EIA Registration Document

OSAFE: Organic and Sustainable Atlantic Food and Energy

A 25 acre organic vegetable, fish, and poultry production greenhouse and farm

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Dear Madam/Sir,

Enclosed please find my application for EIA registration of OSAFE project. As we discussed I decided to start a pilot project to understand the weak-strength points of the proposed methods and also to give you enough time to review the project comprehensively. Please do not hesitate to contact me in case of any questions.

Sincerely yours,

Bahram Rangipour
Date: June 23, 2015

Contents

1 OSAFE

Organic and Sustainable Atlantic Food and Energy aims to develop new methods of organic but inexpensive food production. This will be done by applying modern science and technology into traditional agriculture. Not only we do not use any chemical for food production but also reduce the usage of our valuable and scarce resources particularly fresh water. With the application of the advance science and technology we integrate together several sections of food industry that the waste (and hence the food price) becomes minimum. We reuse as much as possible recycled material in our constructions and avoid adding any un-biodegrading material to the nature. One of our outreach program is to provide kids with disabilities and also low income pregnant mothers with free organic food. We have big concerns about our nowadays food production methods and feel responsible to fix the digressions, from the nature, made by greedy companies who have no contribution to our society excepts gulping our money and making us sicker and unhealthier. We found Canada a place to exercise our ideas based on several reasons: awareness of people about toxic foods, availability of science and technology, and need for food production. We also have a longer goal to export our productions to the US markets that currently Equator, Mexico, and Nederland are benefiting from. In the first phase we only produce foods that is currently imported to the provence.

2 Introduction

I am a professor of Mathematics of the University of New Brunswick in Fredericton. I have lived in the current address for more than 8 years and am familiar with the provence very well. Finding quality food has been always a challenge for my family in Fredericton especially in winters. I have tried to understand the difficulties to produce organic food in the province and came up with the following items as main hinders for local farmers and distributors

Extremely harsh winter sometimes even $-20°F$

Heavy load of solid precipitation such as snow and freezing rain

The provence is not well populated

The average family income is not comparable with that of the other provinces

The provence is far from big cities

The fuel cost is high

The soil is highly acidic

These are very challenging problems. I tried to solve at least those that are in our control. After several years of research I came up with a model that hopefully will prove itself successful. I decided to rely on the free energies:

Animal heat

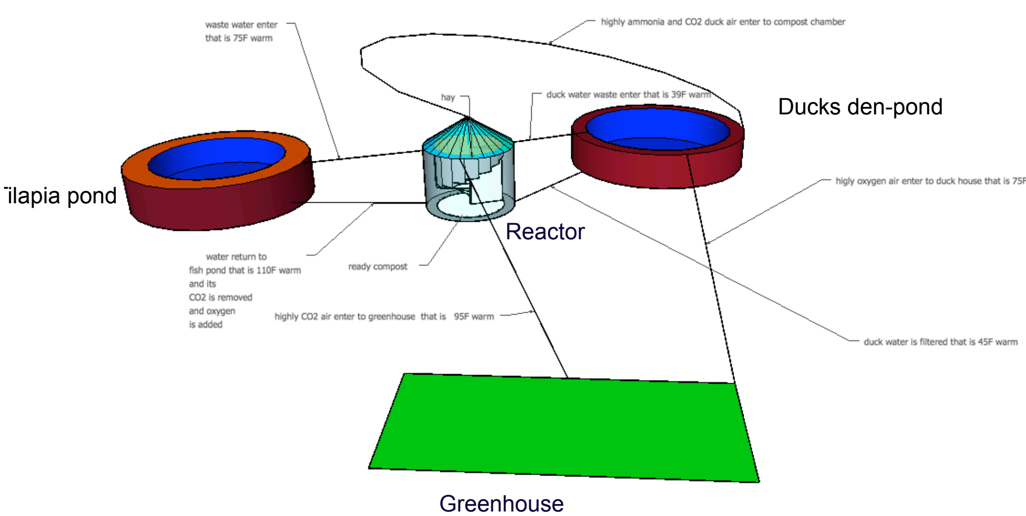
Compost heat

Wind power

We plan to produce our food inside greenhouses and are aware that the shape and mechanism of the greenhouses is extremely important for low cost production. Our greenhouse is like a huge bio-printer that each plant can be monitored at any time even from long distance. Our main product is vegetables that is hard to grow in the cold areas and our byproducts are Tilapia, duck, and bricks. The value of our byproduct helps us to beat the price of our vegetables in the provence even that of inorganic ones that is imported from overseas.
We have already stepped ahead and bought an old farm with 25 acre land. This is ideally located at the bank of Grand Lake with high quality sun and wind.

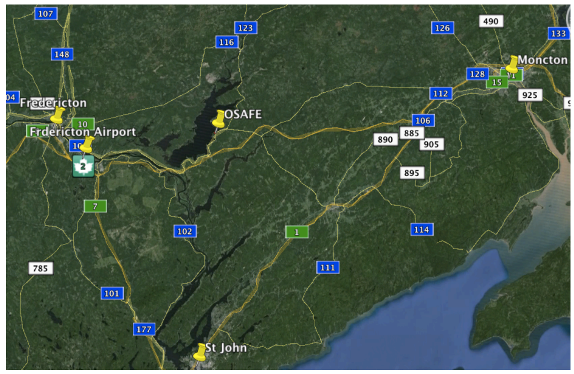
3 Depiction of the system

The following is an abstract depiction of our system. In reality we keep Tilapia inside the greenhouse and ducks in their pond-den outside of the greenhouse. The reactor is the one that connects all departments together. Our main heat transmission system is water and air. The circulation of water and air is done by pitbull pumps (see ref.[8]) and PVC pipes. The greenhouse, that is 2000 square meters, has lumber structure as the designer is working on it. The lumber used in the greenhouse is imported from Guyana and is called Green Heart wood. We do not have yet the details of greenhouse structure. The fish ponds are made of used tire and the floor of the greenhouse is insulated entirely by tires bales. This is due to the fact theta Tilapia pounds ought to be heated 75C-85C and preventing heat lost is the key point for our business. Our greenhouse contains the fish ponds to use the heat escaping from the fish ponds. This way we can offer our organic vegetable in a price close to the nonorganic ones even in the middle of cold winter.

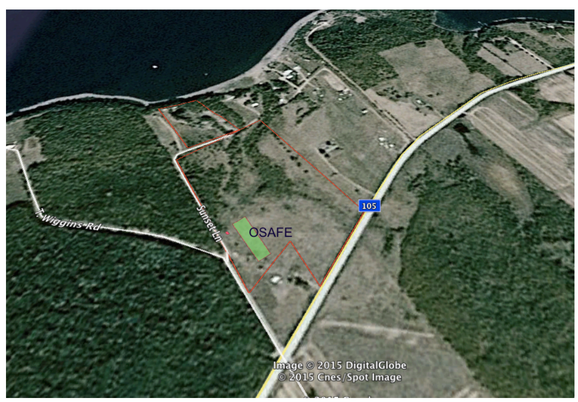


4 Location

OSAFE is located at the East bank of Grand Lake right beside the HW 105 in Waterborough, NB. Its exact coordinate is 45°56′15.70″N, 65°59′12.43″W. It takes less than one hour driving to each of the three major cities of the provence: Fredericton, Moncton, and St John. The International Fredericton Airport is less than 40 minutes driving from OSAFE. Its PID is 45125093.

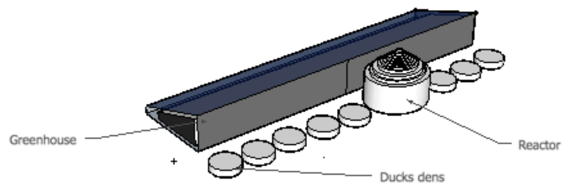


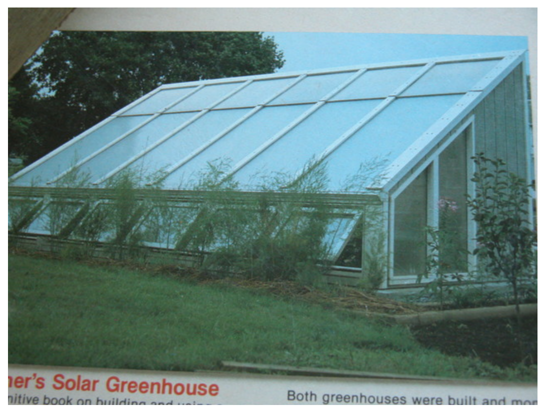
The 2,000 m^2 greenhouse, depicted by green rectangle, is of dimension 100×20 meters along the Sunset Ln with a 35m distance. The well will be located at 45°56′21.30″N, and 65°59′11.29″W. It is shown by red spot in the image and is between Sunset Ln and the greenhouse. We need only 50 cubic meter water per day for emergency drought.



5 The appearance of the facileties

The greenhouse is a trapezoid shape along the Sunset Ln from where it can be seen most clearly. The fish ponds are inside the greenhouse and cannot be seen from outside. From the Grand Lake you cannot see the greenhouse or any other facilities. From the HWY 105 you may see the reactor, which is similar to a silo, duck pond-dens, and back of the greenhouse only if you drive toward Fredericton. The greenhouse is a beautiful building similar to the solar building in the picture.





6 The main players

6.1 A healthy system

We have designed one of the healthiest natural and organic system for indoor agriculture. This claim is based on the basic axiom: remove the contamination from the system before it causes any disease. We combine three methods of removing the problematic elements: quicklime bricks for floor and walls, high temperature compost, and salt bath. This system provides the least stress to fish, ducks, and plants that results less diseases for all. Feeding them organically increase the level of their immune system. The other important difference in our system compare to other systems is the level of amino acid that our animal receive in daily basis. We sprout barley for ducks and fish for 6 days. This procedure increases the volume of fodder by six times. The starch in barley will turn into accessible sugar with a high volume of fibre and water that increases the health of the animals. The major increase is in mineral and amino acid. We also grow our own worm for duck and fish. This way we guarantee that our duck and fish receive enough protein for their growth.

1- Quicklime is the best natural sterilizing agent for fungous by providing a alkaline environment. This method is very old and has been used in Middle East for thousand of years. We produce quicklime bricks for flooring and pond walls. The floor bricks kill those fungi that workers carry by their shoes. The pond wall bricks not only sterilize the pond water but also reduce the CO_2 of water. The hay that we use in compost will soaked in quicklime water for 24 hours before it used for filtration. The mixture of lime and hay not only kill the fungi and molds in hay, that causes major problems in any application of hay, but also kills some of the weed seeds.

2- Hot compost is our major device for killing unwanted elements and growing beneficial bacteria. The fish and duck waste that is filtered by hay will be composted in the reactor for 18-21 days. The average temperature is 110F but for at least 4 days it reaches 160F. This will remove most of pathogen from the system. It should also be noted that all weed seeds will burn in our reactor.

3- All of our fish ponds are circular with diameter around 8 meters. The shape of the ponds is very important for cornering our fish into a salt bath for 5 minutes every week. This will remove any parasite on the skin of fish. The used salt water then will be composted to add mineral for our plants.

6.2 Filtration

We claim to have an efficient filtration system. This is based on three major components of our filtration system: hay, compost, and aquaponic. Most of bacterias, parasites, and fungi live in the solid part of fish waste. Our three times per day filtration remove almost all of the sold waste. Then we fertilize our plant with the water passed through the hay filtration. This will clean the water from the ammonia. The fact that unlike usual aquaponic systems we do not directly fertilize our plant from fish waste help us to have healthier plants with less accumulated bacterias and fungi around their roots. This helps plan to possess better root and respiratory system and a posteriori grow more volume and hence a better yield.

6.3 High level insulation

We need to save 75% of our heat by having a tight insulated greenhouse. We aim to have R200 for floors and R40 for the walls and ceiling. As our greenhouse sits on bales of used tire it is extremely insulated. The wall not only have thermal mass but also is covered by double-wall plastic film that is inflated by hot air. We use a huge thermal mass by having a total of 4,000 cubic meters of water ponds and thick walls made of sand and a lime.

6.4 Reactor

Perhaps reactor can be called the chest (heart, lung, and liver) of the greenhouse. It is responsible for several important jobs. Its main job is to clean the greenhouse out of fish and duck waste. Meanwhile it has to produce heat for the greenhouse. Lastly it has to add oxygen to the water. The hot steam and gases emitted off the reactor will pumped to the double-wall-plastic-film on the top of the greenhouse. After cooling down the collected water that is in fact rich in carbon-dioxide is filtered by raw bricks and then is reused in the system. The reactor is divided into certain sections. This way we can control heat, oxygen, hardness, PH, and most importantly the ammonia of the water. The reactor does a fine job by killing all weed seeds and pathogen in the hay or other compost material as the compost material expose with the temperature of 160F for at least 4-5 days during the 18-21 days it stays in the reactor.

6.5 Compost

The main challenge is to produce cheap heat. Not only we produce free heat but also our method allows us to produce compost and bricks for free. We use the waste of fish and ducks together with hay straw to filter water and consequently produce compost and heat. At first we filter the fish and duck waste three times a day for three days. Then we add the soaked hay bales into the reactor for aeration that produces heat up to 160 F. After 18-21 days it becomes very fine compost that will be used in the greenhouse and its extra will be sold to farmers. We use Berkeley method as it is described briefly in the appendix.

6.6 Bricks

The walls inside the reactor have a very sophisticated system of raw bricks made of lime and sand pressed by a 100 tons hydraulic press machine. This system has several job to do that is discussed in the reactor part. The bricks plays an important role in our system. The bricks has a very special shape that absorb CO_2 that exists in the fish and duck waters (even after filtration) and also extensively in the reactor as a result of composting. After one year the bricks will be replaced with new ones and we can use the old ones that will be hard enough by then for different purposes.

6.7 Ducks

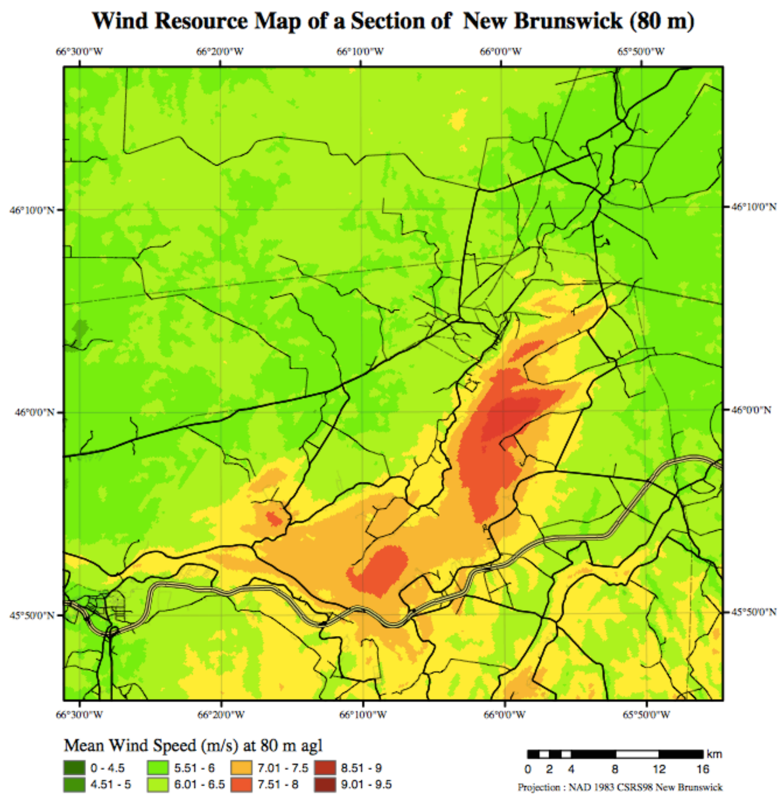
Ducks are native to Canada and have lots of characteristic that helps us to have them on board. They are ok naturally with moist and greenhouse conditions. They do not get sick easily and can search for their own food in wetlands. We aim to raise 3,000 Pekin in our farm. They will come from Metzer Farms (California) by airplane to Fredericton. In winter and part of fall we keep ducks inside but in spring, summer, and part of fall ducks are outside in a fenced pasture area to graze. Ducks play a crucial role in our closed ecosystem. Their main job is to partially help heating the greenhouse. That is provided by their high nitrogen waste. Their dens are made in circular shape with a pond in the middle. Their waste if not already in water together with the hay, that is underneath the ducks to comfort them, will be sweeping by a mechanical device into pond and then the dirty water will transfer into the reactor for process. We feed our ducks with sprout barley, earthworm, and unwanted Tilapia.

6.8 Tilapia

Among fish that can be grown indoor perhaps one of the safest is Tilapia. They are hardy and strong that makes them perfect for our system. In Canada three provinces, BC, ON, and AB, have managed to farm Tilapia (see ref. [4]). Their compatibility with greenhouse is the main reason we can fit them in our closed loop. We decided to raise 30,000 pieces of white Tilapia. They play three roles in our system: a source of income, a source of nitrogen for plants, and a source of food for ducks. We plan to sell 30,000 pieces/year. As it lives in fresh-water and originally is from Africa we do not have any problem in summer for overheating it. Its reproduction rate is also very good. Thanks to ducks we can control their population easily. We feed our Tilapia with three major foods: sprout barley, dock weed, and algae, and earthworm.

6.9 Wind

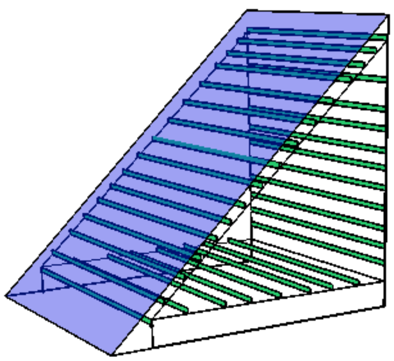
Wind is another valuable assistance to our sustainable system. Almost all mechanical devices in the greenhouse are powered by air pressure that is harvested by windmill and stored in pressure tanks. We build our windmill by our own knowledge and use used car engines to press air to 190 PSI. Then store them in tank and use them for several purposes such as oxygen source, vegetable circulating, and water pump. We do not turn wind power into electricity as it is expensive and inefficient. There will be eight windmill around the greenhouse to guarantee that we harvest all wind power and also wind will not hit the greenhouse. We turn the wind into pressured air and use it as a reliable mechanical energy. We estimate that we harvest an average of 56 kw from the wind.



6.10 Liquid fertilizer

Canadian houses are known to have big lawns and hence they need fertilizer. Currently they use mostly chemical fertilizer that is not only unhealthy but also expensive and on top has no contribution to our local economy. We want to apply our organic and surplus filtered fertilizers as liquid to the lawns. This way we can produce many jobs for our unemployed people and also reduce the toxicity from our homes. Then have a greener grass in addition to a direct connection to our people that has a special position in OSAFE strategic plan. The connection to people is a two way avenue that allows us to sell and advertise directly and also understand their need.

6.11 Greenhouses



Higher greenhouses are easier to control from the heat point of view. This is supported by the fact that heat flow is vertical. We plan to build our greenhouse at least 38 feet high. This way we can trap the heat at top and store it back and hence the lost is extremely low.

The most productive section of our business will be our modern greenhouses. We plan to cover 2,000 sm of the farm under greenhouses. But our greenhouses are different from the conventional ones. It is made of tropical beam, Green Heart, to last at least 50 years and be super strong(see ref. [5] and [6]). The vegetables will be moving to the ceiling of the greenhouse in trays via belts and polys. This method has several advantages: the heat used is maximum, the access to vegetables is maximum and fast, the pollination is maximum without using insects or other technology. This way we have a matrix of vegetable that can be accessed individually within 30 seconds without any relocation of the worker; so the efficiency is maximum. In addition via the matrix method we can fertilize vegetables individually via a simple computer programming without using complicated irrigation system that has always plugging problem. There are two major players in our system to reduce the cost of greenhouse: the first is the fish and ducks ponds and the next is the compost reactor.

We estimated that each bird gives us 6w/Lb heat and hence 3,000 birds generate more than 60kw. We plan to build a compost reactor whose role is explained above. Our research shows that we have 200kw heat from this system.

7 Environment

OSAFE does proudly try to protect the environment by developing new methods of agriculture that the waste and the contamination of the water and soil is minimized. The improvement in man life has caused more food to be wasted and hence be introduced to soil and water without any protection and engineering. We believe OSAFE will become a class to protect our resources and to prevent polluting air and water for food growing.

7.1 Public involvement

We plan to inform our neighbours about the project and ask their opinions about our ideas and address their questions and possible concerns. We cannot have a open house until the pilot project is done. There will be personal letters that will be handed to the neighbours to inform them about the scope of the project and also asking their comments. We also directly discuss and officially inform the project with the elected officials and First Nations.

7.2 Water usage

We have a very high standard for our scarce water. Fortunately the region has around 1,200mm of precipitation that is more than what we need. We need at most 2,000 cubic meters of water per annum. We are delighted to collect as much as possible rainwater that is estimated more than 2400 cubic meters. Rainwater has two important properties: being sterile and not being acidic. We have 2,000 cubic meters fish and duck pond and 1,000 cubic meters of reserved water. Collected water goes directly into reserve ponds. This way the level of oxygen in the reserved ponds is always high and the accumulation of bacteria is minimum. To have an emergency source of water we plan to dig a well in the property that produces at most 50 cubic meters water per day.

7.3 Amount of waste

Our calculation shows that for each Tilapia we have around 20 g of average waste per day. This accumulate 600 kg of waste per day. The same research tells us each adult duck produces 250 g of waste that becomes in total of 750 kg of duck waste per day. All of the waste is composted in the reactor.

7.4 Hay usage

We use hay for filtration and compost. Our estimation shows that we need 15 bales of hay per day which sums up to 5,500 bales per annum.

7.5 Compost production

Using 15 bales of hay and 1350 kg waste we are able to produce 5,000 kg compost per day which is around 10 cubic meters daily.

7.6 Compost usage

We use 2,000 cubic meters of our compost per year in our greenhouse. So annually we have about 1,500 cubic meters compost surplus to either sell or to use in farm.

7.7 Electricity usage

The dependency of our system on power is extremely low. We ultimately plan to use electricity only for our controlling system such as monitoring and miniature water valves used for watering plants. We plan to implement air pressure as the main source of our mechanical need. This is very important as we can then move our farms to any point far from any city or village. As it is mentioned most of our power is produced by 10 wind mills. They produce air pressure that is saved then it in special tanks and is used for daily need. We know the average wind is 19km/h that our calculation shows we can have more than enough power from the it. For the beginning we use electricity but gradually we reduce it. We plan to be totally off grid in the fifth year.

7.8 Cutting trees

The property is used to be a farm and there is no need for cutting any trees for the 2,000 square meters building for the greenhouse and the other facilities.

7.9 Bird nests

We searched and could not find any bird nest within and in the 50 meters distance to the proposed place for the project.

7.10 Flood zone

The property is not on the flood zone and its elevation is above 17m of the see. The Greenhouse is at the highest place of 22m above sea.

7.11 Wetland and Water Course

Part of our farm is wetland but we do not plan to do anything in the wetland and/or in its 30 meters boundary.

7.12 Groundwater contamination

We do not contaminate water at all as our water is reused to the last drop and the waste is composted with high temperature to kill all pathogens in the reactor. Our fish and duck waste will be composted and then used in our greenhouse.

7.13 Air emission and odor

There is no methane gas produced in our system. This is because of hot composting which is aerated and our filtration hay which is renewed every three days. There is also no ammonia released from our system as the duck and fish waste are also composted. We aerate the reactor from duck houses and this way we filter the odor (mostly ammonia) made by ducks through composting(see ref. [3]). Hot compost not only has no door but also it has pleasant smell(see the appendix). Lastly the produced CO_2 in the reactor is absorbed by bricks and is used by plants.

8 Emergency

We are aware of the emergency situations and will develop appropriate devices and procedures to reduce the damage as much as possible.

8.1 Power out

As it is mentioned above our policy is to be off grid as soon as possible. However we need to be prepared for such time. Most of our mechanical need will be based on pumps for air and water. We plan to have two emergency gas pumps for air and the same for water. We also have a 500 gas generator for controlling system in case of emergency.

8.2 Drought

We do not see any problem in our water supply system as it is totally based on rain collection. However in case of a long drought we use our 1,000 cubic meters emergency water reserve.

8.3 Reactor failure

We have three oil furnace in case of any problem in reactor. One of the furnace is for air heating and the others are for fish ponds.

8.4 Disease

We have picked carefully Pekin and Tilapia that are resilience against diseases. We also have designed a sterile environment with least opportunity for pathogens to grow. Caretakers change clothing and boots and use disinfectant foot baths (quicklime) upon entering the building. We keep our environment alkaline to prevent fungi grow which is the most popular problem in Tilapia farm. Our reactor is one of our strength points to reduce pathogen from the system. Constant air circulation is a strong device for duck's health as they get more fresh air compare to their peers in other farms. Rain water is more reliable compare to well or lake water. However in case a decease starts we separate and treat the infected ones to the quarantine place that is designed for such time.

9 Finacial

9.1 Business model

The company is divided into $3,000$ shares. We plan to share our costumers in our system as much as possible. The shareholders receive a substantial priority and discount in our services. We have three kinds of shares A, B, and C. There are several options for these shares that will be detailed later on.

9.2 Budget

9.3 Greenhouse budget

9.3.1 Project cost

We chose to build the structure of greenhouse from Greenheart wood that is one of the best tropical wood for this purpose. The main reason for this is the durability with respect to rot and insect and also its super strength compare to other woods. This way we can build

Table 1: OSAFE budget 2015-2016

	project	operation
Greenhouse	$ 250,000	$ 150,000
Fish and duck pond	$ 20,000	$ 10,000
Liquid Fertilizer and compost	$ 10,000	$ 50,000
Total	$280,000	$210,000

the greenhouse taller and with more light compare to the usual wood frame greenhouse made mainly from cedar wood. In long term it is also economically justified to invest on tropical wood. The structure will be covered by double wall inflated plastic film. The extra insulation is made of bales made of use tires that is used for flooring insulation. We have already bought the woods that costs us about $70,000. We estimate $100,000 for design and building materials and $80,000 to build the greenhouse.

9.3.2 Greenhouse operation cost

We plan to have 2 full-time employes to help us operating the greenhouse that cost us $78,000. We need one person for fish and ducks and one person who helps us with the vegetables. We need to buy $40,000 seeds and grain, $10,000 Tilapia fingerling, $25,000 hay straw, and $10,000 for mineral. We need to spend $60,000 on transportation, maintenance of our system, and brick making. We use $7,000 electricity per year.

9.4 Production

In the first year we mainly produce

- Vegetables (basil, bean and grain shots, bell peppers, broccoli, cabbage, carrot, celery, chive, cilantro, cucumber, garlic, green bean, jalapeno, kale, leek, lettuce, mint, parsley, spring onion, tarragon)
- Tilapia
- Duck and duck egg
- Fertilizer and compost
- Bricks

9.5 Revenue

We expect to sell

- 80,000 kg of Vegetables per year with $250,000 value
- 20,000 kg of Tilapia per year with $ 200,000 value
- Duck and duck egg (we do not sell ducks in the first five years as it is needed for the expansion of OSAFE)
- Fertilizer and compost 3,000 cubic meters with $100,000 value
- Bricks (we do not sell our bricks in the first five years as it is needed for the expansion of OSAFE)

9.6 Marketing

We mostly produce foods and goods that is imported to the provence and hence have a strong demand. We have a full understanding of the vegetable market at least for the provence. Although our production are organic but their finished price will be close to what people currently pay for inorganic foods. This is merely due to the sophisticated technology that is used in our greenhouses and also the value of our byproducts that is produced along our vegetables.

9.7 Jobs

Apart from the indirect jobs created by OSAFE we believe directly the following full-time jobs will be added to NB. Two person as owners, two full-time emploies for fish& ducks and vegetables, and two drivers that works as contractor to deliver fish,vegetables, duck eggs, and compost.

9.8 Benefit for New Brunswick

The main purpose of the project is to build a model of modern agriculture with higher yields and most importantly healthy product. We have found the weak points of our provence which are cold weather and acidic lands and have tried to resolve these issues by using our resources most efficiently. The model we provide here can be adapted to any farm in the provence. This provide a cheaper and healthier method of farming. The positive outcome of this project can revolutionize the economy of the provence and make it one of the world leaders in organic food production. We can easily bypass Mexico in Tilapia production, Nederland in organic vegetable, and Vietnam in duck production. In fact it is a pity that we have no position in duck production countries(see ref[7]) The awareness of people on toxicity of foods that are mass-produced is an ace for our business.

10 References

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2- http://www.agrilabtech.com

3- http://www.bioline.org.br/pdf?se05014

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5- http://www.wood-database.com/lumber-identification/hardwoods/greenheart/

6- http://www.doitpoms.ac.uk/tlplib/wood/wood_strength.php

7- http://www.thepoultrysite.com/articles/1868/global-poultry-trends-asia-dominates-world-duck-and-goose-meat-production/

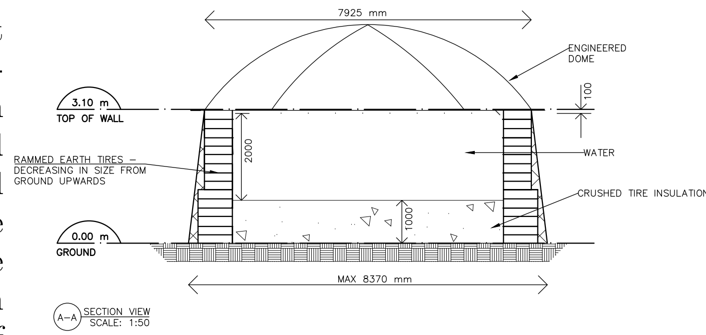
8- http://www.pitbullpumps.com

11 Pilot project

To reduce the cost and risk, we decided to start with a pilot project by reducing the scale of the above project. We start with 1,000 ducks and 10,000 Tilapia. We build 8 little ponds with 8m diameter and 2m depth. The reactor is also rescaled to satisfy the new conditions. We do not expect the reactor provide our heat at this scale and hence ought to heat the pilot greenhouse, which is an ordinary one, by wood stove with a large amount of thermal mass.

11.1 Ponds

For the pilot project we have designed a universal structure that is used for duck ponds, fish ponds, and reactor. It is a cylinder with 3m hight and 8m diameter that is roofed by a dome with 13ft hight. It is made of used recycled tires as it is shown in the picture. All ponds are lined to prevent any leakage to the groundwater. Also all ponds are insulated on the floor by tire bales with dimension 1x2x1 m that are made of 100 tires by a 100 tons press baler.



For the pilot project we do not build a separate greenhouse and we grow vegetables on the top of the fish and duck ponds.

11.2 Tires

For the pilot project we need about 8 ponds to build in total. Each pond need about 4000 tires; so in total we need 32,000 tires which is one fifth of the number for the full scale. TRAC has accepted to provide the tires in case OSAFE satisfies the government conditions.

11.3 Windmill

There will be no windmill in the pilot project.

11.4 Post Pilot

After pilot project is done which means we have mastered controlling the entire system then the 8 ponds will turn into duck pond-dens and we build our main greenhouse and reactor beside them.

12 Appendix

12.1 Hot Compost: Berkeley Method

The Rapid Composting Method

The author is Robert D. Raabe, Professor of Plant Pathology, Berkeley.

Composting is a process in which organic substances are reduced from large volumes of rapidly decomposable materials to small volumes of materials which continue to decompose slowly. in this process, the ratio of carbon to other elements is brought into balance, thus avoiding temporary immobilization of nutrients. One of the many benefits of adding compost to the soil is that the nutrients in it are slowly released to the soil and are then available for use by plants. Decomposition will take place in soil if undecomposed organic materials are added to it, but in the breakdown process nutrients will be tied up and unavailable for plants to use. This may result in nutrient deficiencies and poor growth, especially if large amounts of material are added.

The old method of composting was to pile organic materials and let them stand for a year, at which time the materials would be ready for use. The main advantage of this method is that little working time or effort is required from the composter. Disadvantages are that space is utilized for a whole year, some nutrients might be leached due to exposure to rainfall, and disease producing organisms, some weeds, weed seeds and insects are not controlled.

Recently, a new method has been developed which corrects some of the problems associated with the old type of composting. With this process, compost can be made in 2 to 3 weeks.

Extra effort on the part of the composter is required in exchange for this time saving, but for those who want large amounts of compost, or for those who wish to convert materials which are usually wasted into useable compost, the effort is worthwhile.

There are several important factors essential to the rapid composting method. Because all are important, there is no significance to the order in which they are listed here.

1. Material will compost best if it is between 1/2 to 1-1/2 inches in size. Soft, succulent tissues need not be chopped in very small pieces because they decompose rapidly. The harder or the more woody the tissues, the smaller they need to be divided to decompose rapidly. Woody material should be put through a grinder, but most grinders chop herbaceous materials too finely for good composting. Chopping material with a sharp shovel is effective. When pruning plants, cut material into small pieces with the pruning shears-it takes a little effort but the results (and the exercise!) are good.

2. For the composting process to work most effectively, material to be composted should have a carbon to nitrogen ratio of 30 to 1. This cannot be measured easily, but experience has shown that mixing equal volumes of green plant material with equal volumes of naturally dry plant material will give approximately a 30/1 carbon to nitrogen (C/N) ratio. Green material can be grass clippings, old flowers, green prunings, weeds, fresh garbage and fruit and vegetable wastes. Dried material can be dead, fallen leaves, dried grass, straw and somewhat woody materials from prunings. Such materials are easy to find in fall and early spring but are more difficult to find in the growing season. During this time, paper bags, cardboard boxes, cereal and milk cartons, and paper can be used for dried materials but they must be finely chopped or shredded. Newspapers can be used if shredded and separated by plant tissues so they do not mat - matting is bad because oxygen is necessary for rapid decomposition and matting excludes oxygen. Any material which is cut green and is allowed to dry is considered green. Some green materials, such as grass clippings also may mat if care is not taken to separate them using dry materials.

3. Composting works best if the moisture content of materials in the pile is about 50 percent. This is not easy to measure, but with experience the correct amount of moisture can be estimated. Too much moisture will make a soggy mass, and decomposition will be slow and will smell. if the organic material is too dry, decomposition will be very slow or will not occur at all

4. Heat, which is very important in rapid composting, is supplied by the respiration of the microorganisms as they break down the organic materials. To prevent heat loss and to build up the amount of heat necessary, a minimum volume of material is essential: a pile at least 36" x 36" x 36" is recommended. If less than 32", the rapid process will not occur. Heat retention is better in bins than in open piles, so rapid composting is more effective if bins are used. In addition, the use of bins is much neater. High temperatures favor the microorganisms which are the most rapid decomposers; these microorganisms function at about 160°F (71°C) and a good pile will maintain itself at about that temperature. A thermometer to measure temperatures inside the pile is helpful although not necessary.

5. The compost pile needs to be turned to prevent the pile from getting too hot. if it gets much above 160°F, the microorganisms will be killed, the pile will cool, and the whole process will have to start from the beginning. By turning the pile it will not overheat, and it will be aerated also, both of which are necessary to keep the most active decomposers functioning.

   The pile should be turned so that material which is on the outside is moved to the center. In this way, all the material will reach optimum temperatures at various times. Due to heat loss around the margins, only the central portion of the pile is at the optimum temperature. Because of the necessity for turning, it is desirable to have two bins so the material can be turned from one into another. Bins made with removable slats in the front make the turning process easier.

   Bins with covers retain the heat better than do those having no covers. Once the decomposition process starts, the pile becomes smaller and because the bin is no longer full, some heat will be lost at the top. This can be prevented by using a piece of polyethylene plastic slightly larger than the top area of the bins. After the compost is turned, the plastic is placed directly on the top of the compost and is tucked in around the edges.

   If the material in the pile is turned every day, it will take 2 weeks or a little longer to compost. If turned every other day, it will take about 3 weeks. The longer the interval between turning the longer it will take for the composting to finish.

6. Once a pile is started, do not add anything (with perhaps one exception, which will be mentioned in 9). The reason is that it takes a certain length of time for the material to break down and anything added has to start at the beginning, thus lengthening the decomposition time for the whole pile.

   Excess material should be as dry as possible during storage until a new pile is started. Moist stored materials will start to decompose and if this occurs, they will not do a good job in the compost pile.

7. Nothing needs to be added to the organic materials to make them decompose. The microorganisms active in the decomposition process are ubiquitous where plant materials are found and will develop rapidly in any compost piles.

8. If done correctly, a pile will heat to high temperatures within 24 to 48 hours. If it doesn't, the pile is too wet or too dry or there is not enough green material (or nitrogen) present. If too wet, the material should be spread out to dry. If too dry, add moisture. If neither of these, then the nitrogen is low (a high C/N ratio) and this can be corrected by adding materials high in nitrogen (such as ammonium sulfate, grass clippings, fresh chicken manure or urine diluted I to 5).

9. If the C/N ratio is less than 30/1, the organic matter will decompose very rapidly but there will be a loss of nitrogen. This will be given off as

ammonia and if this odor is present in or around a composting pile, it means that valuable nitrogen is being lost in the air. This can be counteracted by the addition of some sawdust to that part of the pile where there is an ammonia odor - sawdust is very high in carbon and low in nitrogen (a high C/N ratio) and therefore will counteract the excess nitrogen. Other than adding water should the pile become dry, this is the only thing which should be added to a pile once it's started. Because composting can be done anytime, during the rainy season some covering of the pile may be necessary to keep the composting materials from becoming too wet.

10. Materials which should not be added to a composting pile include soil, ashes from a stove or fireplace, and manure from carnivorous (meat-eating) animals. Soil adds nothing but weight to a compost pile and will discourage the turning of the pile which is necessary for the rapid composting process. Wood ashes will not decompose. Most soils in California have a basic pH and as wood ashes are basic, they should not be added to a compost pile or to the soil. Manure from carnivorous animals such as dogs, cats, lions, tigers, etc., could contain disease-producing organisms that might infect humans. It is not known whether or not the rapid composting process will kill these organisms and therefore such manures should not be used - manures from herbivorous animals such as rabbits, goats, cattle, horses, elephants or fowl can be used.

11. The rapid decomposition can be detected by a pleasant odor, by the heat produced (this is even visible in the form of water vapor given off during the turning of the pile), by the growth of white fungi on the decomposing organic material, by a reduction of volume, and by the change in color of the materials to dark brown.

As composting nears completion the temperature drops and, finally, little or no heat is produced. The compost is then ready to use. If in the preparation of the compost, the material was not chopped in small pieces, screening the material through 1-inch-mesh chicken wire will hold back such pieces. These can be added to the next pile and eventually they will decompose.

Advantages of the rapid composting system include:

- The production of a valuable soil amendment from many organic materials which normally might be wasted.
- Compost can be made ready for use in as short a time as 14 to 21 days.
- Rapid composting kills all plant disease producing organisms if done as described. It does not inactivate heat resistant viruses such as tobacco mosaic virus.
- Insects do not survive the composting process. Though some may be attracted to the pile, if they lay their eggs in the compost the will destroy them.
- Most weeds and weed seeds are killed. Some weeds such as oxalis bulbs, seeds of burr clover, some amaranthus seeds and seeds of cheese weed are not killed by the high temperatures in the pile.

In addition to the above, outdoor exercise is an added benefit.

This composting project was supported in part by a grant from the Elvina J. Slosson Fund.

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