"Non-food Crops-to-Industry schemes in EU27"

WP4. Costs and socio-economic impacts

D4.5 Prioritisation of crop-to-product schemes in terms of their economic profitability

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Contents

Introduction

The aim of this report is to prioritise the selected crop-to-product schemes based on their economic profitability, as assessed within the selected cases in WP4 (see D4.3 & D4.4). At this point it should be clarified that the categorisation below does not reflect the sustainability issues related to the under study schemes.

Crops to product schemes under study

Crops to product schemes for industry include all possible combinations of plant species and conversion pathways that can potentially serve as a feedstock base for the production of industrial raw materials.

This report focuses on four crop categories (oil, fibre, carbohydrate & specialty) and prioritises a number of selected crops, representative for the EU27 agricultural system, namely:

- Oilseed crops
- Fibre crops: flax, hemp, kenaf
- Carbohydrate crops: maize, sweet sorghum, potato
- Specialty crops: coneflower, peppermint, pot marigold

in terms of their economic profitability to be used as feedstocks for respective markets.

Oil crops

The crops under study within the Crops2Industry project are rapeseed, sunflower and linseed. Their main product is vegetable oil which can be used as edible, for lubricants, paints/ inks/coatings, polymers and for biodiesel.

Based on their quality characteristics the under study crops can be used in the candidate markets as follows:

- Rapeseed oil can be used in all the above mentioned markets except for paints/ inks/ coatings.
- Sunflower oil has good quality characteristics for all markets.
- Linseed oil is inappropriate for lubricants and biodiesel.

Table 1 below presents the economic performance of the crops in the case study countries in terms of capital expenditure (Capex), Operation & Materials expenditure (Opex) and Profitability Index (PI)[1]

Criteria	Capex					Opex					PI				
Crop \ Country	***GR***	***FR***	***DE***	***I***	***PL***	***GR***	***FR***	***DE***	***I***	***PL***	***GR***	***FR***	***DE***	***I***	***PL***
Rapeseed	O	P	P			N	O	O			O	VP	VP		
Sunflower	O			P		N			O		O			P	
Linseed		O			O		O			N		P			O

VP (3): very positive impact to economic profitability
P (1): positive impact to economic profitability
O (0): Neutral, similar to conventional crops in the region
N (-1): negative impact to economic profitability
VN (-3): very negative impact to economic profitability

[1] Profitability Index: PI = (Sales income)/Production costs. The crop is considered a profitable option when PI≥1

Based on the analysis of the project results, the best performing crop in terms of economic profitability within the oilseeds category in EU27 is rapeseed. This can be attributed to a number of factors:

- Rapeseed is a well-adapted crop in many European countries with good track record of varieties and crop trait improvement.
- Crop management practices are well known to farmers so the crop can be easily integrated in current agricultural systems, rotations and infrastructures.
- Yields are being continuously improved at global level.
- High demand, especially from the European biodiesel industry, secures high market prices for farmers.
- And although the biodiesel market is highly policy-driven and there is controversy over sustainability issues, the lack of immediately available alternatives to support the industry is very likely to keep the market demand very high for the next five to ten years.

Concerning regional distribution, among the three case countries, Greece, France and Germany, it is evident from the analysis that the crop can be considered as a very profitable option in France and Germany, fact which is due to both good yields and efficient crop management practices but is also enhanced by the consistent national biodiesel markets for the oilseeds.

Figure 1. Yields (t/ha) and market prices (€/t) where PI≥1 and rapeseed can be considered economically profitable for the under study countries (GR, FR, DE).

This is not the same for Greece, at the moment due to the fact that irrigation is required (which raises the total production costs), the average yields are still quite lower than central Europe and this restricts profitability.

Figure 1 shows the relationship between yields and market prices in order to achieve crop PI≥1.

Current prices are close to 400€/t so the crop can be very profitable even at lower yields than the average ones in DE and FR (currently around 4 t/ha seeds). Under this yielding potential, the crop remains profitable even if market prices drop at the level of 250 €/t.

In Greece, average commercial recorded yields are around 3 t/ha seeds. This implies that the crop will not be profitable if market prices fall below current market prices unless higher yields are achieved.

Sunflower

Sunflower is examined in southern European conditions (Italy and Greece) in the project.

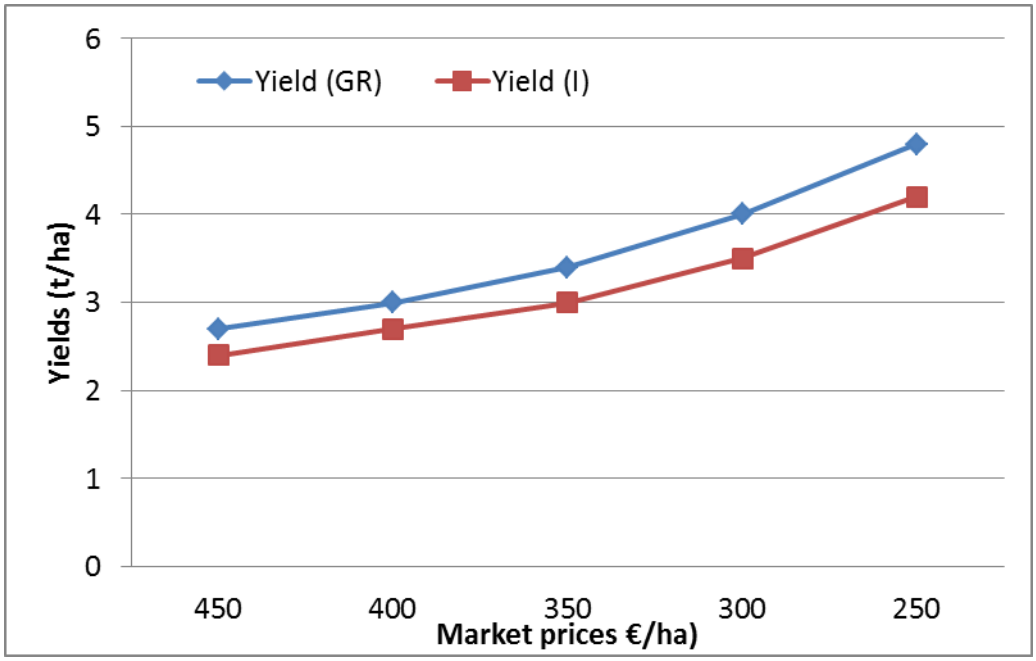

Figure 2. Yields (t/ha) and market prices (€/t) where PI≥1 and sunflower can be considered economically profitable for the under study countries (GR, I).

Figure 2 shows the relationship between yields and market prices in order to achieve crop PI≥1. Current prices are close to 400€/t so the crop can be profitable in Italy, where the average yields are 4t/ha seeds. Under this yielding potential, the crop remains profitable even if market prices drop at the level of 300 €/t.

In Greece, the average commercial recorded yields are around 3 t/ha seeds. This implies that the crop will not be profitable if market prices fall below current market prices unless higher yields are achieved.

Linseed

The case of linseed is examined for Poland and France in the project.

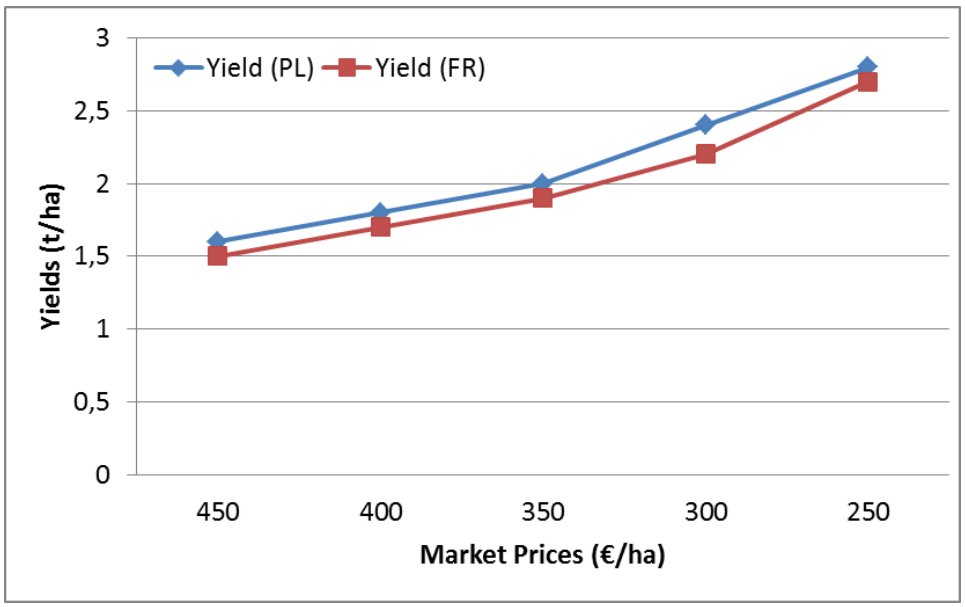

Figure 3. Yields (t/ha) and market prices (€/t) where PI≥1 and linseed can be considered economically profitable for the under study countries (PL, FR).

Figure 3 shows the relationship between yields and market prices in order to achieve crop PI≥1. Current prices are close to 400€/t so the crop can be profitable in both Poland and France, where the average yields are 2 & 2,5 t/ha seeds, respectively. Under this yielding potential, the crop remains profitable even if market prices drop at the level of 300 €/t for France and 350 €/t for Poland.

Fibre crops

The crops under study within the Crops2Industry project are hemp, kenaf and flax.

They can be grown for a wide range of uses including the production of insulation and other building materials, bio-composites for use in the automotive sector, textiles and animal bedding. At the moment, European production of natural fibres focuses largely upon flax and hemp.

Based on their quality characteristics the under study crops can be used in the candidate markets as follows:

- Hemp is primarily used in the textiles industry, for nutritional products, manufacture of oil-based paints, for cooking, and in plastics.
- Kenaf is primarily used for paper and pulp; for insulation material and can be used for energy and second generation bioethanol.
- Flax is used for fabric, dye, paper, medicines, fishing nets, hair gels, soap and as ornamental.

Table 2 below presents the economic performance of the crops in the case study countries in terms of capital expenditure (Capex), Operation & Materials expenditure (Opex) and Profitability Index (PI)

Criteria	Capex					Opex					PI				
Crop / Country	***GR***	***I***	***FR***	***NL***	***PL***	***GR***	***I***	***FR***	***NL***	***PL***	***GR***	***I***	***FR***	***NL***	***PL***
Hemp				N	O				O	VP				N	P
Kenaf	O	O				O	O				O	P			
Flax			O		O			O		O			P		P

VP (3): very positive impact to economic profitability
P (1): positive impact to economic profitability
O (0): Neutral, similar to conventional crops in the region
N (-1): negative impact to economic profitability
VN (-3): very negative impact to economic profitability

Based on the analysis of the project results, the best performing crop in terms of economic profitability within the fibre crops category in EU27 is hemp with flax following closely. This can be attributed to a number of factors:

- higher productivity especially under low input practices, well known genotypes in term of productivity - environment relationships and seed production is in Europe,
- higher fibre quality, less spongy core and then shorter drying period in the field;
- Growing of both hemp and flax can assure applying environment-friendly methods of farming, satisfactory incomes that would allow farmers to have better standard of living, reducing unemployment, replacing non-renewable raw materials by renewable and biodegradable raw materials, reducing problems of the overproduction of food crops.

Concerning regional distribution, Poland is a slightly more attractive country compared to France for hemp, while flax exhibits equal economic performance in both.

Hemp

The case of hemp is examined for Poland and the Netherlands in the project.

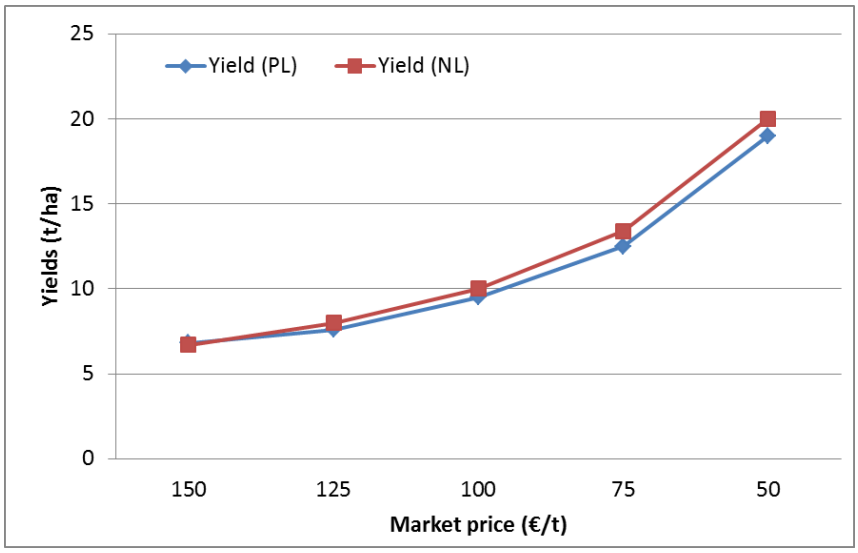

Figure 4. Yields (t/ha) and market prices (€/t) where PI≥1 and hemp can be considered economically profitable for the under study countries (PL, NL).

Figure 4 shows the relationship between yields and market prices in order to achieve crop PI≥1. Current prices are close to 100€/t so the crop is profitable in Poland where the average yields are reported at 10 t/ha. However, as figure also shows, if market prices fall below that value the crop is not profitable. In the Netherlands, where the average yields are reported at 7 t/ha, the crop is not profitable at a market price level of 100€/t. It can reach profitability above 140€/t.

Kenaf

The case of kenaf has been examined in Italy and Greece.

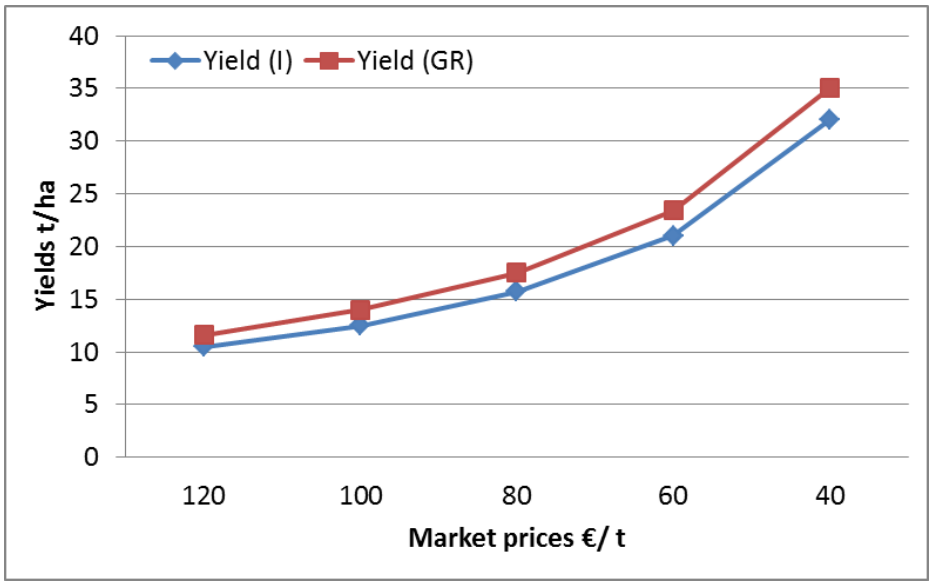

Figure 5. Yields (t/ha) and market prices (€/t) where PI≥1 and kenaf can be considered economically profitable for the under study countries (I, GR).

Figure 5 shows the relationship between yields and market prices in order to achieve crop PI≥1.

Current prices are set to 80 €/t so the crop is profitable in Italy, where the average yields of 15t/ha are reported. Under this yielding potential, the crop cannot be profitable under lower market prices unless higher yields are achieved.

In Greece, the average yields at large field scale are around 13 t/ha. This implies that the crop is marginally profitable under the current price regime but will not be profitable if market prices fall below unless higher yields are achieved.

Flax

The case of flax has been examined in Poland and in France

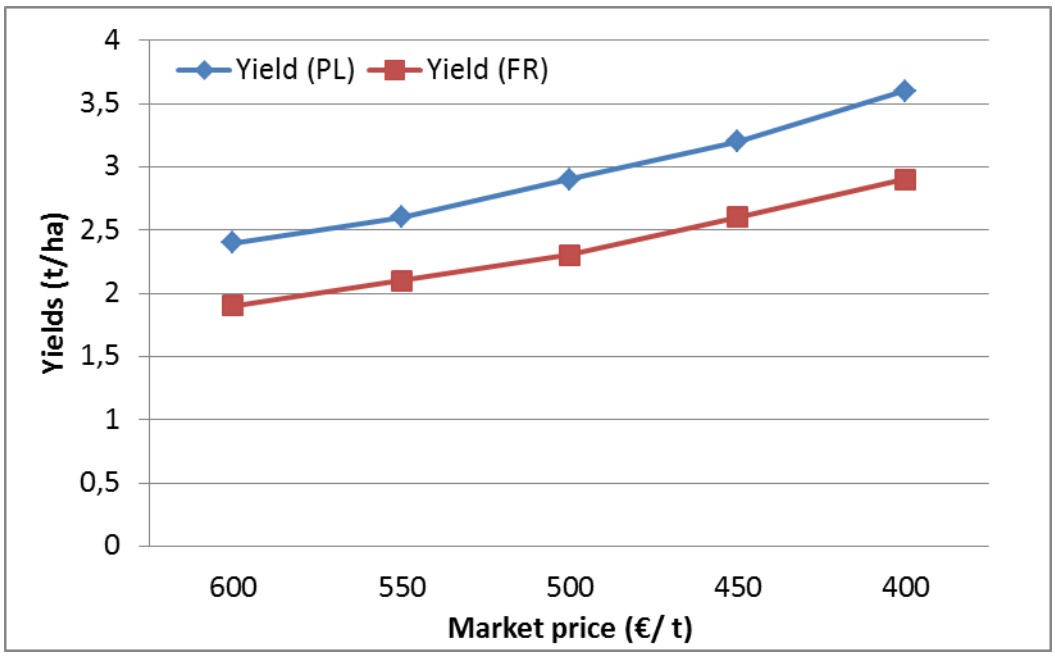

Figure 6. Yields (t/ha) and market prices (€/t) where PI≥1 and flax can be considered economically profitable for the under study countries (PL, FR).

Figure 6 shows the relationship between yields and market prices in order to achieve crop PI≥1.

Current prices are close to 500€/t so the crop is profitable in both Poland and France where the average yields are reported at 5,5 t/ha.

Under this yielding potential, the crop remains profitable even if market prices drop at the level of 300 €/t. The breakeven price is estimated at 260 €/t.

Carbohydrate crops

The crops under study within the Crops2Industry project are maize, potato and sweet sorghum.

They can be grown for a wide range of uses including starch based additives for toothpastes, washing powder, antibiotics, for paints and colorants. The other major use for such products is biodegradable plastics.

Based on their quality characteristics the under study crops can be used in the candidate markets as follows:

- Maize is primarily used for edible purposes (starch & oil products); for plastics, chemicals and bioethanol.
- Potato is primarily used for edible uses (starch), for plastics and animal food
- Sweet sorghum can be used for the production of syrup and bioethanol; none of this is at the moment taking place in Europe

Table 3 below presents the economic performance of the crops in the case study countries in terms of capital expenditure (Capex), Operation & Materials expenditure (Opex) and Profitability Index (PI)

Criteria	Capex				Opex				PI			
Crop / Country	***GR***	***I***	***FR***	***DE***	***GR***	***I***	***FR***	***DE***	***GR***	***I***	***FR***	***DE***
Maize	O		O	O	N		O	O	N		VP	VP
Potato	O			O	O			O	VP			VP
Sweet sorghum	O	O			O	O			P	P		

VP (3): very positive impact to economic profitability
P (1): positive impact to economic profitability
O (0): Neutral, similar to conventional crops in the region
N (-1): negative impact to economic profitability
VN (-3): very negative impact to economic profitability

Based on the analysis of the project results, the best performing crop in terms of economic profitability within the carbohydrate crops category in EU27 is maize with potato following closely. This can be attributed to a number of factors:

- Maize has been widely cultivated all across Europe and both yields and crop management practices are improved.
- The crop has high yielding potential even in south Mediterranean countries, although irrigation is required there, which increases the production costs significantly.
- Yields are still being continuously improved at global level.
- High demand, from a wide range of markets, recently including bioethanol and biogas in Europe, secures good market prices for farmers.

This is not the same for Greece, at the moment due to the fact that irrigation is required (which raises the total production costs), the average yields are still quite lower than central Europe and this restricts profitability.

Maize
The case of maize has been examined for France, Germany and Greece.

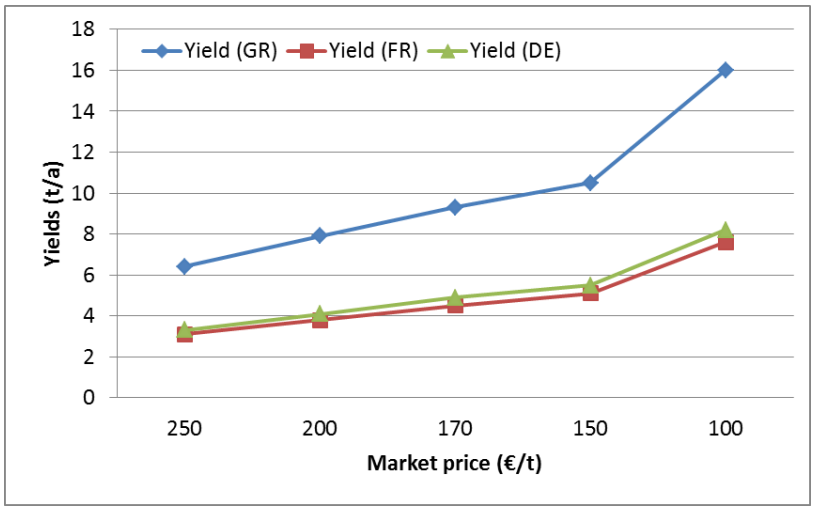

Figure 7. Yields (t/ha) and market prices (€/t) where PI≥1 and maize can be considered economically profitable for the under study countries (GR, FR, DE).

Figure 7 shows the relationship between yields and market prices in order to achieve crop PI≥1. Current prices are close to 170 €/t so the crop can be very profitable even at lower yields than the average ones in DE and FR (currently around 9,8 and 7 t/ha seeds, respectively). Under this yielding potential, the crop remains profitable even if market prices drop at the level of 100 €/t.

In Greece, average commercial recorded yields are around 2,2 t/ha seeds. This implies that the crop is not profitable under the current price regime market prices. For the crop to become a profitable option crop management costs should be reduced along with achieving higher yields.

Potato
The case of potato has been examined for Greece and Germany.

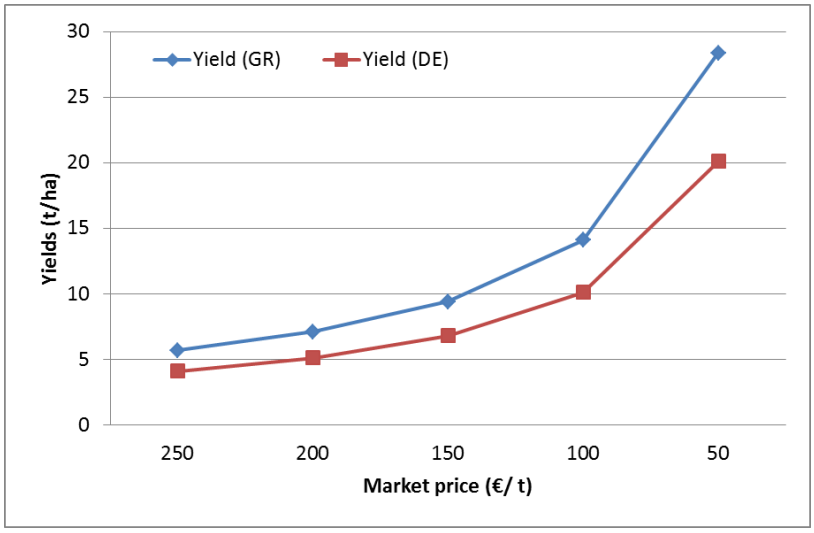

Figure 8. Yields (t/ha) and market prices (€/t) where PI≥1 and potato can be considered economically

Figure 8 shows the relationship between yields and market prices in order to achieve crop PI≥1.

Current prices range between 100- 150 €/t so the crop is profitable in both Greece and Germany. However, due to almost double yields (25 t/ha and 44 t/ha) and lower production costs, the PI in Germany is much higher reaching above 6.

Under this yielding potential, the crop remains profitable even if market prices drop at the level of 100 €/t. The breakeven price for the case of Greece is estimated at 60 €/t.

Sweet sorghum

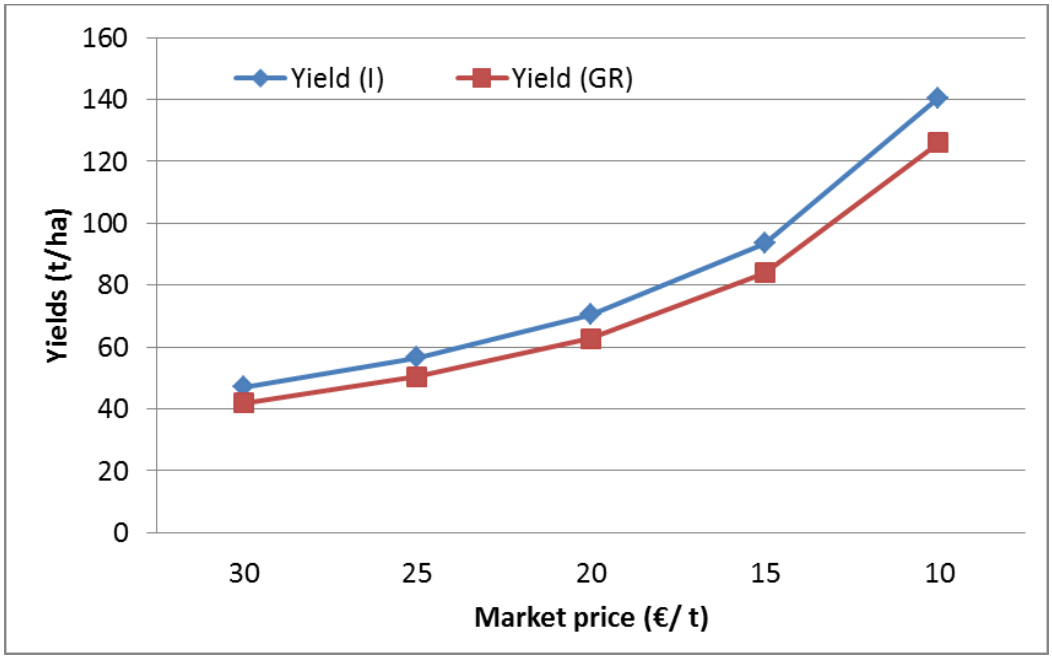

Figure 9. Yields (t/ha) and market prices (€/t) where PI≥1 and sweet sorghum can be considered economically

Figure 9 shows the relationship between yields and market prices in order to achieve crop PI≥1.

Current prices range between 20- 30 €/t[2] so the crop is profitable in both Greece and Italy under current yielding potential for fresh biomass (70 t/ha and 100 t/ha).

Under this yielding potential, the crop remains profitable even if market prices drop at the level of 15 €/t for Italy.

However, in Greece, the crop is not profitable at prices below 20 €/t.

[2] Based on the prices of sugarbeet in Europe

Other specialty crops

The crops under study within the Crops2Industry project are:

- Coneflower *(Echinacea angustifolia DC)*
- Peppermint *(Mentha piperita L.)*
- Pot marigold (*Calendula officinalis L.)*

Based on their quality characteristics the under study crops can be used in the candidate markets as follows:

- ***Echinacea angustifolia*** is used as a fortifier of the immune system, mainly to prevent flu and minor respiratory diseases.
- ***Peppermint*** has a high menthol content, and is often used as tea and for flavouring ice cream, confectionery, chewing gum, and toothpaste.
- ***Pot marigold*** florets used for edible purposes mainly.

All three crops were examined for their economic profitability only in Romania.

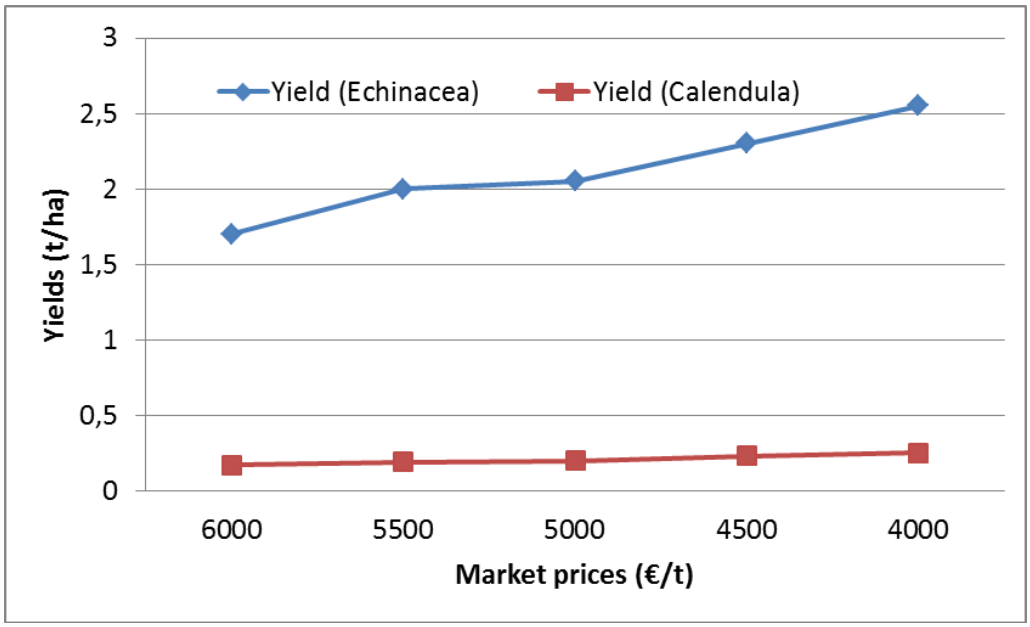

Figure 10. Yields (t/ha) and market prices (€/t) where PI≥1 and echinacea & calendula can be considered economically

Figure 10 shows the relationship between yields and market prices in order to achieve crop PI≥1.

Current prices are reported at 5,000 €/t so the crops are profitable in Romania under current yielding potential (3 t/ha for both).

Due the both good yields and low production costs both crops remain profitable even if prices fall below 4,000 €/t, so they are considered a good option for Romania.

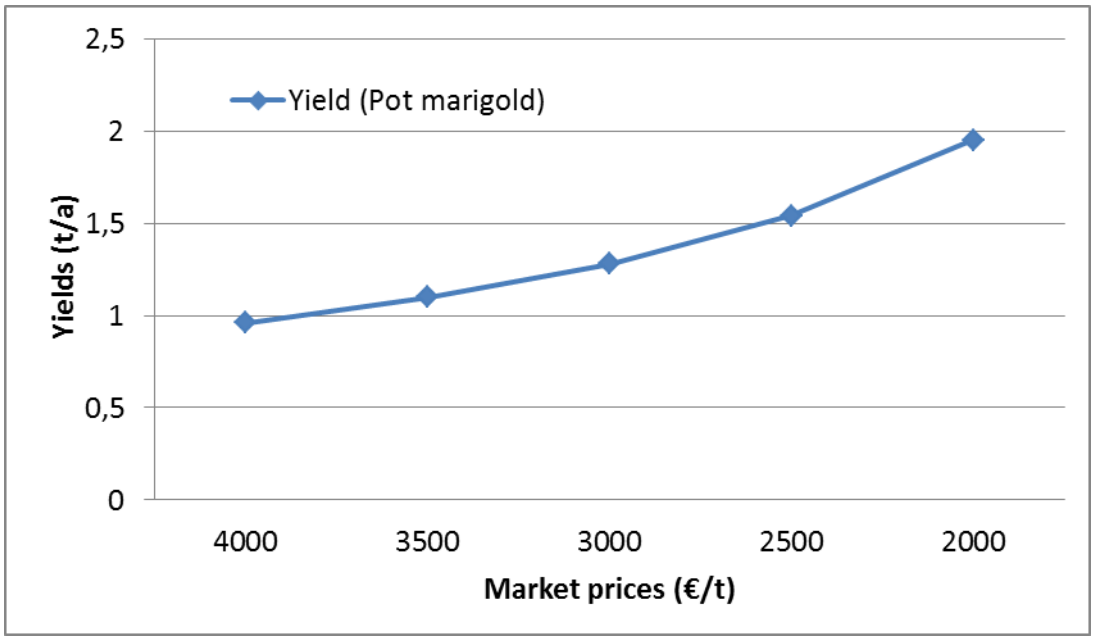

Figure 11. Yields (t/ha) and market prices (€/t) where PI≥1 and pot marigold can be considered economically

Figure 11 shows the relationship between yields and market prices in order to achieve crop PI≥1.

Current prices are reported at 3,000 €/t so the crop is profitable in Romania under current yielding potential (8 t/ha).

Due the both good yields and low production costs both crops remain profitable even if prices fall below 2,000 €/t, so they are considered a good option for Romania.