On Behalf Of
Municipality of Ilida
Project Partner

A S.W.O.T. ANALYSIS
(Strengths, Weaknesses, Opportunities, Threats)

In Agricultural Plastic Waste Management Problem

In Ilida Territory & beyond

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A.W.A.R.D.
Agricultural Waste valorization for a competitive and sustainable Regional Development

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Deliverable 3.2.3.
Introduction

This research is part of a European program AWARD (Agricultural Waste valorization for a competitive and sustainable Regional Development) which is held under the auspices of the 3rd call for EUROPEAN TERRITORIAL COOPERATION PROGRAMME GREECE - ITALY 2007-2013.

Project Partner: Municipality of Ilida (M.O.I)

Ilida’s economic development and competitiveness hinges upon the agricultural sector. It is generally accepted that agriculture should take care of the environmental impacts and the health of the people, in combination with the quality of its agro products. M.O.I. as an AWARD partner is intended to act as the prime agent for the realization of the interested parties’ efforts for a vibrant and internationally competitive sector.

The aim is to organize the removal of agro plastics waste and in which the parties involved will harmonically cooperate for the benefit of all. The parties have been commissioned to inform for the development of a future APW strategy. It is a major subject of interest for a wide audience, including the farming industry, the state, NGOs and the agro-plastic waste management industry.

Conducted by: Heliospho Ltd. (subcontractor)

Heliospho is a company located in Patras, an adjacent to Ilida city, specializing in Renewable Energy Sources (RES).

Heliospho, as an Ilida Municipality’s subcontractor (14SYMVO02408013 2014-11-17 contract number), is an integral part of the program AWARD’s parties, to support the study and propose management of the agro plastic waste problem. It is the first accredited specialized center with ISO 9001.

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The Heliospho team
SWOT ANALYSIS

REPORT

Introduction

Agricultural Plastics are extensively used by farmers, in a wide range of applications. It is estimated that without plastics in agriculture, 60% of the fruit, vegetable and dairy production would be at risk. In general:

- Agro-plastics improve crop production in quantity and quality.
- Agro-plastics reduce the use of pesticides, fertilizers and water.
- Agro-plastics are:
  - non-dangerous, made with no dangerous additives.
  - made of homogeneous polymer (LDPE, HDPE, PP).
  - easily recyclable if collected and cleaned.

A typical use is classified as:

- Non packaging (silage, nets, twines, films, greenhouse covers, irrigation, pots, etc.)
- Packaging (pesticides, fertilizers, dairy, etc)

Farmers generate plastics’ waste and are incapable of handling that waste properly, technically and financially. They need and expect reliable and durable technical and economic solutions. So far, the free market alone has not been able to offer to farmers and growers reliable and durable solutions. This is the reason why National Collection Schemes should be developed.

The most common polymers in the agricultural plastic waste stream are LDPE and PVC, in general PP, PE. LDPE accounts for around 60-65% of the waste stream while PVC represents 18-23%. The following Table lists the types of polymers used in agricultural applications. LDPE can be used in all types of bags and nets, while PVC is used to manufacture pipes and fittings. Some PP is found in ropes and bags.
### Application and Type of Plastic

<table>
<thead>
<tr>
<th>Application</th>
<th>Type of plastic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer bags, liners</td>
<td>PP, LDPE</td>
</tr>
<tr>
<td>Seed bags</td>
<td>PP</td>
</tr>
<tr>
<td>Feed bags</td>
<td>LDPE</td>
</tr>
<tr>
<td>Agrochemical containers</td>
<td>HDPE</td>
</tr>
<tr>
<td>Pots and trays</td>
<td>LDPE, HDPE, PET</td>
</tr>
<tr>
<td>Pipes and fittings</td>
<td>PVC, LDPE</td>
</tr>
<tr>
<td>Nets and mesh</td>
<td>LDPE, HDPE</td>
</tr>
<tr>
<td>Rope, strings</td>
<td>PP</td>
</tr>
</tbody>
</table>

**PP**: Polypropylene  
**LDPE**: Low density polyethylene  
**HDPE**: High density polyethylene  
**PVC**: Polyvinyl chloride  
**PET**: Polyethylene terephthalate

### Plastic waste types at different farms.

<table>
<thead>
<tr>
<th>Type of farm</th>
<th>Generated plastic waste</th>
</tr>
</thead>
</table>
| Dairy farms        | Stretch films of silage bales  
                      | Clamp films  
                      | Large sacks (fertilizers and seeds)  
                      | Canisters  |
| Piggeries          | Large sacks (fertilizers and seeds)  
                      | Canisters  
                      | Polyesterene boxes  |
| Grain farms        | Large sacks (fertilizers and seeds)  
                      | Canisters  |
| Vegetable farms    | Clamp films  
                      | Greenhouse films  
                      | Small sacks for fertilizers |
The AWARD project

“AWARD: Agricultural Waste valorization for a competitive and sustainable Regional Development”

The AWARD program executed in Greece and Italy at the eligible territories involves the following steps to accomplish its aims:

2. A Data Analysis.
3. A Pest Analysis.
4. A SWOT Analysis.
5. Strategic plan to develop a suitable Agro Plastic Waste management schema.
6. Pilot schemes (pilot collection station, experimentation, GIS pilot implementation e.t.c.)

In order to perform a suitable SWOT Analysis some key concepts must be identified:
- The Beneficiary of the SWOT analysis.
- Its aims.

The Beneficiary:
Typically the beneficiary is Ilida’s eligible Territory. But in practice all the parties mentioned and involved are benefited.

Its general aims:

To enhance the competitiveness of agricultural firms, by reducing the costs of APW collection and disposal and by exploiting it, through re-use.

To put special emphasis on the fact that the APW integrated management both benefits the competitiveness of agriculture and protects the environment.

The more Specific Objectives:
1. Exploiting technology (GIS) for data collection and analysis and trans-national policy concerning APW reduction and disposal.
2. Promoting the application of EU and international standards in local public policies, in order to reduce waste flows.
3. Piloting a temporary station for APW disposal, cleaning and re-use
4. Transferring technology to small agricultural businesses based on non-recyclable plastics with cleaner innovative solutions and on the optimization of the waste management.
5. Raising farmers’ awareness on utilizing APW.
6. Fostering the creation of new small businesses in the field of collection and recycling of plastic waste.
7. Mainstreaming results in regional/national policies.

The case:

The plastic waste of the agricultural sector of both Puglia and Western Greece regions is for the most part inappropriately disposed, with serious hazard and danger to the farmers themselves, the agro -food consumers and the environment.

The causes:

i. Difficult collection of APW from the several and widespread small farms.
ii. Bureaucratic requirements, legislation gaps and difficulties on regulations’ implementation.
iii. Lack of information and motivation of farmers.
iv. Lack of an appropriate waste management system,

Questions based on the green paper are (Brussels, 7.3.2013 COM(2013) 123 final):

(1) Can plastic be appropriately dealt under the existing legislative framework for waste management or the existing legislation needs to be adapted?
(2) How can measures for the promotion of greater recycling of plastics be improved, so as to ensure positive impacts for enhanced competitiveness and growth?
(3) Would full and effective implementation of the waste treatment requirements in the existing garbage dump legislation, reduce sufficiently current landfilling of plastic waste?
(4) What measures would be appropriate and effective to promote plastic re-use and recovery over landfilling? Would a landfill ban for plastic be a proportionate solution or would an increase of landfill taxes and the introduction of alternative solutions be sufficient?
(5) At what stage or time is it appropriate to opt for plastic waste energy recovery, since the mechanical recycling can no longer be applied or is non
preferable due to economic reasons?
(6) Should individual- on the spot- collection of all plastic waste, combined with pay-as- you-throw schemes for residual waste, be promoted in Europe, or even be made mandatory?
(7) Are specific plastic waste recycling targets necessary, in order to increase plastic waste recycling? What other type of measures could be introduced?
(8) Is it necessary to introduce measures to avoid substandard recycling, or dumping of recyclable plastic waste without being exported to third countries?
(9) Would further voluntary actions, in particular by producers and retailers, be suitable and effective means for achieving better duration of the life cycle of plastic products?
(10) Is there scope to develop deposit and return or lease systems for specific categories of plastic products? If so, how could negative impacts on competition be avoided?
(11) What type of information would you consider necessary to encourage consumers to make a direct contribution to resource preservation, when choosing a plastic product?

DATA

The Heliospho team (Partner 5) undertook with Partner 6 (Innopolis) interviews of the stakeholders and data collection in Ilida. Data & Data analysis are presented at the PEST deliverable. Since neither the farmers, nor the sellers register officially the exact figures of agro plastics in-out, the various types of plastics used, a further research should be conducted.

Data and Economics of Recycling and Energy recovery

Agro Plastics RRP / ton = 1,500 – 2,000 € depending on the purpose
1 acre requires on average 1,000 kg/year
The Recycling process is schematically shown as:

Step 1: Farmers purchase the required plastics from Plastic producers or the relevant shops.
Step 2: Farmers “produce” APW every year (some plastics have a life expectancy of around 3-5 years but different cultivating periods can differentiate it).
Step 3: Collectors pick up directly from the farmers land only the relatively free of dust, soil and humidity plastic waste in gratis (and may or may not sort it).
Step 4: Collectors sell the raw material to recyclers at a price of 70-100€/ton in average.
Step 5: Recyclers produce from the waste the granulated regenerated plastic
and may also produce plastic products like garbage bags.

Step 6: Recyclers sell the regenerated plastic to Plastics Industry at a price varying with a maximum of 550€/ton, having a process cost of 150-200€/ton.

Ilia’s agro waste plastic “production” is estimated at 8,000 net tons/year, that means an average of 16,000 tons “gross” (mostly mixed with soil and less with humidity). Ilia’s recycled agro plastic waste is estimated at 20% i.e. 1,600 tons yearly.

In Ilia ex-Prefecture, the area of interest, according to the general study data for a civil solid waste factory to be constructed-from a projected 2020 data-of about 100,000 tons of municipality solid waste per year, there will be about 8% of plastics (film, PET, PVC etc). It is estimated that 8,000 more tons of plastic waste coming out of the municipality solid waste, will be produced at the area.

A recycler located in Preveza area has a recycling capacity of around 7000 tons / year for PE and PP. On the other hand a recycler located in Ilida actually processes around 500 tons yearly, as calculated by his balance sheet (Names and data are withheld). Both recyclers do not treat PET plastics, so their interest is at films, especially agro films. It is noteworthy that the recycler in Preveza imports plastic waste from Italy, especially from the AWARD program’s eligible area. There is also a recycling factory at Tripoli (not too far from Ilida), which is specialized at municipality solid waste recycling. Because the cleansing machines remain the same, as well as the whole recycling process and only the regenerating plastic process lines are different for PET – PE/PP, it is therefore easy for such factories to expand the plastic waste range of use.

The APW cycle: the Parties involved

The Producers:

In Greece there are a few dozens of agricultural plastic producers. (The Greek plastic industry association has 42 members). Usually these producers have a large gamut of plastic products, with uses not only for the agricultural field. The capacity and the turnover of these companies are very different. There are small companies, as well as companies with turnover of more than 100 million EUR annually.

The estimated use of agricultural plastic in Greece is 80,000 tons per year. A few low capacity recycling factories operate near the areas of disposal. A network of collectors has developed, but due to high transportation costs and the lack of incentives, they only deal with their nearby farmers. They are interested more in recycling the heavy and clean plastics due to economic reasons. According to them, 25% to 30% of the used APW is recycled or reused. Lastly, the preliminary results of a survey carried out by Heliospho, show that the AP
industry acknowledges the same problems that AWARD tries to resolve.

It is worth mentioning that the producers of plastic are willing to use recycled plastic; they encourage the farmers to give their APW to the collectors and also larger companies are involved in the recycling sector, too. They have extended knowledge and experience of the technical issues of recycling plastic. They indentify the recycling market as a promising one and potentially with good profits and prospective. A find of the research is that the plastic industry pays a special fee, an amount on every invoice issued, at EOAN (National Organization for Recycling) for the management for the plastics used for packing. No fees are been applied for the agro plastics and therefore no management system for APW is funded by EOAN.

The Farmers:

The majority of the farms in Ilida are small with ≤5 ha per farm, on average. They are dispersed all over the territory and their products are not necessarily the same with others in their proximity. Thus different APs are used, depending on the kind of their products and the method of coverage, resulting in very different disposals. According to them, approx. 20 to 25% of APW is collected or reused. The rest is burned, buried in the soil or disposed in landfills. Especially for the thinner films there is no interest of collection. There is also no interest in the collection of the plastic containers of the pesticides. We must pinpoint here that a management system, especially for these plastics does not exist. Farmers are not obliged to be integrated in a waste management system. They take no compensation for the plastics they give to the collectors. The collectors pay for the labour they use for the collection. Many farmers are now aware of the health and environmental issues APW causes.

The consequences of plastic buried in landfills are significant. It is of utmost importance to note that in spite of being a man made chemical product, it can take many years to disintegrate. Taking this for granted, the recycling of plastic is still vital, as the holding capacity of landfills is limited.

The new concepts of biodegradation (where starch additives are incorporated in plastic) and photo degradation (where photo sensitive additives are integrated in the manufacture of plastic products) have been controversial regarding commercial applications. Light and air must be available in order for the biodegradable and photodegradable materials to disintegrate, along with sufficient moisture and nutrients to sustain microbial action (Alter, 2003) (Boettcher, 1992). Thus, the deeper these plastics are buried in dumps, or in the soil, the less likely they are to degrade. “Moreover, making plastics degradable would lower the quality and performance of the material and therefore would mitigate some of its major desirable features in various applications” (Siddique et al., 2008, p.1839).
For all the above, it is reasonable to conclude that the market for plastic recycling is not threatened by biodegradable and photo degradable plastic products. Due to the higher manufacturing costs of these products compared to regular plastics, and the lack of environmental benefits, firms are not willing to replace conventional plastic products in the near future.

The effect of burying APW in the farms' soil is: Choked soil (plastics in the soil do not allow the free flow of water and air, preventing plant life); Blockage of drains (films choke drainage and sewerage systems, thereby causing functional disruption and leading to water clogging which in turn leads to environmental health problems); Animal deaths (plastics ingested by animals result in death by obstructing their intestines); and Food hazards (this is a hazard associated with the additives used to films which permeate into food products).

The farmers usually produce via their plastics, five main polymers; polyethylene (PE), polypropylene (PP), polyethylene terphthalate (PET), Poly Styrene (PS) and Poly Vinyl Chloride (PVC).

The Collectors:
There are mainly very small-labour companies that collect the APW from the farms, on the basis that they "relieve" farmers of the burden of having to deal with tons of APW by themselves. No compensation is given to farmers.

Therefore it is logically expected that a preferential "selection" treatment is established on the basis of collection convenience, the cost of it and the cleansing condition of the APW. Since Ilida's consumption is about 5,000 to 8,000 tons of APW -25% reported to be collected annually- an average of 1,250 to 2,000 tons in total would give in theory the maximum quantities for all the collectors involved.

The collectors still handle a positively priced AP material. This is feasible because they can choose which APW will be collected. But as it happened with the plastic packaging material recycling market, that saws a Negative-pricing (the industry parlance for paying someone to take the recycled materials), if they increase the collected percentage of APW, this may not longer continue. The labour costs and the transport costs are high. Moreover the license issue for a legitimate collection station, according to them, is very time-consuming, due to bureaucratic reasons and uneconomical, too. Thus another matter is the unlicensed collectors, who collect APW uncontrollably.
The Transportation:

The road network of Ilida is of poor quality. This is also the situation for the rest of Western Greece. No highways, no train, no scrap cargo ship lines. Thus the cost of APW transportation, frequently dealing with transshipment to recycling factories, is getting higher. As a consequence, this calls for the construction of low capacity recycling factories only in nearby areas.

The cost for the transport of a full load truck from Ilida to Bari is approximately 700 to 800 euros depending on the time period. The dimensions of the truck trailers are 13.6m X 2.4m x 2.5m and the maximum transport weight of 24 tns. Due to volume limits of the trucks or containers, it should be taken into account that it is difficult to load a truck at full weight. The volume of an unrolled plastic film is greater than a rolled one. Even if strong presses of 100bars will be used, to compress the APW, the transport cost per ton could not fall below 35 to 40 EUR.

It is worth mentioning that a few months ago the city of Pirgos has made a contract award, for the transport of solid waste from Pirgos area to a landfill at Naupaktos. The distance is about 150 km. The cost per ton is 29EUR.

The main problem for the transportation of the APW is the large amount of dirt and humidity that the used films have. Even up to 75% of the cargo can be dirt and water. The thinner the film, the greater the problem. According to the collectors, the difference in the amount of dirt and water between thick films and thin films, especially if certain measures by the collection do not apply, could be up to 100%.

In order to lower the costs of transportation, it is essential to construct local collector stations, where cleansing and sorting processes will be applied to APW, before transported to recyclers and regenerators. Then the material should be compressed. By evaluating the quantities a more competitive transport price could be arranged, therefore optimizing use and cost of transportation.

The Recyclers / Regenerators:

The recycled plastics’ industry is based on a strong demand for the use of recycled plastics, in plastics’ packaging. It is the packaging industry’s response to consumers’ requests to see some recycled content in the packaging of the products they purchase, as part of their own zero waste principals and environmental consciousness. Until early 2008, before the global recession affected the entire economic activity, markets and uses for recycled plastics expanded rapidly. Although the current economic crisis is a downfall for any start up business, a plastic recycling company has great potential to succeed.
However, new markets can be created for plastic products, and recycled plastics, as we have created many markets so far.

The aim of the EU is to reach a rate of recycling of plastics up to 60%, in addition to regulating the activities of plastic recycling. For a successful APW recycling company, it is mandatory that it will be capable of processing very dirty and contaminated greenhouse films, that none of the other packaging recycling companies could accept. Moreover, sorting and washing also needs space and technology, to give high-quality product for processing. Water management is also an issue.

There is only one recycler in the Ilia territory and recycles mainly the clean greenhouse films and water line systems. Bag production can be combined with recycling, too. Lastly the cost of recycling is a major issue. Ilia’s recycling economic plans are discussed in the Data and Economics of Recycling section.

The Incineration plants:

The alternative to recycling is incineration. Actually burning APW serves two purposes: a) Get ridding of the burden which is a residue of waste and b) use of APW to create energy / heat.

The Energy / Heat Industry:

For waste residues not suitable for further material recovery, such as recycling, energy recovery by combustion is probably the only alternative to landfill disposal. This is especially true when dealing with waste residues of high calorific value and low biodegradability, such as plastics. Highly degraded or soil contaminated plastics that cannot be mechanically recycled, can be successfully used as an alternative fuel in power plants or in cement factories. In energy recovery the plastic behaves as fuel: 1 ton of plastic gives off as much energy as 1 ton of oil (Barrales-Rienda 2002).

Agricultural plastic waste could make an ideal replacement for regular fuels. By using plastic as fuel, other primary energy sources, such as gas, oil or coal, can be conserved. This therefore fulfills the basic idea of recycling, i.e., to conserve raw materials and reduce waste.

This is an industry totally lacking in the area, although it is highly involved with the transformation of APW to energy, at the same rate with oil. There are no adjacent electricity plants, nor heat providing ones. Nor natural gas pipelines or LNG Deposit stations. They haven’t been planned to be constructed in the near future, too. The nearest cement factory is at Patras and the nearest
lignite factory at Megalopoli.

The cement factories are more interested in RDF (refuse derived fuel) because of their technical specifications. A direct burn of APW has technical issues concerning the temperature achieved in the incinerator. Pilot tests have been made at the cement factory in Chalkida. We must also take into account that the demand for cement has dropped rapidly over the last years, due to the economic crisis. Therefore the APW use at the lignite station in Megalopoli seems to be more adequate. The lignite quality in Megalopolis is poor; that means it has a low percentage of pure lignite per ton. Therefore, even a direct burn of APW could be considered. Of course, special studies should be made.

The Inhabitants:

The awareness of the APW causing environmental problems is not satisfactory. People are familiar to using the plastic packing of the agro products but they don’t know much about APW.

The recycling logo does not really mean that the recyclable product will be recycled, it just denotes what type of plastic it is, based on the number in the center; the plastic industry refuses to change the misunderstood symbol. “67 percent of people believe that the recycling symbol guaranteed recyclability” – stated the David Sadiki study in California (Morrison & Ellenwood, 2008). Even though the benefits of recycling over disposal are manifold, individuals should keep in mind that it better serves the environment to “reduce and reuse”, before “recycling” even becomes an option.

The Local Authorities:

In Greece most of the LAs are involved in the collection and separation of the so called recyclable materials. In terms of plastic waste, this comes mainly by plastic packaging, collected and dumped or picked by companies for processing.

The LA of Ilia has programmed to build a municipality waste management factory that will be able to process civil solid waste. LAs do not have an acquired network of heat / natural gas/ pipelines in West Greece. Therefore there are no energy recovery plants, yet.

It is noteworthy, that the municipalities are not responsible for not urban municipality waste. Therefore industrial waste, as well as APW, is not their responsibility. The FoDSAs (Management Bodies of solid waste), are the authorized bodies for the specification and implementation of the objectives and activities of the Regional Solid Waste Management Plans, particularly for temporary storage, transshipment, recovery and disposal of waste.
Key issues for a functional management system are:

a. A clear and explicit state will for the formation of a reliable APW management. Proper legislation enforcement.
b. Control measures to impose collection and management.
c. Financial resources for a management system to function smoothly and without obstructions.

A first step towards this, is the analysis of the so called AWARD system, based on SWOT that will result to a decision making process and possibly to a well defined Business, Management and Operating Plan of the "best" solution.

Waste Hierarchy according to EU legislative framework (source: EU Directive 2008/98 EC)
The table below shows demands, strengths and weaknesses of the two process methods; material recovery against energy recovery.

<table>
<thead>
<tr>
<th>Utilization method</th>
<th>Demands for the material</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material recovery</td>
<td>• Clean material needed&lt;br&gt;• Different plastic fractions have to be separated from each other</td>
<td>• Higher in the traditional waste hierarchy&lt;br&gt;• Public acceptance&lt;br&gt;• Raw material conservation</td>
<td>• Often high cleaning costs&lt;br&gt;• Difficulties in finding suitable material in large scale&lt;br&gt;• Transportation costs of the plastic waste&lt;br&gt;• Plastics which are exposed to the sun for long time, as well as old plastic is difficult or even impossible to be regenerated&lt;br&gt;• Efficient waste management systems should be applied&lt;br&gt;• Public awareness is needed</td>
</tr>
<tr>
<td>Energy recovery</td>
<td>• No separation of the materials needed.</td>
<td>• Economic&lt;br&gt;• Plastics have an excellent colorization value&lt;br&gt;• Replacement of fossil fuels</td>
<td>• Public acceptance&lt;br&gt;• Large investments&lt;br&gt;• Continuously and sufficient flow of waste is needed&lt;br&gt;• Health risks especially from air pollutants&lt;br&gt;• High environmental standards must be applied</td>
</tr>
</tbody>
</table>

The whole production, use, collection, transportation, recycling and energy recovery need to be considered as a system that provides incentives to anyone involved and be addressed accordingly. As a result, the parties involved may seek to optimize their profit.

**Organization formations for the certification of APW management**

EOAN (National Organization of Recycling) is the public body responsible for the license and function of sustainable recycling management systems in Greece. They do not have sufficient knowledge of the APW problem and therefore no measurements have been taken. The farmers need for the distribution of their products, certifications for integrated management of agricultural products. These certifications are issued by certified centers. Although the APW management is part of the certification, no serious control measures are taken.
THE SWOT TABLE:

STRENGTHS

Ilida’s, and Farmers’ strengths:
- Majority of agricultural Population.
- Vast market for agro products.
- Cheap labour.
- Water and electricity availability.
- Geographical position.
- Increasing agro production.
- Increasing flow of APW.

Collectors’ strengths:
- No serious competition.
- Almost charge free APW to be collected.
- Cheap labour.
- Ability to select only the cleaner APW.
- Vast amounts of APW.

Recyclers’ strengths:
- No serious competition.
- Almost all regenerated production is sold.
- Cheap labour.
- Ability to select only the cleaner APW.
- Vast amounts of APW.

Municipality’s strengths:
- A bio Waste Factory is to be constructed.
- Landfills already in place.
- Cheap labour.
- A national highway is under construction.
- A small and easily accessible population to be informed.
- PPP schemas are promoted by the state.
- GIS can be easily applied.

WEAKNESSES

The local authorities and organizations for waste management do not have any guidelines for Agro plastic waste management. The same situation applies at national level, too. The existing legislation is very general (no burning, no throwing in the land, “the polluter pays” and so on) but does not specify
where agro plastic waste can be disposed. So the whole responsibility is transferred to farmers but with no control mechanisms and no farmers’ incentive and reward plans.

The Local Authorities do not manage agro plastic wastes, although they already do that for their citizens and domestic waste. Of course a new or spin off schema could be easily formed to (e.g construction of low cost collection places etc).

Major weaknesses in the area can be considered to be the lack of major infrastructure networks such as:

- Natural gas (heating networks)
- Train (lower transportation costs of waste)
- Commercial Port

The planned waste factory construction (now at the bid process) will handle only bio waste and composting, with no plans for handling plastics. The recyclable material will be separated but, for the time being, there are no specified plans for their treatment. So apart from the bio waste average of 18,000 tons/year, another equal amount is also disposed in the landfills. The study does not have current data of waste per type category.

Collectors and recyclers do not have an efficient marketing and communications’ scheme. They highly depend on the clearness of the APW. The expansion of business does not seem to be in their priorities. Collectors especially depend on the free of charge collection. The collectors are not willing to collect small quantities of APW or thinner films, especially at smaller farms, because of transportation costs.

Weaknesses summarized:

- No APW managing schema.
- Lack of awareness.
- Lack of technology and equipment.
- Weak economic situation.
- Lack of transportation infrastructure.
- No standards for using agro plastic recycle.

**OPPORTUNITIES**

Getting agro plastics waste properly handled means avoidance of soil, agro products’ and environment’s pollution, as well as public health risks. No plastic should be thrown to landfills, be burned open air uncontrolled or buried in the soil. At the same time the local communities could get substantial financial benefits, as increased labour would be needed for collection, transportation and recycling.
Agro Products’ quality could be further improved by:

- Avoidance of further soil contamination—better food safety.
- Even more 70% of agro waste plastics to be recycled.
- Increasing the quantity and quality of recycled plastics by enforcing plastic waste administration system and new recycling technologies.
- Expansion of Ilida’s potential market (local and external).
- Using the experience in plastic recycling by the project’s partners and experts.
- Recycling businesses’ potential to expand their market (local and export) by including plastic packaging.
- Prevention of Olympia’s territory from the plastic waste consequences by millions of water plastic bottles, disposed by tourists every year.

Business opportunities in the field of agricultural plastic waste (APW).

It is very important and useful that APW can actually be a resource: if correctly recovered and recycled, it can become a source of energy.

In the agricultural sector plastic is used with increased tendency. The use of plastic reduces the needs for chemical pesticides, fertilizers and water. On the other hand an integrate management system for the plastic waste is not applied. In Greece about 80,000 tons of agricultural plastic -mainly PE and PP- is sold and only about 20% to 25% is recycled per year. The rest is buried or burned at the fields illegally and with severe environmental cost. At the same time about 1,5 million tons APW are sold annually in the E.U. The information that we have from other EU countries is similar to the Greek reality.

The PE and PP plastic waste can be regenerated up to 3-5 times and an amount of 80 to 99% from the original product can be won back in each cycle. Every time the plastics are regenerated, the result is a product of lower quality and with other technical specifications than the original. That means that the regenerated product has inferior value to the original and the technical usage of it is therefore more limited. Nevertheless, plastics are excellent fuel for incubation stations because plastic colorization value is equal to oil. Regeneration does not affect the colorization value of plastic.

The price for a ton of regenerated plastic (pellet) is between 450 to 550 EUR (2nd quartal 2014). We should consider that the price of oil and natural gas
affects the final price of plastics. In the 1st quartal of 2015 the price of the oil barrel (125 lt) is around 50USD and that is 30USD lower than in the 2nd quartal 2014. Natural gas which is used at electricity thermal stations has the same devaluation. Also USD / EUR rate should be considered. At the period from the 2nd Q 2014 to the 1st Q 2015 euro has been devaluated 12% against USD.

The farmers are interested in getting rid of the plastic waste and they give it to the recyclers with the only obligation to collect it at their own expense. About 70 to 100 EUR are paid by the recycling stations to collectors per ton they supply (2014 prices). The cost for the plastic regeneration procedure is about 150 EUR per ton, depending mainly on the energy cost, the machinery type and the contamination of the plastic waste. The investment for a regeneration station with a capacity of 8,000 tons annually is about 500,000 to 600,000 EUR. In the case that RES (Renewal Energy Systems) for energy saving are integrated, the investment will be about 1,000,000 EUR. The project can be subsidized by the EU and also financed by the European Bank.

New projects and studies for PET plastic regeneration can be introduced easily and at a low cost. Household plastic waste is also a large sector. For example the production of plastic bags is also very profitable. One ton of garbage bags for example, is sold at the wholesale price of 1,500 EUR (2nd Q 2014). The wholesale prices for agro films is also in the range between 1,500 to 2,000 EUR per ton.

It should be also considered that as the recycling sector is an innovative one, continuous research is taking place and new and more effective and profitable techniques and machinery are introduced every year.

**THREATS**

Recycling does not pollute the environment by releasing chemical gas. The soil dispensed can be easily regenerated. Neither chemical liquids are used, nor any toxic substances. Therefore there is no question on the success of a recycling process.

Greece was requested to close down all non-compliant landfills. Instead organic dumps’ facilities should be constructed. Today this requirement is not yet fulfilled and therefore the pressure on existing ones is very high and large penalties are continually imposed.
The cost of a plastic recycling plant or an incineration plant is high. Due to the large amounts the project implementation should be closely monitored. In this field, everything depends on "selective and clean collection at source", ie on the field of every farmer. Also, the present initiatives are only partially supported and promoted, which discourage others to consider recycling APW as an example of good practice! The lack of interest shown by the local authorities deepens - but it should not - the gap between the existing burn or throw away practice and the responsible attitude over waste and the environment, just by putting the blame on economic hardships only.

APW management has become a worldwide priority. The failure in taking early necessary measures leads to major environmental and Public Health risks. All the parties involved should also take into serious consideration that APW current burn or bury practice reduces the quality of agro products, thus endangering exports through failing quality requirements and food standards. The costs of an integrated management system will affect the prices over the agricultural products, but the environmental and food quality gains are obvious.
FINDINGS AND DISCUSSION on SWOT Analysis

In Greece, the Greek Recycling Organization (EOAN) and the local FoDSA are the authorized ‘players’ in the field of organizing Waste Management. The state also endorses projects concerning awareness on environmental issues. In schools of all grades there are more and more environmental activities for recycling and recovery of the waste etc. Several environmental campaigns take place, too. The APW is a complex problem mainly due to geographical and financial reasons. But it can be handled accordingly.

The main strengths of key players involved are the following:

- APW collection and recycling can be profitable for all parties involved.
- Awareness on APW management is increasing.
- The recycling market is NOT mature, so it is open for new investors.
- The cost of machinery needed is not considered to be as a big investment.
- There is labour willing to work.
- Public-private partnerships are encouraged.

Main Weaknesses found out are:

- The percentage of APW flow to recyclers is not enough. Therefore some of them have to use other raw material, too.
- The recycling legislation is very general; thus it does not answer on how the farmers should deal with their APW.
- The facilities in the area are very poor, therefore costs can be high.
- The economic situation does not help in investing.
- The ever changing tax laws are a drawback for investors.

As far as Opportunities are concerned:

- Environmental protection is not only a “green” global concern but also one of the most prolific areas for future business. For example, we are required to replace the existing landfills, which are sources of diseases and infections, with organic dumps, which are environmentally friendly and comply with the European legislation.
- Any business in the domain may help to create the integrated waste management system.
- APW is a great opportunity for visionary businessmen and politicians.
- APW management, marketing and recycling mean also economic recovery and are, in the specialists’ opinion, more profitable than those of water, air and soil.
- APW exportation can also become feasible and lucrative.
- Non-recyclable waste could be burned as a fuel in cement factories, or
power plants.

- APW can be combined with Plastic Packaging Waste.
- Funds for waste management, biodiversity, ecological revival and pollution prevention can be accessed.
- Following the Kyoto agreement to reduce emissions, the European Union urged member countries for at least 2% of total fuels by the end of 2005 and 20% by the end of 2020 be clean fuel. And APW is fuel.

The Threats for the APW recycling project and key ‘players’ can be summarized as:

- Poor Decision making and support by Local Authorities.
- Poor investment due to limited bank loans.
- Indifference of farmers due to zero earnings by giving their APW.
- Non enforced legislation.
- No APW specific management and administration.

**Conclusion**

APW has environmental impacts, affects food safety and agro products’ quality. APW is also recourse of raw material and energy. Economic benefits, as well as environmental benefits, for all the interested parties can be achieved, if a sustainable management system is applied.

The decision makers need assistance in determining the course of action needed to be taken. At the same time regulations’ implementation is imperative, along with the introduction of more explicit and detailed legislation. It is of great importance that the public and the farmers should be thoroughly informed on the agro plastic waste value and simultaneously contribute to public health. Lastly, all the parties involved should be supported in developing a consensus on accepting agro plastic waste plans.
Bibliographical References


GREEN PAPER On a European Strategy on Plastic Waste in the Environment in Europe
