other planted crops for several observations. Therefore, observations with missing data were dropped from the analysis. Similar to milk productivity outcome, two matching algorithms revealed insignificant ATT. NNM and KBM showed a non-significant impact of the SPHS on increasing land use. However, the results from Stratification and Radius Matching revealed a significant negative effect of SPHS on land use, indicating that dairy farmers that participated on SPHS decreased their land use for pastures, meadows and other crops. This is expected due to the fact, that dairy farmers also plant grains for their dairy operation, and the government implements another scheme of direct payments for planted areas with grains. Therefore, the other scheme might serve as a stimulation for farmers to use their land for grains. Generally, the results imply that the SPHS program did not achieve its objective to increase the land use among the participants of the program.

*Gross income*

Gross income of dairy farmers from the dairy operation was measured as the total annual gross income combined from different income sources of the dairy operation such as income received from milk sales, secondary dairy products sales such as cheese, cottage cheese, income from animal sales, manure sales and the payments received from the program. Gross income was estimated as a natural log. The results revealed that the SPHS did not have any effect on improving the income of dairy farmers that were participants in the program. All four matching algorithms displayed insignificant ATT (see Table 13). GAP (2016) claimed that the actual subsidy scheme of MAFRD is increasing income of farmers in the short run, however in the long run, it prevents the development of the dairy sector, since it supports and keeps in the market also the farmers that less productive.

*Number of dairy cows*

Increasing the average number of dairy cows is one of the specific objectives of DP program. Therefore, this outcome was measured as the total number of dairy cows per farm. Similarly to land use outcome, three matching algorithms showed insignificant impact on increasing the number of dairy cows for the participant farms. Moreover, one of the algorithms (Radius matching) revealed a significant negative ATT, implying that participant dairy farmers decreased the number of dairy cows by 19 percent. According to GAP (2016), direct payment program aimed to increase the number of cows, consequently increasing the domestic milk production. However their findings showed that in 2013, Kosovo had the lowest cattle inventory and total milk production since 2007. Moreover, this policy impacted the farm structure, which continues to be heterogeneous, with 94.2% being family farms (1-5 milking cows) and only 5.8% being considered as commercial farms, with more than 5 cows (GAP, 2016).

*Summary*

As suggested by Khandkder et al. (2010), the four matching algorithms were used to compare the results and check the robustness of results. The findings with different matching techniques are quite consistent. In all four outcomes, it can be seen that SPHS program is not accomplishing its objectives. Results revealed that SPHS did not have any effect on increasing land use, gross income and the number of dairy cows per farm. Furthermore, results revealed that SPHS had a partial effect on improving milk productivity, considering that two matching algorithms estimated statistically significant ATT, while two other estimated insignificant ATT estimates. Therefore, the null hypothesis that SPHS has had no effect on any of the intended outcomes cannot be rejected.

## 4.3 Efficiency results

### 4.3.1 Descriptive statistics of farm and non-farm specific variables

The summary statistics for the output and input variables included in the stochastic production frontier and the inefficiency model, including the sample size, mean, standard deviation and a description for each variable are presented in Table 14 below.

On average, cows of the sampled dairy farms in 2014 produced 11.85 liters of milk on a daily basis. Farmers used on average 10.49 ha of land, or 1.03 ha per cow. Pastures are an important part of the production process in the dairy farms in Kosovo; the sampled farmers had cattle on pasture for an average of 133 days. Farmer`s average daily feeding rates per cow were 3.40 kg of concentrate and 8.8 kg of silage. Silage feeding rate is within the suggested range of 7 to 13 kg per cow (MAFRD, 2014). Silage is considered one of the main inputs in the dairy operations in Kosovo. Many farmers regardless of size, produce their own corn or grass silage (USAID, 2007).

Dairy farms in Kosovo use two barn production system alternatives, tied or free stall systems, however, the tied system is dominant. On average, sampled dairy farmers planted 6.11 ha of grains, where wheat (3.62 ha) and corn (2.30ha) constituted the main planted grains in terms of average planted area. Raw milk and cheese sales represent the main income sources for most of the dairy farmers. Cow breeds were captured as Holstein, Simental, Busha and mixed. The mixed group was constituted by cross breeds, and other secondary breeds such as Graufi, Montbeilard and Angus. Cross breeds are dominant in the dairy farms.  Lastly, four variables were incorporated in the inefficiency effects as dummy variables, farm record keeping, and whether the farmers are located in the Prishtina, Mitrovica or Gjilan regions.

**Table 14. Definitions and summary statistics**

| Variable | Description | N | Mean | S.D. |
|---|---|---|---|---|
| *Production function* | | | | |
| Nocows | Number of dairy cows per dairy farm | 243 | 8.25 | 5.06 |
| mcowday | Daily milk production per cow (liters/cow) | 243 | 11.85 | 2.07 |
| landuse | Total land use (ha) | 243 | 1.31 | 1.03 |
| dayspast | The annual number of pasture days | 243 | 133.09 | 55.27 |
| haykgday | Daily amount of hay per cow (kg) | 243 | 10.38 | 4.06 |
| conckgday | Daily amount of concentrate per cow (kg) | 243 | 3.39 | 1.50 |
| silkgday | Daily amount of silage per cow (kg) | 243 | 8.72 | 9.58 |
| *Inefficiency effects* | | | | |
| totalfeedday | The total amount of feed per cow on daily basis (kg) | 243 | 23.19 | 3.88 |
| hayratio | The ratio of hay to total amount of feed per cow | 243 | 0.47 | 0.20 |
| Barn | If the farm keep the cows tied in the barn (yes=1) | 243 | 0.98 | 0.13 |
| Grains | Total area planted with grains (ha) | 243 | 6.11 | 8.19 |
| Wheat | Total area planted with wheat (ha) | 243 | 3.62 | 5.82 |
| Corn | Total area planted with corn (ha) | 243 | 2.30 | 2.80 |
| Holsteinratio | The ratio of Holstein stock in the barn | 243 | 0.08 | 0.20 |
| Simentalratio | The ratio of Simental stock in the barn | 243 | 0.66 | 0.37 |
| SPHS | If the farm was supported with SPHS (yes=1) | 243 | 0.40 | 0.49 |
| frecords | If the farmer keeps farm records (yes=1) | 243 | 0.62 | 0.49 |
| PrishtinaR | If the farmer is located in Prishtina region (yes=1) | 243 | 0.30 | 0.46 |
| MitrovicaR | If the farmer is located in Mitrovica region (yes=1) | 243 | 0.16 | 0.37 |
| GjilanR | If the farmer is located in Gjilan region (yes=1) | 243 | 0.16 | 0.37 |

S.D. - Standard Deviation.

Source: author.

### 4.3.2 Stochastic production frontier model estimation results

Maximum likelihood estimates of the Stochastic Frontier production function are presented in Table 15. From six estimated coefficients, two are highly statistically significant ($p<0.001$), one coefficient ($p<0.01$) and one ($p<0.05$). All the estimated coefficients have the expected signs. Hay per cow per day and the number of cows, even though they have the expected signs, they are not statistically significant. Since number of cows is not statistically significant, it implies constant returns to size for the sampled dairy farms.

Since all the variables are estimated as natural logarithms, their coefficients can be interpreted as output elasticities. The negative elasticity (-0.01) of pasture days implies that a 1% increase in number of days that cows are kept in pastures, milk production per cow will decrease by 0.01%. Pasturing is considered as an extensive production system, resulting in lower milk yields (Nehring et al., 2011; Bargo et al., 2002; Dartt et al., 1999; Kolver and Mueller, 1998). Concentrate and silage are highly significant ($p<0.001$), indicating that they have a significant positive relationship with the daily milk productivity of cows. Concentrate and silage have the highest impact on the productivity level with elasticities equal to 0.12 and 0.06, implying that a 1% increase in concentrate or silage results in an estimated increase in output per cow (milk production) of 0.12 and 0.06 percent, respectively. Concentrate is mainly used on pasture based systems, as a supplementary feed to improve milk production (Hills et al., 2015; Holmes and Roche, 2007; Stockdale, 2000; Bargo et al., 2002; Turki et al., 2012).

**Table 15. Maximum likelihood estimates of the Production function and inefficiency effects model**

| Variables | Parameters | Std. Err. | t-value |
|---|---|---|---|
| *Production function* | | | |
| Constant | 2.235 | 0.082 | 24.36*** |
| lnlandusecow | 0.038 | 0.011 | 3.30** |
| lndayspast | -0.011 | 0.005 | -2.60* |
| lnhaykgday | 0.044 | 0.023 | 1.68 |
| lnconckgday | 0.126 | 0.020 | 6.28*** |
| lnsilkgday | 0.064 | 0.009 | 6.59*** |
| lnNocows | 0.023 | 0.017 | 1.13 |
| *Variance parameters* | | | |
| lnsig2v | -5.022 | 0.261 | -19.27*** |
| lnsig2u | -3.962 | 0.294 | -13.02*** |
| Log likelihood | 185.27 | | |
| chibar2(01) | 7.35*** | | |
| Significance levels: * p<0.05, ** p<0.01, *** p<0.001 | | | |
| Std. Err. - Standard Error | | | |

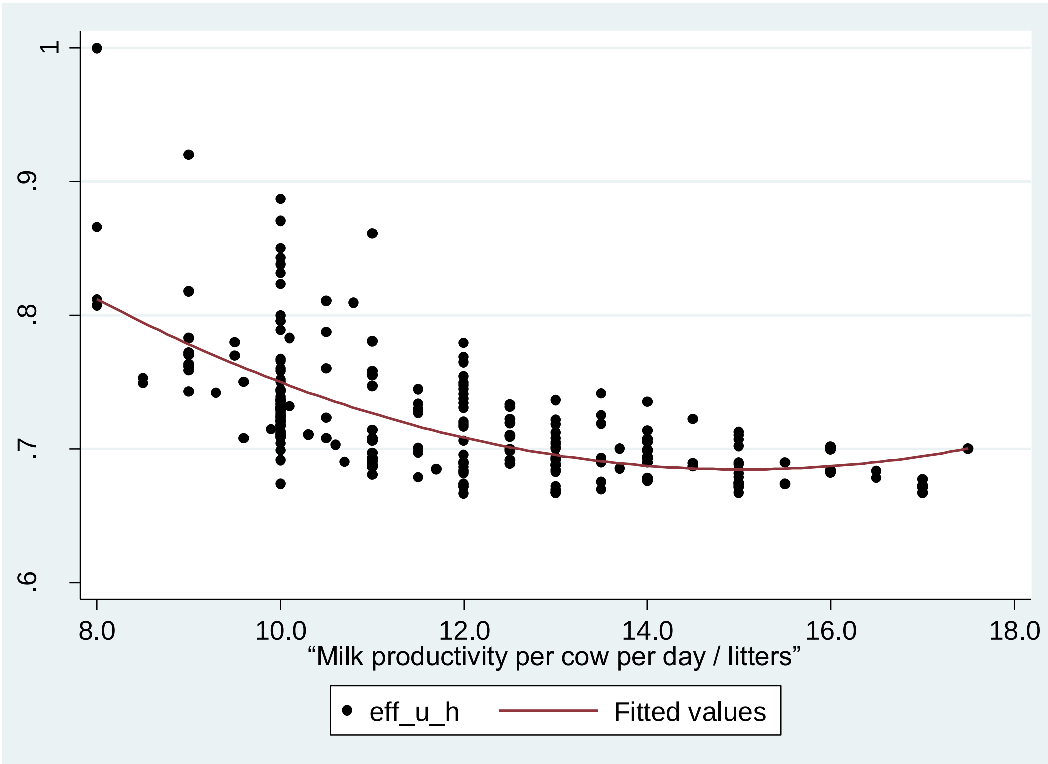
The next highest elasticity is for hay (0.04), followed by land use (0.03), and number of cows (0.02). The sum of elasticities is equal to 0.31, revealing that dairy farms in Kosovo operate under decreasing returns to scale (DRS). This implies that the combination of inputs and outputs is not scale-efficient (Aldeseit, 2013). These farms can improve their efficiency level by decreasing their size. Similar results where farms were operating under DRS were obtained also by (Wei, 2014; Wadud and White, 2000; Sharma et. al., 1997; Mwajombe and Mlozi, 2015; Fraser and Graham, 2005),

The results from this model are estimated based on the assumption that the inefficiency terms have a half normal distribution. The likelihood ratio is 7.35 with a p-value of 0.003. According to Masunda and Chiweshe (2015), the significance of the likelihood ratio test confirms the presence of the one sided error term in the composite error term, indicating the presence of technical inefficiencies in production. Furthermore the variance parameters of the model are statistically significant. According to Hanzeci & Ceyhan (2015) their significance indicates that a deterministic function is not an adequate representation of the research data.

The mean value of technical efficiency of dairy farms in Kosovo was estimated at 0.72, ranging from 0.67 to 1 (fully efficient). Considering these results, dairy farms can reduce their input use by an average of 28% without causing any reduction in milk production. Increasing their technical efficiency might help them to reduce their production costs, increase productivity and their overall competitiveness.

As it can be seen on Figure 1, there is a variation on the distribution of the estimated efficiency scores with the levels of milk production per cow per day. Most of the dairy farmers are operating on a range of 0.7 to 0.8 TE, corresponding to the range of 10 to 14 liters of milk productivity per day per cow.

**Figure 1. Relationship between estimated technical efficiency and milk production per cow**




The estimated levels of technical efficiency were compared also by the farm size in terms of number of dairy cows. Table 16 presents the estimated levels of TE divided by the farm size.

**Table 16. Farm size and technical efficiency level of dairy farms in Kosovo**

| Farm size (cows) | Number of farms | TE | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| (1-4) | 40 | 0.72 | 0.04 | 0.67 | 0.87 |
| (5-15) | 183 | 0.72 | 0.05 | 0.67 | 1 |
| (16-25) | 17 | 0.73 | 0.07 | 0.67 | 0.92 |
| (26-35) | 3 | 0.73 | 0.08 | 0.67 | 0.82 |
| Total | 243 | 0.72 | 0.05 | 0.67 | 1 |

TE - Technical efficiency.

The difference in TE between farm sizes is statistically insignificant.

As expected, the estimated levels of efficiency are quite consistent among the farm size groups, considering that dairy farmers in Kosovo use a similar production technology. There is no statistical difference of TE among farm size groups, however dairy farms with more cows (>15) tend to be slightly more efficient. Subsequently the second comparison used a sample that was constituted by a group of dairy farmers that were supported with SPHS program and a sample of non-supported farmers. Supported farmers were supported with SPHS or also with other schemes of (DP) program such as the subsidy on milk quality and area payments for wheat and corn. The results revealed that there is no significant difference in terms of efficiency level between supported and non-supported dairy farmers. Moreover, non-supported dairy farmers had on average a higher efficiency level.

**Table 17. A comparison of technical efficiency level between SPHS supported and non-supported dairy farmers**

| | Number of farms | TE | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Supported | 96 | 0.72 | 0.05 | 0.67 | 1 |
| Non-supported | 147 | 0.73 | 0.05 | 0.67 | 0.92 |
| Total | 243 | 0.72 | 0.05 | 0.67 | 1 |

TE - Technical efficiency.
The difference in TE between groups is statistically insignificant.

### 4.3.3 Determinants of technical inefficiency

In order to determine the factors that affect the inefficiency, the estimated levels of technical inefficiency were modeled against a set of variables including total amount of feed, hay ratio to total feed, barn production system, wheat and corn ratios to total planted grains area, the ratio of Holstein stock, the ratio of Simental stock, farm records keeping and three regions that had the largest number of participants in our sample. Results of this estimation are presented on Table 18[12].

**Table 18. Inefficiency model estimates**

| Variables | Parameters | Std. Err. | t-value |
|---|---|---|---|
| *Inefficiency model* | | | |
| Constant | 0.765 | 0.034 | 22.21*** |
| totalfeedday | 0.001 | 0.001 | 0.59 |
| hayratio | -0.079 | 0.017 | -4.7*** |
| Barn | 0.051 | 0.021 | 2.44* |
| wheatratio | -0.007 | 0.011 | -0.65 |
| cornratio | -0.032 | 0.012 | -2.63** |
| Holsteinratio | -0.108 | 0.016 | -6.76*** |
| Simentalratio | -0.070 | 0.008 | -8.49*** |
| frecords | -0.005 | 0.006 | -0.78 |
| PrishtinaR | -0.005 | 0.007 | -0.71 |
| MitrovicaR | 0.019 | 0.008 | 2.37* |
| GjilanR | 0.018 | 0.008 | 2.22* |
| Significance levels: * p<0.05, ** p<0.01, *** p<0.001 | | | |
| Std. Err. - Standard Error | | | |

The results from the inefficiency model showed that the variables of hay ratio ($p<0.001$), Barn ($p<0.05$), corn ratio ($p<0.01$), the ratio of Holstein stock ($p<0.001$), the ratio of Simmental stock ($p<0.001$), and the region of Mitrovica ($p<0.05$) and Gjilan ($p<0.05$) were statistically significant. The other variables including the total amount of feed, wheat ratio, farm records keeping and Prishtina region were statistically insignificant. However, all the variables included in the model had the expected signs.

[12] Technical inefficiency increases as the index gets larger.

Keeping the cows tied in the barn and whether the dairy farmers are located in Mitrovica or Gjilan region affect the efficiency level negatively, they have a significant positive relationship with inefficiency.

Increasing the amount of hay ratio to amount of feed per cow per day affects the efficiency level positively. However hay should be combined with other supplementary feeding ratios in order to improve efficiency, such as concentrate and silage. Currently, hay is used throughout the year in the dairy farms in Kosovo. Cattle are kept in the barn from the second part of November until the end of April (winter period) and over this period, feeding is mostly hay-based (Bytyqi et al., 2009; Kokko et al., 2015). Further, the model revealed several factors that affect the technical efficiency positively. Corn ratio decrease the technical inefficiency, indicating that as a farmer plants more corn relative to its grain planted area, its technical inefficiency decreases. Wheat and corn constitute the main grains for the dairy farmers in Kosovo, while corn production is mainly used for cattle feeding, wheat is used for human consumption. As expected, the Holstein and Simental stock ratio have a significant effect on decreasing the technical inefficiency. As the stock ratio of Holstein and Simental increases on the dairy farm, its technical efficiency will increase. Crossbreeds are dominant in dairy farms in Kosovo, mainly originated from the native breed Busha (Bytyqi et al., 2009). Lastly, the results revealed a positive relationship between the inefficiency and the dairy farmers located in Mitrovica and Gjilan region. None of these regions are known as large dairy regions in Kosovo.

From the inefficiency model results, the null hypothesis that the specified determinants have no effect on the variation in technical efficiency of Kosovo dairy farms can be rejected.

# Chapter V. Conclusions and Recommendations

## 5.1 Conclusions

Using primary data from 325 households across the seven regions of Kosovo, two studies on the dairy sector in Kosovo were conducted. The first study evaluated the effect of the government direct payment scheme, the Subsidy per Head Scheme (SPHS), in achieving four of its objectives, while the second study estimated the production (technical) efficiency of dairy farms in Kosovo.

The impact of one of the largest subsidy programs in the agricultural sector in Kosovo, the Subsidy per Head Scheme (SPHS) was found to be slightly positive for milk productivity and generally insignificant for the other three objectives. The study evaluated the program`s effectiveness in achieving its four objectives: 1) increasing milk production; 2) increasing land use; 3) increasing the average number of dairy cows and 4) increasing farm incomes. Propensity Score Matching approach was used to assess the impact of this scheme by comparing two similar groups of dairy farmers, a group of participants and a group of non-participants during the 2013-14 farming season. The robustness of impact results was tested by employing four different matching algorithms.

The results revealed that the SPHS did not achieve most of its objectives. In terms of increasing production (measured as daily milk productivity per cow), we found partially significant results for two matching algorithms, while the results from the two other algorithms revealed insignificant effect. Furthermore, the significant ATT estimates for productivity are small in an empirical sense.

Subsequently, the results revealed that SPHS did not have any effect on increasing land use, gross income and farm size in terms of number of cows. Moreover, for land use (two matching algorithms) and number of dairy cows (1 matching algorithm), results showed that SPHS had a negative effect, indicating that participant dairy farmers decreased their used land for pastures, meadows and other crops, and furthermore decreased their number of cows.

In general, the estimated results confirm the results from previous studies (INDEP, 2015; GAP, 2016) that SPHS did not have any effect on increasing land use, farm size and gross income for the dairy farmers that participated in the program. Significant effects of SPHS on improving milk production are relatively low percentage wise (11 percent). These findings are important considering that the SPHS program was initiated in 2009. Since then, MAFRD has spent over €8 million to fund the SHPS. Furthermore, over the same period MAFRD has increased its budget allocation for SPHS by an annual average increase of 47 percent. Only in 2014, over €2.2 million were used by MAFRD to implement the SPHS. However, the results from this impact assessment suggest that SPHS is not achieving its four objectives, particularly its objectives on increasing land use, gross income and farm size in terms of dairy cows. These findings are consistent with the results of GAP (2016), who stated that in terms of 1) transforming the farm structure; 2) increasing production and improving milk quality, the current subsidy scheme is not effective. Also INDEP (2015) argued that SPHS did not have any effect on increasing milk productivity or milk quality. Annual milk productivity per cow remains relatively low, an average output per cow of 2075 liters (MAFRD, 2015). Since 2009, milk productivity per cow increased only by a very small annual average rate of 0.7 % (Bajrami et al., 2016). Also the farm structure is dominated by small farms, on average 4 cows per farm, while farms with 1-9 cows constitute 65 percent of cattle inventory in Kosovo (MAFRD, 2015). This small scale dairy farm structure represents a major obstacle for the further development of the dairy sector in Kosovo. The current agricultural policy seems to be ineffective, especially on improving productivity and increasing (transforming) farm structure. It is necessary for the government of Kosovo to cut expenses on ineffective programs and develop new complementary strategies that will address needs more efficiently and transform the dairy sector into a competitive one.

The second study estimated the technical efficiency level of 243 dairy farms in Kosovo in 2014 farming season. A stochastic frontier production function following a two stage procedure was utilized. The results revealed that feeding ratios (feed/cow), specifically concentrate, silage, and land use per cow and the number of days that cows have been kept on pastures have a significant impact on milk productivity per cow. The mean technical efficiency of dairy farms was estimated at 0.72. This empirical evidence suggests that dairy farms can increase their output considerably, without increasing input use. Moreover, dairy farmers with more than 15 dairy cows showed higher level of efficiency, while farmers with 1-15 cows had slightly lower efficiency levels. From these results it can be concluded that farmers in Kosovo use a similar production technology, therefore their efficiency level is quite consistent. More importantly, the results revealed that there is no significant difference in terms of efficiency level between supported and non-supported dairy farmers with the SPHS program.

The findings from the second study suggest that funds should be reallocated on improving genetics of the national herd by increasing the ratio of Simental and Holstein stock on the dairy farms throughout Kosovo. The current stock tends to be dual purpose. Furthermore, promoting free range production systems, expanding the corn planted areas, and increasing and combining the levels of hay use with concentrate and other supplementary materials may reduce the technical inefficiency of the sampled dairy farmers. Moreover, special attention should be given to educational programs that will teach farmers improved feed technologies and practices that could serve to improve milk productivity. In terms of investments, the government should regionalize their investments, mainly focusing on those regions that are known as dairy regions, such as Prishtina.

Taking into consideration that Kosovo is planning to join the European Union (EU) in the future, its dairy farms should improve their efficiency in order to improve their competitiveness, reduce their costs and be competitive with their counterparts from EU.

The results from both studies are particularly important for the policy makers in Kosovo and are expected to provide insights for the future formulation of dairy policy, with a special focus at designing the support measures.

**5.2 Recommendations**

The recommendations from the both studies are presented below on bullet points:

- Based on results from the SPHS impact study and its high cost of implementation, MAFRD should consider to terminate the whole Direct Payment (DP) program;
- The DP program could be redesigned into a decoupled subsidy, where farmers would be supported based on the land area they own; as a result MAFRD would not incentivize particular sectors and it will also serve as an incentive that only the efficient farmers would be engaged in particular agricultural sectors;
- If MAFRD is allowed to keep a coupled subsidy, DP could be also redesigned into a subsidy coupled to the amount of production. The scheme for the dairy sector could be coupled to amount of liters sent to the collection centers. Furthermore this scheme could incentivize the further formalization of the sector. The subsidy for cereals could be coupled to the amount of grains that were sent for processing by the farmer. These schemes might be more efficient measures that would incentivize farmers to improve their productivity and also commercialize.

- In the future, MAFRD should follow the common agricultural policy of EU in terms of subsidies; coupled subsidies are not being applied anymore in the entire European Union. Furthermore MAFRD should orient its policies on improving the competitiveness of the dairy farmers.
- Based on the efficiency results, MAFRD should invest on educational programs that will help dairy farmers with updated information on feeding programs.
- In the future, the government of Kosovo should focus their investments on improving the cattle breed in the dairy farmers, mainly by substituting the cross breeds with pure breeds of Holstein, Simental or other high milk productivity breeds. Furthermore, in the future, production will need to be segmented on beef type and milk type breeds to achieve significant improvement in both milk and beef meat efficiency.
- Increasing the optimal use of hay combined with concentrate, silage and other supplementary feeds, expand the planted areas with corn, and targeting regions with greater efficiency potentials will serve on to improve the technical efficiency of dairy farms, increase their productivity, decrease their costs and overall increase their competiveness.
- Due to the lack of official data, MAFRD should make DP program participation conditional on record keeping in order to be able to better gauge the impact of the program.

### 5.3 Limitations and Future Research

A major limitation of these studies if that are based on recall observations for only two years (recall data). Dairy programs tend to have long-term objectives, therefore an ideal data set would have had a longitude of 5 years (2009-14). Furthermore, the lack of official impact data represents a major hindrance for researchers to evaluate the public policies in the agricultural sector in Kosovo.

In terms of impact assessment, the results are sensitive to the specification form, however, in this particular example, the specification form was constructed based on previous knowledge using alternative PSM algorithms.

A following research with a larger sample over a longer time period would have been desirable.

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## VI. Appendix

### Survey (English version)

| INTRODUCTORY TEXT |
|---|

Dear respondents:

You are invited to participate in a research study about the dairy sector in Kosovo. The purpose of this study is to evaluate the agricultural support policies in Kosovo and their impact on production, farm size and the economic efficiency of dairy farms.

Your participation as a dairy farmer will require to give us information about your dairy farm, milk production, costs, capital, income, demographics, institutional support, needs and plans for the future. The identifying personal information that will be collected in the survey will be used only to classify farmers. Your name will never be associated with the results. All the information that will be collected will remain confidential and it will be used only for research purposes.

There are no anticipated risks for the participants in this research.

The research results from efficiency analysis will provide useful advices for farmers for their production efficiency, specifically identifying their inefficient units of production.

The participation in this research is completely voluntary and refusing to participate will not adversely affect any other relationship with the University or the researchers. You are free to refuse to participate in this activity and to stop filling out the survey at any time.

If you have questions or concerns about this study, you may contact the principal researcher via e-mail at ebajrami@uark.edu or the faculty advisor at ewailes@uark.edu. For questions or concerns about your rights as a research participant, please contact Ro Windwalker, the University`s Compliance Coordinator, at (479)-575-2208 or by e-mail at irb@uark.edu.

| INFORMED CONSENT FORM |
|---|

"I understand that my completion of this survey indicates that I agree for my answers to be used in this research."

## SURVEY Part A

**SECTOR 1. DATA FOR THE HOUSEHOLD**

| | |
|---|---|
| **No. of survey:** | ____**A** |
| **Date:** | __/__/2015 |
| **Interviewer:** | |
| **Name and surname:** | |
| **Number of telephone:** | |
| **Gender of the farmer: M F** | |
| **Village:** | |
| **Municipality:** | |
| **Region:** | |
| **The distance of the farm from the city (urban area) in km:** | |
| **Number of household members:** | |

| | | |
|---|---|---|
| **Q1.1** | The age of the farmer: | |
| **Q1.2** | Your education in years: | |
| **Q1.3** | Your experience in milk production in years? | |

**Q1.4** Is the farm your primary source of household income?

☐ Yes (1) ☐ No (0)

**SECTOR 2. DATA FOR THE FARM**

| **No.** | **Question** | **Options** | |
|---|---|---|---|
| **Q2.1** | Farm production type; | ☐ Grazing; | ☐ Non-grazing; |
| **Q2.2** | The housing system for cows; | ☐ Tied; | ☐ Free; |
| **Q2.3** | Milk storage room; | ☐ Yes; | ☐ No; |
| **Q2.4** | Bulk milk cooling system; | ☐ Yes; | ☐ No; |
| **Q2.5** | Watering system for cows; | ☐ manual; | ☐ automatic; |
| **Q2.6** | Electric barn ventilation system; | ☐ Yes; | ☐ No; |
| **Q2.7** | Barn windows in horizontal position; | ☐ Yes; | ☐ No; |
| **Q2.8** | Separated storage for voluminous food (hangars); | ☐ Yes; | ☐ No; |
| **Q2.9** | Separated silage storage (horizontal system); | ☐ Yes; | ☐ No; |
| **Q2.10** | Separated concentrated feed storage; | ☐ Yes; | ☐ No; |
| **Q2.11** | Box for newborn calves; | ☐ Yes; | ☐ No; |
| **Q2.12** | Common calves boxes up to 10 calves; | ☐ Yes; | ☐ No; |
| **Q2.13** | Manure disposal; | ☐ manual form; | ☐ falls on the canal (hole); |
| **Q2.14** | Lagoon/ Landfill for farmyard manure (liquid and solid) | ☐ Yes; | ☐ No; |
| **Q2.15** | Thermometer on the barn; | ☐ Yes; | ☐ No; |

**Q2.16** Farm composition.

| Type of animal | | Type (breed) | Number | Average age (years) | Source* | Use* (destination) |
|---|---|---|---|---|---|---|
| Cows | | | | | | |
| | | | | | | |
| | | | | | | |
| Bulls | | | | | | |
| | | | | | | |
| | | | | | | |
| Heifers | | | | | | |
| | | | | | | |
| | | | | | | |
| Calves* | M | | | | | |
| | F | | | | | |
| | M | | | | | |
| | F | | | | | |
| | M | | | | | |
| | F | | | | | |
| **Q2.17** | The total capacity of the farm building in dairy cows | | | | | |

*Source a) purchased; b) inherited;
*Use (destination): a) milk; b) meat; c) combined (milk & meat);

**Q2.18** How long have you had this number of cows? _______ (months);
**Q2.19** Are you planning to increase the number of cows within the next twelve months?
☐ Yes (1) ☐ No (0)
**Q2.20** The average length in km from the farm to the land? ___km
**Q2.21** The distance in km from your farm to the nearest milk collection center? ___km
**Q2.22** The distance in km from your farm to the nearest cattle farm in the surrounding area? ___km

**Q2.23** Please list below the agricultural machinery that you own?

| No. | The type of the agricultural machinery | Year of manufacture | The year and price when purchased (Euro) | | The actual price in € (Euro) | Source of funding* |
|---|---|---|---|---|---|---|
| 1 | | | | € | | |
| 2 | | | | € | | |
| 3 | | | | € | | |
| 4 | | | | € | | |
| 5 | | | | € | | |
| 6 | | | | € | | |
| 7 | | | | € | | |
| 8 | | | | € | | |
| 9 | | | | € | | |
| 10 | | | | € | | |

*Source of funding: a) own funds; b) commercial loan; c) borrowing from family/ friends; d) own funds + loan; e) Grants; f) other (specify) _______

## SECTOR 3. PRODUCTION & MARKET & FINANCIAL SOURCES & NETWORK

**Q3.1** If milk production in your farm has improved during the last two years, according to you, which of the factors listed below caused this milk productivity improvement?
☐ Improvement within the same breed;
☐ Replacement of breed with another breed;
☐ Health care practices including increasing hygiene and veterinary visits;
☐ Improving nutrition;
☐ Other (specify);

**Q3.2** In what method do you milk cows?
☐ Manual (with hands); ☐ mechanical (milking machines); ☐ with pipeline system;

**Q3.3** In what method do you do the insemination of cows?
☐ Natural; ☐ Artificial;

**Q3.4** How do you manage the animal manure? (check all that apply)
☐ I sell it; ☐use as fertilizer on my land; ☐ burn it; ☐ compost; ☐ throw it in another place as waste; ☐ other (specify)

**Q3.5** Where do you need most the support from Ministry of Agriculture (MAFRD)?
(Please prioritize from 1-most needed to 7-less needed)

| | |
|---|---|
| Subsidies per head; | (__) |
| Subsidies for milk quality; | (__) |
| Support with inputs; | (__) |
| Insurance of agriculture business; | (__) |
| Advisory services (technical assistance); | (__) |
| Veterinary services (free); | (__) |
| Breeding technology; | (__) |
| Other (specify) | (__) |

**Q3.6** If you receive government support, when did you join these programs (write the year)?
☐ Subsidies per head_______;
☐ Subsidies per milk quality_______;
☐ Subsidies per cereals_______;
☐ Grant program_______;

**Q3.7** Do you sell the milk?
☐ Yes (1) ☐ No (0)

**Q3.8** If yes, where do you usually sell your milk?

☐ Retail market nearby;
☐ At a collection point (center);
☐ Private persons;
☐ Milk processing plant;
☐ In small stores;
☐ other_________________

**Q3.9** Have you received loans from banks for your dairy operation?

☐ Yes (1) ☐ No (0)

**Q3.10** If yes, the purpose of the loan was: ______________;

**Q3.11** Do you think that in the future one of your children will work on livestock, specifically on milk production?

☐ Yes (1) ☐ No (0)

**Q3.12** Were you visited by the advisory services of the municipality or Ministy of Agriculture (MAFRD)?

☐ Yes (1) ☐ No (0)

**Q3.13** If yes, how many times did you have meetings with these service agents during each of the last two years?

2013_____times; 2014_____times;

**Q3.14** Are you a member of a farmer association?

☐ Yes (1) ☐ No (0)

**Q3.15** If financial support from Ministry of Agriculture (MAFRD) was discontinued? Would you:

☐ Expand;
☐ No Change;
☐ Reduce;
☐ Quit;
☐ Other (specify) _______;

## SURVEY Part B

No. of survey ____**B**

**TABLE 1: FARM & MILK PRODUCTION**

| Year | Average No. of cows* | No. of cows at the end of the year* | Annual Total Milk in liters (liters) | | | | Average annual Milk price (€) | Average Milk quality* | Notes /Recall* |
|---|---|---|---|---|---|---|---|---|---|
| | | | Production (l) | | Sales (l) | Consumption* (l) | | | |
| | | | Per cow | Total | | | | | |
| 2014 | | | | | | | | | |
| 2013 | | | | | | | | | |

*Average No. of cows: (average number of cows throughout the year);
*Consumption: Includes home use and milk fed to calves; The other amount that is not included in Sales or Consumption is considered as waste liters of milk;
*Average Milk quality: (average milk quality throughout the year), 1-first class, 2- second class, 3-third class, 4-extra class, 5-don`t know;
*Notes/ Recall: Notes, it means that the data that we collected are directly from the notes of the farmer and it is written with one (1), while recall means that the farmer is recalling the data, he/she has no notes to check for their validity and it's written with zero (0). This rule applies for all the tables below.

**TABLE 2: LAND USE**

| Year | Land in hectares (ha) | | | Rental rate per ha (€)* | No. of plots* | *Land use in hectares (ha) | | | Land use for cereals in hectares (ha) | | | | | Notes/ Recall |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Own | Lease | Rent | | | P&M | C | O | Wheat | Corn | Barley | Oat | Other | |
| 2014 | | | | | | | | | | | | | | |
| 2013 | | | | | | | | | | | | | | |

*Rental rate per ha (€): Average rental rate in that area (village).
*Number of plots: write the number for both land types, owned and rented.
*Land use in ha: P&M-pastures and meadows, C-cereals, O-other;

**TABLE 3: LABOR**

| Year | Number of employees | | | | Hours per day | | Number of working days per year | | Average wage rate per hour in (€) | Notes/ Recall |
|---|---|---|---|---|---|---|---|---|---|---|
| | F* | | PT* | | F* | PT* | | | | |
| | NHM* | HM* | NHM* | HM* | | | NHM* | HM* | | |
| 2014 | | | | | | | | | | |
| 2013 | | | | | | | | | | |

*F-Fulltime, PT-part time;
*NHM-Non household member, HM-household member;

| TABLE 4: NONLABOR INPUTS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Average annual feeding in kg per cow per day* | | | Average annual feeding cost in kg per cow per day (€) | | | Annual no. of veterinary visits | Average cost per one visit (€) | Average cost per health care per year (€) | Transportation costs* | Other costs* | Notes/ Recall |
| | H | C | S | H | C | S | | | | | | |
| 2014 | | | | | | | | | | | | |
| 2013 | | | | | | | | | | | | |

*Average annual feeding kg per cow per day: H-Hay, C-concentrate, S-silage;
*Transportation costs: Include all the transportation costs related to milk production that the farmer had throughout the year;
*Other costs: Include all other costs that the farmer mentions and are not included as options on the table or survey;

| TABLE 5: CAPITAL | | | |
|---|---|---|---|
| Type of capital | Years | | Notes/Recall |
| | 2013 (€) | 2014 (€) | |
| Land | | | |
| Buildings | | | |
| Livestock | | | |
| Machinery | | | |
| Other | | | |
| **TOTAL** | | | / |

| TABLE 6: INCOME | | | |
|---|---|---|---|
| **Source** | **Gross (Total) Income** | | Notes/ Recall |
| | 2013 (€) | 2014 (€) | |
| Milk Sales | | | |
| Animal sales | | | |
| Crop sales | | | |
| Other products | | | |
| Other agricultural activities | | | |
| Non-agricultural activities | | | |
| Remittances | | | |

*Other products-it denotes other farm products that were sold throughout the year such as: cheese, beef.

| TABLE 7: ANNUAL TOTAL TRANSFERS FROM SUPPORT MEASURES PER YEAR IN EUROS (€) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Policy* | | | | Subsidies per head per cow (€) | Subsidies per milk quality* (€) | Subsidies for cereals* (€) | Grant | | Notes/ Recall |
| | S | M | C | G | | | | Type | Amount (€) | |
| 2014 | | | | | | | | | | |
| 2013 | | | | | | | | | | |

*Policy: S denotes subsidies per head, M denotes subsidies per milk quality, C denotes subsidies per cereals and G denotes grants. Write 1 (one), if the farmer it is supported with the certain policy, otherwise write 0 (zero). For those farmers that are supported with grant, please specify the type of grant, where 1-infrastructure improvement; 2-purchased machinery; 3-purchased farm equipment's (e.g. milking equipment's); 4 –other (specify); ________
*Subsidies per milk quality are given according to the produced milk quality.
*Subsidies for cereals are given per hectare.

| TABLE 8: PRODUCTION & TOTAL REVENUES & TOTAL COST | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Type of activity | Name | Production (ha) | | Years | | | | Notes/ Recall |
| | | | | 2013 (€) | 2013 (€) | 2014 (€) | 2014 (€) | |
| | | 2013 | 2014 | TR | TC | TR | TC | |
| Milk Production | / | / | / | | | | | |
| *Crop 1 | | | | | | | | |
| *Crop 2 | | | | | | | | |
| *Crop 3 | | | | | | | | |
| *Crop 4 | | | | | | | | |
| *Crop 5 | | | | | | | | |
| *Crop 6 | | | | | | | | |
| *Other | | | | | | | | |

*TR=total revenue for one year; TC=total cost for one year;
*Crop: the revenue and cost should be given per hectare (ha);
*Other: other agriculture activities;

**Thank You!**

**Table 19. Descriptive statistics for some of the variables used in PSM or SFA approach (2014 and 2013)**

| | | 2014 | | | 2013 | | |
|---|---|---|---|---|---|---|---|
| Variable | Description | N | Mean | S.T.D. | N | Mean | S.D. |
| Number of cows | Number of dairy cows per dairy farm | 325 | 8.29 | 5.54 | 322 | 7.85 | 5.73 |
| Milk yield day | Daily milk production per cow (liters/cow) | 325 | 12.06 | 2.11 | 322 | 11.91 | 2.09 |
| Milk yield year | Annual milk production per cow (liters/cow) | 325 | 3678.86 | 643.12 | 322 | 3632.34 | 637.50 |
| Milk sales | Annual sales of raw milk (liters) | 277 | 20930.83 | 22208.27 | 275 | 18741.02 | 22007.26 |
| Cheese sales | Annual sales of cheese (kg) | 325 | 117.88 | 548.56 | 322 | 118.48 | 536.54 |
| Milk consumption | Daily milk consumption per person (kg/person) | 323 | 0.64 | 0.25 | 320 | 0.64 | 0.25 |
| Grains | Total grains planted area (hectares) | 325 | 6.44 | 8.23 | 322 | 6.25 | 7.72 |
| Wheat | Wheat planted area (hectares) | 325 | 3.99877 | 6.2182 | 322 | 3.93 | 5.55 |
| Corn | Corn planted area (hectares) | 325 | 2.29611 | 2.66472 | 322 | 2.21 | 2.93 |
| Experience | Experience in years in dairy operation | 325 | 8.80 | 5.40 | 322 | 7.88 | 5.37 |
| Education | Formal education in years | 325 | 11.24 | 2.71 | 322 | 11.24 | 2.72 |
| Age | Age in years | 325 | 45.02 | 12.67 | 322 | 44.13 | 12.67 |
| Household | Household size | 323 | 9.30 | 5.54 | 320 | 9.30 | 5.57 |

S.D. – Standard Deviation.

**The dairy policy in the European Union (EU)**

The agricultural sector in the EU is regulated through the Common Agricultural Policy (CAP), a policy framework initiated in 1962, which regulates the policy regarding animal welfare, environment and subsidies. CAP is applicable in all the 28 EU member states, however, according to Andersson & Gotting (2011) within the CAP framework, each member state may implement the policy in a slightly differently way.

Since its introduction, CAP has undergone several progressive reforms. These reforms mainly aimed to restructure the form of support for different agricultural sectors. The dairy policy in EU was created to stabilize market conditions for EU dairy producers and processors (European Commission, 2006). The original objectives were to manage the markets for dairy products, protect product prices that permit milk producers to obtain a fair standard of living, and ensure the competitiveness of dairy products in the internal market. In order to achieve these objectives, various schemes of support were introduced and applied in the dairy industry and market. A consolidated regulation adopted in 1968, formed the basis for the dairy policy until 2008, when a single Common Market Organization (CMO) for the whole CAP was created (Meijerink & Achterbosch, 2013). From its beginnings until the 1990s, the dairy policy was primarily focused on intervention prices, while in 1992 this form of support was reduced and partly replaced by direct payments (Andersson & Gotting, 2011). During the next two decades, several market support mechanisms were used such as intervention buying prices of butter and skim milk powder (SMP), a milk quota regime, dairy premiums, export subsidies, import regime tariffs, financial support for private storage of butter, SMP and cheese with Protected Designation of Origin (PDO)/Protected Geographical Indication (PDI) (Meijerink & Achterbosch, 2013).

A fundamental reform of CAP was adopted in June, 2003, where the Single Payment Scheme (SPS) and Single Area Payment Scheme (SAPS) were introduced (Andersson & Gotting, 2011). This major policy change is known as a move from coupled to decoupled payments. Before, coupled payments were related to the farm size, production and number of livestock (Andersson & Gotting, 2011). Decoupling is the removal of the link between the recipient of a direct payment and the production of a specific product (European Commission, 2016). In simple terms, decoupling represents a direct payment that is not related to production, but it is based on the amount of the eligible agricultural land under cultivation. It has been organized by the two systems mentioned above, SPS and SAPS. Dairy farmers are eligible to receive SPS payments, but the payments are bound to the fulfilment of "Cross Compliance" provisions, which provide a set of environmental and agricultural conditions (rules), aiming to maintain good standards on the land and to comply with rules of public health, animal welfare, crop protection and environmental friendliness (Andersson & Gotting, 2011). In addition, SPS payments are based on historical payments during a reference period.

The milk quota regime was abolished in April 2015. It was introduced in 1984 in order to address problems of surplus production by limiting the milk production at national level. Since 2003, the incorporation of premiums in the Single Farm Payments has shifted the support to dairy farmers from production and price support towards income support, which is supposed to make the dairy policy more market-oriented, i.e. and less trade-distortive (Meijerink & Achterbosch, 2013).

**Dairy policy in Germany, Sweden and Denmark**

Besides the general policy framework of CAP, each member state applies specific measures. Regarding the CAP reform, member states were able to choose to introduce the SPS in 2005, 2006 or 2007. Dairy payments could be included in the SPS starting from any one of these years. In addition, member states could choose to maintain a limited link between subsidy and production to avoid abandonment of particular production types.

Regarding the specific measures for the dairy sector, SPS implementation may vary from country to country. For example in Germany, the SPS accounts for the largest share of all payments (Andersson & Gotting, 2011). By 2013, Germany had a totally decoupled production support and a regional model in use. The bulls, slaughter and suckler cow premium was transferred to the single payment which is related to the land.

Contrary to Germany, in Sweden, the payment entitlements are destined to a specific region which means that you can only use them in that region and the payment values depend on the region where it is located (Andersson & Gotting, 2011). The only production related subsidy is a premium for bulls (Andersson & Gotting, 2011). In 2012 the bulls premium was decoupled and transferred to payment entitlements as "top ups". The magnitude of the "top ups" is decided from the average number of animals delivered during a reference period 1st of October 2009 – 31st of December 2011 (Andersson & Gotting, 2011).

In Denmark the value of the individual payment entitlements cannot exceed 5000 Euro per hectare (Andersson & Gotting, 2011). In terms of cattle payments, Denmark had a slaughter premium for cattle from 2000 to 2005. However in 2015, this premium was transferred from a coupled to a decoupled subsidy (Andersson & Gotting, 2011). Similar to the extensification premium, which was an additional subsidy for producers who were recipients of bulls' premium or suckler cow premium, it was transferred to a decoupled subsidy in 2005. However the main production related subsidy in Denmark is a special premium for bulls. This is one of few remaining production related subsidies and it is also an EU-related subsidy.

As mentioned above, under the 2007-2013 rules of the Common Agricultural Policy, farmers received direct payments under either the Single Payment Scheme or the Single Area Payment Scheme. The 2013 reform of the Common Agricultural Policy replaced the Single Payment Scheme with the Basic Payment Scheme (BPS), which has been implemented since January 2015. BPS is operated on the basis of payment entitlements allocated to farmers in the first year of application of the scheme and activated each year by farmers. Eligibility for BPS starts with the Single Area Payment Scheme, as a precondition for farmers to receive other direct payments such as the green direct payment, the redistributive payment, the payment for areas with natural or other specific constraints and the payment for young farmers (European Commission, 2016).

**Previous studies that assessed the impact of dairy policy in EU**

There is considerable research that has evaluated the impact of CAP, specifically the impact of direct payments on several aspects of EU farms, such us productivity, efficiency, and investments allocation. For example, Rizov, Pokrivcak and Ciaian (2013), investigated the impact of CAP on the total productivity of EU commercial farms using a structural, semi-parametric estimation algorithm (regression approach). They found that subsidies had a negative impact on farm productivity in the period before the decoupling reform was implemented, while after decoupling the effect of subsidies on productivity was more distinctive, as in several countries it turned positive. Contrary to Rizov et al., Sipiläinen and Kumbhakar (2010) showed that there is a positive relationship between the amount of subsidy and total output. Using the data from EU's Farm Accountancy Data Network (FADN) on Danish, Finnish and Swedish dairy farms covering the period 1997 – 2003 (the period before decoupling) in a production function model approach, their results suggest that direct payments affect production technology, input elasticities and returns to scale. At the country level, Francksen, Hagemann, & Latacz-Lohmann (2012) found that growth of milk production is negatively affected by the share of subsidies. Furthermore, the authors suggest that a reduction of direct payments in the CAP post 2013 will provide a strong incentive for growth, based on their results that higher direct income support reduces the need to improve competitiveness through exploiting economies of scale.

In terms of efficiency, Latruffe et al. (2011) examined the association between agricultural subsidies and farm efficiency using 18 years (1990-2007) of FADN data for specialized dairy operations in seven countries: Denmark, France, Germany, Ireland, Spain, the Netherlands, and the United Kingdom. Separate translog stochastic input distance frontiers were estimated for each country. Their results showed that higher subsidies and hired labor dependence were significantly associated with higher technical inefficiency across all seven countries. Furthermore, the latest CAP reform introducing fully decoupled payments has reduced TE in all countries considered except Denmark. Similar results were obtained from Lakner (2009), who showed that the agri-environmental payments and investment programs during the period 1994/95 to 2005/06 had a negative effect on the efficiency of organic dairy farms in Germany.

An assumption that CAP direct payments reduce farm investments due to the ”secure” additional income that farmers get is well known among researchers. Therefore, Sckokai and Moro (2005) evaluated the impact of the recent 2003 CAP reform on farm investment and output decisions by using a FADN sample of Italian arable crop farms. The main finding of their research is that a policy change that shifts resources from price support to direct payments tends to consistently reduce farm investments. Nevertheless, this is not clearly reflected in a negative impact on farm output. Similarly with reference to investments, Vercammen (2006) used a simple stochastic dynamic programming model to study the link between direct payments and agricultural investments. His findings showed that even in the absence of risk aversion, direct payments may stimulate farm investment. Additionally, his results revealed that the investment response to a direct payment is comparatively small for either a low or high-equity farmer and is comparatively large for a medium-equity farmer, which possibly represents the majority of real-world farmers. The study also suggests that a younger farmer is likely to have a greater response to a direct payment than an older farmer.

## Institutional Review Board (IRB) Approval

UNIVERSITY OF ARKANSAS

Office of Research Compliance
Institutional Review Board

June 26, 2015

MEMORANDUM

| | |
|---|---|
| TO: | Egzon Bajrami<br>Eric Wailes<br>Bruce Lawrence Dixon<br>Arben Musliu |
| FROM: | Ro Windwalker<br>IRB Coordinator |
| RE: | New Protocol Approval |
| IRB Protocol #: | 15-06-768 |
| Protocol Title: | *A Production Efficiency and Impact Assessment of Government Support Programs of the Dairy Sector in Kosovo* |
| Review Type: | ☒ EXEMPT ☐ EXPEDITED ☐ FULL IRB |
| Approved Project Period: | Start Date: 06/25/2015 Expiration Date: 06/24/2016 |

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website (https://vpred.uark.edu/units/rscp/index.php). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

**This protocol has been approved for 400 participants.** If you wish to make *any* modifications in the approved protocol, including enrolling more than this number, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 109 MLKG Building, 5-2208, or irb@uark.edu.

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