LIFE Project Number

LIFE15 ENV/GR/000257

LIFE PROJECT NAME or Acronym

LIFE-F4F (Food for Feed)

Annex Data	
Action:	B3 Initiating, Operating and Optimising the F4F System
Partner:	ALL PARTNERS
Deliverable:	B3.3 Optimum operational mode

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1. Problems encountered during the initial operational period and Suggestions for technical and operational optimizations

During this initial operational period, from the operation of the F4F Pilot all the individual problems that have been arisen were recorded by partners, for both the pretreatment and the solar drying unit. In each case partners tried their bests in order to find out the optimum solutions and suggested technical and operational additions/alterations for the optimum operation of the pilot unit. All partners tried their best so as all the proposed alterations to be concluded until the start up of the 1st full scale operational period, which was on May, 2019.

The most significant problems identified by partners during this operational period are being presented in the following paragraphs:

- **The input food wastes purity.** Beyond food wastes, during hand sorting personnel have located materials such as glass, paper, cardboard, toothpicks, plastic wrapping film, etc. All these materials create important problems not only in the final product which cannot be used, but also in the mechanical equipment of the unit. In the picture below materials that are forbidden for the production process of the projects' pilot unit are being presented.

  The training of hotels' kitchen personnel on how to correctly sort at the source their wastes and the proper management of their food wastes (a great deal of attention to what they reject into the project's bins) is a key factor in the optimal operation of the plant and in the production a product with high quality characteristics.

Picture 1. Materials that should not get into the production process of the project.

- **Operation of the pretreatment unit mechanical equipment:** as it was foreseen, into the pretreatment unit there was a hand sorting conveyor belt, a shredder and a pump. However, problems during feeding the pump after shreddering were encountered. These problems were not only due to materials that have passed from the conveyor belt to the shredder (such as small glass items or toothpicks, which couldn't be seen by hand sorting personnel etc) but also due to some food wastes (such as orange, potato and watermelon peels) which couldn't be shredded is items smaller than 1cm. This had as a result blockages and damage to the mechanical parts of the pump to arise. During attempting to solve these problems of the pump, it was found that the shredder couldn't sufficiently graft some categories of some food wastes (orange peel, watermelon, potato, carrot, leafy vegetables etc.). This had as a result difficulties during feeding of the pump, as these large particles pass through the pump, causing blockages. To deal with this problem partners (in cooperation with a

mechanical engineer of the pump supplier), it was suggested to add a screw after the shredder in order to better promote the material and feed the pump more efficiently.

Picture 2. Problems during some kinds of food wastes shreddering

Picture 3. Screw placed after the shredder and before the pump

To avoid any blockages of the pump, it is suggested by partners the hand sorted food wastes after grinding to be pulped in order the final product before drying to be as a pulp so as to significantly reduce the granulometry (3-7mm) of the materials. This product texture is much better manageable in the drying unit, homogenous, with better drying rate. Moreover, the use of a screw (which has already added in the main equipment of the pretreatment unit) helps to easily feed the pump with this pulp. The use of the shredder in combination with the pulp and the screw will achieve better uniformity in the final product. It is therefore proposed to additionally add a pulverizer, which will be placed after the shredder. Using the pulverizer, the final material to be dried will have a 3-7mm particle size.

Picture 4. Suggested pulverizer

- **Under floor heating system in the drying halls:** During the reference period and as the temperature of water in the floor heating system which was written down by sensors, it turned out that this temperature was about 45-maximum 50ºC. As it has been arisen from trials that partners carried out the previous period (drying rates before the pilot unit construction in TEIC) this temperature for better results (so as not to cause alterations of the product's quality during drying due to microorganisms growth) has to be more than 50ºC and about 55ºC or 60ºC if this is possible. The temperature inside the greenhouse is also among 45-50ºC in a shinny day. So, in order to be able to increase the product's temperature partners have to reinforced the underfloor heating system so as to contribute to faster and better drying rate of the material under conditions that will not alter its physicochemical characteristics. For this reason, it was considered necessary a heating pump and 5 more solar collectors to be installed (which were not initially foreseen), in order to enhance the underfloor heating system for better efficiency and acceleration of the materials drying rate.

Picture 5. Temperature indication for both solar drying halls

Picture 6. Heating pump

2. Proposals for the optimization in the construction and operation of the pilot unit

After the completion of the first operational period of the F4F project, in brief, the following were proposed by partners to optimize the operation of the pilot unit:

Suggestions for the pilot F4F unit:

- Additional equipment in the pretreatment unit for better grinding. A screw which partners have already added and a pulverizer, following the shredder, which has been routed by partners for the next operational period of the project.
- Additional equipment in the floor heating system (heating pump and more panels). This action has already been routed by partners and the pilot unit the next full scale operational period will be supported by this extra equipment.
- Additional insects' protection (air curtain) in every door or window in the unit. Partners have already routed this action for the next full scale operational period.
- Mechanisms for automatic door closing. Partners have already routed this action for the next full scale operational period.
- Additional thermal drying after the solar drying of the end product, in higher temperatures for pasteurization is being proposed by partners and they will investigate this option. More specifically, they will investigate the moisture reduction rate into the solar drying halls up to 30% and then they will try to use a thermal dryer so as to reduce the product's moisture up to 10-12& at 90° C in order to achieve final product pasteurization and a faster moisture rate reduction
- Use of organic acids for the products' disinfection. Partners will also try to investigate the use of organic acids the next two operational periods of the project.

Suggestions for a full scale F4F unit:

- Refrigerators in all cooperative with the project hotels' kitchens for storing the food wastes
- Different material for covering the drying halls (not inox). Partners already investigate the use of epoxic floor for better heat transmission and better material management
- Optimization of the solar drying turners
- Smaller solar drying halls in the solar drying unit (or separation in apartments)
- Lower height greenhouse

All these proposed alterations are also being presented in the mid term report, in paragraph 6.3. Evaluation of Project Implementation.

3. Optimizations in the pilot unit after the initial operational period and before the startup of the first full scale operational period.

Preparatory actions by partners for the startup of the new full-scale operational period of the pilot unit were made. Partners during this period moved on with actions for the optimization in the construction and operation of the pilot unit. More specifically, on April 24th, ESDAK assigned a procurement concerning the optimization of the equipment of the pretreatment unit. This assignment included the following:

1. Additional equipment in the pretreatment unit for better grinding. A pulverizer has been added, following the existing shredder.

Picture 7. The pulverizer connected after the shredder

2. Additional equipment in the floor heating system has been added. More specifically, a heating pump and 4 more solar panels were added.

Picture 8. The heating pump and 4 more new solar panels

3. Additional insects' protection, air curtains were added in the doors of the pretreatment unit.

Picture 9. Two air curtains have been added in the doors of the pretreatment unit

4. Moreover, in the entrance of the solar drying unit a closet covered with protection insect net has also been added.

Picture 10. Entrance in the solar drying unit with insect protection

5. Mechanisms for automatic door closing has been added

Picture 11. Automatic mechanisms in the doors

6. Hydraulic lifting system for bins.

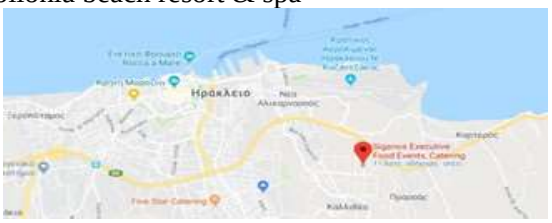
Picture 12. Hydraulic lifting system

7. A pressure washer machine with hot water for cleaning the equipment and the interior of the pre-treatment unit.

Picture 13. Pressure washer machine

A new hotel and a catering service have been added for this period in the F4F project. These are APOLLONIA BEACH RESORT & SPA and Siganos executive food events (Catering).

Picture 14. Apollonia beach resort & spa



Picture 15. Siganos executive food events (catering)

4. Optimizations in the pilot unit after the initial operational period and before the startup of the first full scale operational period.

After the construction and the first operation of the project's pilot unit, all partners having the experience from the operational systems that have been tested for a long time, proposed and then moved on with the most crucial and important optimization actions. The actions made for this purpose had as a result the better operation of the pilot unit.

With the operational systems tested and improved within the years and the experience of the personnel concluded the operation of the project's pilot unit.