Module 04 :
Planning operations

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Week 04:
Plan operational
resources

Resource Recovery and Reuse
(RRR) Entrepreneurship

Week 4 module 4: Plan operational resources

"Welcome to week 4 of module 4: plan your operational resources.

This week you are going to define the resources you need to start and run your RRR business.

In week 1 I introduced you to carrying out your RRR process planning.

You started with the analysis of the data you developed in previous modules for specifying the quality of the final product and the sales volume.

Also, you prepared a first draft of your process flow diagram, considering not only treatment, but also transport and storage.

We continued during weeks two and three to look at specific technologies for:

- Nutrient and organic matter recovery
- Energy recovery and
- Water recovery.

At the end of week 3, you identified the type of technology, the capacity of each step and the list of all the required equipment.

Now it is time to talk about the required land, the location of your treatment plant and the distribution of the different work units, meaning the layout.

Because of the extensive nature of the treatment processes that I showed you in week 3, the most important requirement is **space**.

For **composting** you will need a flat piece of land with shade for setting up your piles or boxes, as well as the maturation piles. Also, don't forget about the sorting and the packaging areas, as well as the area where the waste trucks will unload.

The space required for **briquette production** will depend on the scale of your business. If the quantities are rather small, you might be able to start in your own backyard. But if you are planning to produce large quantities of briquettes, you will need to secure land with enough space for carbonization, grinding, binding and drying.

For recovering water from **wastewater treatment**, make sure that enough space in the outskirts of the settlement is allocated for the construction of the ponds and wetlands. These also have to be close to the agricultural land, so that you can save on transportation costs. Since for most of irrigation water businesses, the local government is involved, finding land should not be a problem.

Let me give you some specific examples to illustrate **how much space we are talking about.**

This is an example of the required space for a composting plant processing three tons of waste per day. Data is presented for two technologies: windrow composting and box composting. Notice that it includes all the workflow units, including sorting, storage of rejects, storage of recyclables, composting pad, maturation area, screening and bagging area and compost storage. Additional space should be allocated to the manager's office and sanitary facilities. Keep in mind that this is only an example, the final setup is strongly dependent on the local conditions.

As I said before, the land requirement for the production of briquettes depends on the scale of production and the type of technology chosen.

This table shows the typical premises used for the production of briquettes in Uganda. You can see that according to this data, if you produce less than 20 tons per year, you might be able to produce in your garden, but if you are planning to produce 2000 tons per year, you will need a dedicated factory on approximately 2 acres of land.

In the case of wastewater treatment, last week you were able to estimate how much surface is required for each treatment step depending on the hydraulic retention times and the typical depths of your units.

As a reference, here you can see the typical land requirements per capita for various sewage treatment systems.

Notice how a pond system composed of an anaerobic pond, a facultative pond and a maturation pond will require a maximum of 5 square meters per inhabitant. If you will be treating the wastewater of a town of 5000 inhabitants, you will thus require 2.5 hectares. This is equal to 3.5 soccer fields, only for treatment.

Download the worksheet below to list all the production units and their land requirements for producing your RRR product plus additional space for offices and sanitary facilities.

Now, that you are able to estimate the land required, let us look at the location of your treatment plant – an important factor for keeping your transport costs down.

When selecting the location of your production plant, you need to consider:

- **Proximity to customers.** Take into account that a plant close to customers will reduce the cost of transportation.
- **Proximity to raw materials**. This is particularly important for you, since your raw material, meaning the waste, is bulky and transporting large amounts of waste is very costly.
- **Good transport infrastructure**. These are needed for the movement of your raw material, products and of course your workers. For instance, you need a sewer system to bring the wastewater to your treatment plant. Ideally irrigation channels to distribute the treated wastewater exist as well. For composting and briquetting, it is key to have access roads.
- **Availability of power:** which is particularly important if your system works with pumps or any equipment that requires energy. Other facilities like offices, changing rooms, laboratory, etc. will also require electricity.
- **Availability of water**: which is key for the production of compost, but also required for your sanitary facilities.
- **Government policies**: These need to be supportive particularly related to taxes, permits and land allocations for handling waste.
- **Environmental and community considerations**: you need to comply with the environmental policies of the location you will be operating at. In some cases, it might be prohibited to install a plant that releases toxic effluents or cut trees to make room for your treatment plant. Opposition from the community regarding the construction of a waste handling site in their neighbourhood can disrupt your whole project.
- **Availability of cheap land:** You might need to locate your plant in remote areas with low land costs, or areas assigned by the local government.
- **Low construction costs**: construction costs may be lower at a particular location due to cheap labour or construction material.
- **Availability of cheap, skilled and efficient labour**. also make sure that there are communities near your plant that you can recruit workers from.

Again, use the worksheet below to assess various sites and their suitability.

Once you have chosen the location of your plant and acquired land, you need to make a sketch or plan to decide where each production unit, entrance and exit gates, sanitary facilities, storage areas, etc. will be located. This is what we call **layout planning**.

Good layout planning allows you to plan and arrange production units so that a steady flow of production is ensured at minimum cost. A good plant layout always results in less accidents, better working conditions, and increased productivity.

The layout of treatment units should follow the waste-to-resources flow. This means that the pre-treatment units should be located near the entrance of the plant, followed by the principal treatment, finishing with the value addition, conveniently laid out for easy loading and transportation to customers.

Let's take look at this example of a windrow composting plant, treating up to five tons of mixed household waste and composting three tons of organic waste.

Notice how the layout supports the workflow of the composting process.

Waste is delivered directly to the sorting platform from where it is transferred either to the composting area, the recycling storage or the storage of rejects. The screening area is nearby as well as the storage area for compost.

This other example shows the layout of the wastewater treatment system and fish farming at Agriquatics in Bangladesh. This company inherited 4 facultative ponds, which were not functional, to which they added a duckweed wastewater treatment system. Notice how the designer of the system connected only the first pond to the serpentine duckweed system. The other 3 ponds were converted into fish ponds, filled with the final effluent of the duckweed system and groundwater.

When recovering water from **wastewater treatment**, it is possible that you will have to work with already existing dysfunctional infrastructure. This will definitely reduce your investment costs, but you have to be clever deciding how to make the best use of it!

To make a first draft of your layout, use the worksheet below!

Once you have designed the layout of your treatment plant, you need to estimate the staff required.

It is important to keep in mind that staff working in a RRR business needs to be willing to work with waste.

In many cultures, working with waste is associated with having a low social status, and it is normally reserved for marginalized people. Next to being a social business and offering quality jobs, you need to make sure that your workforce is motivated and trained to do the job right. It is thus your responsibility to offer good working conditions, continuous trainings and a safe working environment.

For planning the staff requirements, you need to calculate the time that each of the production activities takes.

A composting plant for instance is extremely labour intensive. Think about the time it takes to sort the waste manually and to mix it into piles. Add the time required to turn and water the piles, as well as screen and package the final compost.

As a reference, a composting plant treating 3 tons of waste per day requires 6 workers. Some of them should be literate, since the composting process requires reliable monitoring and recording activities (e.g. temperature, weight and moisture measurements).

The workforce requirements for the production of carbonized and non-carbonized briquettes depends on the technology selected and the scale.

Here you have some examples of the workforce requirements in East Africa. You notice how the numbers vary case by case.

Extensive wastewater treatment systems, such as ponds and wetlands, usually have low workforce requirements.

So for recovering water for agriculture, one to two managers might be sufficient.

Besides your workforce, you will need to hire dedicated engineers or any skilled workers, that can support you with the overall management of the plant.

Again, use the worksheet below to note your production activities and estimate the required time for each activity per specific production output.

Now, you should have a basic idea of the land, location, layout and workforce needed to efficiently operate your business.

In the next module, you will start calculating the associated costs for starting and running your business. In particular, you are going to estimate your investment costs, for building and buying the infrastructure and machinery required for transportation, treatment and storage, and you will calculate your operational costs.

So, head over to module 5 for planning your finances.”

List of Reference:

Graph sources:

- Unless otherwise noted, all graphics and case studies from OTOO, M. (Editor), DRECHSEL, P. (Editor) (2018): *Resource Recovery from Waste. Business Models for Energy, Nutrient and Water Reuse in Low- and Middle-Income Countries.* International Water Management Institute (IWMI). Routledge
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- Table: Land requirements for production of carbonized briquettes: Based on: GVEO 2012, briquette business in Uganda.
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- Waste Stabilization Ponds: TILLEY, E., ULRICH, L., LÜTHI, C., REYMOND, P., SCHERTENLEIB, R., ZURBRÜGG, C. (2014): Compendium of Sanitation Systems and Technologies. 2nd Revised Edition. URL: http://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/schwerpunkte/sesp/CLUES/Compendium_2nd_pdfs/Compendium_2nd_Ed_Lowres_1p.pdf [Accessed: 29.03.2018]

Image sources:

- Unless otherwise noted, all images from IWMI flickr library www.flickr.com/photos/iwmi/

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In such a case we apologize and kindly ask for feedback to correct them.