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INVESTIGATION OF THE HUMAN RESOURCES NEEDS FOR THE EFFECTIVE AND EFFICIENT IMPLEMENTATION OF THE SHEEP AND GOAT BRUCELLOSIS PROGRAM IN GREECE

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Abstract: The sheep and goats brucellosis program is one of the most important animal health programs with significant animal health, public health, and international trade consequences. Several factors are involved in the implementation of this program, while its success depends on the availability of an effective, well-trained, and fully engaged staff. Considering the poor results of sheep and goats brucellosis program in Greece mainly related to the limited number of veterinarians working in the regional veterinary services, the present study aims to approach the number of the human resources and more precisely of veterinarians that are essential for the effective and efficient brucellosis control strategy in Greece. Therefore, the data derived by the performance of the program for the years 2012 to 2015 are analyzed. Finally, economic and political circumstances – external factors that affect the functionality of the program as well as all relevant bottlenecks are being discussed. The findings of the present study indicate that approximately 485 veterinarians with 485 assistants working for the needs of the brucellosis program would significantly assist on the complete implementation of the brucellosis control and eradication of the disease in Greek sheep and goat holdings.

Keywords: Brucellosis, Greece, brucellosis program, personnel

INTRODUCTION

The transmission of *Brucella* spp. to humans is of zoonotic importance and is related to the direct contact with infected tissues or secretions of affected animals or to the consumption of unpasteurized milk or products thereof (Atluri VL, 2011). Brucellosis is endemic in countries around the Mediterranean basin (Edgardo Moreno 2014), while Greece has the highest rates of human cases among European countries (European Centre for Disease Prevention and Control, 2015). *Brucella melitensis* is associated with the vast majority of human cases (M.J. Corbel 2006).

In Greece the implementation of the Sheep and Goats (S&G) brucellosis program started in 1977 regulated by law (Presidential Decree 332 1977) and resulted in a significant decrease of clinical cases in animals and humans. Initially it was performed with the subcutaneous (sc) vaccination of young sheep and goats (3-6 months of age). During the period 1992 to 1998, the Central Competent Authority (CCA), which is the Animal Health Directorate of the Ministry of Rural Development & Food, decided to redesign the national brucellosis program in animals and gradually stopped the vaccination in some areas and initiated an eradication program based on the serological testing of the animals and the culling of infected sheep and goats. Initially, the islands (1992) were included in this new approach and gradually Peloponnese (1993) and then all animal holdings in

the entire country (1994) were included in the eradication program. This change resulted in a dramatic increase of brucellosis incidents in both humans and animals, mainly attributed to the incomplete and scarce application of the eradication program. This can be explained due to the following cause: the man-hours needed for approximately 15,000,000 blood samples were multiplied in relation to the vaccination of the replacement animals only, which was almost 3,000,000 (15-20% of the total population). The existing staff could not respond to the excessively increasing demands of the program. To address the problem, the massive vaccination of female, young and adult sheep and goats started again in the mainland and Evia, whereas on the islands, where the prevalence was lower, the eradication program continued (1999). The vaccination strategy returned in Lesbos and Leros islands in 2003 and in Thasos in 2008 due to human cases reported in these islands.

Until 2012, the sheep and goat vaccinations were not recorded per each individual animal-per ear tag-, but as a sum of animals in a vaccinated holding. The vaccinated animals were not recorded in any database and were recognized only individually from the tattoo on their right ear, if distinguished. With the Ministerial Decision 4888/130873/31.12.2012 (GG II/3545) (Edgardo Moreno 2014) the tattooing was repealed (due to involved

problems as it is painful for animals, dangerous for the person who applies it, time consuming etc.). Instead, the individual registration on a datasheet of the vaccinated animals was established according to their number of marking [an ear tag or a bolus, which is the individual animal identification number (ID)]. Subsequently, the IDs should be entered in the Central Data Base (CDB) by the authorized staff in RUs, but this was not strictly applied. Unfortunately, due to the fact that not all vaccinated animals are registered per ID in the country (before 2012), it is extremely difficult for the CCA which is competent for the evaluation of the effectiveness of the program at central level, to conclude the accurate results (number of alive vaccinated animals when compared to the total animal population), as CCA

relies on estimations for the number of vaccinated animals of the regional veterinarians which are responsible for the implementation of the program at local level and keep all the records.

Between 2012 and 2015, the S&G brucellosis program in Greece, divides the country in two zones: 1) A vaccination zone (VZ), where female sheep and goats are vaccinated once in their lives (over the age of 3 months old) and male animals are routinely blood-sampled for further serological testing every 6-12 months (over the age of 6 months old). 2) An eradication zone (EZ), where blood-sampling (every 6-12 months) and slaughter policy is implemented for all animals (over the age of 6 months old) (Ministerial Decision, 2012) (Fig. 1).

Table 1. Vaccination zone (VZ). Data refer to the 31st December of each year

Year	Active farms (No)	Sheep & goats (No)	Vaccinated animals (No)	Unvaccinated animals (No)	Vaccination coverage at animal level (%)
2012.	103.569	11.871.587	7.683.545	4.188.042	64,72
2013.	90.719	11.642.501	8.696.434	2.946.067	74,69
2014.	87.937	11.562.550	8.525.347	3.037.203	73,73
2015.	54.817	9.106.569	7.181.215	1.925.354	78,85

In EZ, farms are classified in four categories according to their health status as to brucellosis; “M+” for positive holdings, “M1” for holdings of unknown status, “M2” for holdings with negative results, “M4s” for officially free holdings suspended and “M4” for

officially free holdings. More precisely, given that a farm is assigned to the “M1” health status (namely an unknown health status regarding brucellosis) two consecutive blood collections and testing are required in 6 to 12 months intervals with negative results regarding the

presence of *Brucella* spp. If the results of the first blood sampling are negative the farm can switch to an “M2” health status. Then, it is required a second blood collection with negative results and the holding can be characterized as “M4” (officially brucellosis free).

In the VZ, farms are classified as 1) “vaccinated”, 2) “unvaccinated” and 3) “farm with positive animals”.

The vaccine contains live *Brucella melitensis* bacteria; strain REV-1, which are pathogenic to humans (Vaccine’s package leaflet, 2004). Hence, vaccination process should be performed in a place protected from wind and dust. All persons involved in the vaccination process (veterinarian, assistant and farm owner) are obliged to adopt the adequate biosecurity measures. In addition, they should not be positioned in a direction opposite to the wind. In the vaccination place, no one else should be present due to the increased risk of airborne infection or contact of the vaccine droplets with the mucosal tissues. Especially pregnant women should be outside the farm and avoid visiting it for the next few days. The vaccination of animals is required to be carried out by an official veterinarian. Moreover, since 2013 even private veterinarians, who have been approved by the Veterinary Department of the Directorate for Rural Economy and Veterinary of each Regional Unit, were permitted to participate in the implementation of the program (Instructions Manual, 2016).

Additional difficulties in the implementation of the program related to the socioeconomic situation in Greece that emerged in 2010. The major one was the reduction of expenditure in public sector, which caused a freeze in public servants’ salaries, and reductions in their additional bonuses and overtime and travel allowances (Pipini M, 2014).

Moreover, the general *de minimis* ceiling of geotechnical employees’ allowable movements per month and year, according to the Article 9 of Law 3833/2010¹², was limited to sixty (60) days from one hundred and twenty (120) that were set by the provisions of a previous Law, more specifically of Article 2 of Law 2685/1999 (Law 2685/1999). Exceeding the 60 days limit (up to 80 days) is permitted only for dealing with emerging events to support special service needs (https 2016a).

The above, combined with a) the restriction of compensated kilometric distances [Article 9 of Law 2685/1999, i.e. for a 20-40 km distance the compensation amounts to one third ($\frac{1}{3}$) of 10.000 GRDs¹], b) the two Insurance Laws (Law 3863 And Law 3865 of 2010) which favored the massive retirement of mainly women veterinarians (https 2016b), and c) the provisions of Article 11 of Law 3833 of 2010¹² «one recruitment per five retirements», affected negatively the implementation of the program.

The S&G brucellosis program aims to safeguard animal health and protect public health. So far the predicted targets have not been reached yet. The purpose

of the present study is the investigation of the minimum possible personnel (in the form of a two-person-group) for the effective and efficient application of the program.

MATERIALS AND METHODS

For the present study a closed-ended type questionnaire was used, which was sent from the Department of Zoonoses (DZ) of the Directorate of Animal Health (DAH) of Ministry of Rural Development & Food (MRDF) to all Veterinary Departments (VDs) of Greece during the years 2012 until 2015. The questionnaire was sent at the end of each semester (on June 30th) and at the end of each year (on December 31st), so that official veterinarians who filled it became accustomed to its form and content. It consisted of two sections; the first one referred to the VZ and included 42 questions, and the second to the EZ and had 29 questions. The VZ section was divided into six subsections, namely, Holdings and Population; Vaccination with REV-1, Blood Sampling, Epizootiology and Epidemiology, Human Resources and Aims.

From the total of the 42 questions concerning the Regional Units (RUs) of the Vaccination Zone (VZ), the fields 41 and 42 of the subsection Aims of the questionnaire were used, i.e. «A group can vaccinate in one day an average number of (41) ...female animals or collect (42)... blood samples». As for the RUs of the Eradication Zone (EZ), from the total of the 29 questions, the field 27 of the questionnaire was used, i.e. «A group can

collect an average number of (27) ... blood samples in one day». Thereby it became possible to calculate the approximate capacity of a group (one veterinarian and one assistant) for each RU, based on the particular circumstances and the experience of veterinarians who applied the program for many years.

The next factor that should have been evaluated was the number of days that public veterinarians are entitled by law to work away from their office. This is widely known as the “days away” which each employee in the public sector is entitled to and for which he is compensated. In Greece since 2010, the maximum number of “days away” provided by legislation (Law 3833, 2010) is “60”. Multiplying the number of vaccinations or blood samplings by “60” the result reflects the total number of animals that is feasible to be vaccinated or blood sampled in the specific RU during a year.

Another important element that was assessed concerning the VZ resulted from the field 14 of the subsection Vaccination with REV-1 of the questionnaire: «From the total animal population of our RU, (13) % of sheep and goats vaccinated and there are still (14)... unvaccinated animals». In VZ, the fundamental parameter needed is the number of unvaccinated females in an RU. Unfortunately, from the total

¹ Greek drachmas. Monetary value in Greece until 2001.

of 60 RUs some RUs did not provide data. More specifically, in the year 2013 one RU and in the year 2015 two RUs did not provide data. For the years 2012 and 2014 all RUs responded to the questionnaire.

The number of employees who worked in the program derived from the fields of the subsection of Human Resources of the questionnaire. More specifically for the VZ the fields used were: «*In the Directorate of Rural Economy and Veterinary of our Periphery (Region) are currently working (31)... veterinarians (of permanent and contracts of indefinite duration),(32)... other employees (administrative staff, workers, etc.), (33)... veterinarians (seasonal) and (34)... other employees (seasonal)*. For the EZ the fields that refer to Human Resources are

the same just with different numbering.

For reasons of convenience and as the calculation of the second and third condition is quite complex and of minor importance in relation to the first, this study was focused on the calculation of the necessary groups based only on the number of unvaccinated female animals. In almost all RUs requested to reply, the vaccine coverage as well as the number of remaining unvaccinated animals, was data obtained from the experience of the veterinarians, local service archives and the nearest possible statistical approach. Data that was sent from the official veterinarians of all Veterinary Departments were not checked for their accuracy, but they were accepted as received.

RESULTS

Thereafter, the results that arose from the answers received by the CCA on an annual basis are presented in full detail and further discussed. (The document 2012, The document 2013, The document 2014, The document 2015).

For the years 2012 to 2013 the number of active farms (which have live animals) and sheep and goats was determined by an approximate estimation performed by the official veterinarians concerning farms that were breeding animals in their RU, or was obtained directly from the Central Data Base (CDB). For the years 2014 and 2015 the determination of those two numbers was based on the

registration farmers made in the CDB for the previous year. The Department of Animal Identification and Registration Artificial Insemination and Veterinary Institutions of the Directorate of Animal Protection of the MRDF sent the registration data of the CDB to the DZ of the DAH of the MRDF. Thus, the number of active farms and the number of sheep and goats is considered to be closer to reality from the year 2014 onwards.

As it is shown in Table 1, in the VZ the number of active farms in 2012 was 103,569 and suffered a considerable decrease reaching 54.817 in the year 2015. This significant reduction is mainly due to the CDB's clearance (the

massive deletion of inactive holdings). The number of live sheep and goats also decreased from the year 2012 and after for the same reason. In the animal population, males were included and they are estimated at approximately 5-10% of the total population.

The number of vaccinated animals was obtained indirectly from the deduction of unvaccinated animals from the total animal population included in the vaccination scheme of the VZ. As for the number of unvaccinated animals it was extracted from the completion of the question 14 of the questionnaire.

The vaccination coverage was calculated based on the percentage of

vaccinated sheep & goats in the total sheep and goat population, as they were stated in the questionnaires. In calculating the vaccination coverage male animals (5-10%) were not taken into account.

For the year 2013 the reduction rate of active farms in the entire country was 12.83%, for 2014 it was 2.67% and for 2015 it was 38.03%. Thus, it resulted in a total reduction of holdings taken into account for the program of 47.43% in the years 2012-2015. The reduction rate of sheep and goat number was 3.23% in 2014 and for the year 2015 it was 18.59%.

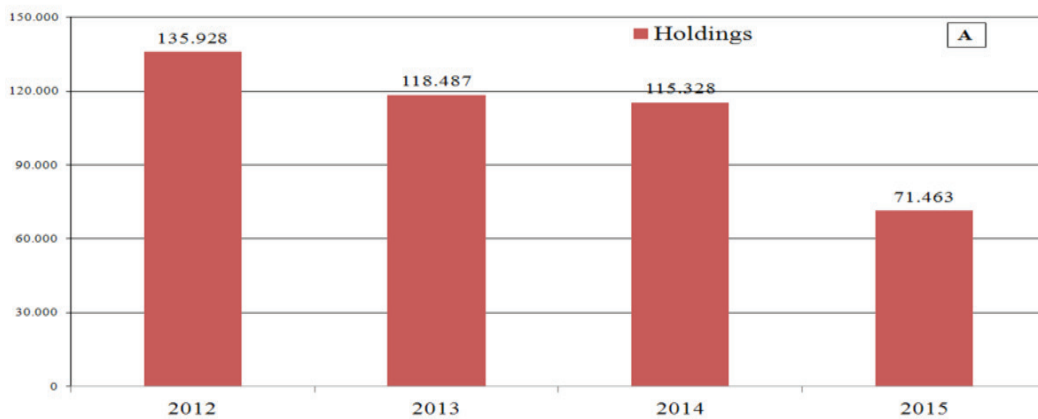


Fig 1. The number of sheep and goat holdings in the entire country is shown and the number of sheep and goats in the entire country per year is shown in Fig. 2.

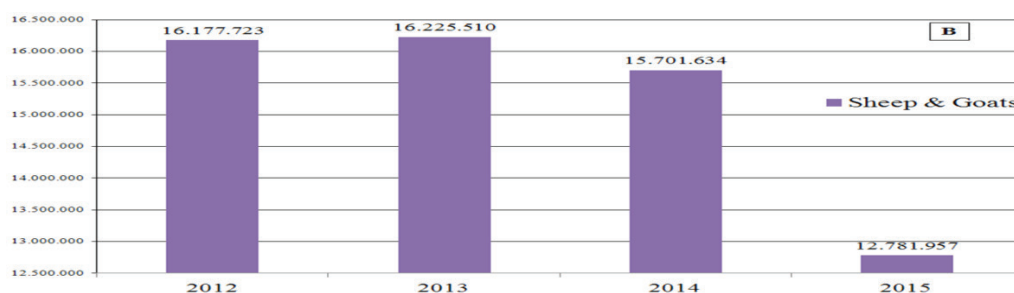


Fig 2. The number of sheep and goats in the entire country per year is shown

The correct registration of ovine and caprine population is a key parameter for the approximation of the necessary human resources to implement the program. Since M2 and M4 holdings of the EZ are “insignificant” compared to the total number, there was an indicative calculation of the at least one

blood collection of the total number of sheep and goats of the EZ. The basic and main parameter necessary is the actual number of animals older than 6 months in a RU since male and female animals older than 6 months are blood sampled (Table 2).

Table 2. Eradication Zone (EZ). Data refer to the 31st December of each year

Year		2012	2013	2014	2015
Holdings and animals in the programme	Holdings	28.155	27.827	28.543	16.646
	Sheep & Goats	4.306.136	4.583.015	4.138.404	3.675.388
Unknown status (M1)	Holdings	19.231	26.689	24.332	14.862
	Sheep & Goats	3.603.942	4.376.260	3.550.050	3.257.763
Positive holding (M+)	Holdings	44	37	30	33
	Sheep & Goats	16.887	16.523	12.779	12.004
Holding with negative results (M2)	Holdings	1.968	565	2.647	1.350
	Sheep & Goats	181.065	96.361	498.160	317.253
Officially free holding suspended (M4s)	Holdings	6.692	134	2	72
	Sheep & Goats	460.016	19.118	110	18.398

Officially free holding (M4)	Holdings	220	402	380	329
	Sheep & Goats	44.226	74.753	83.605	69.970

For the faster and safer implementation of vaccinations or blood samplings at least two persons are required (“group”) and the owner of the animals or someone who is in charge of their catch and restraint during the vaccination/sampling. The “group” consists of the official veterinarian who prepares the vaccine and instills it into the right eye of the animal or takes the blood sample and

his assistant who records the vaccinated/blood-sampled animals in a catalogue and in general assists the veterinarian.

The reduction in the number of registered holdings, in the number of sheep and goats after 2013, and in the animals’ population which is to be vaccinated or to be serologically tested, resulted in the gradual reduction of the total number of groups required (Table 3).

Table 3. Summary table with data on animal population, herds and human resources for the period 2012-2015, in whole country

Year	2012	2013	2014	2015
Registered holdings in the CDB	135.928	118.487	115.328	71.463
Number of sheep & goats	16.177.723	16.225.510	15.701.634	12.781.957
Number of animals’ population to be vaccinated or/and taken blood	8.089.886	7.837.837	7.305.702	5.743.742
Total of groups required	716	734	618	485
Permanent personnel (veterinarians + other employees)	810 (480+330)	687 (413+274)	675 (404+271)	656 (394+262)
Seasonal personnel (veterinarians + other employees)	29 (5+24)	123 (59+64)	103 (50+53)	9 (7+2)

The reduction of permanent staff (veterinarians and other technical/administrative employees) working on the implementation of the program for the years 2012-2015 is clearly illustrated. For the year 2013 it was (15.18%) **10.78%**, for the year 2014 **1.75%** and

for the year 2015 **2.97%**. Thus, a total reduction of permanent staff for the years 2012-2015 of (19.35%) **14.95%** resulted. As for the number of seasonal employees recruited in this period it apparently varies.

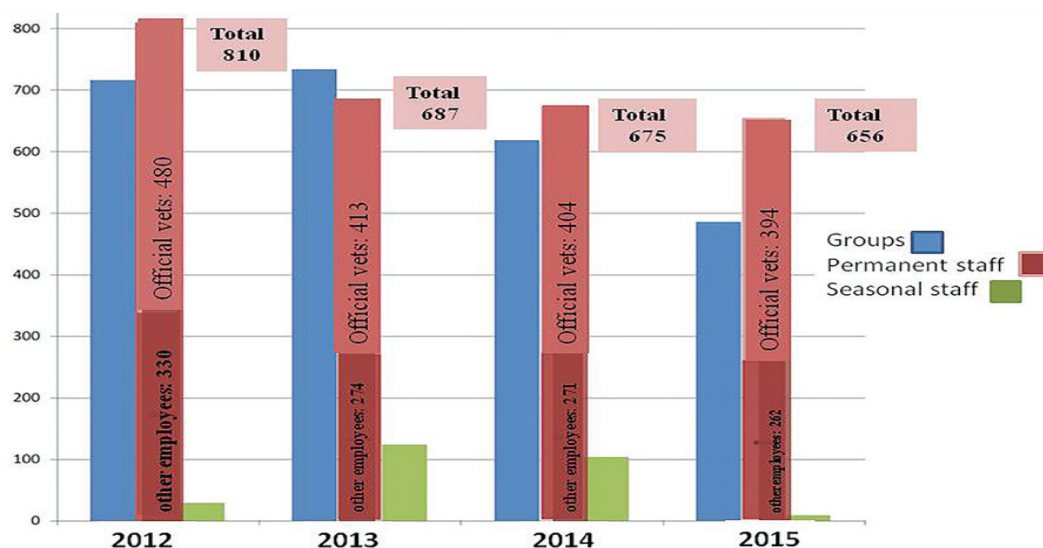


Fig 3. The analogy between the number of permanent staff, groups and seasonal employees during the years 2012-2015 is depicted.

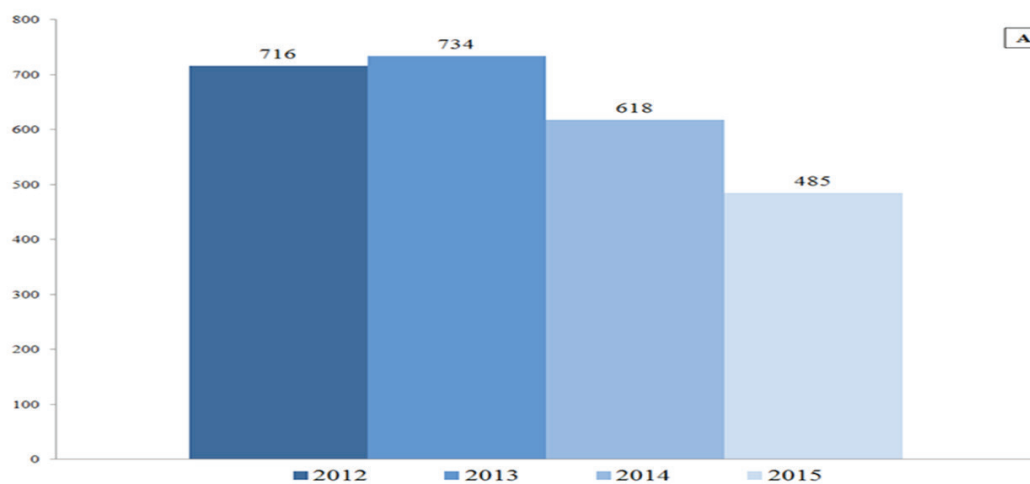


Fig 4. The number of necessary groups to effectively implement the program was calculated as following: 716 for the year 2012, 734 for the year 2013, 618 for the year 2014 and 485 for the year 2015.

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As it resulted from the questionnaire, each Periphery has different needs in groups. The greatest number is demanded in the Peripheries of Crete (PC: 205 groups) and in the Periphery

of Western Greece (PWG: 71 groups). More specifically, in the PC the RU of Rethymno needs 121 groups and in the PWG the RU of Etolia-Acarmania needs 44 groups.

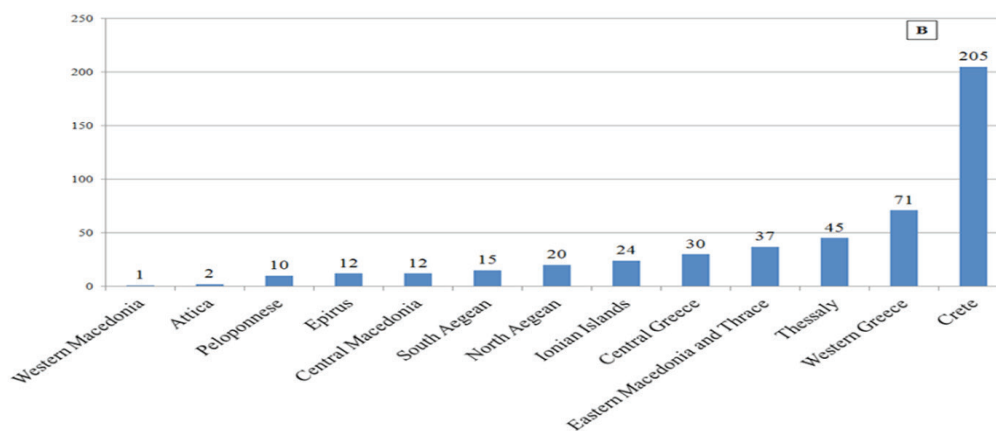


Fig 5. For the year 2015 the number of necessary groups in each Periphery is shown in

DISCUSSION

It is the first time that a scientific paper assesses in a holistic way information related to the total number of alive animals vaccinated with REV-1. In addition, updated data over serologically tested sheep & goats in Greece are provided for the years 2012-2015. The main goal of this study was to determine the minimum requirements in human resources that are considered as necessary on an annual basis for the effective implementation of the sheep and goat brucellosis program, by evaluating data obtained by the competent veterinary authorities that

implemented this program during the above period.

Evaluating the main outcomes of the present study it is obvious that the control and eradication program of sheep and goats' brucellosis in Greece was not possible to be applied successfully for the years 2012-2015.

The effort by the CCA to rationalize the number of holdings and animals resulted in the depicting of the reality in a better approximation, due to the accounting reduction of sheep & goats' number. Thus, a decrease in the number

of groups emerged. In fact, the necessary number of groups that should be involved for the program's needs during the year 2015 is 485 and approaches greatly the number of "holding's veterinarians" that are currently registered in the official database of the MRDF, which is 460 (http 2016). Taking into account the current economic conditions in the country, the recruitment and unique occupation of $485 \times 2 = 970$ public servants exclusively for the needs of brucellosis program cannot be considered as a realistic scenario, although politicians are being informed especially during the last years by the CCA, for the necessity of staffing of the regional veterinary services. However, evaluating the main conclusions of the present study, one could claim that at least partly, the minimum requirements in personnel for the effective implementation of brucellosis program in sheep and goats in Greece might be covered by the involvement of private veterinarians.

However, even in the case that private veterinarians (or farm's veterinarians) are able to fully address the needs of the program, it should be further investigated whether the permanent veterinary staff in the Regional Units has the capacity to supervise the program's implementation and perform the appropriate sample checks.

The time period of 2012-2015 is considered as one of the "hardest" periods

with regard to the early retirements of experienced veterinarians and other skilled professionals in the Public Sector. Thus, the number of permanent staff was reduced while on the other side, new administrative procedures regarding new official documents introduced (e.g. data entry, vaccination certificate, serological testing certificate), led to the increase of the necessary administrative procedures to address the services needs. In addition to that, there was a limitation of allowable movements and compensations as well as a significant reduction in the salaries of permanent and qualified staff. This situation affected negatively the implementation of the program.

A parameter that might have affected the validity of the extracted data presented in this study is that the analysis is based on estimations and approximations obtained by the implementation of the program by the official veterinarians in the regional units.

However, this study provides clear evidence regarding the extent of the problem related to the non-effective implementation of the Greek sheep and goats' brucellosis program and the importance of adoption of corrective actions in order to address the aforementioned bottlenecks.

CONCLUSIONS

Summarizing, the fiscal situation in Greece during the period 2012 to 2015 affected adversely the implementation of sheep and goat brucellosis program. For the effective and efficient implementation of the program, the recruitment of permanent and seasonal staff in the veterinary services is considered as of outmost importance. In addition, an increase in the “*days away*” threshold for the official regional veterinarians in order to restore the situation in the previous level of the 180 “*days away*” is also necessary as

brucellosis program is fully implemented in the field. Furthermore, the public veterinary sector at both central and regional level should deploy in a more effective way the already registered farm veterinarians so as to fill the gap in human resources. The above corrective actions have to be performed based on the livestock capacity among different peripheries.

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