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## HOW SUSTAINABLE BIODEGRADABLE AND RENEWABLE MULCH FILMS ARE?

*A quantitative approach in the light of  
sustainable development goals*

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NOVAMONT - NOVARA,



Arcachon, 30<sup>th</sup> May 2018





## WHO ARE WE?

- OUR MISSION
- PILLARS OF OUR DEVELOPMENT MODEL
- OUR DNA



## INTRODUCION & AIM

- PLASTIC MULCHES IN EU
- THE UN MAP FOR SUSTAINABILITY
- AIM OF THE WORK



## INDICATORS AND SDGs

- ENVIRONMENT
- WASTE PREVENTION
- RENEWABLE MATERIAL
- ENVIRONMENTAL PRODUCT PROFILE
- PRODUCT FUNCTIONALITY
- ECONOMIC ASPECTS



## METHODS

- UN ROAD MAP TO SUSTAINABILITY
- SDGS



## CONCLUSIONS





## OUR MISSION

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Developing materials and biochemicals through the integration of **chemistry** and **agriculture**, by starting up **biorefineries** integrated in the territory and providing application solutions that ensure an efficient use of resources throughout their entire life cycle, with **advantages** for **social**, **economic** and **environmental** systems





# THE PILLARS OF OUR DEVELOPMENT MODEL

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## BIOECONOMY AS TERRITORIAL REGENERATION

NOVAMONT is the international leader in the **bioplastics** sector and in the development of **biochemicals** and **bioproducts** obtained from the integration of chemistry, agriculture and the environment.

It promotes a **model of the bioeconomy** as a factor of **territorial regeneration**, based on three pillars:



### REGENERATION OF DEINDUSTRIALISED SITES

**Reindustrialisation** of no longer competitive sites thanks to **proprietary technologies first in the world** in order to create "**bioeconomy infrastructure**", integrated with the territory and interconnected



### INTEGRATED AGRICULTURAL VALUE CHAIN

Development of **low impact value chains** through the valorisation of marginal land not in competition with food production, integrated in local areas and connected with the bioeconomy infrastructure



### PRODUCTS CONCEIVED AS SOLUTIONS

Products and value chains are conceived and designed to provide **unique** and **sustainable solutions** for specific environmental and social problems.  
Elements of a system with broader impacts of the single product



# OUR DNA

NOVAMONT: A GROUP WITH A TRIPLE VOCATION

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- Turnover: 170 mln/€
- >600 people
- 4 production plants
- 7 compounding lines
- 4 discontinuous and 1 continuous polymerization lines



- 7,4% of investments compared to turnover
- 20% of people dedicated to research, development and innovation activities
- 4 world-first technologies
- ~ 1.000 patents



- 350 training activities since 1996 for young researchers and experts
- multidisciplinary training paths activated on complex projects





# MULCH FILM IN EUROPE

## MARKET & END OF LIFE

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- In Europe about **85.000 ton/y** of mulch films for agriculture are used, covering **460.000 ha**\*
- **End of life:**
  - ✓ Plastic mulches should be removed and disposed of properly
  - ✓ Most common end of life in EU is still landfilling (ca. 50 %), followed by incineration and finally mechanical recycling (data, 2014)
  - ✓ At the end of crop cycle mulches are heavily contaminated
  - ✓ Since January 2018: China prohibited the import of 24 types of waste categories, including agricultural films



\* Source: *Plasticulture*, 2016

# UN ROAD MAP TO SUSTAINABILITY

## SUSTAINABLE DEVELOPMENT GOALS

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ONU road map to sustainability – signed in 2015 by 198 countries - indicates **17 Sustainable Development Goals (SDGs)** and targets to be pursued by governments and private sector from now up to 2030



# AIM OF THE WORK AND METHODS

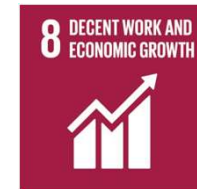
## BIODEGRADBLE MULCHES AND SDGs

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- In this work the biodegradable mulch films used for vegetable cultivations were analysed compared to SDGs
- This aims to underline the important role that these innovative products may have on the **territory**, on the **environment** and on the **society** if increasingly implemented in the cultivation practices
- The analysis addressed the case history of Mater-Bi biodegradable mulch film in **Italy on vegetable production**
- **8 SDGs** were identified to be applicable for mulch films, corresponding to **6 indicators**



SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture



SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all



SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation



SDG 12: Ensure sustainable consumption and production patterns



SDG 13: Take urgent action to combat climate change and its impacts



SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development



SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss



SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels





# ENVIRONMENT: BIODEGRADATION IN SOIL

SDG2, SDG 14, SDG 15

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**FACING PROBLEMS: plastic residues in soil**  
**(«white pollution»)**

**HOW A CERTIFIED BIODEGRADABLE MULCH CAN CONTRIBUTE?**

- ✓ Full biodegradability in soil
- ✓ No toxic effects

- **New EU standard to guarantee the stakeholders:**

**EN 17033: 2018 “*Plastics-Biodegradable mulch films for use in agriculture and horticulture-Requirements and test methods*” (CEN, 2018)**

Main features:

- Biodegradation > 90 % in 24 months at room T° in soil
- Ecotoxicology: thresholds or heavy metals, tests on plants, main soil organisms, nitrification test
- Mechanical and optical minimum requirement





# WASTE PREVENTION: PRODUCT CYRCULARITY

SDG 2 and SDG 12

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## FACING PROBLEMS: production of plastic waste difficult to recycle due to high contamination

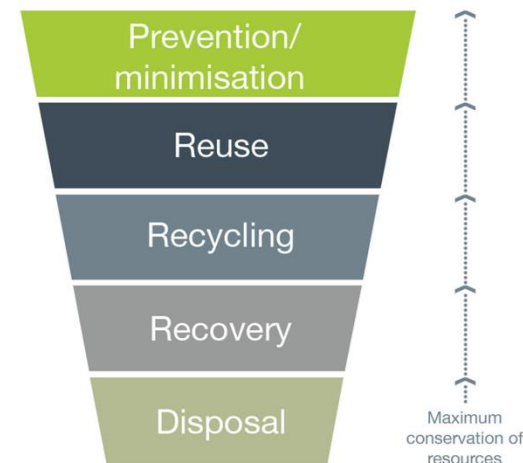
- ✓ high level of contamination on mulch films at the end of life: coefficient of 2,8 or 65 % of contamination rate
- ✓ contamination makes difficult recycling
- ✓ China restrictions to import solid waste

## HOW A CERTIFIED BIODEGRADABLE MULCH CAN CONTRIBUTE?

- ✓ IMPORTANT ASPECT LINK TO MULCH FILMS REMOVAL: loss of Soil Organic Carbon (SOC) present in soil
- ✓ Assuming a SOC percentage of 1,2% (i.e. about 2% of soil organic matter)\* and a soil contamination equal to two times the weight of plastic films:

**About 1800 tonnes of SOC are annually removed and loss from EU agricultural land**

Source: Sare, 2018





# RENEWABLE RAW MATERIALS: RENEWABLE CONTENT

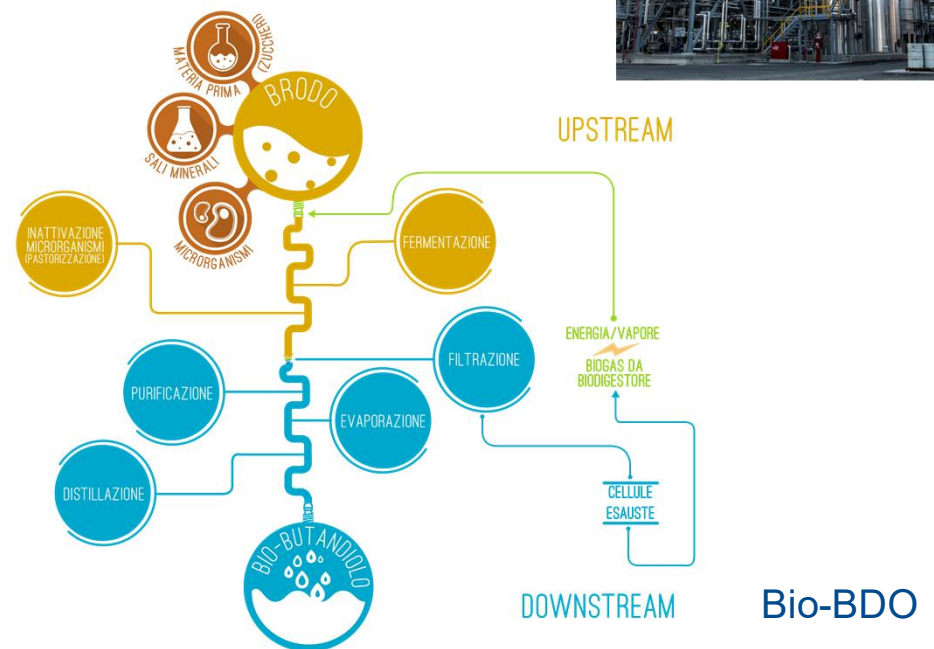
SDG 12 and SDG 9

11

**OPPORTUNITIES: implementing use of renewable resources**

## HOW A CERTIFIED BIODEGRADABLE MULCH CAN CONTRIBUTE?

- ✓ Novamont's policy on Mater-Bi production is to supply, whenever possible, of constituents and raw materials of biogenic (bio-based)
- ✓ The aim is to favour renewable resources for our feed-stocks







## ENVIRONMENTAL PRODUCT PROFILE: LIFE CYCLE ASSESSMENT

SDG 12 and SDG 13

12

### HOW TO ASSESS THE OVERALL IMPACT OF AN INNOVATIVE SOLUTION?

- Evaluation of the “Cradle to grave” environmental performance of two different mulch film systems (**traditional and biodegradable mulch films**) within the Italian context.
- functional unit (FU): “1 ha of mulched agricultural land”, corresponding to the use of 6000 m<sup>2</sup> of mulch film.

#### • Main outcomes:

- ✓ The granule production phase of both materials dominates the environmental impacts especially for carbon and energy footprints;
- ✓ the end of life treatments are significant for PE plastic mulch films (especially GHG emissions from incineration);
- ✓ for impact categories like Eutrophication and Acidification polyethylene granule production has a lower potential impact compared to starch-based bioplastic material, however, since a higher amount of plastic is required for the FU and considering the compulsory removal and the disposal phases, the environmental performance obtained is worse whichever end of life scenario is considered
- ✓ **the worse scenario** is represented by **landfilling** of **non-biodegradable mulch film** since neither energy nor material is recovered and
- ✓ the **overall reduction of the potential impacts** when biodegradable mulch film is used as an alternative to non-biodegradable plastic ranged **from 25 to 80%**.





# PRODUCT FUNCTIONALITY: FIELD TRIALS

SDG 12, SDG 13 and SDG 16

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## HOW A CERTIFIED BIODEGRADABLE MULCH CAN CONTRIBUTE?

- ✓ On the market since end of '90
- ✓ Being proved comparable in the field results to conventional plastic mulches in terms of mechanization, control of weed and crop quality and quantity
- ✓ Can be used with positive results on crops which are not normally mulched with plastic films:
  - rice, maize,
  - Processing tomatoes
  - vine



| Year | Treatment | Quantitative parameters          |                          |                                      | Qualitative parameters        |                        |
|------|-----------|----------------------------------|--------------------------|--------------------------------------|-------------------------------|------------------------|
|      |           | Total yield (kg/m <sup>2</sup> ) | Average fruit weight (g) | Non-mark. yield (kg/m <sup>2</sup> ) | Hardness (g/cm <sup>3</sup> ) | Soluble Solids (°Brix) |
| 2002 | BS        | 3.4                              | 1473.0 b                 | 0.1                                  | 1287                          | 10.9                   |
|      | B-LDPE-45 | 5.2                              | 1656.0 a                 | 0.0                                  | 1390                          | 12.2                   |
|      | C-LDPE-45 | 4.0                              | 1614.0 a                 | 0.0                                  | 1376                          | 12.2                   |
|      | B-MB-15   | 4.8                              | 1611.0 a                 | 0.0                                  | 1392                          | 12.7                   |
|      |           | ns                               | *                        | ns                                   | ns                            | ns                     |
| 2003 | W-P       | 4.8b                             | 2235a                    | 0.1                                  | 1400                          | 11.7                   |
|      | B-MB-12   | 7.0a                             | 2321a                    | 0.3                                  | 11.9                          | 7.2                    |
|      | B-MB-15   | 6.9a                             | 2399a                    | 0.2                                  | 11.8                          | 7.2                    |
|      | B-LDPE-45 | 6.6a                             | 2087a                    | 0.3                                  | 11.8                          | 7.2                    |
|      | BS        | 0.6c                             | 1392b                    | 0.1                                  | 11.4                          | 7.2                    |
|      |           | *                                | *                        | ns                                   | ns                            | ns                     |
| 2004 | B-MB-12   | 5.5abc                           | 1468a                    | -                                    | 1272a                         | 12.0a                  |
|      | B-MB-15   | 5.2bc                            | 1423a                    | -                                    | 1351a                         | 11.5a                  |
|      | B-LDPE-45 | 5.8abc                           | 1493a                    | -                                    | 1294a                         | 10.8a                  |
|      | C-LDPE-45 | 6.4a                             | 1393a                    | -                                    | 1327a                         | 10.8a                  |
|      | BS        | 0.2d                             | 698b                     | -                                    | 1018b                         | 8.9b                   |
|      |           | ***                              | *                        |                                      | **                            | *                      |
| 2005 | B-MB-15   | 4.0                              | 1422                     | -                                    | 1400                          | 15.3                   |
|      | C-LDPE-45 | 4.8                              | 1367                     | -                                    | 1400                          | 15.0                   |
|      |           | ns                               | ns                       |                                      | ns                            | ns                     |
| 2006 | B-MB-15   | 2.8                              | 1368                     | 0.3                                  | 1558                          | 11.8                   |
|      | C-LDPE-45 | 2.0                              | 1287                     | 0.3                                  | 1586                          | 13.7                   |
|      |           | ns                               | ns                       | ns                                   | ns                            | ns                     |

Table 2. Agronomical data from 2002 to 2006 on muskmelon in protected cultivation. Data analysed according to the Duncan's test. In each column the data with no letter in common are statistically different with a confidence interval of  $P \leq 0.05$ . Significance: ns= not significant; \* =  $P \leq 0.05$ ; \*\* =  $P \leq 0.01$ ; \*\*\* =  $P \leq 0.001$ .









## CASE HISTORY: RICE

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### Crop cycle in the field





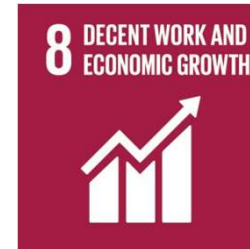
# ECONOMIC ASPECTS: ECONOMIC BALANCE

SDG 8

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## HOW A CERTIFIED BIODEGRADABLE MULCH CAN CONTRIBUTE?

- ✓ Analysis of costs from growers and growers association in Italy (North and South):
- ✓ Crops: zucchini, lettuce and melon



## CONSIDERATIONS:

- Cost/kg of a **biodegradable** mulch film: **2-2.5 times** the cost of a traditional plastic mulch
- removal and disposal costs of a traditional plastic mulch from **270 to 370 €/ha**
- **the total costs are very similar**
- No **clear indications on the cost of the overall recycling process or landfilling**















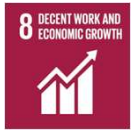


# CONCLUSIONS

## HOW BIODEGRADABLE MULCHES CONTRIBUTE TO UN ROADMAP TO SUSTAINABILITY

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Thanks to their peculiarities like innovation, biodegradability and renewability mulch films provide valuable insights also to the achievement of 8 out of 17 SDGs

| TOPIC |  | INDICATOR                                  | CORRESPONDING SDGs  |   |   |
|-------|--|--|---|---|---|
| 1     | ENVIRONMENT (SOIL)                     | Biodegradation in soil/ecotoxicity         |    |    |    |
| 2     | WASTE PREVENTION                       | Product circularity                        |   |    |    |
| 3     | RENEWABLE RAW MATERIAL                 | Renewable content                          |   |    |    |
| 4     | ENVIRONMENTAL PRODUCT PROFILE          | Life Cycle Analysis                        |   |   |   |
| 5     | PRODUCT FUNCTIONALITY                  | Mechanical Properties, agronomical results |  |  |  |
| 6     | ECONOMIC ASPECT (farmer's perspective) | Economic balance                           |   |   |  |



*""The challenge of our millennium is in the balance between the technical means that humanity possesses and the wisdom in how we will make use of them""*

UMBERTO COLOMBO



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**THANK YOU FOR YOUR ATTENTION**

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