Bulgarian Journal of Agricultural Science, 22 (No 1) 2016, 158-164
Agricultural Academy

INFLUENCE OF THE MODULAR APPROACH ON THE PRODUCTION COSTS DURING INTRODUCTION OF EWES' MACHINE MILKING

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Abstract

SABKOV, H., E. VIDINOVA, E. RAYCHEVA and T. IVANOVA, 2016. Influence of the modular approach on the production costs during introduction of ewes' machine milking. *Bulg. J. Agric. Sci*., 22: 158–164

The object of this study is the status of sheep breeding in the Republic of Bulgaria and the possibility of reducing the production costs in the sub-sector by application of the modular approach. The analysis of the status and trends in sheep breeding showed that despite the favourable geographical location, climate conditions, rich sheep breeding traditions and wide variety of local indigenous breeds, the sheep population has been reduced about 6-times over the last 20 years, with entire breeds being in danger of extinction. The sheep breeding sub-sector is characterised by low technical and technological level, hand milking of the sheep and shortage of investments. As a rational option to ease the investment process and to reduce the production costs it is proposed the application of modular approach to introduce machine milking in expanding sheep farms with shortage of investment capital. It was found that when the necessary investments for machine milking introduction are covered by a bank loan, the total amount of investment of the modular approach is lower than that of the traditional approach, respectively with: 15.64% for initial sheep farm with 80 ewes and 19.12% for initial sheep farm with 40 ewes. The application of modular approach also contributes to a significant decrease in the depreciation allowances, both in absolute terms and in relative value per production unit. For the conditions of the conducted study it was found that the modular approach contributes to savings from depreciation allowances in size of, respectively, BGN 7515 for initial sheep farm with 80 ewes and BGN 7432 for initial sheep farm with 40 ewes. The survey results suggest that the application of the modular approach contributes to a decrease of the production costs, and therefore can be regarded as a significant factor for the increasing of sheep farms capacity and the development of dairy sheep breeding.

Key words: sheep breeding; milking; machine milking; modular approach

Abbreviations: TA – traditional approach; MA – modular approach; DA – depreciation allowances; ISF-80 – initial sheep farm with 80 ewes; ISF-40 – initial sheep farm with 40 ewes

Introduction

The geographical location and natural and climate conditions of Republic of Bulgaria are favourable prerequisites for development of sheep breeding. Historically, this has determined sheep breeding's establishment as a major livestock sub-sector and an important factor for the Bulgarian economy. The favourable natural conditions help the emergence of a significant number of indigenous types and breeds of sheep, adapted to the specific conditions in the different regions of the country. According to some authors (Dochevski, 2002; Zhelev at al., 2009; Tyankov at al., 2000) Bulgaria takes one of the first places in the world with respect to the number of local indigenous breeds.

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Status and trends in Bulgarian sheep breeding

According to statistical data for the period from 1890 to 1990 (NSI, 1995) Bulgarian sheep population maintains a relatively high number - between 7 and 11 million (Figure 1), regardless of the economic situation in the country or the changing economic and political systems.

After the last change of the political system (in 1989) and the subsequent transition from central planned to market economy, the sheep breeding has entered into a period of deep crisis, which led to drastic reduction in the number of animals and threatened some breeds with extinction. The sheep population declined about six-fold: from 8.130 million in 1990 to 1.361 million in 2012 (Figure 2) (Tyankov at al., 2000; MAF, 2003, 2007, 2011, 2013; MAF, 2002, 2006, 2010, 2012).

Apart from the drastic reduction of the population, another issue is the degradation of the farm capacity structure. According to statistical data for 2012 (MAF, 2002, 2006, 2010, 2012), in 72.1% of the sheep farms were grown from 1 to 9 ewes and the average number of raised ewes in one sheep farm was 16.8. These facts are in close relation with the low technical and technological level in dairy sheep husbandry. It is ineffective to introduce advanced technologies and organise competitive production of sheep milk in farms with such capacity.

The analysis of trends and growth rates of the average ewes number per farm for the period from 2000 to 2012 suggests that a change in the state of the farms and conditions to organise competitive production will not be observed soon (Figure 3) (MAF, 2003, 2007, 2011, 2013; MAF, 2002, 2006, 2010, 2012).

Furthermore, there has been a persisting trend for the Bulgarian rural population to decrease and its average age to increase, which leads to deteriorating conditions for development of sheep husbandry.

In order to overcome that negative trend and improve the sheep breeding conditions, a radical change in Bulgaria's national policy toward creation of favourable business environment and attracting of investments is required. The problem is multi-faceted and will require a complex approach to be overcome.

Milking of ewes is a basic technological process in dairy sheep breeding. In Bulgaria, the majority of milking is performed manually. Manual milking is one of the most labour-intensive and most unattractive technological processes in conventional farming technologies. Its continued practice leads to chronic professional diseases of the milkman. The contemporary solution of the problem is the transition to machine milking.

The sheep machine milking is a typical practice in the countries with modern sheep breeding. The reasons for this are machine milking's role in reducing the amount of manual labour and improving health conditions for the milkman, on one hand, and the increasing market demands with respect to quality of milk and milk products, on the other.

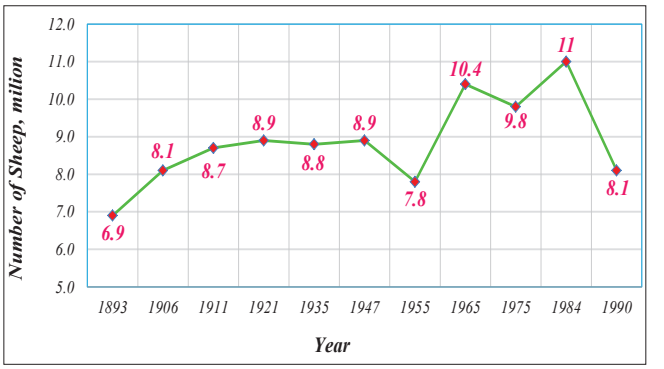

Fig. 1. Amendment of sheep population in the Republic of Bulgaria for the period from 1890 to 1990

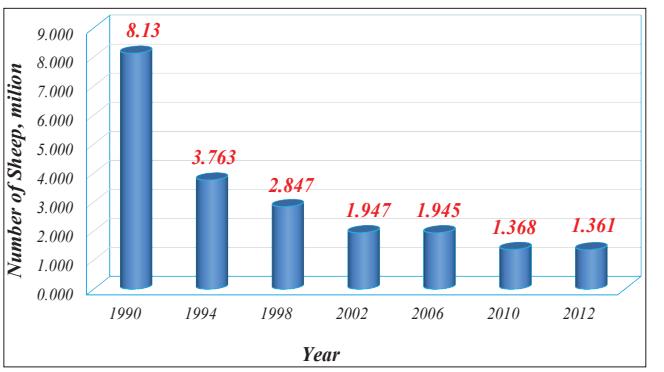

Fig. 2. Amendment of sheep population in the Republic of Bulgaria for the period from 1990 to 2012

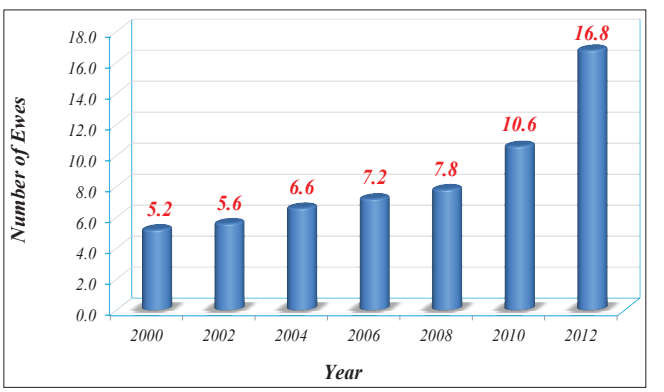

Fig. 3. Average number of ewes reared in a statistical sheep farm in the Republic of Bulgaria for the period from 2000 to 2012

The current study presents some results of the application of MA in sheep farms in enlarging process (under the scheme of expanded reproduction) and the concomitant introduction of machine milking.

The aim of the study

It was to carry out an evaluation of the effect of MA application at the introduction of machine milking on some elements of the production costs.

Materials and Methods

The TA during the introduction of machine milking requires synchronisation of the capacity of milking equipment with the ultimate design capacity of the farm. This approach implies providing a significant initial investment for milking equipment. However, in many cases such investment is not possible, both for newly established and for existing sheep farms that are subject of reconstruction and modernisation.

The application of MA during the introduction of machine milking, alongside with stepwise increase of the farm capacity, is a possible option to facilitate the investment process. Such an approach would allow a phased increase of the milking installation capacity, in parallel with the increasing of farm capacity, until the final design capacity has been reached.

To assess the effect of the application of this approach it has been investigated the influence of TA and MA on some elements of the production costs. The comparative method and the approach, applied by Sabkov at al. (2014), have been used.

In order to achieve a more detailed clarification of the effect of MA application, the following variants were investigated:

- ISF-80, with an initial capacity of 80 ewes; design capacity of 280 ewes; index of multiplication of the milking module n = 3 and the term for reaching the farm design capacity - four years;
- ISF-40, with an initial capacity of 40 ewes; design capacity of 160 ewes; index of multiplication of the milking module n = 4 and the term for reaching the farm design capacity - five years.

In the investigated farms are raised sheep of the 'Synthetic Population Bulgarian Milk" breed.

The basic parameters of sheep farms are shown in Table 1 (Ivanova, 2013).

The sheep farms are subject of gradual expansion (under the scheme of expanded reproduction) until reaching the design capacity. The enlargement process is accompanied with the transition from manual to machine milking. For the period of enlargement a low level of animal technological rejection was assumed, which is not taken into account in the study.

The turnover of the herds until reaching the design capacity is shown in Table 2, and in Table 3 - the farm expansion

Table 1
Main parameters of the initial sheep farms

№	Parameter	Measure	Value	
1.	Initial farms capacity (number of ewes)	*Number*	40	80
2.	Designed farms capacity	*Number*	160	280
3.	Average milk production per 120-days lactation period	*l*	110	
4.	Prolificacy	*%*	140	
5.	Live weight of ewes	*kg*	65.00	
6.	Average selling price of milk	*BGN/l*	1.4	

Table 2
Flocks turnover untill reaching the designed farms capacity

Year	Number of ewes in the beginning of year		Lambs		Yearlings		Number of ewe lambs at the end of year		Number of ewes at the end of year	
	ISF-80	ISF-40	ISF-80	ISF-40	ISF-80	ISF-40	ISF-80	ISF-40	ISF-80	ISF-40
1-st	80	40	112	56	-	-	56	28	80	40
2-d	80	40	112	56	56	28	56	28	136	68
3-d	136	68	190	95	56	28	95	47	192	96
4-th	192	96	268	134	88	44	40	20	**280***)	140
5-th	-	140	-	196	-	20	-	30	-	**160***)

*) the designed farms capacity is reached

Table 3
Technological schemes for introduction of machine milking during application of modular approach

Stages	Year	Number of milked ewes in the beginning of year		Capacity of milking installation	
		ISF-80	ISF-40	ISF-80	ISF-40
1-st	1-st	80	40	8 places	4-places
	2-d	80	40		
2-d	3-d	136	68	16-places	8-places
3-d	4-th	192	96	16-places	8-places
4-th	5-th	**280***)	140	24-places	12-places
5-th	6-th	-	**160****))	-	16-places

***)** the designed farm capacity is reached at the end of 4-th year

****))** the designed farm capacity is reached at the end of 5-th year

Table 4
Relative DA during the application of TA and MA for introduction of machine milking

Year	Number of ewes in the begging of year	Relative DA:		
		At TA. BGN/l	At MA. BGN/l	MA relative to TA, %
For ISF-80				
1-st	80	0.42	0.15	35.71
2-d	80	0.42	0.15	35.71
3-d	136	0.25	0.15	60.00
4-th	192	0.17	0.11	64.71
5-th	280	0.12	0.12	100.
For ISF-40				
1-st	40	0.63	0.17	26.98
2-d	40	0.63	0.17	26.98
3-d	68	0.37	0.19	51.35
4-th	96	0.26	0.14	53.85
5-th	140	0.18	0.13	72.22
6-th	160	0.16	0.16	100.

stages, the technological schemes for introduction of milking equipment and its necessary capacity.

The technological schemes are designed on the base of, respectively, 8 places milking module (for ISF-80) and 4 places milking module (for ISF-40).

The current study was conducted under the assumption that the necessary investments for the purchase of milking equipment are covered by bank loans.

For the MA, the loan period is divided into separate stages. The number of those stages is a function of the multiplication index. The loan term for each separate module is determined by the time until the next module needs to be introduced. The loan term for the last modules in both variants (ISF-80 and ISF-40) is five years.

For the TA, the crediting process is a single act, dictated by the requirement to purchase the necessary milking equipment in the beginning of the enlargement process.

For comparability of the two approaches it is assumed that the loan terms used for TA match the overall loan terms used for MA - respectively, 108 months for ISF-80 and 120 months for ISF-40.

The following cost elements of milk have been evaluated:

- Relative DA for milking equipment;
- The costs of servicing the loans for milking equipment purchase.

The relative DA is determined by the application of the linear depreciation method (IAS 16).

The loan interest due in each period has been calculated by using an "Interest Calculator" (ProCredit Bank, 2015). The calculations have been performed with the assumption of an interest rate of 6.5%. The Bank fees for handling requests for loans and other bank fees are not included.

Results and Discussion

In Table 4 the calculated results for the relative DA at the application of TA and MA for introducing of machine milking are presented.

(Table 4)

The data analysis shows the same trend under both variants: as compared to TA, the relative DA at MA are significantly lower during the 1st and 2nd year, then this difference decreases, and for the last year the relative DA are aligned.

- The specific data for each of those options are:
- For the ISF-80: through the first and second years the relative DA for the MA are 2.8 times lower; in the third year - 1.67 times and for the fourth year - 1.55 times. The relative DA for the both approaches are equal upon reaching the farm design capacity;
- For the ISF-40 these ratios are: during the first and second years - 3.71 times; for the third year - 1.95 times; for the fourth year - 1.86 times and for the fifth - 1.38 times. The relative DA for the both approaches is equal in the sixth year.

Along with this, the results in the table let us to conclude, that the investments at MA are significantly more evenly dis-

tributed during the term of the machine milking introduction. This fact determines the relatively constant value of the relative DA (see Table 5, Figure 4 and Figure 5).

(Table 5, Figures 4 and 5)

The annual DA (in absolute value) and the relative DA per production unit are shown at Figure 4 and Figure 5 (respectively for ISF-80 and ISF-40).

The results in the figures show that for the TA, the annual DA are constant magnitude until reaching the farm design capacity, while for the MA the annual DA are variable (increasing) magnitude.

In the second case the results are determined by the milking equipment capacity, which "grows" in parallel with the farm capacity increase.

Table 5
Numerical characteristics of the relative DA during the application of TA and MA for introduction of machine milking

An approach	Values of numerical characteristics of the relative DA		
	$\bar{X}$, BGN/l	σ, BGN/l	Var, %
For ISF-80			
TA	0.276	±0.139	±50.36
MA	0.136	±0.018	±13.24
For ISF-40			
TA	0.372	±0.213	±57.26
MA	0.16	±0.022	±13.75

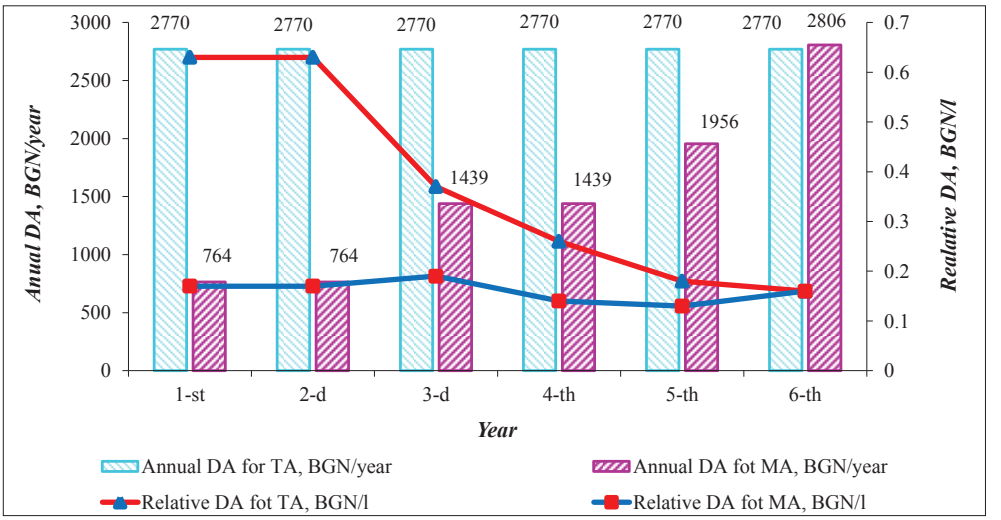

Fig. 5. Amendment of DA during the introduction of machine milking in ISF-40

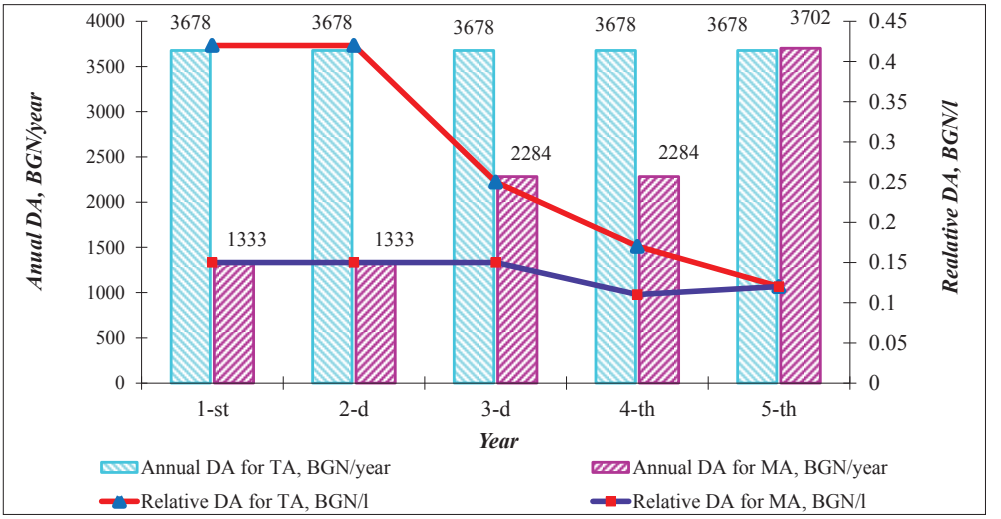

Fig. 4. Amendment of DA during the introduction of machine milking in ISF-80

The trend of the relative DA is in opposite direction: for the TA the values gradually decrease, while for the MA they are relatively permanent. The relative DA for both approaches are aligned upon reaching the farm design capacity.

The analysis of the graphics shows the common trends and the advantages of MA, for both variants (ISF-80 and ISF-40):

- The total values of DA (both in absolute and in relative terms) are significantly lower;
- The relative DA in the costs of milk production are relatively constant for the entire duration of machine milking introduction;
- The values of relative DA in the initial stages of machine milking introduction are notably lower.

The lower values of relative DA for MA could be explained by more efficient matching between the capacity of equipment and the flock size. Upon reaching the farm design capacity, the efficiency of equipment loading as well as the relative DA, for both approaches, are equalised.

Under the conditions of the current study, the obtained results show that the application of MA enables savings of DA in size of, respectively, BGN 7515 for ISF-80 and BGN 7432 for ISF-40. These savings are a result of more efficient loading of equipment in the process of machine milking introduction.

In Tables 6 and 7 the financial flows for the machine milking introduction via a bank loan are presented.

The data analysis shows that the total payable interest at MA is smaller than that at TA, respectively with 2.94 times for ISH-80 and with 3.80 times for ISH-40.

The total investment sum at the TA is higher than that of the MA as follows:

- For ISF-80 - with 15.64%;
- For ISF-40 - with 19.12%.

These significant differences could be explained by the fact that the application of MA allows stepwise "rescheduling" of lending process, according to the stages of farm expanding until the full farm capacity is reached.

Conclusion

Despite the favourable geographical location and climate conditions, the rich traditions and a wide variety of local in-

Table 6
Scheme of financial flows during the application machine milking in ISF-80

Stage of the investment	Initial value of the investment, BGN	Term of repayment of the loan, months	Interest payable for the term of loan, BGN	Monthly installments, BGN/ monthly	Final value of the investment, BGN
1. Value of the investment during the application of TA					
1-st	18,390	108	5,948.98	225.36	24,338.98
2. Value of the investment during the application of MA					
1-st	6,666	24	460.69	296.95	7126.69
2-d	4,752	24	328.42	211.68	5080.42
3-d	7,092	60	1233.84	138.76	8325.84
Total:	18,510	108	2022.95	-	20532.95

Table 7
Scheme of financial flows during the application machine milking in ISF-40

Stage of the investment	Initial value of the investment, BGN	Term of repayment of the loan, months	Interest payable for the term of loan, BGN	Monthly installments, BGN/monthly	Final value of the investment, BGN
1. Value of the investment during the application of TA					
1-st	13,850	120	5021.85	157.26	18871.85
2. Value of the investment during the application of MA					
1-st	3,820	24	264.01	170.17	4084.01
2-d	3,286	24	227.08	146.38	3513.08
3-d	2,585	12	91.92	223.08	2676.92
4-th	4,250	60	739.31	83.16	4989.31
Total:	13,941	120	1322.32	-	15263.32

digenous breeds, the "Sheep breeding" sector in Bulgaria is in a state of deep crisis. For the last twenty years the sheep population has been reduced nearly six times and entire breeds are faced with a real threat of extinction. The subsector is characterized with low technical and technological level, hand milking and shortage of investments.

For the sheep farms in state of expansion and shortage of investment capital the application of modular approach for introduction of machine milking is proposed as a rational alternative to ease the investment process and reduce the production costs.

In case of ensuring the necessary investments for the introduction of machine milking by a bank loan, the total amount of investment for the modular approach is lower than that of the traditional approach, respectively with: 15.64% for sheep farm with 80 ewes and 19.64 % for sheep farm with 40 ewes.

The application of modular approach helps to significantly reduce the depreciation allowances, both in absolute terms and in relative value per production unit. Under the conditions of the conducted study it was found that the modular approach contributes for savings from depreciation allowances in size of, respectively, BGN 7,515 for a sheep farm with 80 ewes and BGN 7,432 for a sheep farm with 40 ewes.

In conclusion, the application of modular approach to the introduction of machine milking in sheep breeding facilitates the reduction of production costs, and therefore can be regarded as a significant factor in the development of dairy sheep breeding.

References

Dochevski, D., 2002. Factors, Influencing the Process of Milk Formation and Milk Releasing at the Production of Sheep Milk. Sofia, *Institute of Animal Science*, 52 pp.

International Accounting Standard (IAS), *2016. Property, Machines and Equipment. http://www.fisconsult.bg/dokumenti/nacionalni-i-mejduna-rodni-schetovodni-standarti*

Ivanova, T., 2013. Milk production of ewes from synthetic population Bulgarian milk in the flock IAS-Kostinbrod, PhD thesis, *Institute of Animal Science*, Kostinbrod, 32 pp.

National Statistical Institute, 1995. Agricultural Animals at 1-st January, Statistical reference book, *National Statistical Institute*, 155 pp.

Sabkov, H., E. Vidinova, E. Raycheva and T. Ivanova, 2014. Economic aspects of modular approach at machine milking of sheep. *Animal Science*, **1-2**: 34-39.

Tyankov, S., I. Dimitrov, I. Stankov, R. Slavov and D. Panayotov, 2000. Sheep Breeding and Goat Breeding. *Abagar*, Veliko Tarnovo, 588 pp.

Zhelev, K., S. Bachvarova, V. Georgiev, E. Boycheva, D. Petrov, E. Georgieva, G. Yordanov and I. Tanchev, 2009. Genetic Resources of the Animal Breeding in R. Bulgaria. *MZH - Executive Agency for Selection and Reproduction in Animal Breeding,* Sofia, 96 pp.

http://www.mzh.government.bg/MZH/bg/Documents/AgrarenDoklad.aspx?Page=1 (б.а.: Agrarian Reports for 2013,2011, 2007, 2003

http://www.mzh.government.bg/MZH/bg/ShortLinks/SelskaPolitika/Agrostatistics/livestock_breeding/Posts_copy4/Buletini2013.aspx(a's.n.: Statistical bulletin "Agricultural animals in Bulgaria": 2012, 2010, 2006, 2002)

http://www.procreditbank.bg/bg/onlayn-kalkulatori/page/1181

Received September, 8, 2015; accepted for printing December, 23, 2015