TA to support the "Filière du Vin" operation and the beneficiary SMEs

Republic of Moldova

Project Reference Code: TA 2013020 MD NTF

STE Mission Report

Viticulture efficiency and productivity benchmarking exercise

March, 2016

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The technical assistance operation is financed by the Neighbourhood Investment Facility Trust Fund. This Fund - established in 2008 and financed, to date, by 15 EU Member States - aims to contribute to the achievement of the European Neighbourhood and Partnership Instrument (ENPI) strategic objectives, through targeted funding aimed at strengthening infrastructure interconnection between the EU and its neighbours in the areas of transport and energy, at addressing common environmental concerns and at supporting other relevant activities.

Table of Contents

1 Abreviations – Conversion – Preliminary remarks

MDL = Moldovan Lei
1 Hl = 10 Dal = 100 Lt
1 ha = 1 hectare = 10,000 m²
€ht = in Euro, without the VAT
IGP = Indication Geographic Protected
AOP = Appellation of Origin Protected
PDO = Protected Denomination of Origin

Approximation used: 1.5 kg of grape produces 1lt of wine
Exchange rate used : 1 EURO = 22 MDL

2 Mission objectives

This grape production efficiency and productivity Benchmarking exercise has the following objectives:
(1) Measure efficiency and productivity parameters of two Moldovan grape growing/winemaking operations, and compare with corresponding parameters of grape growers from other countries.
(2) Prioritize areas where effort could be most effective to enhance efficiency and productivity.
(3) Prepare an efficiency and productivity Benchmarking template for Moldovan grape growers.

3 Methodology used for the Benchmarking analysis

In order to conduct coherent analysis in comparison with international data available, we have created the following set of "***Viticultutal operations cost clusters***":

- **(1) Fertilization – "*Fertilizare*" (from November to July)**
  It includes
  - Operations, manual or mechanized, consisting in adding N, P, K, Mg elements (under pure mineral form or mixed), and eventually other nutriments, in or on the soil or on the leaves.

- **(2) Pruning and tying – "*Taiatul vitei*" (from December to March)**
  It includes:
  - Pre-cutting ("*Tăiatul aței și a cîrceilor dintre sîrme*") vine canes, cutting previous year canes and shoots and ligatures, removing the cuttings from the trellisings, throwing them in the middle of the row, shredding them ("*Marunțirea viței tăiate*"), bending and tying on the lowest wire the remaining cane(s).

- **(3) Trellising maintenance – "*Reparația șpalerului*" (from February to April)**
  - Replacing defective wires, old poles, consolidating the contra-force poles, etc …

- **(4) Work on soil (from February to May)**
  - Plowing ("*Aratul de toamnă*"), disking ("*Discuit*") and any cultivation operations ("*Cultivare*") conducted on soil between vine rows. These operations are usually conducted in winter or early spring, before start of the vine vegetative cycle.

- **(5) Work on rows ("Erbicidare, Prașit, Cosit iarbă") (from March to August)**
    - These operations are conducted from spring to end of summer.
    - They consist in removing the weeds (mechanically or manually) ("*Introducere erbicide*"), mowing the grass between the vine rows ("*Cositul ierburilor*") and cleaning (mechanically or manually) under the vines ("*Prașitul*").

- **(6) Green operations ("*Lucrări în verde* ") (from April to September)**
    - These operations start with the awakening of the vegetative cycle of the vine.
    - The first operation, called de-budding ("*Lăstăritul*"), consists in taking out some of the non-bearing fruit buds and suckers in order not to uselessly consume the sap to the detriment of old wood, giving the shape to the vine, aerating the plant and controlling the number of expected grapes.
    - It is then followed by trellising ("*Dirijatul lăstarilor între sîrme*") and tying ("L*egatul parțial*") the growing shoots (which means positioning the shoots upwards whilst holding them between 2 trellising wires or/and tying the shoots on the wires).
    - Then the trimming operations ("*Ciupitul lăstarilor*") will take place as shoots must not form a roof over the vines, which could create shade, reduce the exposure of the leaves to the sun and cause bad aeration. These trimming operations are usually conducted on the side of the vine rows but also on the top which means cutting off the end of the growing shoots in order to even out the trellising and prevent the vine from excessive growth.
    - Deleafing ("*Defoliere*") could then take place. It consists of eliminating the leaves situated close to the bunches of grapes so as to aerate them and increase their sun exposure. It could also diminish the risks of diseases. The deleafing is usually conducted few weeks to a couple of month before the expected date of the harvest. It is implemented only if necessary and for top quality grapes.
    - Green harvesting ("*Optimizarea roadei*") could be conducted (quite often at the same time as the deleafing) and consist in removing some of the immature grape bunches or in adapting the desired number of bunches per vine. It is implemented only if necessary and for vines allocated to producing top quality wines.

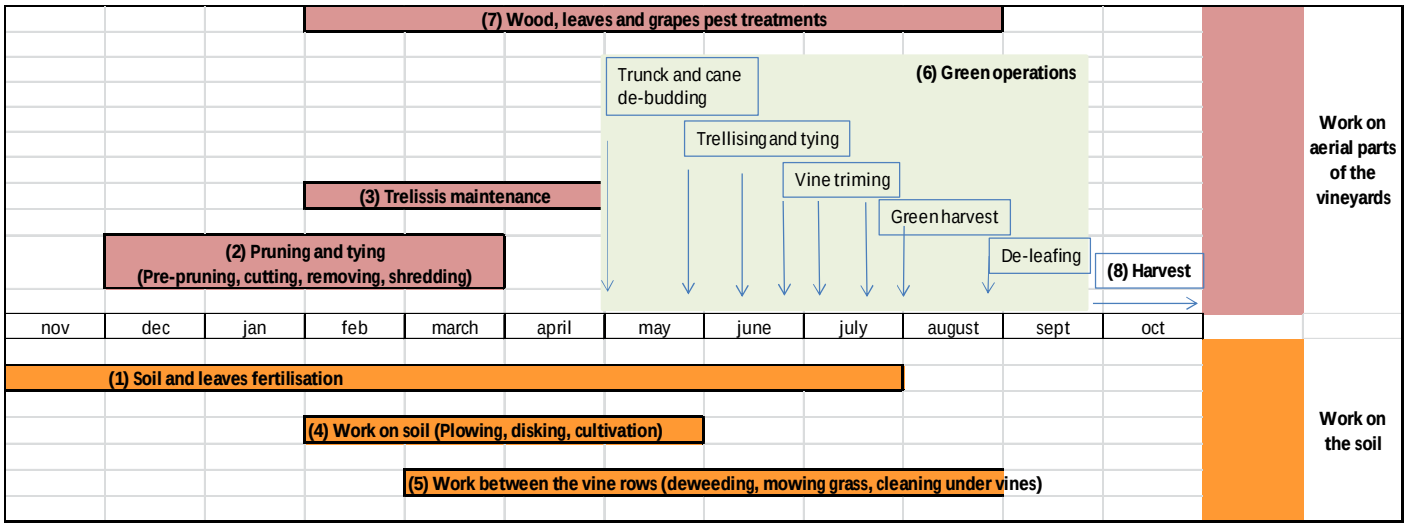
- **(7) Wood, leaves and grape pest treatments ("*Stropitul* ") (February to August)**
    - These treatments are aiming at maintaining the production potential at its maximum by fighting against diseases and parasites. The objectives are to protect the vines against cryptogamic diseases such as mildew, oïdium or grey mould (botrytis) but also against some dreaded insects (Cochylis, Eudemis, Scaphoideus, grape caterpillars …).

- **(8) Harvest ("*Recoltarea*") (September to November)**
    - It includes all harvesting operations, manual and/or mechanical: from actual picking to transportation of grapes or personnel, renting additional equipment, etc…

- **(9) Other costs**
    - This cluster includes additional costs that are difficult to allocate to one specific operation. It includes use of fuel, spare parts for machinery maintenance, electricity, insurance, …

The timing of these Viticulture operation cost clusters during the year could be summarized as follow:

Table 1 – Implementation of the viticultural operations costs clusters over the season



4 Efficiency and productivity parameters for grape growing in Moldova and comparison with other countries

4.1 Efficiency and productivity parameters for grape growing in Moldova

It was initially envisioned to conduct the exercise on two different entities in Moldova.
After taking in consideration the specificity of grape growing in Moldova, it was decided to extend the analysis on three different entities that could be described as follows:

4.1.1 Entity 1 in South of Moldova:

Number of vines per hectare: 3,000 vines/ha
Flat land easy to mechanized.
Trellising system: 4 wires (1 – 2 – 1)
Expected yield: average of 8.6 tons / ha

Global gathered costs of viticultural operations for this entity were:

Total cost per ha without harvest: 1,040€/ha
Total cost per ha with harvest: 1,269€/ha
Total cost per kg (8,600 kg/ha): 0.148€/kg or 3.25MDL/kg

Detailed costs of viticultural operations for each cost cluster in South of Moldova, are the followings:

Table 2 – Viticultural operations costs clusters in South of Moldova

22 = Exchange rate €/MDL		Efficiency ratio	South of Moldova: product cost €/ha	Operation conducted	Mechanised W h/ha	Mechanised W €/ha	Manual W h/ha	Manual W €/ha	Total €/ha
1 Fertilization (Soil and leaves)	***Fertilizare (Sol și frunze)***	Soil: 200kg/ha Leaves: 2 to 3,5l/ha	**108,33 €**						**108,33 €**
2 Pruning and tying	***Tăiatul și legatul viței***		**8,18 €**		**1,4**	**1,30 €**	**142,01**	**145,30 €**	**154,78 €**
Pre-pruning	*Tăiatul aței și a cîrceilor dintre sîrme*			1 Operation for everything	0,0	- €	2,28	2,31 €	2,31 €
Cutting	*Tăiatul viței*	25 to 30 vines /h			0,0	- €	98,01	104,25 €	104,25 €
Removing	*Adunarea viței tăiate*				0,5	0,46 €	0,00	- €	0,46 €
Tying	*Legatul viței*		8,18 €		0,0	- €	41,72	38,74 €	46,92 €
Shredding	*Marunțirea viței tăiate*				0,9	0,84 €	0,00	- €	0,84 €
3 Trellisis maintenance	***Reparația spalerului***		**8,18 €**		**0,0**	**- €**	**10,50**	**9,75 €**	**17,93 €**
4 Work on soil	***Prelucrarea pămîntului***				**9,5**	**9,11 €**	**15,98**	**16,58 €**	**25,69 €**
Plowing	*Aratul de toamnă*			1 time/year	0,7	0,67 €	0,00	- €	0,67 €
Disking	*Discuitul*			5 times/year	1,2	1,14 €	0,00	- €	1,14 €
Cultivation	*Cultivare*			5 times/year	7,6	7,30 €	15,98	16,58 €	23,88 €
5 Work on rows	***Erbicidare, prășit si cosit iarbă***		**17,25 €**		**0,8**	**0,86 €**	**32,78**	**35,06 €**	**53,17 €**
Deweeding	*Introducere erbicide*		17,25 €	5 times / year	0,8	0,86 €	9,99	11,97 €	30,09 €
Mowing between rows	*Cositul ierburilor*				0,0	- €	0,00	- €	- €
Cleaning under vine	*Prășitul*				0,0	- €	22,79	23,08 €	23,08 €
6 Green operations	***Lucrări în verde***				**2,8**	**2,07 €**	**190,70**	**141,41 €**	**143,49 €**
Trunk debudding	*Lăstăritul*	60 to 100 vines/h		3 to 4 times/yea	0,0	- €	68,08	48,63 €	48,63 €
Cane debudding	*Copilitul lăstarilor*				0,0	- €	21,88	17,05 €	17,05 €
Trellising	*Dirijatul lăstarilor între sîrme*			3 times/year	0,0	- €	50,66	39,47 €	39,47 €
Trimming	*Ciupitul lăstarilor*			Manual - 3 time	2,8	2,07 €	28,75	20,54 €	22,61 €
Tying	*Legatul parțial*	60 to 70 vines/h			0,0	- €	7,56	5,89 €	5,89 €
Deleafing	*Defoliere*	130 vines/h		1 time/year	0,0	- €	13,77	9,84 €	9,84 €
Green harvest	*Optimizarea roadei*				0,0	- €	0,00	- €	- €
7 Wood, leaves and grape pest treatments	***Stropitul***		**360,66 €**		**6,6**	**7,12 €**	**0,00**	**- €**	**367,78 €**
Mildew + Oidium	*Bacterioze, mană + Făinare*		261,54 €	7 treatments					
Cochilis + Cicadelle	*cicade,molia strugurilor*		37,92 €	3 treatments					
Antibotrytis	*mucegai cenusiu (soiuri sensibile)*		61,20 €	2 treatments					
8 Other costs	***Alte costuri***		**168,68 €**						**168,68 €**
Fuel	*Combustibil*		137,77 €						137,77 €
Maintenance of equipment	*Reparația tehnicii*		21,82 €						21,82 €
Equipment insurance	*Asigurarea tehnicii*								
Other	*Altele*		9,09 €						9,09 €
9 Harvest	*Recoltarea*				**24,3**	**89,91 €**	**79,3**	**139,45 €**	**229,37 €**
Harvest	*Recoltarea*				12,3	77,91 €	79,33	139,45 €	217,37 €
Transport	*Transportare*				12,0	12,00 €			12,00 €

Grand Total without harvest	***Total fara recoltare***		**671,29 €**		**45,3**	**20,47 €**	**471,30**	**348,10 €**	**1 039,86 €**
% of total cost/ha					*8,8%*	*5,6%*	*91,2%*	*94,4%*	
Grand Total with harvest	***Total cu recoltare***		**671,29 €**		**69,6**	**110,38 €**	**550,6**	**487,55 €**	**1 269,23 €**
% of total cost/ha					*11,2%*	*18,5%*	*88,8%*	*81,5%*	
Harvest estimates (kg/ha)	***Recolta estimata***								8 600
Cost per kg EURO	***Cost la kg EURO***								**0,148 €**
Cost per kg MDL	***Cost la kg MDL***								3,25

4.1.2 Entity 2 in Center of Moldova:

Number of vines per hectare: 3,000 vines/ha
Slopes and not easy to mechanized. Green operations are done manually.
Trellising system: 3 wires (1 – 1 – 1)
Expected yield: 9 tons / ha

Global gathered costs of viticultural operations for this entity were:

Total cost per ha without harvest: 1,317€/ha
Total cost per ha with harvest: 1,569€/ha
Total cost per kg (9,000 kg/ha): 0.174€/kg or 3.84MDL/kg

Detailed costs of viticultural operations for each cost cluster in the Center of Moldova are the followings:

Table 3 – Viticultural operations costs clusters in Center of Moldova

22 = Exchange rate €/MDL		Efficiency ratio	Center of Moldova: product cost €/ha	Operation conducted	Mechanised W h/ha	Mechanised W €/ha	Manual W h/ha	Manual W €/ha	Total €/ha
Fertilization (Soil and 1 leaves)	***Fertilizare (Sol și frunze)***	Soil: 200kg/ha Leaves: 2 to 3,5l/ha	**112,00 €**						**112,00 €**
2 Pruning and tying	***Tăiatul și legatul viței***		**9,23 €**		**0,9**	**0,84 €**	**138,8**	**140,99 €**	**151,06 €**
Pre-pruning	*Tăiatul aței și a cîrceilor dintre sîrme*			1 Operation for everything	0,0	- €	-	- €	- €
Cutting	*Tăiatul viței*	25 to 30 vines /h			0,0	- €	89,7	95,45 €	95,45 €
Removing	*Adunarea viței tăiate*				0,0	- €	-	- €	- €
Tying	*Legatul viței*		9,23 €		0,0	- €	49,0	45,53 €	54,76 €
Shredding	*Marunțirea viței tăiate*				0,9	0,84 €	-	- €	0,84 €
3 Trellisis maintenance	***Reparația spalerului***		**9,23 €**		**0**	**- €**	**10,5**	**9,75 €**	**18,98 €**
4 Work on soil	***Prelucrarea pământului***				**4,3**	**4,15 €**	**17,9**	**18,60 €**	**22,76 €**
Plowing	*Aratul de toamnă*			1 time/year	0,7	0,67 €	-	- €	0,67 €
Disking	*Discuitul*			3 times/year	0,7	0,67 €	-	- €	0,67 €
Cultivation	*Cultivare*			3 times/year	2,9	2,81 €	17,9	18,60 €	21,41 €
5 Work on rows	***Erbicidare, prășit si cosit iarbă***		**15,48 €**		**3,8**	**3,61 €**	**68,7**	**74,66 €**	**93,76 €**
Deweeding	*Introducere erbicide*		15,48 €	3 times/year	0,3	0,25 €	13,2	15,63 €	31,35 €
Mowing between rows	*Cositul ierburilor*			2 times / year	3,5	3,37 €	-	- €	3,37 €
Cleaning under vine	*Prășitul*				0	- €	55,5	59,03 €	59,03 €
6 Green operations	***Lucrări în verde***				**0,0**	**- €**	**289,0**	**249,26 €**	**249,26 €**
Trunk debudding	*Lăstăritul*	60 to 100 vines/h			0	- €	65,1	46,53 €	46,53 €
Cane debudding	*Copilitul lăstarilor*				0	- €	19,6	19,89 €	19,89 €
Trellising	*Dirijatul lăstarilor între sîrme*				0	- €	-	- €	- €
Trimming	*Ciupitul lăstarilor*			Manual - 2 time	0	- €	68,8	49,13 €	49,13 €
Tying	*Legatul parțial*	60 to 70 vines/h			0	- €	94,2	95,45 €	95,45 €
Deleafing	*Defoliere*	130 vines/h		2 times/year	0	- €	41,2	38,25 €	38,25 €
Green harvest	*Optimizarea roadei*				0	- €	-	- €	- €
7 Wood, leaves and grape pest treatments	***Stropitul***		**486,11 €**		**6,7**	**7,24 €**	**-**	**- €**	**493,35 €**
Mildew + Oidium	*Bacterioze, mană + Făinare*		313,84 €	7 treatments					
Cochilis + Cicadelle	*cicade,molia strugurilor*		43,50 €	2 treatments					
Antibotrytis	*mucegai cenusiu (soiuri sensibile)*		128,76 €	2 treatments					
8 Other costs	***Alte costuri***		**176,18 €**						**176,18 €**
Fuel	*Combustibil*		138,32 €						138,32 €
Maintenance of equipment	*Reparația tehnicii*		26,23 €						26,23 €
Equipment insurance	*Asigurarea tehnicii*								
Other	*Altele*		11,64 €						11,64 €
9 Harvest	*Recoltarea*				**30,3**	**53,41 €**	**115,2**	**198,86 €**	**252,27 €**
Harvest	*Recoltarea*				15,3	38,41 €	115,2	198,86 €	237,27 €
Transport	*Transportare*				15	15,00 €			15,00 €
Grand Total without harvest	***Total fara recoltare***		**808,23 €**		**45,9**	**15,85 €**	**640,1**	**493,25 €**	**1 317,33 €**
% of total cost/ha					6,7%	3,1%	93,3%	96,9%	
Grand Total with harvest	***Total cu recoltare***		**808,23 €**		**76,2**	**69,26 €**	**755,2**	**692,12 €**	**1 569,61 €**
% of total cost/ha					*9,2%*	*9,1%*	*90,8%*	*90,9%*	
Harvest estimates (kg/ha)	***Recolta estimata***								9 000
Cost per kg EURO	***Cost la kg EURO***								**0,174 €**
Cost per kg MDL	***Cost la kg MDL***								3,84

4.1.3 Entity 3 in South East of Moldova:

Number of vines per hectare: 3,000 vines/ha
Slopes and not easy to mechanized. Green operations are conducted manually.
Trellising system: 4 wires (1 – 2 – 1)
Expected yield: 8.5 tons / ha

Global gathered costs of viticultural operations for this entity were:

Total cost per ha without harvest: 1,293€/ha
Total cost per ha with harvest: 1,636€/ha
Total cost per kg (8,500 kg/ha): 0.192€/kg or 4.23MDL/kg

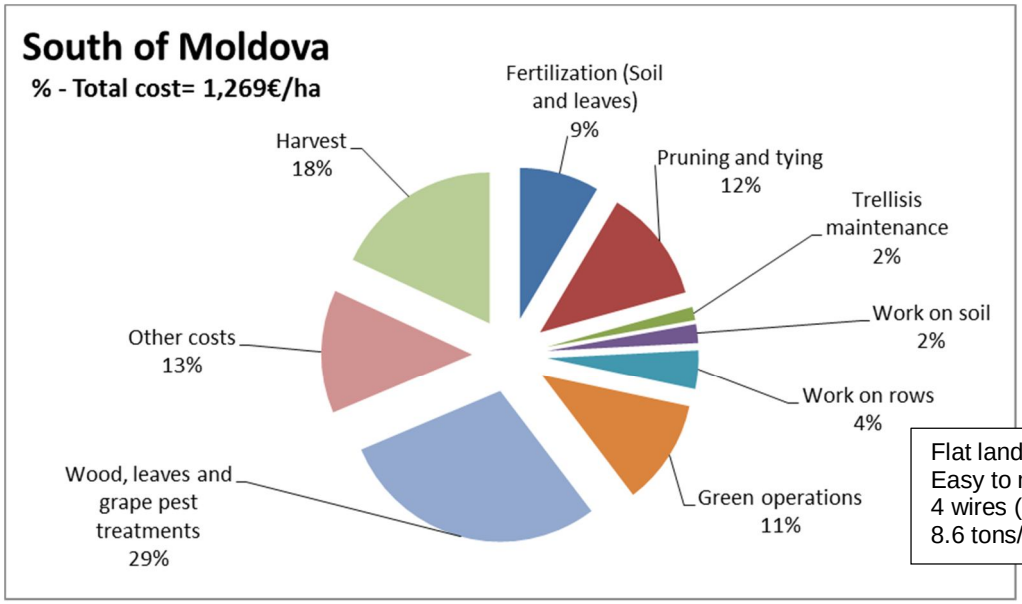
Detailed costs of viticultural operations for each cost cluster in the South East of Moldova are the followings:

Table 4 – Viticultural operations costs clusters in South East of Moldova

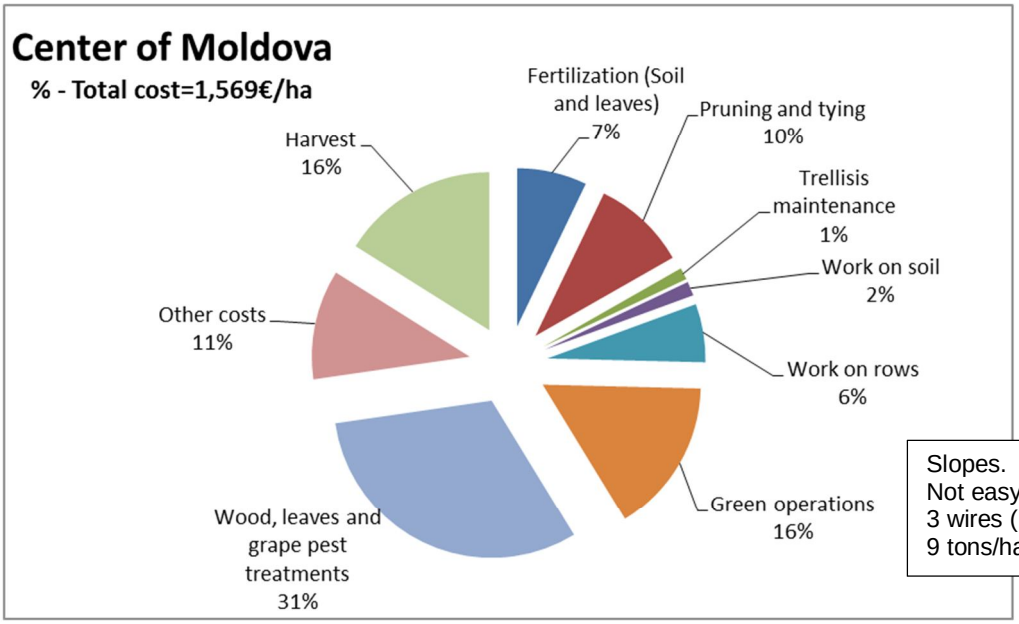
22 = Exchange rate €/MDL		Efficiency ratio	South East of Moldova: product cost €/ha	Operation conducted	Mechanised W h/ha	Mechanised W €/ha	Manual W h/ha	Manual W €/ha	Total €/ha
Fertilization (Soil and 1 leaves)	***Fertilizare (Sol și frunze)***	Soil: 200kg/ha Leaves: 2 to 3,5l/ha	**112,00 €**						**112,00 €**
2 Pruning and tying	***Tăiatul și legatul viței***				**1,4**	**1,30 €**	**148,2**	**151,75 €**	**161,23 €**
Pre-pruning	*Tăiatul aței și a cîrceilor dintre sîrme*				0,0	- €	1,9	1,95 €	1,95 €
Cutting	*Tăiatul viței*	25 to 30 vines /h			0	- €	103,4	110,01 €	110,01 €
Removing	*Adunarea viței tăiate*			1 Operation	0,5	0,46 €	0,0	- €	0,46 €
Tying	*Legatul viței*		8,18 €	for everything	0	- €	42,9	39,79 €	47,97 €
Shredding	*Mărunțirea viței tăiate*				0,9	0,84 €	0,0	- €	0,84 €
3 Trellisis maintenance	***Reparația șpalerului***		**7,64 €**		**0**	**- €**	**10,5**	**9,75 €**	**17,39 €**
4 Work on soil	***Prelucrarea pămîntului***				**6,4**	**6,13 €**	**30,7**	**31,89 €**	**38,02 €**
Plowing	*Aratul de toamnă*			2 times/year	1,4	1,35 €	0,0	- €	1,35 €
Disking	*Discuitul*			6 times/year	1,2	1,14 €	0,0	- €	1,14 €
Cultivation	*Cultivare*			5 times/year	3,8	3,65 €	30,7	31,89 €	35,54 €
5 Work on rows	***Erbicidare, prășit si cosit iarbă***		**17,25 €**		**8,5**	**8,37 €**	**38,7**	**41,65 €**	**67,27 €**
Deweeding	*Introducere erbicide*		17,25 €	4 times/year	2,1	2,25 €	8,6	9,81 €	29,31 €
Mowing between rows	*Cositul ierburilor*			3 times/year	4,2	4,04 €	1,3	1,21 €	5,25 €
Cleaning under vine	*Prășitul*				2,2	2,07 €	28,8	30,63 €	32,71 €
6 Green operations	***Lucrări în verde***				**2,8**	**2,07 €**	**300,5**	**255,38 €**	**257,45 €**
Trunk debudding	*Lăstăritul*	60 to 100 vines/h			0	- €	72,1	51,52 €	51,52 €
Cane debudding	*Copilitul lăstarilor*				0	- €	43,5	44,04 €	44,04 €
Trellising	*Dirijatul lăstarilor între sîrme*			2 times/year	0	- €	21,6	16,83 €	16,83 €
Trimming	*Ciupitul lăstarilor*				2,8	2,07 €	60,9	43,52 €	45,59 €
Tying	*Legatul parțial*	60 to 70 vines/h			0	- €	51,8	52,52 €	52,52 €
Deleafing	*Defoliere*	130 vines/h		2 times/year	0	- €	45,6	42,35 €	42,35 €
Green harvest	*Optimizarea roadei*				0	- €	5,0	4,61 €	4,61 €
7 Wood, leaves and grape pest treatments	***Stropitul***		**464,10 €**		**6,6**	**7,09 €**	**0,0**	**- €**	**471,19 €**
Mildew + Oidium	*Bacterioze, mană + Făinare*		313,84 €	7 treatments					
Cochilis + Cicadelle	*cicade,molia strugurilor*		43,50 €	2 treatments					
Antibotrytis	*mucegai cenusiu (soiuri sensibile)*		106,75 €	2 treatments					
8 Other costs	***Alte costuri***		**168,82 €**						**168,82 €**
Fuel	*Combustibil*		131,95 €						131,95 €
Maintenance of equipment	*Reparația tehnicii*		24,64 €						24,64 €
Equipment insurance	*Asigurarea tehnicii*								
Other	*Altele*		12,23 €						12,23 €
9 Harvest	*Recoltarea*				**50,12**	**67,77 €**	**179,5**	**275,00 €**	**342,77 €**
Harvest	*Recoltarea*				25,12	42,77 €	179,5	275,00 €	317,77 €
Transport	*Transportare*				25	25,00 €			25,00 €
Grand Total without harvest *% of total cost/ha*	***Total fara recoltare***		**769,80 €**		**75,7** 9,7%	**24,97 €** 4,8%	**708,1** 90,3%	**490,42 €** 95,2%	**1 293,37 €**
Grand Total with harvest *% of total cost/ha*	***Total cu recoltare***		**769,80 €**		**125,8** *12,4%*	**92,74 €** *10,8%*	**887,6** *87,6%*	**765,42 €** *89,2%*	**1 636,14 €**
Harvest estimates (kg/ha)	***Recolta estimata***								8 500
Cost per kg EURO	***Cost la kg EURO***								**0,192 €**
Cost per kg MDL	***Cost la kg MDL***								4,23

4.1.4 Summary of Grape growing costs in Moldova

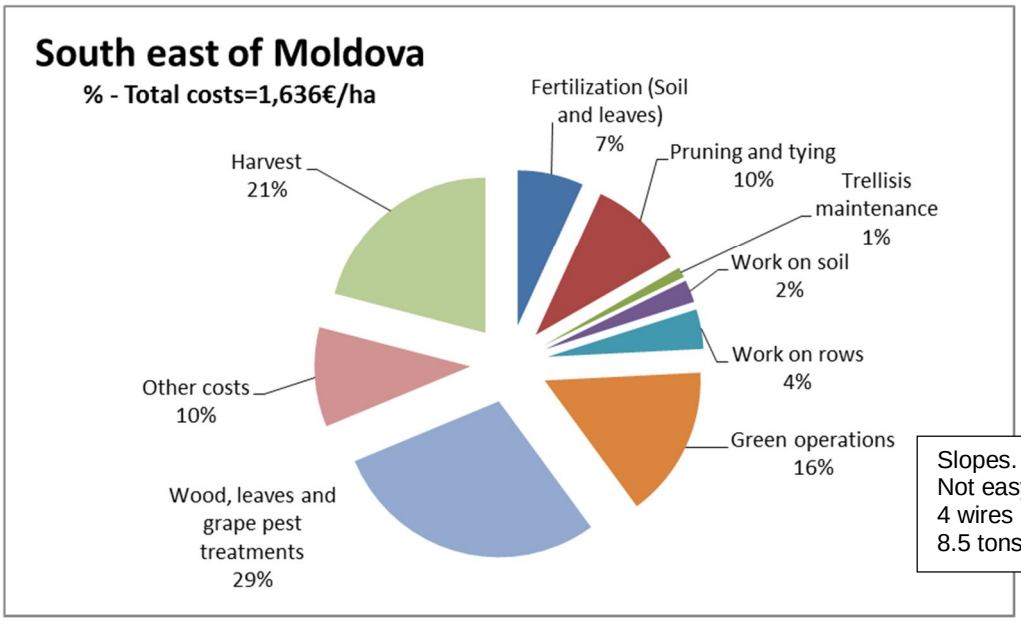
Table 5 – Summary of viticultural operations costs clusters in Moldova (% - €/ha)



Flat land.
Easy to mechanized.
4 wires (1-2-1)
8.6 tons/ha



Slopes.
Not easy to mechanized.
3 wires (1-1-1)
9 tons/ha



Slopes.
Not easy to mechanized.
4 wires (1-2-1)
8.5 tons/ha

4.2 Efficiency and productivity parameters for grape growing in other countries

During this exercise, for comparison with Moldova, we have been able to compile the viticulture costs of production from the following wine regions / countries:

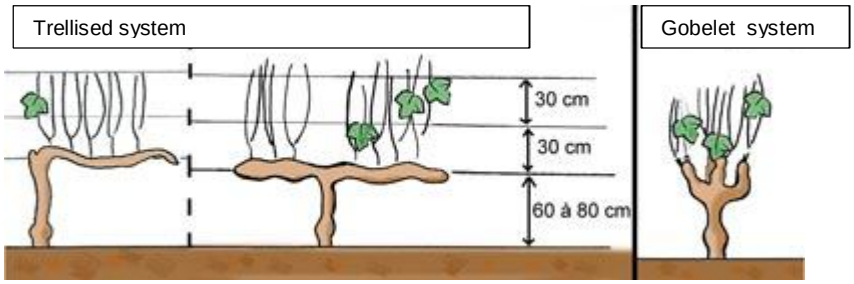
4.2.1 Countries and regions analysed

(i) Spain

- **Castilla de la Mancha (Cf Annex 3)**

  Castilla de la Mancha is the largest wine grape region in Spain with 460,000ha of vineyards in production (representing 48% of total Spanish vineyard).
  Total production of wine is 25,815,862 hl (2014) plus 7,434,163 hl of must and other grape products.
  Vineyard is usually 2.5m*2.5m in gobelet (1,600 vines per ha, 70% of total vineyard) or 3.0m*1.5m when trellised (2,222 vines/ha, 30% of total vineyard).

Table 6 – Main form of trellising system in Castilla de la Mancha



Production is

- 44% wines without any indication – Average yield 80hl/ha (11.5 tons/ha)
- 18% wine with varietals – Average yield 100hl/ha (13.5t tons/ha)
- 8% Wine without IGP – Average yield 60hl/ha (8.5 ton/ha)
- 10% wine with AOP – Average yield 53hl/ha (7.5 ton/ha)
- Rest is must and other products

The main varieties (red) are: Airen (48%), Tempranillo (16%), Bobal (8.5%), Garnacha (4.5%), Monastrell (4%), Garnacha Tintorera (3%), Macabeo (3%), Syrah (3%), Cabernet sauvignon (1.7%), Verdejo (1.3%)
35% of the vineyard in this region is with irrigation ("Riogo") and yield is 15tons/ha on average, 65% without ("Secano") with a yield of 7tons/ha.

In this Benchmark exercise, we have compiled data on the trellised system (2,222 vines/ha), irrigated (15 tons per ha) and not irrigated (7 tons per ha).

- **Rioja (Cf Annex 4)**
  Rioja is the 4th largest wine producing region in Spain with 57,761ha in production (representing 7% of total Spanish vineyard).
  Total production of wine is 2,951,646 hl (2014).
  Irrigation is authorized in Rioja region but is still in minority.
  According to local regulation, the minimum density of plantation is 2,850 vines per ha but the usual density is 4,000 vines per ha.

Maximum authorised yield is 6.5 tons per ha for red grapes (which represent 90% of the total production) and 9 tons/ha for white grapes.
The main varieties (red) are: Tempranillo, Garnacha, Graciano, Mazuelo and Maturana Tinta.

In this Benchmark exercise, we have compiled data on a not irrigated vineyard, 4,000 vines/ha, producing 6.5 tons/ha.

(ii) France

- **Bordeaux – AOP Bordeaux (Cf Annex 5)**

  Bordeaux is the largest French region producing AOP wines (113,000ha with a total production of around 6 million hl). 85% is red wine.
  Irrigation is not authorized.
  Inside the region of Bordeaux, 60 appellations (AOP) have set their own rules for grape and wine production.

  In this benchmark exercise, it is the generic "AOP Bordeaux" (100% red) that has been analysed.
  Vineyard is trellised at 3.0m*1.0m, with 3,333 vines per hectare.
  Maximum yield is 55hl/ha (around 8 tons per ha).
  The main varieties (red) are: Cabernet Sauvignon, Merlot, Cabernet franc, Petit Verdot.

- **Val de Loire - AOP Muscadet (Cf Annex 6)**

  Val de Loire is the third largest wine region in France with 41,000ha in production (2 million hl produced per year, 36% white, 29% rosé, 20% red and 15% sparkling).
  Irrigation is not authorized.
  Inside the region of Val de Loire, 50 appellations (AOP) have set their own rules for grape and wine production.

  In this benchmark exercise, it is the generic "AOP Muscadet" (100% white) that has been analysed.
  Vineyard is trellised at maximum 1.5m * 0.90m to 1.10m, with 6,500 vines per hectare.
  Maximum yield is 65hl/ha (around 10 tons per ha).
  The only grape variety for AOP Muscadet (white) is Melon de Bourgogne.

- **Languedoc Roussillon – IGP Vin de la Méditérranée (Cf Annex 7)**

  Languedoc Roussillon is the largest wine region in France with 246,000ha in production. It produces 12 million hl per year (1/3 of the total French wine production), including 36% of AOP, 50% of IGP and 14% table wine.
  Languedoc is composed of 23 AOP regions and 22 IGP regions.

  In this benchmark exercise, it is the "IGP Méditerranée" (100% red) that has been analysed.
  Density of plantation is 4,000 vines per hectare.
  Expected yield is 80hl/ha (around 10.8 tons per ha).
  The main red varieties are: Grenache, Carignan, Syrah, Mourvèdre, Cinsault.

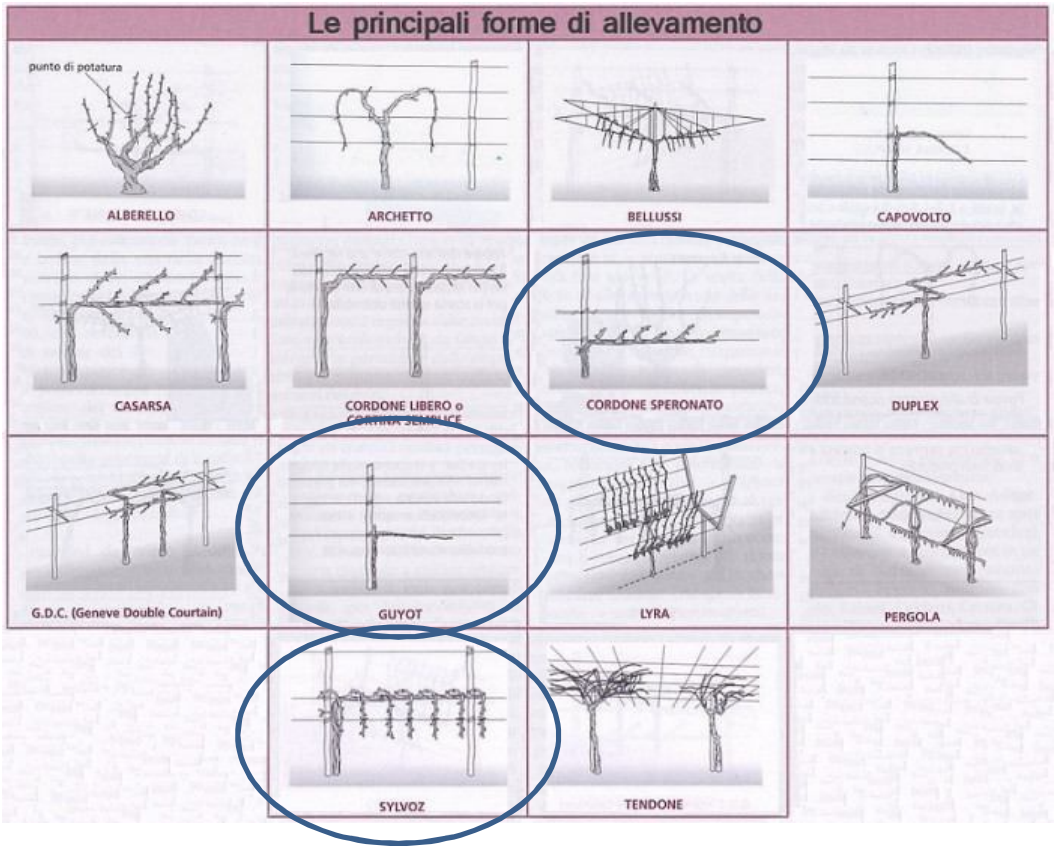
(iii) Italy – Veneto Region (Cf Annex 8)

Italy is implementing various system of vineyard management that do not have the same costs impacts.

Among these different forms of vineyard management, we have collected the data from North East of Italy (IGT Veneto), a region with similar land scape than Moldova, and using **Guyot intensivo at 2.5m X 0.8m (5,000 vines/ha)**, **Cordon Speronato at 2.5m X 0.8m (5,000 vines/ha)**, **Guyot medio at 2.8m X 1.0m (3,570 vines/ha)** and **Sylvoz at 2.5m X 1.2m (2,976 vines/ha).**

Grapes used for IGT Veneto are mostly Merlot, Cabernet and Chardonnay.

Table 7 – Main form of trellising system for IGT Veneto (Italy)



For the purpose of comparing with Moldovan vineyards, we have computered the available data on Guyot medio and Sylvoz trellising systems.

Guyot medio at 2.5m X 1.0m:
Number of vines per hectare : 3,570 vines/ha
Trellising system: 7 wires (1 – 2 – 2 - 2)
Expected yield: 9 tons/ha

Sylvoz medio at 2.5m X 1.2m:
Number of vines per hectare : 2,976 vines/ha
Trellising system: 4 wires (1 – 1 – 2)
Expected yield : 12 tons/ha

(iv) Chile (Cf Annex 9)

Total are under vineyard in Chile is 211,000ha with a total production of wine estimated at around 10.5 million hl (OIV - Year 2014).

Chilean vineyards are very fragmented as more than 70% are less than 5ha. The vast majority (over 78%) are irrigated and yields generally range between 9 and 15 tons per hectare depending on the region and the trellising system. Red varieties account for ¾ of the planted area with Cabernet Sauvignon by far the most popular variety. White varieties are dominated by Sauvignon Blanc and Chardonnay.
Yield could vary from 9 tons /ha up to as high as 15 tons/ha.
For this Benchmark exercise, we have taken figures for a production of 12 tons/ha
For this exercise, the costs in Chilean pesos have been converted in EURO using the average exchange rate of 1€ = $747 pesos.

4.3 Efficiency and productivity parameters for grape growing between Moldova and other countries

4.3.1 (1) Fertilization

- Moldova

In Moldova, fertilization is usually not done. Most of the companies seem to consider Moldovan vineyards soil rich enough (chernozem dominant) and do not necessitate any addition of organic or mineral matters.

Recently however, some companies have started making some soil analysis and some mineral deficiencies have been identified. Therefore, addition of N, P, K is just initiated.
It is usually added mechanically in soil (used under granulated form N:9% - P²O:25% - K2o:25%).

When fertilization operations are conducted in Moldova, estimated cost of products used per ha, depending on the quantity added (usually 200kg/ha), is around 110€/ha. The price paid per ton is around 450€/ton, and seems to be higher than price paid in foreign countries analysed for similar products available.

- Comparison between Moldova and Benchmark data

Table 8 – Benchmark data on (1)Fertilization

	Moldova			Spain			France			Italy - Veneto		Chile
	South Moldova	Center Moldova	South East Moldova	Castilla de la Mancha Not irrigated	Castilla de la Mancha Irrigated	Rioja	AOP Bordeaux	Val de loire AOP Muscadet	Languedoc Rousillon IGP Méditérranée	Guyot	Sylvoz	
(1) **Fertilization**												
(cost of products €/ha)	108€	112€	112€	95€	180€	142€	165€	90€	208€	108.2€		60€
	Granulated N, P, K: 450€/ton			300€/ton for NPK 20€/ton for humus		22€/ton for humus	Granulated NPK : 200 to 300€/ton			Na	Na	na
Dose	200kg/ha for NPK			150kg/ha for NPK + 2.3tons/ha for humus	250kg/ha for NPK + 5 tons/ha for humus	200kg/ha for NPK + 6.5 tons/ha for humus	From 200 kg/ha to 400kg/ha of NPK depending on product and soil deficiency. Humus is added every 3 years if necessary.					
Man power (h/ha)	1h	1h	1h	0.5	0.5	0.8	1	1	1	1		0.8

For further assistance and information to grape growers, prices for simple and mixed fertilizers (granulated or liquid form) available in France could be found in Annex 1.

4.3.2 (2) Pruning and tying

In Moldova, the operations of pre-pruning and cutting, removing the cut shoots from the wires and throwing them in the middle of the row, are purely manual. No mechanisation is involved due to several factors:

(i) Equipment for pre-pruning is complicated to operate due to the ciment poles usually in place for the trellising system.

(ii) Experiments with using pneumatic or electric secators did not seem to have brought any significant productivity improvements and did not appear as bringing cost savings.

- ***Pre-pruning operation benchmark***

International benchmarking is showing that pre-pruning operations are systematically conducted, and are always done mechanically.
The equipment used could vary from one winery to another but usually it is placed in tractor's front, on a mast, working on single row, with 8 pairs of discs.

The following costs generated by this operation are:

- Average cost of a pre-pruning equipment (type of equipment: 1 row, 8 pairs of discs, including the mast): average price 12,000€ht
- Average efficiency: 1.5 hour to pre-prune 1 hectare with 3,333 vines /ha

- ***Cutting operation benchmark***

On average, vine cutting in Moldova is conducted with simple manual secators.
The efficiency is then around 25 to 30 vines per hour, 110 to 120 hours per ha of 3,000 vines density per ha.
International benchmarking data are showing that most of cutting operations are conducted with pneumatic or electric secators. The efficiency is then around 95 vines per hour, 35 to 40 hours per ha of 3,300 vines density per ha.

Table 9 – Benchmark data on (2)Pruning and Tying

(2) Pruning and tying	Moldova			Spain			France			Italy – Veneto		Chile
	South Moldova	Center Moldova	South East Moldova	Castilla de la Mancha Not irrigated	Castilla de la Mancha Irrgated	Rioja	Bordeaux AOP Bordeaux	Val de Loire AOP Muscadet	Languedoc Roussillon IGP Méditérranée	Guyot	Sylvoz	
Cutting												
Density	3,000 vines/ha			2,222 vines/ha		4,000	3,333	6,500	4,000	3,570	2,976	na
Cost (€/ha)	104€	95€	110€	168€	224€	240€	560€	1134€	630€	1000 €	900 €	500€
	100% manual			100% done with electric or pneumatic secator								
Efficiency (vine/hour)	Average 25 to 30 vines per hour			Average of 95 vines per hour								n/a
(hours/ha)	98h/ha	95h/ha	103h/ha	25h/ha	32h/ha	32h/ha	35h/ha	110h/ha	43.5h/ha	Na	Na	Na

For information to grape growers, the following cost of equipment could be used to evaluate the opportunity for Moldova to move into modernization of this operation:

- Average cost of electric secator: 1,300€ht (battery included)
  (blades need yearly maintenance and secators should be replaced every 3 to 5 years, depending on proper maintenance)

- ***Tying operation benchmark***

In Moldova, tying is done manually, using a ligature rope with a not that hold the cane to the lowest wire.
International benchmarking data are showing that this operation is done with workers using vine pliers distributing metal, galvanized or aluminium staples.

Table 10 – Benchmark data on (2)Pruning and Tying

(2) Pruning and tying	Moldova			Spain			France			Italy - Veneto		Chile
	South Moldova	Center Moldova	South East Moldova	Castilla de la Mancha Not irrigated	Castilla de la Mancha Irrigated	Rioja	Bordeaux	Val de loire	Languedoc Roussillon	Guyot	Sylvoz	
Tying												
Density	3,000 vines/ha			2,222 vines/ha		4,000	3,333	6,500	4,000	3,570	2,970	na
Cost (€/ha)	47€	55€	48€	Na	Na	Na	158€	175€	192€	150€	100€	80€
	100% manual			100% done with vine pliers and staples								
Efficiency (vine/hour)	Average 70 vines per hour			Average of 450 vines per hour								na
Hours/ha	50 hours/ha			Average of 8h/ha								Na

It clearly appears the Moldova has a very low efficiency in this operation: 50 hours to perform tying of 1ha (3,000 vines/ha), compared with 8 hours for the same operation in the countries analysed (with even higher vine density per ha).

The explanation could be found in the equipment used in most foreign countries: workers performing the tying are equipped with vine payers and cane and shoots are tied with galvanised or aluminium staples (metal are even sometime used).

For assisting Moldovan producers willing to explore moving into modernization of this operation, the following cost of equipment could be used :

- Average cost of a manual vine plier : 50€ht (Type: Rapid LIG175)
- Average cost of galvanised or aluminium staples : 50€ht (box of 5,000 pieces, type C75 or C85)
- 1 to 3 staples are used per vine. Cost is then around 60€ht/ha of 3,000 vines

- ***Shredding operation benchmark***

In Moldova, shredding is done mechanically at a ratio of 0.9 hours per ha for a vineyard with a density of 3,000 vines/ha, which is very similar to international data showing an average of 1h per ha for shredding vines (80ch tractor).

Table 11 – Benchmark data on (2)Pruning and Tying

(2) Pruning and tying	Moldova			Spain			France			Italy - Veneto		Chile
	South Moldova	Center Moldova	South East Moldova	Castilla de la Mancha Not irrigated	Castilla de la Mancha Irrigated	Rioja	Bordeaux AOP Bordeaux	Val de loire AOP Muscadet	Languedoc Rousillon IGP Méditerranée	Guyot	Sylvoz	
Shredding												
Cost (€/ha)	1€	1€	1€	15€	60€	75€	18€	24€	22€	62€		10€
	100% mechanized			100% done mechanized								
Efficiency (hour/ha)	Average 0.9 hour per ha			0.5h	2h	2.5h	1h	1.5h	1h	Average of 1 to 2h hours per ha		na

4.3.3 (3) Trellising maintenance

In Moldova, polls sustaining the wires are in cement and maintenance of trellising is mostly composed of changing or repairing some wires.

In other countries, the operations conducted are more complex as they also involve changing wooden poles, re-fixing wires, replacing protection for younger vines, etc ….
If time spent on maintenance is quite similar between Moldova and foreign countries analysed, cost of products in foreign countries is higher as well as cost of man power.

Table 12 – Benchmark data on (3)Trellising maintenance

(3) Trellising maintenance	Moldova			Spain			France			Italy - Veneto		Chile
	South Moldova	Center Moldova	South East Moldova	Castilla de la Mancha Not irrigated	Castilla de la Mancha Irrigated	Rioja	Bordeaux AOP Bortdeaux	Val de loire AOP Muscadet	Languedoc Rousillon IGP Méditérranée	Guyot	Sylvoz	
Cost of trellising products (€/ha)	8€	9€	7.5€	92€	207€	150€	80€	121€	8€	9€		29.5€
Efficiency (hour/ha)	10.5h	10.5h	10.5h	10h	10h	8h	10h	12h	10h	12 h		10h
Total cost (€/ha)	18€	19€	17€	162€	277€	195€	164€	191€	136€	85€		98€

4.3.4 (4) Work on soil

In Moldova, tradition coming from Soviet time is resulting in heavy work conducted on soil between rows: ploughing (1 per year), discking (4 to 5 times per year) and cultivation (5 times per year) is usually done in order to prevent any grass from growing on soil.
In addition, in Central and South East of Moldova, manual work is also conducted due to slopes and difficulties for the existing mechanized equipment to clean properly under the vines.

These cultivation methods are not in line with the current trend seen in foreign countries where grass is very often kept between rows and cultivation is concentrating just under the vines:

Moldovan vineyard

Foreign vineyard

For the purpose of the Benchmark analysis, it could, however, be useful to compare globally the total amount and time spent per hectare for the cost cluster "Work on soil".

Table 13 – Benchmark data on (4)Work on soil

(4) Work on soil	Moldova			Spain			France			Italy	Chile
	South Moldova	Center Moldova	South East Moldova	Castilla de la Mancha Not irrigated	Castilla de la Mancha Irrigated	Rioja	Bordeaux AOP Bordeaux	Val de loire AOP Muscadet	Languedoc Roussillon IGP Méditerranée		
Costs (€/ha)	26€	23€	38€	180€*	225€*	144€*	27€*	12€	12€	Na	53€
Ploughing	100% mechanized									Na	
Frequency	1 time per year										
Efficiency (hour/ha)	Average 0.7 hour per ha										
Discking	100% mechanized										
Frequency	5 per year	3 per year	6 per year								
Efficiency (hour/ha)	1.2h/ha	0.7h/ha	1.2h/ha								
Cultivation	Mechanized and manual			100% mechanized							100% mechanized
Frequency	5 per year	3 per year	5 per year	3 to 4 times per year	3 to 4 times per year	3 times per year	2 times per year. Every two rows	1 time per year. Every two rows	1 time per year. Every two rows		1 time per year.
Efficiency (hour/ha)	7.6h/ha machine	2.9h/ha machine	3.8h/ha machine	6h/ha	7.5h/ha	4.8h/ha	1.5h/ha	1.5h/ha	1.5h/ha		na
	16h/ha manual	18h/ha manual	31h/ha manual								
Total time spent (hour/ha)	25h	22h	37h	6h	7.5h	4.8h	1.5h	1.5h	1.5h		

(*) man power + amortisation of equipment

As expected from previous observations, it appears that Moldova is spending much more time on working on soil that in the foreign countries analysed. In addition to working on every row, time spent in Moldova is higher also due to the fact that most tractors have only one hydraulic pump, allowing performing only one activity at a time.
In foreign countries analysed, modern tractors have minimum 2 hydraulic pumps and can then operate 2 to 3 different equipment at the same time.
For quality improvement of vine growing, for better adaptation to the global warming climat, and also due to the trend toward using less herbicides and chemicals on soil, we envision that Moldova, in a near future, will have to intensify modernization of soil cultivation methods and adapt to a more environment concern approach by leaving more grass between rows. Cost might increase, although moderately as it involves more mechanical than manual work.

Current usual situation in Moldova

New approach seen and slowly developing

4.3.5 (5) Work between the vine rows

For this cost cluster "*Work between the vine rows*", comparison between Moldova and other countries is not easy: South of Moldova is mostly preventing any grass to grow between the rows, Central and South East of Moldova are starting letting grass grow, keeping it under control.
In addition, cost of herbicides are higher in the foreign countries analysed due to a tougher environmental legislation obliging the use of less effectives but more expensive weed killing molecules.

Due to the use of more modern equipment in the foreign countries analysed, it is very common that more than one operation is conducted at the same time: for instance "*mowing*" is usually combined with "*trimming*", "*cleaning under the vine*" is *combined with "working on soil*"….

Table 14 – Benchmark data on (5)Work between the rows

(5) Work between the vine rows	Moldova			Spain			France			Italy - Veneto		Chile
	South Moldova	Center Moldova	South East Moldova	Castilla de la Mancha		Rioja	Bordeaux AOP Bordeaux	Val de loire AOP Muscadet	Languedoc Roussillon IGP Méditerranée	Guyot	Sylvoz	
				Not irrigated	Irrigated							
Cost of herbicides (€/ha)	17.25€	15.48€	17.25€	Na	Na	Na	78€	153€	80€	90€		52€
Deweeding	Mechanized and manual			Na			100% mechanized			Na		
Frequency of deweeding	5 times per year	3 times per year	4 times per year				2 to 3 treatments	2 treatments	2 treatments			
Efficiency (hour/ha)	0.8h/ha machine	0.3h/ha machine	2h/ha machine				2h/ha	2h/ha	2h/ha			
	10h/ha manual	13h/ha manual	9h/ha manual									
Mowing	100% Mechanized						100% mechanized					
Frequency	0	2 times per year	3 times per year				4 times / year combined with trimming	2 times per year	2 times per year			
Efficiency (hour/ha)	0	3.5h/ha	4.2h/ha					1h/ha	1h/ha			
Cleaning under vine	manual	manual	2.2/ha machine				100% mechanized. Combined with other activities					
	23h/ha	56h/ha	28h/ha manual									
Efficiency (€/ha)	53€	94€	67€	60€	60€	78€	154€	201€	148€	226€	226€	100€
Efficiency (hour/ha)	77h	103h	87h	2h	2h	7.8h	11h	8h	6h	6h	6h	Na

4.3.6 (6) Green operations

In Moldova, most green operations are conducted manually.

In the foreign countries analysed, to the exception of “cane de-budding” and “green harvesting”, the green operations are mostly conducted mechanically.
Even “trunk de-budding”, as well as “de-leafing”, are conducted with adequate chemicals or equipment, minimising the use of man power.
It is also quite usual in foreign countries to have these operations being contracted to outside companies that will invoice services based on the number of hectare (cost would vary from 81€/ha for mechanized de-leafing to 204€/ha for mechanized chemical de-budding)

It appears then, due to the low cost of labour and even if almost all operations are manual and not mechanized, average cost of green operations in Moldova is cheaper than in other countries.

Table 15 – Benchmark data on (6)Green operations

(6) Green operations	Moldova			Spain			France			Italy - Veneto		Chile
	South Moldova	Center Moldova	South East Moldova	Castilla de la Mancha Not irrigated	Castilla de la Mancha Irrigated	Rioja	Bordeaux AOP Bordeaux	Val de loire AOP Muscadet	Languedoc Roussillon IGP Méditerranée	Guyot	Sylvoz	
Total cost (€/ha)	143€	250€	257€	295€	225€	386€	529€	720€	595€	484€	334€	440€
Efficiency (hours/ha)	457h	776h	783h	Na	Na	161h	179h	264h	99h	83h	72.5h	na
De-budding	**100% Manual**					**Manual and mechanized**						
Frequency	3 to 4 times per year					2 times per year		1 times per year	2 times per year		1 time per year	
Norms (Vine/ha)	67 to 98 vines /h					175 vines/h when manual						
Manual (h/ha)	68h	85h	115h			17h	21h	80h	21h	20h	15h	na
Mechanized (h/ha)	0					5h	6h	0	6h	Na	na	
Trellising	**Manual**		**Manual**			**Manual**						
Frequency	3 times per year		3 times per year			2 times per year						
Hours/ha	51h		21h			30h	25h	24h	24h	10h	10h	na
Trimming and Tying	**Manual**					**Mechanized trimming Manual tying**						
Frequency	3 times per year	3 times per year	3 times per year			4 to 5 times per year		3 times per year				
Hours/ha	29h	160h	110h			1.6h + 5h**	3h + 6h**	4h + 8h**	3h + 5h**	1.5h + 6h**		na
De-leafing	**Manual**						**Mechanized or manual**					
Frequency	1 time per year	2 times per year	3 times per year				2 times per year	1 per year				
Hours/ha	13h	41h	45h				2h or 15h***	3h or 20h***				
Green harvest	**No**	**No**	**5h/ha manual**	**4h/ha Manual**	**1h/ha manual**	**No**	**4h/ha manual**	**No**	**No**	**Na**	**Na**	**No**

(*) Trunk debudding
(**) Mechanized + Manual
(***) Mechanized or manual

Looking specifically at numbers of hours spent per hectare, it clearly appears that the efficiency of the labour to conduct the green operations, is much lower in Moldova than in other country: it takes between 68 hours to 115 hours per ha to do the trunk and cane de-budding, compared with around 20 hours in other countries (for a similar 3,000 vines per ha).

Trimming is also a time consuming operation in Moldova (29 to 160 hours per ha) due to the fact that it is conducted manually. In other countries this operation is conducted mechanically. Same observations can be made for the de-leafing operation, conducted manually in Moldova compared with often mechanized (heating or vacuum de-leafing) in foreign countries analysed.

4.3.7 (7) Wood, leaves and pest treatments

It mostly includes fungicides and insecticides treatments to fight against Mildew, Oîdium, Flavescienca, Eudemis, Scaphoideus, etc…

Number of treatments for the major fungicides and insecticides are very similar in Moldova and in the different countries analysed.

Costs of products paid in Moldova do not differ significantly from the prices paid in the other countries analysed. It is even usual to experience lower costs in Moldova for similar products.

Total costs (Product + man power) slightly differ between Moldova and other foreign countries as man power is more expensive in foreign countries. But, as the treatments are conducted mechanically the influence of man power does not have a significant impact, resultant in similar costs for the cluster in Moldova and in other countries.

Table 16 – Benchmark data on (7) Wood, Leaves and Pest treatments

(2) Wood, leaves and Pest Treatments	Moldova			Spain			France			Italy - Veneto		Chile
	South Moldova	Center Moldova	South East Moldova	Castilla de la Mancha Not irrigated	Castilla de la Mancha Irrigated	Rioja	Bordeaux AOP Bordeaux	Val de loire AOP Muscadet	Languedoc Roussillon IGP Méditerranée	Guyot	Sylvoz	
Mildew + Oïdium												
Number of treatments per year	7	7	7	4	4	4	7 to 9	7	5	8	8	4
Cost of product (€/ha)	261€	314€	314€			234€	230€	335€	200€	252€	252€	
Cochilis + Cicadelle + Insects												
Number of treatments	3	2	2	3	2	4	3	2	2	3	3	2
Cost of product (€/ha)	38€	43.5€	25€			32.50€	26€	78€	30€	28€	28€	
Antibotrytis												
Number of treatments per year	2	2	2	1	1	2	1	1	1	1	1	1
Cost of product (€/ha)	61€	129€	12€			22€	104€	137 €	125€	120€	120€	
TOTAL COST Products (€/ha)	**361€**	**486€**	**464€**	**15€**	**60€**	**280€**	**360€**	**550 €**	**355€**	**400€**	**400€**	**182€**
TOTAL COST (Product + man power) €/ha	**368€**	**493€**	**471€**	**425€**	**590€**	**625€**	**536€**	**642 €**	**447€**	**788€**	**788€**	**480€**

For further assistance to Moldovan grape growers, Annex 2 is giving the list of pesticides and herbicides available in France and there selling prices (Year 2015).

4.3.8 (8) Harvest

Harvesting could be conducted manually or mechanically.

In Moldova, it is still very unusual to have mechanical harvesting, even if some wineries are starting to.
Therefore, this analysis has mostly concentrated on manual harvesting to make it useful to most Moldovan grape growers.

For manual harvesting, two main sources of expenses are generated: time and cost of labour for harvesting and time and cost of transport of grapes from vineyards to winery.

Figures collected for this benchmark exercise could vary significantly from one region to another due to cost of man power, but also density of vines per hectare, quantity harvested per hectare, distance of vineyards from the winery, etc…

Table 17 – Benchmark data on (8) Harvest

(3) Harvest	Moldova			Spain			France			Italy - Veneto		Chile
	South Moldova	Center Moldova	South East Moldova	Castilla de la Mancha Not irrigated	Castilla de la Mancha Irrigated	Rioja	Bordeaux AOP Bordeaux	Val de loire AOP Muscadet	Languedoc Roussillon IGP Méditerranée	Guyot	Sylvoz	
Kg harvested /Ha	8,600 kg	9,000 kg	8,500 kg	7,000 kg	15,000 kg	6,500 kg	8,000 kg	10,000 kg	10,800 kg	9,000 kg	12,000 kg	12,000 kg
Nb vines/ha	3,000 vines/ha			2,222 vines/ha	2,222 vines/ha	4,000 vines/ha	3,333 vines/ha	6,500 vines/ha	4,000 vines/ha	3,570 vines/ha	2,976 vines/ha	na
Cost (€/ha)	**229€**	**252€**	**342€**	**333€**	**598€**	**400€**	**1,312€**	**1,384€**	**896€**	**1,562€**	**2,093€**	**850€**
Transport	*12€*	*15€*	*25€*	*45€*	*150€*	*60€*	*318€*	*64€*	*540€*			*520 €*
Manual	*217€*	*237€*	*317€*	*288€*	*448€*	*340 €*	*923€*	*1,320 €*	*356€*	*1,562€*	*2,093€*	*330 €*
Efficiency of manual harvesting												
Harvest (h/ha)	80h	115h	179.5h	36h	56h	62h	70h	80h	65h	90h	95h	
Transport of grapes (h/ha)	12h	15h	25h	4.5h	15h	3h	1.5h			2h	3h	
Cost € per kg	**0.026€**	**0.028€**	**0.040€**	**0.047€**	**0.039€**	**0.061€**	**0.164€**	**0.138€**	**0.083€**	**0.173€**	**0.174€**	**0.071€**

Even if the harvesting efficiency (number of hours per harvested hectare) in Moldova is lower (and even if time spent on transport of grape is far more than in other countries due to vineyards located at a greater distance from the winery), the cost of harvesting grapes in Moldova (per hectare or per kilo), is significantly lower than in the foreign countries analysed, to the exception of the irrigated vineyards in Castilla de la Mancha.

For wineries doing mechanical harvesting, and willing to compare their efficiency with foreign practices, the ratio of 2hours to 4hours for harvesting one hectare of 3,000 to 4,000 vines/ha could be used.

4.3.9 (9) other costs

It mostly includes cost of fuel, spare parts for machinery maintenance, insurance, electricity …
It is however difficult to make any relevant conclusions from this cost cluster analysis as each country and data compiled do not include the same source of costs.

Table 18 – Benchmark data on (9) Other costs

(9) Other costs	Moldova			Spain			France			Italy	Chile
	South Moldova	Center Moldova	South East Moldova	Castilla de la Mancha Not irrigated	Castilla de la Mancha Irrigated	Rioja	Bordeaux	Val de loire	Languedoc Roussillon		
Fuel	137€/ha	138€/ha	132€/ha	Na	Na	148€/ha*	152€/ha*		152€/ha*	287 €/ha*	
Maintenance of equipment	22€/ha	26€/ha	25€/ha	Na	na	179€/ha	80€/ha		80€/ha		
Equipment insurance				54€/ha	180€/ha	10.71€/ha	110€/ha**	210€/ha**	55€/ha	300€/ha	
Other	9€/ha	11.5€/ha	12€/ha	91.28€/ha	207€/ha						
Total	**169€/ha**	**176€/ha**	**169€/ha**	**175€/ha**	**387€/ha**	**338€/ha**	**287€/ha**	**210€/ha**	**287€/ha**	**587€/ha**	**250€/ha**

(*) Fuel + oil
(**) Equipment + vineyard

Regarding cost of fuel, based on the cost of fuel in Moldova compared with cost in foreign countries, we can very roughly approximate the use or fuel for grape growing operations.

Table 19 – Benchmark data on (9) Other costs – Use of fuel

(9) Other costs	Moldova			Spain			France			Italy
	South Moldova	Center Moldova	South East Moldova	Castilla de la Mancha Not irrigated	Castilla de la Mancha Irrigated	Rioja	Bordeaux	Val de loire	Languedoc Roussillon	
Fuel	137€/ha	138€/ha	132€/ha	Na	Na	148€/ha*	152€/ha*		152€/ha*	287€/ha*
Price of fuel (€/l)*	0.6€/l**			0.987€/l**			1.13€/l**			1.322€/l**
Quantity used (l/ha)	228 l	230 l	220 l			150 l	134 l		134 l	217 l

(*) Fuel + oil
(**) Source: http://www.cnr.fr/Indices-Statistiques/Espace-Gazole/Prix-Europe

Taking in consideration the very low ratio of mechanization (in h/ha) in Moldova (between 6% to 8% - Cf Table 21 under) compared with foreign countries (between 55% to 74%), it demonstrates that the tractors and trucks used in Moldova, dating from the Soviet time, are far from minimizing the use of energy!

4.3.10 Total costs per hectare and per kilogramme of grape harvested

When all the 9 cost clusters are added, it is possible to have an estimate on the total costs of grape growing operations in Moldova and compare it with the different countries analysed in this benchmark exercise.

Table 20 – Benchmark data on Total costs

	Moldova			Spain			France			Italy - Veneto		Chile
	South Moldova	Center Moldova	South East Moldova	Castilla de la Mancha Nit irrigated	Castilla de la Mancha Irrigated	Rioja	Bordeaux AOP Bordeaux	Val de loire AOP Muscadet	Languedoc Roussillon AOP Méditerranée	Guyot	Sylvioz	
Cost for vineyard operations €/ha	**1,269€**	**1,569€**	**1,636€**	**1748 €**	**2,826€**	**2,623€**	**3,786€**	**4,783€**	**3,753€**	**5,050€**	**5,283€**	**2,926 €**
Man power cost €/h (net, without taxes)												
Permanent)	0.8€/h			13€/h	13€/h	15€/h	14€/h	13.5€/h	14€/h	15€/h	15€/h	12€/h
Seasonal	1€/h			7€/h	7€/h	7.5€/h	9.6€/h	9.2€/h	8€/h	10€/h	10€/h	8.7€/h
Nb vines/ha	3,000			2,222		4,000	3,333	6,500	4,000	3,570	2,976	
Yiel kg/ha	8,600	9,000	8,500	7,000	15,000	6,500	8,000	10,000	10,800	9,000	12,000	9,000
Cost €/kg	**0.148€**	**0.174€**	**0.192€**	**0.264€**	**0.188€**	**0.404€**	**0.473€**	**0.478€**	**0.348€**	**0.561€**	**0.440€**	**0.325€**

It appears that, despite the low efficiency of some of the grape growing operations conducted, Moldova is able to produce grapes at better competitive prices (€/kg) than most of the countries analysed in this benchmark exercise.
The main factor explaining this competitive advantage, comes for the low cost of labour, both for permanent and seasonal workers, paid in Moldova (in Moldova, seasonal workers are paid slightly higher than permanent workers due to the difficulty to find and higher workers for short term operations).

The only region that seems to be able to have costs of grape growing operations competitive with Moldova, is the irrigated region of Castilla de la Mancha, where the cost of grape growing per kilo of grape produced is 0.188€/kg compared with South East of Moldova which at 0.192€/kg.

5 Areas where efforts could be effective for higher efficiency and productivity in grape growing in Moldova

5.1 Increase in mechanization

The competitive advantage of Moldova in having access to a cheap labour, combined with the difficulty for companies in having access to equipment financing, has not pushed the industry toward increasing mechanization and improving work efficiency.

In Moldova, only 5 to 7% of the numbers of hours spent per hectare on grape growing operations are with mechanical equipment.
In the foreign countries analysed, it is more than 50% to 70% of the hours spent in vineyards that are mechanized.
If the manual harvesting cost is not taking into consideration, 80% of the work done on grape growing operations in the foreign countries analysed, are with mechanized equipment!

Table 21 – Benchmark data on ratio of mechanisation of grape growing activities

	Moldova			Spain			France			Italy - Veneto		Chile
	South of Moldova	Center of Moldova	South East of Moldova	Castilla de la Mancha		Rioja	Bordeaux	Loire	Languedoc			
				Secano	Riego					Guyot	Sylvoz	
Ratio of Mechanisation vs manual (Hour per ha)												
Before harvesting	7%	5%	7%	79%	85%	87%	82%	81%	80%	89%	92%	82%
Incl harvesting	8%	6%	8%	63%	72%	74%	58%	53%	71%	59%	54%	70%

5.2 Increase in work efficiency

In almost all the ***Viticultutal operations cost clusters***, Moldova has room for improvement of work efficiency.
Compared with the average data compiled in this benchmark exercise from foreign countries, Moldova, is using before harvesting almost the same number of mechanized hours per hectare but 288% more hours of manual work.
If harvesting and transport of grapes are included, number of mechanized work hours is then 110% higher in Moldova and 194% more hours of manual work are used in Moldova for conducting similar operations per hectare of vineyards.

Table 22 – Benchmark data on ratio of work efficiency on grape growing activities

		Moldova		International Benchmark	
Work Efficiency Average	***Costul lucrului***	Mecanizat W h/ha	Manual W h/ha	Mecanizat W h/ha	Manual W h/ha
Fertilization	*Fertilizare*	-	-	1	2
Pruning and tying	*Taiatul si legatul vitei*	1,2	143,0	2,5	57
Trellisis maintenance	*Reparatia spalerului*	-	10,5	-	10
Work on soil	*Arat vie, Cotoritul viei, Cultivat, Discuit*	6,7	21,5	2	-
Work on rows	*Erbicide/Prasit/Iarba*	4,3	46,7	2	-
Green operations (*)	*Lucrari in verde (*)*	1,9	279,0	7	60
Pest treatment	*Stropit*	6,6	-	6	-
TOTAL without harvest		20,7	500,8	20,5	129
		1%	288%		
Harvest (**)	*Recoltare (**)*	17,6	124,7	4	85
Transport	*Transportarea*	17,3		2	
TOTAL		55,6	628,3	26,5	214
(*) Manual deleafing		110%	194%		
(**) Manual harvesting					

When numbers of hours spent are added (mechanized + manual), Table 23 shows that Moldova is spending between 620 hours to 1,013 hours per hectare to conduct all the necessary grape growing operations.
It implies that a Moldovan winery controlling 200ha of vineyard, and with workers doing 7h/day and 252 working days per year, needs to have between 70 to 115 full time employees, compared with 22 to 55 employees in foreign countries analysed.

Table 23 – Benchmark data on number of hours spent on grape growing activities

	Moldova			Spain			France			Italy - Veneto		Chile
	South of Moldova	Center of Moldova	South East of Moldova	Castilla de la Mancha		Rioja	Bordeaux	Loire	Languedoc	Guyot	Sylvoz	
				Not irrigated	Irrigated							
Ratio of Mechanisation vs manual (Hour per ha)												
Before harvesting	9%	7%	10%	79%	85%	87%	82%	81%	80%	89%	92%	82%
Incl harvesting	11%	9%	12%	63%	72%	74%	58%	53%	71%	59%	54%	70%
Total number of hours before harvest	517	686	784	168	215	252	203	146	127	278	372	228
Total number of hours incl harvest	620	831	1 013	286	326	369	410	299	202	489	502	289

5.3 Other areas of possible improvements

A deeper analysis of the cost structure (in % based on €/ha) of the grape growing operations in Moldova compared with foreign countries, is demonstrating the following additional main observations:

Table 24 – Benchmark data on cost of production (% of €/ha) on grape growing activities

		Moldova			Spain			France			Italy - Veneto		Chile
		South of Moldova	Center of Moldova	South East of Moldova	Castilla de la Mancha		Rioja	Bordeaux	Loire	Languedoc	Guyot	Sylvoz	
					Secano	Riego							
1 Fertilization (Soil and leaves)	*Fertilizare*	9%	7%	7%	5%	6%	5%	5%	2%	6%	2%	2%	2%
2 Pruning and tying	*Taiatul si legatul vitei*	12%	10%	10%	10%	10%	12%	26%	28%	27%	24%	20%	20%
3 Trellisis maintenance	*Reparatia spalerului*	1%	1%	1%	9%	10%	7%	4%	4%	4%	2%	2%	3%
4 Work on soil	*Arat vie, Cotoritul viei, Cultivat, Discuit*	2%	1%	2%	10%	8%	5%	1%	0%	0%	0%	0%	2%
5 Work on rows	*Erbicide/Prasit/Iarba*	4%	6%	4%	0%	2%	3%	4%	4%	4%	4%	4%	3%
6 Green operations	*Lucrari in verde*	11%	16%	16%	11%	8%	15%	14%	15%	16%	10%	6%	15%
7 Wood, leaves and grape pest treatments	*Stropit*	29%	32%	29%	24%	21%	24%	14%	13%	12%	16%	15%	16%
8 Other costs		13%	11%	10%	10%	14%	13%	8%	4%	8%	12%	11%	9%
9 Harvest	*Recoltare*	17%	15%	20%	19%	21%	15%	24%	29%	24%	31%	40%	29%
Grand Total without harvest		83%	85%	80%	81%	79%	85%	76%	71%	76%	69%	60%	71%
Grand Total without harvest		**1 039,86 €**	**1 317,33 €**	**1 293,37 €**	**1 415,00 €**	**2 228,00 €**	**2 223,00 €**	**2 863,00 €**	**3 399,00 €**	**2 857,00 €**	**3 488,00 €**	**3 190,00 €**	**2 076,00 €**
Grand Total with harvest		**1 257,23 €**	**1 554,61 €**	**1 611,14 €**	**1 748,00 €**	**2 826,00 €**	**2 623,00 €**	**3 786,00 €**	**4 783,00 €**	**3 753,00 €**	**5 050,00 €**	**5 283,00 €**	**2 926,00 €**
Harvest estimates (kg/ha)		8 600	9 000	9 600	4 500	15 000	6 500	8 000	10 000	10 800	9 000	12 000	12 000
Cost per kg EURO		0,146 €	0,173 €	0,168 €	0,388 €	0,188 €	0,404 €	0,473 €	0,478 €	0,348 €	0,561 €	0,440 €	0,244 €

- **On Fertilization**

  It represents between 7% to 9% of the total cost of grape growing operations in Moldova, compared with 2% to 6% in the countries analysed. Efficiency could be improved mostly through identifying cheaper source of fertilizers: cost of products is on average 400€/ton in Moldova compared with 200€ to 300€/ton in foreign countries.

- **On Pruning and tying**

  These operations represent 10% to 12% of total grape growing costs in Moldova compared with over 20% in the foreign countries analysed.

  We have, however identified that this competitive advantage in Moldova was mostly due to its low labour cost. It is obvious that the pruning/cutting operations (through using electric secators1) and the tying operations (through using vine plyers), could greatly be improved (25 to 30 vines/h in Moldova compared with 95 vines/h in foreign countries).

[1] We would not recommend using pneumatic secators as it is less flexible to operate and generates additional costs through the use of an air compressor system.

- **On Green operations**
  These operations represent 11% to 16% of total grape growing costs in Moldova compared with 8% to 16% in the foreign countries analysed. We have, however, identified that great areas of efficiency improvement exist in Moldova
    - o de-budding trunk/canes operation: 60 to 100 vines /h in Moldova compared with 175 vines/h in foreign countries
    - o trimming operations (manually done in Moldova compared with mechanical in most foreign countries): 100 to 160h/ha in Moldova compared with 3h/ha in foreign countries.
    - o de-leafing operations: 40 hours/ha, done 1 to 3 times in Moldova, compared with 15 hours/ha done 1 to 2 times in foreign countries

- **On fuel**
  An average of 220 to 230 litres/ha of fuel are used in Moldova compared with 130 to 150 litres/ha (of fuel + oil) on average in foreign countries.
  Differences in age and type of tractors used could greatly explain these observations.

6 Efficiency and productivity Benchmarking template for Moldovan grape growers.

Based on the data compiled in Moldova and from other foreign countries analysed in this benchmark exercise, we have been able to create a template that could help the local grape growers to evaluate their own efficiency and productivity:

Table 25 – Benchmark data on Norms of production on grape growing activities

Opérations		Moldova			International practices		
		Comments	Norms	Average cost	Comments	Norms (3,500 vines/ha)	Average cost
Fertilization	***Fertilizare***	***Seldomly practice***					
Soil	*Sol*	Granulated NPK	200kg/ha	450€/ton	In most countries, soil analysis of NPK (+Mg) is conducted. Then, if necessary, defiency are corrected. Product used are organic or mineral. See Annex 1 for example of products and costs	Granulated form of NPK: between 150 to 400kg/ha. Organic humus: 1 to 5 tons per ha. Is usualy done every 3 years	60 to 200€/ha
Leaves	*Fruze*				If case of deficiency in N, Bore, Zn etc...	2 to 3,5 l/ha	
Pruning and Tying	***Tăiatul și legatul viței***						
Pre-pruning	*Tăiatul aței și a cîrceilor dintre sîrme*	Not done			Mechanical	1,5h/ha	Equipment: 12,000€ (1 row, 8 pairs of blades, mast)
Cutting	*Tăiatul viței*	Manual	25 to 30 vines /hour	105€/ha	Manual with electric/pneumatic secators	95 vines/h - 36hours/ha	Equipment: 1,300€ (blades and battery included)
Tying	*Legatul viței*	Manual	60 to 70 vines/hour	50€/ha	Manual with vine plier	450 vines/h - 8h/ha	Equipment: 50€ (Type: Rapid LIG175)
Deweeding	***Introducere erbicide***	*3 to 5 times per year*	Glyphosat	17€/ha	1 row out of 2	See Annex 2 for list of available products	See Annex 2
Green Operations	***Lucrări în verde***						
Trunk Debudding	*Lastarilor*	Done at the same time as cane debudding			Mechanical + Chemical (1 per year)	6h/ha	Chemical: 40€/ha
Cane debudding	*Copilitul lastarilor*	Manual (3 to 4 times per year)	60 to 100 vines/hour		Manual (1 per year)	20h/ha - 175 vines/hour	
Trimming	*Ciupitul lăstarilor*	Manual (3 times per year)	100 to 160h/ha		Mechanical (4 to 6 times per year)	3h/ha	
Deleafing	*Defolierea strugurilor*	Manual (1 to 3 times per year)	130 vines/hour - 40h/ha		Manual (2 per year)	15h/ha	
					or Mechanical (2 per year)	2h/ha	Equipment: 15,000€ - heat or sucking
Green harvest	*Optimizarea roadei*	*Manual*	5h/ha		Manual	4h/ha	
Pest treatments	***Stropit***						
Oïdium + Mildew	*Bacterioze, mană + Făinare*	7 treatments per year		300€/ha	7 to 9 treatments per year		250€/ha
Cochilis + Cicadelle	*cicade,molia strugurilor*	2 to 3 treatments per year		42€/ha	2 to 4 treatments per year		40€/ha
Antibotrytis	*mucegai cenusiu (soiuri sensibile)*	2 treatments per year		100€/ha	1 to 2 treatments per year		110€/ha
Mechanical vs Manual before harvest	*Tehnicii vs Manual fara recoltare*	h/ha	8,37%			84%	
Mechanical vs Manual after harvest	*Tehnicii vs Manual cu recoltare*	h/ha	10,93%			64%	
Cost per hectare without harvest	***Total fara recoltare***	€/ha		1 217 €			2 648,78 €
Cost per hectare with harvest	***Total cu recoltare***	€/ha		1 492 €			3 330,67 €

7 Annexes

Annex 1 – Fertilizers available in France – Products and prices (2015)

Source: Institut Français de la Vigne et du Vin – Edition 2016 - Prices are without Vat -

Category	Product	Commercial name	Forme	usual Packaging (kg)	Price €ht per 100 kg	Units or pur Kg for 100kg	€ht per unit
Simple Mineral fertilizers	Azote : N	Nitrate de chaux	Granulate	25	50,50 €	15,00 €	3,37 €
		Sulfate d'ammoniaque		50	41,80 €	21,00 €	1,99 €
		Ammonitre 33,5		35	48,80 €	33,50 €	1,46 €
		Perlurée		25	52,70 €	46,00 €	1,15 €
		Liquid Azote (Engrais Belloc)	Liquid	for 1000l	89,00 €	29,00 €	3,07 €
	Anhydride Phosphorique: P2O5	Super triple 44:44%	Granulate	-	57,10 €	45,00 €	1,27 €
	Oxyde de Potassium: K2O	Kalisop (K+S Kali), Sulfate de potassium		25	71,85 €	50,00 €	1,44 €
		60er Gran (K +S Kali), Chlorure de potassium		50	45,30 €	60,00 €	0,76 €
		Chlorure de potassium (Plantin/ICL)		-	60,00 €	61,00 €	0,98 €
	Oxyde de Magnesium: Mg	ESTA Kiésérite (K+S Kali), Sulfate de magnésium		25	43,80 €	25,00 €	1,75 €
		Sulfate de magnésium (Plantin/ICL)			37,00 €	16,00 €	2,31 €
Mixed fertizers	N + P	Phosphate d'ammoniaque (N:18 - P2O:46)		25	68,20 €	78,48 €	
		Nergetic (N:20 - P2O:17)		25	65,75 €	44,22 €	
	N + K	Nitrate de Potasse (N:13 - K2O:46)		25	89,90 €	49,32 €	
		Univaire Bio (Angibaud) (N:3,5 - K2O:9,5)	Liquid	-	150,00 €	11,12 €	
	K + Mg	Patentkali (K+S Kali) (K2O:30 - Mg:10)	Granulate	50	54,90 €	45,60 €	
		Oxyfertil (Lhoist France) (K2O:18 - Mg:8)		600	30,50 €	31,98 €	
	N + P + K	Ultimate (K+S Kali) (N:15 - P2O:5 - K2O:20)		25	58,50 €	36,90 €	
		Fertivigne K (Interfertil) (N:14 - P2O:5 - K2o:20)		50	43,00 €	37,26 €	
		Fertivigne N (Interfertil) (N:18 - P2O:5 - K2O:10)		50	40,50 €	34,32 €	
		SK Nitrophosca (N:12 - P2O:12 - K2O:17)		25	68,00 €	41,55 €	
		Bioforce (Angibaud) (N:4,5 - P2O:2,5-K2O:5)	Liquid	for 100l	45,00 €	12,03 €	
		Liquofruit bronze (Angibaud) (N:7-P2O:3-K2O:14)		for 100l	52,00 €	22,26 €	
	N + P + K + Mg	Liquoplant rose (Plantin (N:4,6-P2O:2,5-K2O:8-Mg:1,3)		For 100l	35,52 €	17,40 €	
		Multigro N Enrobé (Haifa France) (N:15-P2O:5-K2O:22-Mg:4)	Granulate	-	59,00 €	49,14 €	
		Liquoveg Terre (Angibaud) (N:4-P2O:2,3-K2O:6,1-Mg:1)	Liquid	For 100l	60,00 €	14,34 €	
		Apex (Timac Agro) (N:12-P2O:6-K2O:19-Mg:2)	Granulate	600	65,00 €	40,11 €	
		Mineral (Plantin) (N:10-P2O:10-K2O:15-Mg:2)		-	51,00 €	39,87 €	

Source: Institut Français de la Vigne et du Vin

Annex 2 – Pesticides and herbicides available in France – Products and prices (2015)

Source: Institut Français de la Vigne et du Vin – Edition 2016 - Prices are without Vat -

Annex 3 – Castilla de la Mancha - Spain – Benchmark data

Annex 4 – Rioja - Spain – Benchmark data

Annex 5 – AOC Bordeaux - Bordeaux - France – Benchmark data

Annex 6 – AOC Muscadet - Val de Loire - France – Benchmark data

Annex 7 – IGP Méditerranée - Languedoc Roussillon - France – Benchmark data

Annex 8 – Veneto - Italy – Benchmark data

Annex 9 – Chile – Benchmark data