FIRST2RUN

Flagship demonstration of an integrated biorefinery for dry crops sustainable exploitation towards biobased materials production

WP 1: Feedstock Oil Crops

Luigi Capuzzi
NOVAMONT

Kick-Off Meeting, Bruxelles
July 23rd, 2015

This project has received funding from the Bio Based Industries under European Union's Horizon 2020 research and innovation programme under grant agreement No 669029

WP 1 - Feedstock Oil Crops

CONTENTS

- Background
- WP's general description
  - Objectives
  - Tasks
  - Main expected results
  - Description of deliverables
  - Time-scheduling (including milestones and deliverables)
  - Partners involved in the WP
- First 6 months' planning in the WP

Background:
Why Cardoon (Cynara cardunculus) for Sardinia?

- It is a spontaneous polyennial plant
- It needs amount of water compatible with winter rain regime (400 mm)
- It can be grown in marginal areas become a source of extra income for farmers and sheperds
- It produces oil usable as feedstock for the monomers plant
- Proteic meals can be used in feed
- It produces big amount of biomass usable immediately to produce all the energy needed by the plant and in the mid term for the manufacturing of strategic monomers

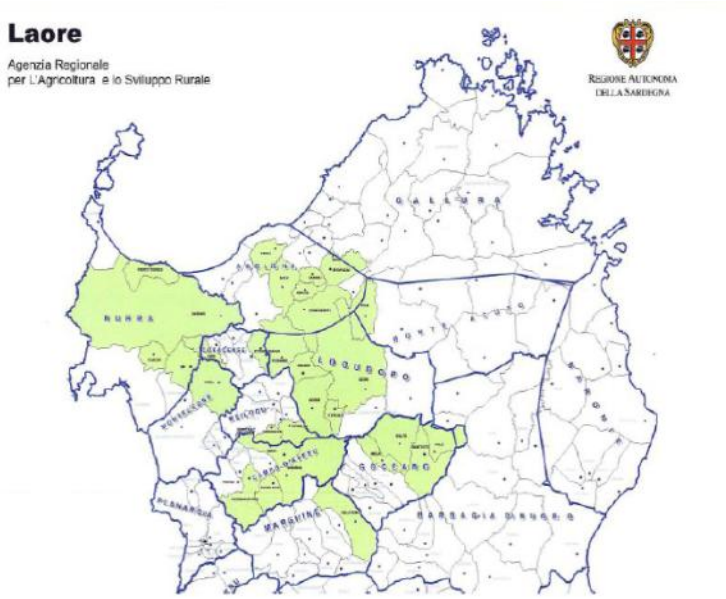
Background:
Potential areas for Cardoon production

**HARABLE LAND IN SARDINIA:
JUST IN SASSARI PROVINCE 70,000 HA OF HARABLE LAND LOST FROM 1982 TO 2010
(SOURCE: ISTAT)**

Anno	1982	1990	2000	2010
Territorio				
Italia	15.832.613	15.025.954	13.181.859	12.856.048
Sardegna	1.431.302	1.358.018	1.019.955	1.153.691
Sassari	316.160	319.816	240.027	246.822
Nuoro	255.516	259.036	191.688	229.376
Cagliari	256.398	221.943	165.958	203.047
Oristano	202.996	197.665	156.288	166.691
Olbia-Tempio	138.723	139.980	88.552	94.707
Ogliastra	70.885	70.980	56.731	69.869
Medio Campidano	109.762	94.911	75.241	82.998
Carbonia-Iglesias	80.863	53.687	45.470	60.181

Dati estratti il 20 nov. 2012, 17h28 UTC (GMT), da censagri.Stat

La Superficie Agricola Utilizzata (SAU) ammonta a circa 1.153.691 ha, dei quali solo poco più del 34,1% è destinato a seminativo.



Background : Some images from Cardoon harvesting in Matrìca experimental fields (August

AFTER 3 CONSECUTIVE YEARS OF EXPERIMENTATION:

- **BIOMASS PRODUCTION > 15 TON/HA (17 TON/HA IN 2014)**
- **SEEDS PRODUCTION ~ 1,5 TON/HA (1,74 TON/HA IN 2014)**
- **ENGINEERING OF SPECIFIC FARMING MACHINES SUITABLE FOR SARDINIAN STONY GROUNDS**

WP & Activities

WP1 - Feedstock: oil crops
Task 1.1 Dry cardoon crop cultivation and fields management
Task 1.2 Oil extraction and characterization
Task 1.3 Selection of other sources of oil

WP2 - Chemical and biochemical conversions of vegetable oils into biodegradable esters
Task 2.1 Catalysts preparation
Task 2.2 Vegetable oils to carboxylic acids
Task 2.3 Catalytic and bio-catalytic esterification processes of carboxylic acids with polyols

WP3 - Scale-up
Task 3.1 Demonstration of biobased monomers production up to 20,000 ton/year
Task 3.2 Demonstration of biodegradable esters of pelargonic acid production up to 10,000 ton/year
Task 3.3 Process polymerization and compounding + validation up to 50,000 ton/year

WP4 – Biobased products formulation and validation
Task 4.1 Bioplastics formulation and validation
Task 4.2 Biolubricant formulation and validation
Task 4.3 Cosmetics validation

WP5 – By-products and co-products valorization/exploitation
Task 5.1 Recovery and valorisation of residual lignocellulosic biomass
Task 5.2 Recovery and valorisation of seed panel
Task 5.3 Recovery and valorisation of glycerol

WP6 – Sustainability and standardization
Task 6.1 Techno-economic analysis
Task 6.2 Environmental, economic and social sustainability
Task 6.3 Economic model for building the 3rd generation biorefinery
Task 6.4 Standardization/certification

WP7 – Dissemination and exploitation
Task 7.1 Dissemination
Task 7.2 Exploitation

WP8 – Management and coordination
Task 8.1: Project coordination
Task 8.2: Consortium management
Task 8.3: Administrative, financial and contractual management

WP1 - Objectives

- **Main Objective**: To **demonstrate** at **large scale** the **cultivation** of **cardoon crops** in identified marginal lands through the implementation of **sustainable agronomic protocols** for fields cultivation management aimed at **reducing inputs** and **increasing seed yield** as well as to demonstrate the **implementation of innovative oil extraction techniques** towards the obtaining of sufficient oil quality, reduction of waste streams and improved energetic performances.
- Specific objectives:
  - Large scale cultivation of cardoon crop in identified marginal lands
  - Implementation of sustainable agronomic protocols for the reduction of required inputs for crops cultivation
  - Optimization of harvesting, separation, storage and transportation of the collected fractions
  - Implementation of innovative mechanical treatment for oil extraction with reduced energy requirement, decreased loss and improved oil yield

WP1 – Partners &Tasks

- **PARTNERS INVOLVED IN WP: NOVAMONT, MATRICA**
- **MONTHS 1-48**

- **TASKS:**
  - TASK1.1 – Dry cardoon cultivation and fields management
    - TASK LEADER: NOVAMONT, no other partners involved
  - TASK1.2 – Oil extraction and characterization
    - TASK LEADER: NOVAMONT; INVOLVED: MATRICA
  - TASK1.3 – Selection of other source of oil
    - TASK LEADER: NOVAMONT, no other partners involved

WP1 – TASK1.1

TASK 1.1 – Dry cardoon crop cultivation and fields managemenent

- **Purpose:** Establish a large scale cultivation system of cardoon crop in already identified dry marginal areas (c.ca 3-5 kha) by focusing the effort on the implementation of sustainable agronomic techniques allowing to improve the natural resources use efficiency and maximize raw material yields for the further requirements of the biobased value chain.
- **Optimization of crop rotation system** already developed and successfully tested at small-scale for the large-scale production
- **Intensive breeding program** aimed at improving the crop performances in terms of biomass yield and to stabilize the biomass quality traits during the multi-years cultivation cycles will be carried out
- **Chemical characterization** of these raw materials with reference to the crucial parameters for the subsequent industrial exploitation process.

WP1 – TASK1.2

TASK 1.2 – Oil Extraction and characterization

- **Purpose:**The purpose of the following task is to separate the fats from the other elements constituting the seeds
- **Optimization and implementation of** an innovative technology of seeds pressing already successfully tested at pilot scale to demonstrate its suitability to the cardoon crop seeds.
- **Measurement and characterization** of the extracted oil for the determination of the parameters of the process implemented in WP2 with particular reference to the contents of the saturated and unsaturated fatty acids, acidity and humidity.

WP1 – TASK1.3

TASK 1.3 – Selection of other sources of oil

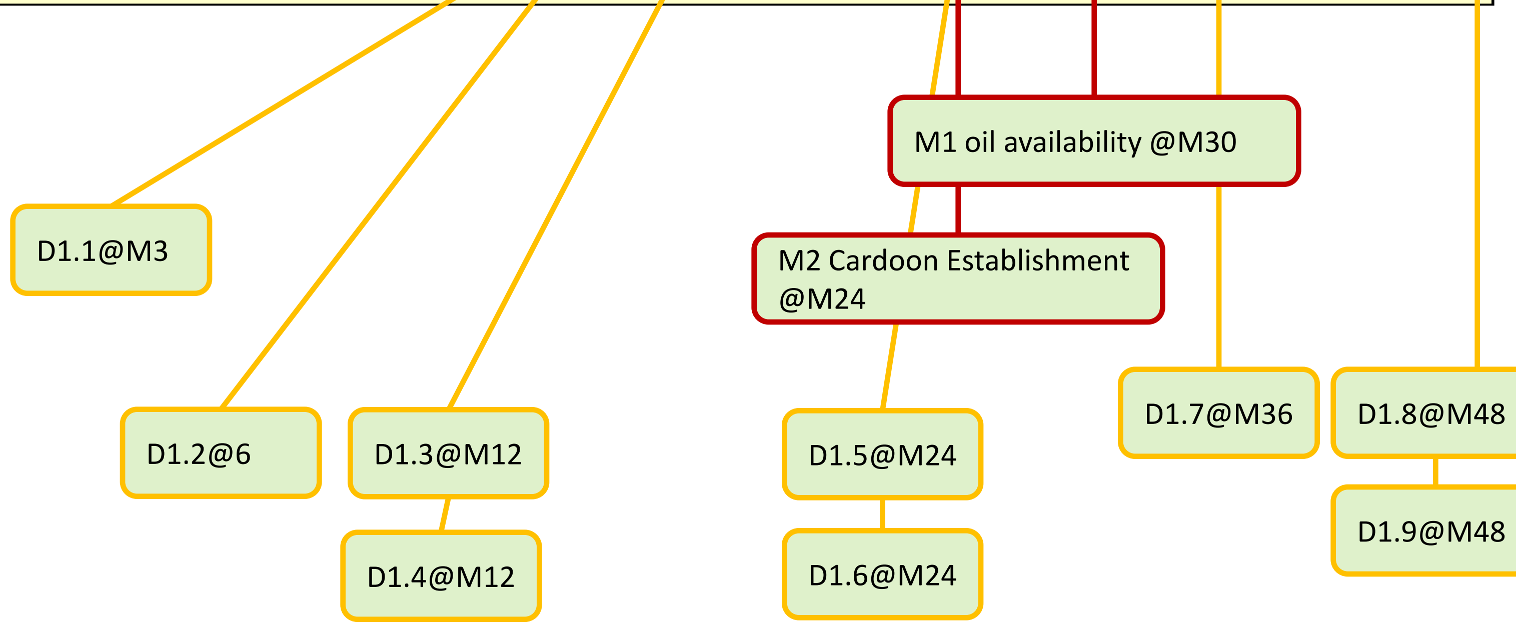
- **Purpose:** Preliminary and complementary activity will be carried out in order to identify additional oil source to be tested in WP2 during the first months of the project to assure the enough amount of oil for the implementation of the project activity especially when fields are still in starting phase and productivity is low.
- **Screening and Identification** of the most promising oil will be based on the following criteria: abundance, content of monounsaturated fatty acids, economic and environmental sustainability, ease of transport and storage in relation to plants proximity, competitive uses which might threaten their utilization in the proposed biobased value chain, avoided competition with food and animal feed chains.
- **Characterization of oils** and a **listing of pros and cons** for each oil.

WP1 - DELIVERABLES

- **D1.1** Report on the availability on the territory of oil sources with high potential of application in the biobased sector (Report M3)
- **D1.2** Optimized agronomic protocols for cardoon crop cultivation and fields management (Report M6)
- **D1.3** Optimized protocols for harvesting, separation and storage (Report M12)
- **D1.4** Optimized system for oil extraction from cardoon seeds and quali-quantitative assessment of oil and cake (Report M12)
- **D1.5** Feedstock industrial plan assessment (Report M24)
- **D1.6** First report on quali-quantitative assessment of the harvested fractions towards their industrial exploitation (Report M24)
- **D1.7** Intermediate reporton quali-quantitative assessment of the harvested fractions towards their industrial exploitation(Report M36)
- **D1.8** Final report on quali-quantitative assessment of the harvested fractions towards their industrial exploitation(Report M48)
- **D1.9** Large scale cultivation of cardoon crop(Demo M48)

WP1 – TIME SCHEDULING

WP/Task			Project Duration																																															
	Year		Year 1												Year 2												Year 3												Year 4											
	Month	LEADER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
WP1	**Feedstock: oil crops**	**NOVAMONT**																																																
Task 1.1	Dry cardoon crop cultivation and fields management	NOVAMONT																																																
Task 1.2	Oil extraction and characterization	NOVAMONT																																																
Task 1.3	Selection of other sources of oil	NOVAMONT																																																



WP1 – First 6 months' Planning

TASK 1.1 – DRY CARDOON CROP CULTIVATION AND FIELDS MANAGEMENENT

- **Harvesting cardoon plants** already in place to confirm the results obtained in the past years and to verify and optimize **the agronomic protocols (Deliverable 1.2: Report M6 on Optimized agronomic protocols for cardoon crop cultivation and fields management) and to test and characterize** seed, oil, proteic flour, biomass and roots.
- **Expanding cultivation area up to 700-1000 ha**
- **Starting up a breeding program to improve** the crop performances in terms of biomass yield and stability of the biomass quality traits.

TASK 1.2 – Oil Extraction and characterization

- **Producing pilot quantities (50 liters at least) of refined Cardoon Oil for testing and characterization**
- **Starting up basic engineering for crushing plant**

TASK 1.3 – Selection of other sources of oil

- **Screening and Identification of different oils (Deliverable 1.1 : Report M3 on the availability on the territory of oil sources with high potential of application in the biobased sector**

Contacts

- Luigi Capuzzi
- Luigi.Capuzzi@novamont.com
- T +39 0321 699619
- www.novamont.com