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申 请 人 姓　名：GATOT GUNARSO
指　导　教　师：Dr Tang De Cai
合　作　教　师：________________________
专　业　名　称：MANAGEMENT SCIENCE
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所　在　学　院：COLLEGE OF INTERNATIONAL STUDENT

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Feasibility Study
on
Creating Organic Fertilizer Factory
in
Nanjing, China

Thesis Submitted to

Nanjing University of Information

Science &Technology

For the degree of

Master of Management Science

by

GATOT GUNARSO

(Management Science)

Thesis Supervisor: Dr. TANG DE CAI

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DECLARATION

I, GATOT GUNARSO, wish to declare that this thesis is my own unaided research work. It is being submitted in partial fulfillment of the requirement for the award of Master of Management Science at the School of Economics and Management, Nanjing University of Information Science and Technology, Nanjing, Jiangsu Province, China.

I further declare that this work has never been submitted in part or whole for any purpose anywhere, and that the thesis is presented with the consent of my supervisor. Works by other authors, which served as a source of information, have been duly acknowledged by references to the authors.

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in His Service

Gatot Gunarso

Abstract

International food availability and price is uncertain due to many factors, including energy price volatility, natural disasters, climate change, disrupted distribution channels, fertilizers' price, and imperfect market.. Food security has been the first priority of China since 70 years ago, yet faces many problems. To answer fertilizers availability problem, farmers can make their own fertilizers. The problem with the self-production fertilizers is the time, energy and resources needed sometimes more than the acceptable price willing to be paid by the farmers themselves. One of the opportunities are Decomposer Agent (DA) manufacturing because DA can speed the time needed to make organic fertilizers, reduce complicated procedures, improve the quality of the produced fertilizers, while at the same time can function as a type of organic fertilizers itself.

The answer to help farmers is, make a DA manufacturing factory. But before can reach to a decision to make or not make, a feasibility study is required. The research must find out where is the suitable area for the factory ? Are the raw materials and the market available in the nearby area ? How high is the demand for the product ? How mature is the market? How long the demand will last ? Will it grow or will it shrink ? How to distribute the products efficiently ? What are the policy from the government ? What the financial analysis say about the planned factory ? How much to invest ? How profitable the business will be ? Will it be more profitable than putting the money in the bank ? Will it be sustainable ? How long until the investors get their money back ? Will it benefit the shareholders only or the whole stakeholders including employees ? How social responsible will the business be ? Will the profiteering process harm the environment ?

List of Tables, Figures, Diagrams and Pictures

Chapter 1
INTRODUCTION

This feasibility study is to fulfill requirement of Thesis writing as part of graduation in Nanjing University of Information Science and Technology (NUIST). Several parts of this Thesis use Hand a Hand (HaHa) project progress report in NUIST Student In Free Enterprise (now ENACTUS), a Non-Profit Non-Governmental organization, since the writer is also the project manager of HaHa. Full report of progress can be acquired from ENACTUS NUIST or ENACTUS China.

As the HaHa project progresses, it became apparent that Organic Fertilizer especially Decomposer Agent (DA) currently employed in the ongoing first phase of the project, has potential market in China. This assumption is based on the facts much improvement experienced by farmers as well as from government data of organic fertilizers demand in China. The DA itself should be combined with the current treatments, and not to be used as a full substitute of current fertilizers Therefore, DA should not be considered as a competitor for current products such as mineral fertilizer, compost, manure, slurry or other conventional products.

1.1 Purpose and Scope of Study

Efficient and effective production-marketing-support systems must be devised before commencement of commercial phase of DA penetration to China market. This feasibility study examines the problems, challenges, opportunities, advantages, disadvantages in the following business areas : **setup, production, marketing, distribution, and support system**.

The end result of this study can be used to determine if the creation of an organic fertilizer plant will be beneficial economically, scientifically, and socially for farmers, investors, and other stakeholders.

The study's conclusions are based on the following assumptions:

- There is no regulation or policy change by China government, which could affect the production, marketing and support system .
- There is a free market or almost free market for organic fertilizer and there is no harmful government intervention on the market.
- The proposed solution should benefits all stakeholders who produce their own DA, the company who will produce standardized DA, the farmers, and other consumers
- The feasibility report is applicable and replicable in other parts of China or other countries

1.2 Using the report

This feasibility study includes information about ENACTUS, agricultural science, marketing plan, and business plan.

This thesis can also be used as a technical reference to acquire and apply organic fertilizers. Every technical information here have been tested thoroughly either in China or in other countries, and have been verified as well as replicated in other parts of the world.

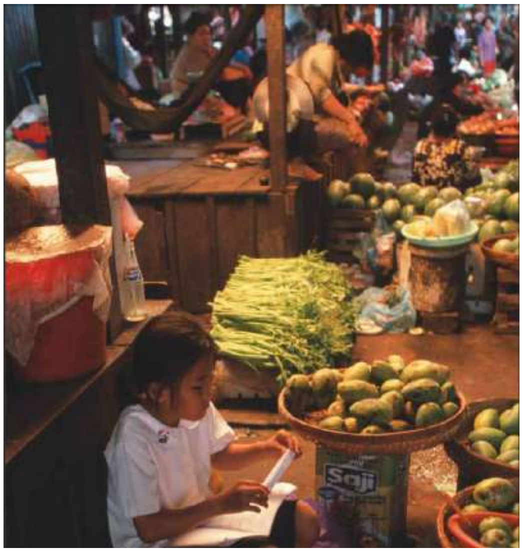
From the business side, this report provide comprehensive and balanced information to pursuade investors to make an organic fertilizer plant in Nanjing China. The feasibility study particularly will provide a few strategies in three commercial phases which are adjustable according to the size and scope of the future company.

The report will also include suggestions and recommendations to socially develop the communities which in the end will expand the market itself. The chosen method to socially develop the communities is cooperation with several Non-Profit Organizations with ENACTUS as the starter.

Chapter 2

BACKGROUND

2.1 International Food Price Situation



In 2011 international food prices spiked for the second time in three years, igniting concerns about a repeat of the 2008 food price crisis and its consequences for the poor. The World Bank Food Price Index rose 184 percent from January 2000 to June 2008 (figure 1). In February 2011 it again reached the 2008 peak, after a sharp decline in 2009, and stayed close to that peak through September. Poverty typically rises initially with higher food prices, because the supply response to higher prices takes time to materialize and many poor (farm) households are net food buyers. Thus, higher food prices lowers their real incomes [1]

Estimates of poverty on a poverty line of $1.25, by region

Region	1990	2005	2008	2015
Share of population living on less than $1.25 a day (2005 PPP)				
East Asia and Pacific	56.2	16.8	14.3	7.7
of which, China	60.2	16.3	13.1	—
Europe and Central Asia	1.9	1.3	0.5	0.3
Latin America and the Caribbean	12.2	8.7	6.5	5.5
Middle East and North Africa	5.8	3.5	2.7	2.7
South Asia	53.8	39.4	36.0	23.9
Sub-Saharan Africa	56.5	52.3	47.5	41.2
Total	**43.1**	**25.0**	**22.4**	**16.3**
Total, excluding China	37.2	27.7	25.2	—
Millions of people below $1.25 a day (2005 PPP)				
East Asia and Pacific	926.4	332.1	284.4	159.3
of which, China	683.2	211.9	173.0	—
Europe and Central Asia	8.9	6.3	2.2	1.4
Latin America and the Caribbean	53.4	47.6	36.8	33.6
Middle East and North Africa	13.0	10.5	8.6	9.7
South Asia	617.3	598.3	570.9	418.7
Sub-Saharan Africa	289.7	394.9	386.0	397.2
Total	**1,908.6**	**1,389.6**	**1,289.0**	**1,019.9**
Total, excluding China	1,226.8	1,177.7	1,116.0	—

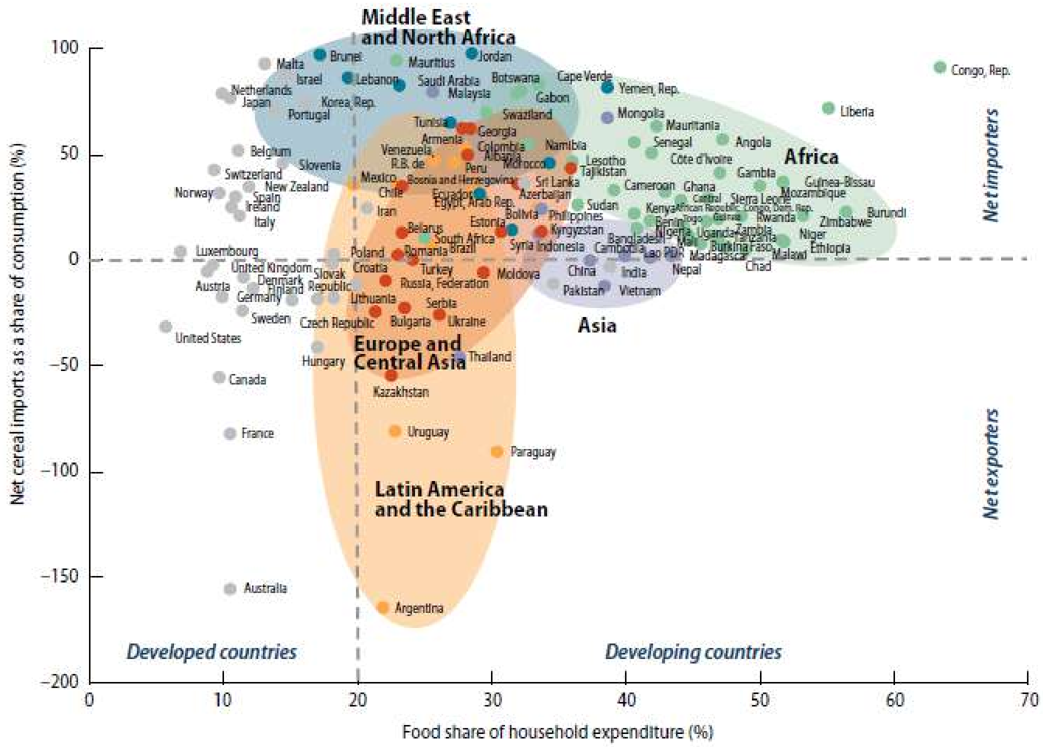
Source: World Bank staff calculations from PovcalNet database. For additional information and data, see http://iresearch.worldbank.org/PovcalNet/index.htm.
— = not available.

Table 1 Poverty Estimation

2.1.1 How the poor cope

High and volatile food prices hurt food security. Large, sudden, and particularly unexpected

Figure 1 **Countries' vulnerability to global food price shocks tracked by share of cereal imports in domestic consumption and food share in household expenditure**



Source: World Bank 2011d.

food price increases make it difficult for households to adjust—eroding consumer purchasing power, reducing calorie intake and nutrition, and pushing more people into poverty and hunger. The poor bear a disproportionate burden in adjusting to high food prices. This is especially true for poor households in urban settings and those headed by women, who typically spend more than half their incomes on food and are more likely to curtail consumption in the face of higher prices.

The higher prices also have indirect effects. Poor people have experienced global shocks in recent years, from the spikes in fuel and food prices to the economic contraction starting in 2008 and the consequent reductions in remittances. And droughts have made things even worse in many countries and locales. Qualitative survey-based research shows that the responses of poor people to past global shocks produced severe indirect impacts. Less nutritious diets caused malnourishment and made people more susceptible to failing health. The sudden influx of workers into the informal economy lowered earnings. The hardships even led to criminal activities, eroding trust and cohesion in communities[1].

2.1.2 The causes of price spike

The factors that caused the price spikes also have the potential to make prices more volatile and thus less predictable. Biofuel mandates, which have boosted demand for grains, despite slowing demand for food globally, have reduced the price elasticity of demand for grains. Sharp increases in fertilizer prices, linked to energy prices, have made production costs more volatile and, to the extent that higher prices have reduced the use of fertilizers, have made yields less stable. Adverse weather patterns also have become more frequent and more variable. Low global stocks have contributed to price volatility at time of production shortfalls. Moreover, trade interventions meant to stabilize domestic prices often have had the adverse effect and increased price volatility globally.

Table 2 **Major drivers of world cereal prices**

Average price levels		Price volatility	
Dependent on:		Dependent on:	
Long-term change in demand • Population • Income • Biofuels	*Long-term demand responsiveness/ elasticity to prices* • Share of food in consumption • Biofuels mandates • Oil/maize price ratio	*Short-term change in demand* • Oil prices volatility • Exchange rate volatility • Precautionary hoarding • Food reserves	*Short-term demand responsiveness/ elasticity to prices* • Stock release policies • Oil/maize price ratio
Long-term change in supply • Area planted • Yield changes	*Long-term supply responsiveness/ elasticity to prices* • Output and input market integration • Price risk management	*Short-term change in supply* • Droughts and floods • Share of production in more volatile production regions • Trade policy responses (export bans and sharp reductions in import tariffs)	*Short-term supply responsiveness/ elasticity to prices* • Trade openness

Source: World Bank 2012b, forthcoming.

2.2 Agricultural Situation and Trends in China

Fertilizer contributes 8% to 40 % to food price at food producers level, thus definitely lowering the cost of fertilizer will decrease the price of food or the volatility. And because the synthetic fertilizer depends heavily on oil and other energy sources in their processing methods, oil price increase will drive the price of fertilizer to a higher level. The recent price trend is pushing the price higher despite optimist forecasts there will be reductions of price in the coming years[2] There are many records in the past years where some fertilizers exporter countries banned the export of their fertilizer stocks in fear of insufficiency for domestic food production There are also many records shew that oil or other energy sources required to process But putting trust in an unproven forecasts are dangerous for food security for any country. (Jingzu Zhao, 2008)[3], said inappropriate usage of fertilizers is among the greatest obstacles to sustain China agricultural development.

2.2.1. Problems and Challenges

An alternative to synthetic fertilizers are organic fertilizers which can be made from organic ingredients available on the arable land or its surrounding. The obstacles however, are the labor needed to gather such organic materials, the knowledge to process them, the time required to prepare them, proper application methods, and the quality of the produced organic fertilizers.

Compost as one of the most widely used organic fertilizers have experienced stagnancy or even declined percentage in adoption for farming. *Composting is considered hard work by organic farmers because labor is required to collect and prepare materials, build and turn compost heaps and to apply compost to the land. Most farmers also consider buying manure and other inputs to be expensive, especially in areas closer to urban areas where demand for these inputs is highest and supplies are lowest* [4] Beside price, time also becomes one of the major obstacles because it requires six months to one year to make compost.

Quality of the produced organic fertilizers also become a major obstacle in the adoption. Farmers see organic fertilizers as inferior due to the improper preparation of organic fertilizers, the raw material quality, and the improper application methods. There is a misconception among farmers that think organic fertilizers are the magic formula to repair the land within one or two months. Though major improvement might occur in less than three months, but most of the improvements happen after one or two crops cycle within one year or two [5].

Quantity of organic fertilizer also become a problem since to more quantity of organic fertilizers are required to match the amount of nutrition from mineral fertilizers. For example : a hectare of grape vineyard might require five to six tons of compost, compared to 600 to 800 kg of mineral fertilizers[6]

All these problems are also superimposed by the non-mature distribution channels of organic fertilizers when compared to mineral fertilizers. Even in the most remote area of agricultural area, farmers can acquire mineral fertilizers, but they might not able to get organic fertilizers. Not only the unavailability of organic fertilizers itself, but also the unavailability of information on how to make the organic fertilizers, make the adoption of organic fertilizers remain at low level.

2.2.2 Answers and Opportunities

Decomposer Agent is the answer to the above problems. The problem of long time needed to make compost, can be answered by adding beneficial soil microbes into the raw materials to reduce the time to 12-15 days [7] .There are many names for these microbes, such as Decomposer Agent (DA), Innoculant Microbes, Soil Microbial, etc. By reducing the time needed to make compost, farmers can produce compost in less time.

Quality of compost and other organic fertilizers can be greatly improved by proper addition of DA during the production process. DA will function as a catalyst for the plants to absorb nutrition effectively and efficiently.

Since production time is reduced, there will be more compost produced in less time too. Thus, by adding DA in the production process, larger quantity of good quality compost and other organic fertilizers will be available for applications.

Opportunities from the imminent new industry of organic fertilizers and its support industries, will rise. This phenomenon have happened in the advanced countries where agricultural sector has grown maturely. It estimated that the organic fertilizers market size in China is at US$ 6 billion. with increment of 2-3% p.a [8] . This organic fertilizers industry alone is a potential market for DA as it will enrich the quality of the products. The entire fertilizer industry in China with market size of US$ 61 billion [8]. is a also a very potential market to tap. As reflected in one of the largest online B2C market, Taobao, there is no DA producer that big enough who can fulfill the market demand, and currently market price of the DA products are still considered uneconomical to be applied in full scale by most non-organic farms [9].

2.4 Conventional and organic agriculture in China

According to report published by CBF China Bio-Fertilizer AG in 2008, there is a shift from conventional ways toward more environmentally friendly agricultural practice. This trend is triggered by the demand for healthier, better quality, and more quantity of food as well as the emerging consciousness about sustainability of the nature for future generations.

2.4.1. Conventional agricultural practices

Food security has long been one of the top priorities of the Chinese Government given the large and growing population but relatively small and stabilized plantation area in the nation. In order to improve the yield of crops to cope with the demand and for more income, there has been an overuse of chemical fertilizers by farmers in China in the last few decades which leads to serious pollution to the environment but also reduces the soil fertility severely.

Due to the lack of potassium (K) resources in China, the country is experiencing an under-supply of potash fertilizer. According to a 2010 report issued by China Chemical Reporter, around 70% of potash fertilizers need to be imported. Going forward, IFA estimated that the demand for chemical fertilizer in China would rise steadily for all types . In addition, chemical fertilizers, like other chemicals, have their prices fluctuate according to its raw materials which are commodities[8].

2.4.2. Organic agricultural practices

Currently, most organic farms rely on compost to meet soil fertility needs. Compost is made using a mix of rice straw, cow or buffalo manure, wood ash, molasses and a starter culture of micro-organisms. Organic vegetable farmers often have to buy manure and straw for making compost. Many do not apply enough manure or compost for optimum soil fertility and most organic vegetable fields could benefit from an additional source of nutrients and organic matter. Conventional and organic vegetable farmers need to minimize the risk of contamination with pathogens such as bacteria, parasites and viruses. This risk can be reduced by application of proper production standard as mentioned in "WRAP BSI PAS-100 : 2011 Standard for Compost Materials "[10], and its safety can be further enhanced by application of DA during production process.

Organic farmers also use manure and rice straw based compost at relatively low rates (2 tons per hectare or less.) These farmers tend to have more land and free roaming avian and other livestock to helps collect nutrients from grazing areas in their manure for use in growing plants. Many traditional varieties of plants will grow too fast and then fall down if they get too much nitrogen, so farmers apply less mineral and organic fertilizer to traditional varieties than the do to improved varieties. [4]

2.5 Fertilizers type, demand, availability, distribution, prices, and use.

Food and Agricultural Organization (FAO) adopts the International Fertilizer Industry Association (IFA) definition of fertilizers as “Any natural or manufactured material, which contains at least 5% of one or more of the three primary nutrients (N, P2O5, K2O)”.[11] IFA furthermore classify fertilizers into two major groups : mineral fertilizers and organic fertilizers. Industrially manufactured fertilizers are called *mineral fertilizers*, while organic materials used for soil amendments are called *organic fertilizers*. [12]

Picture 1 IFA Logo

2.5.1 Mineral fertilizers availability, distribution, prices and use

Mineral fertilizers that contain only one primary nutrient are referred to as *straight fertilizers*. Those containing two or three primary nutrients are called *multinutrient fertilizers*, sometimes also binary (two-nutrient) or ternary (three-nutrient) fertilizers.

Due to its simplicity, flexibility and safety (against weathering and greater losses as well as adulteration) the 50-kg bag is the main distribution method to small-scale farmers. Most governments have established strict regulations through the Ministry of Agriculture or other authorities, on the type of fertilizer bags (or containers) in which mineral fertilizers are delivered to the farmer and how they have to be labeled. The information on the label comprises the nutrient (primary and/or secondary and/or micronutrients), the contents of the fertilizer (in most cases also the nutrient forms) and indicating the analysis or grade.[11]

IFA estimated that the demand for chemical fertilizer in China would rise steadily for all types. In addition, chemical fertilizers, like other chemicals, have their prices fluctuate according to its raw materials which are commodities as can be seen from the Pink Data of World Commodities Price from World Bank Report [13]. According to IFA, the chemical fertilizer market in China is highly fragmented, with over 5,000-6,000 players each occupying not more than single-digit market share. It is expected the chemical fertilizer market will consolidate going forward.

	Phosphate rock ($/mt) KPHOSROCK	DAP ($/mt) KDAP	TSP ($/mt) KTSP	Urea ($/mt) KUREA_EE_BULK	Potarsium chloride ($/mt) KPOTASH
2000	48.97	172.62	154.15	113.19	137.13
2001	49.23	174.15	149.56	112.36	139.20
2002	47.90	186.84	157.83	111.93	134.40
2003	42.13	198.90	165.58	154.00	125.60
2004	42.19	227.79	191.82	180.47	128.24
2005	42.00	247.03	201.48	219.02	158.18
2006	43.27	254.75	197.37	218.22	170.82
2007	65.33	398.42	312.31	284.99	184.37
2008	295.25	826.30	751.28	420.95	487.07
2009	111.29	295.53	235.48	228.31	576.71
2010	108.94	443.37	338.18	255.56	293.88
2011	150.40	503.43	437.85	342.43	354.08

Table 3 World Bank Data of Fertilizers Price from 2000 to 2011

2.5.2 Organic fertilizers availability, distribution, prices and use in Nanjing, Jiangsu Province (study area)

Organic fertilizer (OF) is the fertilizer that comes from the nature of the remains of living organisms both plant and the rest of the remaining animals that contain elements of both macro and micro micro needed by plants in order to flourish. Organic fertilizer made from renewable materials, recycled, transformed by soil bacteria into nutrient elements that can be used by plants.

Organic fertilizer only started to develop since 2000 in China and the track record of DA production is even shorter. According to China Organic Fertilizer Net, currently the annual production and sales of organic fertilizer is about 10 million tons (less than 1% is DA) and the growth rate in the past couple of years is higher than that of mineral fertilizer. There are about 1,500 organic fertilizer manufacturers in China and their production scale is relatively small. 66% of the total has an annual production capacity smaller than 20,000 tons and only 4% has an annual production capacity larger than 50,000 tons.

According to the registration of organic fertilizers products in the Ministry of Agriculture of China, there are only about 10 companies manufacturing the similar product in the nation, with total annual production of 30,000 tons. None of them are listed on any stock exchange.

To aim for a more sustainable agriculture industry, the government has put organic fertilizer in the top priority for 6 consecutive years since 2005. According to China Organic Fertilizer Net, the government would introduce some favorable policies such as to offer preferential rail transportation to promote the use of organic fertilizers [8].

A variety of organic fertilizers are available in the study area, including crop residues, animal manure, compost, guano and "bio-fertilizers". Sewage sludge is used in at least one district, although this practice has declined sharply as mineral fertilizers have become more easily available. Green manure crops can also be grown in the study area, but efforts to promote them have not been well accepted in the past [14].

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2.5.2.1 Manure

Animal manure is the main input for biogas and the closest substitute product for biogas slurry. Because animals such as buffalo and cattle graze freely, recovery rates for manure are low and many farmers have insufficient supplies on farm to ensure adequate fertility. While manure shortages exist in some areas, surpluses are produced by large pig and poultry farms in other parts of the study area. According to farmers interviewed during the study, inadequate information and high transaction and transportation costs make the manure market inefficient. Most manure trading takes place within social and family groups at the village and villages cluster level, except for poultry manure, which farmers consider to be more valuable and are willing to transport across longer distances. [4]

. While manure is commonly used as an organic input, its disadvantages include bulkiness, the potential to spread weeds and pathogens, smell and the fact that the balance of nutrients in manure may not be appropriate for some crops. Manure must also be applied to the crop prior to planting, or very early in the season to ensure its nutrients are available to the plants and to minimize the risk of contaminating food with bacteria, parasites and viruses.

Picture 2 Cow's Manure by Juddy

Picture 3 Compost-Aeration by Lesman

2.5.2.3 Crop Residues (Compost)

Crop residues are an important source for organic fertilizer and soil amendments in the study area, particularly when they are made into compost. The most common crop residues available are rice straw and rice husk, both of which are high in potassium but low in phosphorus and nitrogen. Rice straw is often removed from fields to feed buffalo and cattle or it is collected to mix with manure, ash and molasses for compost. Rice husks are sometimes used in a similar way or are returned directly to fields but they are not preferred by farmers because their high silica and lignin content makes them slow to decompose. In the past rice straw and husks were usually available for free, but promotion of composting in the area has started to give rice straw a market value in some villages. While compost made from rice straw and manure is reasonably common, it is primarily produced and used on-farm or traded on a very small scale between farmers within villages. Limited amounts of compost fortified with Effective Microorganisms ® in Nanjing are sold commercially under the name of EM1

2.5.2.6 Decomposer Agent

DA is the abbreviation for Decomposer Agent, known also as Soil-Microbial (SM), or Effective Microorganism (EM), or Bio-fertilizer (BF)**. EM was first discovered by prof. Teruo Higa of the University of Ryukyus. Japan, with its EM.** DA is a combination of useful regenerated micro-organisms that exist freely in nature and are not manipulated in anyway. In this DA there are about 80 genera fermenter. This mixture increases the natural resistance of soil, plants, water, humans, and animals.

Picture 4 . Effective Microorganism 1

Picture 5. Professor Teruo Higa

There are several advantages of organic production systems over conventional, high-input production systems, including elimination of synthetic fertilizers and pesticides and the building of healthy soil [15]. Application of DA can reduce fertilizers usage from 25% in most cases up to 50% in some soils which already have good condition. This means application of DA might reduce food production cost from five to ten percents. Proper addition of DA to the conventional farming system might increase crops yield resulting from 10 to 200% [16.] However, when only organic fertilizers are used, crops yield will experience reduction but have better qualities and taste[18].

Decomposer Agent can also improve the soil structure, remedy soil condition, helps decompose pesticides residue, nutrition absorption level by plants, and suppress harmful microbes in the soil which will result increment in quantity and quality of plants along with crops[16] .

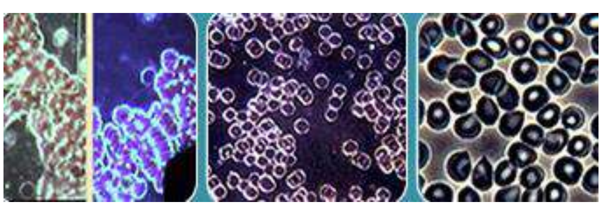
When given to the livestock, DA will improve appetites, nutrition absorption, and health. When used in fisheries, DA will enhance the speed of growth, health, and weight. When applied in sludge or other organic waste processing, will reduce odor, BOD, and chemical residues in the environment [16].

The possibilities and benefits in using DA include but not limited to the following:

- For use in the home in daily life for everyone
- The recycling of kitchen waste and turning it into valuable organic material;
- To improve soil structure, increase productivity and to suppress both disease and weeds
- For solving all kinds of environmental problems such as water, air, and soil pollution;
- In agriculture and horticulture, fruit and flower cultivation;
- In animal husbandry and for all kinds of pets;
- In fisheries, aquariums and swimming pools;
- In personal bodily hygiene

DA consists of the following five families of micro-organisms:

1. Lactic acid bacteria: these bacteria are differentiated by their powerful sterilising properties. They suppress harmful micro-organisms and encourage quick breakdown of organic substances. In addition, they can suppress the reproduction of Fusarium, a harmful fungus.
2. Yeasts: these manufacture anti-microbial and useful substances for plant growth. Their metabolites are food for other bacteria such as the lactic acid and actinomycetes groups.
3. Actinomycetes: these suppress harmful fungi and bacteria and can live together with photosynthetic bacteria.
4. Photosynthetic bacteria: these bacteria play the leading role in the activity of EM. They synthesize useful substances from secretions of roots, organic matter and/or harmful gases (e.g. hydrogen sulphide) by using sunlight and the heat of soil as sources of energy. They contribute to a better use of sunlight or, in other words, better photosynthesis. The metabolites developed by these micro-organisms are directly absorbed into plants. In addition, these bacteria increase the number of other bacteria and act as nitrogen binders.
5. Fungi that bring about fermentation these break down the organic substances quickly. This suppresses smell and prevents damage that could be caused by harmful insects



Picture 6 Microorganism Colonies in DA

	Element	Binding	Weight %
Mineral	Calcium	CaO	8.3%
	Kalium	K_2O	5.1%
	Magnesium	MgO	1.0%
	Phosphate	P_2O_5	0.2%
	Sulphur	S	0.1%
Trace Elements	Iron	Fe_2O_3	4.1
	Titaan	TiO_2	0.4%
	Manganese	MnO	0.2%
	Zinc	Zn	760*
	Copper	Cu	11.5*
	Molybdeen	Mo	9.0*
	Cobalt	Co	6.5*
	Borium	B	0.1*
	Silicium	SiO_2	48.2
	Sodium	Na_2O	5.9

*In mg/per 1000gr

Table 4 Chemical Contents of DA

Chapter 3

TECHNICAL ASPECTS OF FERTILIZERS

(Courtesy of : Lestari Mandiri Farmers Organization)

3.1 Organic Materials – An Introduction

3.1.1 Definition

Organic materials are materials that can be renewed, recycled, revamped by soil bacteria into elements that can be used by plants without polluting the soil and water. Soil organic matter is an accumulation of the remains of plants and animals that have undergone some weathering and the re-establishment. Such organic materials in the active decay and fall prey to attack micro bodies. As a result these materials change continues and unstable so that should always be updated through the addition of the remains of plants or animals.

3.1.2 Source of Organic Materials

The primary source of organic material is plant tissue of roots, stems, twigs, leaves, and fruit. Organic matter produced by plants through photosynthesis process so that the element carbon is the main constituent of the organic material. The element carbon is in the form of polysaccharide compounds, such as cellulose, Hemicellulose, starch, and pectin substances and lignin. Addition of nitrogen is the most elements in organic materials accumulated as an important element in the microbial cells are involved in the reform process of soil organic matter. This plant tissue will decompose and be transported to the lower layer and then incorporated with the soil. Plants not only a source of organic material, but the source of organic material of all living things.

Secondary sources of organic material is fauna (animals). Fauna first have to use organic materials from the plants before finally contribute organic materials from their waste or remains. Soil organic matter can also be derived from the dead living tissues and from part of rocks.

Different sources of organic material will provide different effects of contribution to the soil. It is closely related to the composition or structure of the organic material. Content of organic materials in each type of soil are not the same. This depends on several things, namely: the type of vegetation in the area, the soil microbial populations, soil drainage conditions, precipitation, temperature, and soil management. The composition or composition of plant tissue will differ much from animal tissue. In general, animal tissue would be destroyed faster than the plant tissue. Plant tissue largely composed of water that vary from 60-90%, averagely the percentage is about 75% of the total weight. The rest 25% solid part is composed of 60% carbohydrate, 10% protein, 10-30% lignin and 1-8% fat. Judging from the composition of the elements, carbon is the largest part (44%), followed by oxygen (40%), hydrogen, and ash about 8%. Ash composition itself consists of all the absorbed nutrients and plant required except C, H and O.

3.1.3 Humus

Humus is one form of organic material. Original tissues from dead plant or animal's body which had not yet decayed, will continue to experience attacks from microbes that use them as sources of energy and building materials. Results of the decomposition by microbes are called humus. Humus color is usually dark and is found primarily in the top layer of soil. Definition of humus is the fraction of soil organic matter more or less stable, most of the rest of the plant and animal residues that have been the decomposition.

Humus is organic material forms a more stable, whom in such form, organic material is usually much accumulated in the soil. Humus has the largest contribution to the durability and soil fertility. Humus is active and similar like clay, which is negatively ionic charged. But unlike most of the crystalline clay, humus is always in amorphous (irregular shape).

Humus is a complex compound decayed which somewhat decay-proof(resistant), brown, amorphous, colloidal nature and derived from plant or animal tissue that have been modified or shaped by a variety of microbes. Humus is not completely resistant to the bacteria work. They are unstable, especially in the event of change in temperature, humidity and aeration. Humus in the soil helps reduce the bad influence of clay on soil structure, which in many cases stimulate granulation humus soil aggregation. Humus ability to retain water and nutrient ions exceeds clay capacity in retaining. High holding power (saving) the nutrient is due to the high cation exchange capacity of humus, because the topsoil has several active compounds, especially carboxyl compounds. Thus the nature of existence with humus in the soil will help improve soil productivity.

3.1.3.1 The nature and characteristics Humus

- Seem like colloidal · similar like clay but amorphous.

· Surface area and absorption capacity far exceeds the clay.

· Cation exchange capacity of 150-300 me/100grams, while clay only can exchange 8-100me/100 g.

· Ability to absorb water 80-90% of its weight, while clay can only absorb 15-20%

· Power cohesion and plasticity is low, thereby reducing clamminess of clay and soil aggregate assist granulation.

· The miscellaneous composition of humus are of lignin, poliuronida, and proteins clay accompanied by C, H, O, N, S, P and other elements.

· Negative ion charge comes from the-COOH and-OH sticking on the outskirts where the Ion H can be replaced by other cations.

· Has ability to increase the availability of nutrients such as Ca, Mg, and K,

- Source of energy for microbes
- Darken soil's color.

3.1.4. Factors Affecting Soil Organic Materials

Among the many factors that affect the levels of organic matter and soil nitrogen, an important factor is the depth of soil, climate, soil texture and drainage.

The depth of the layer determines the level of organic matter and N. Highest levels of organic material found in the top layer thickness of 20 cm (15-20%). As the soil deepen, organic matter content decreased. This is because of the accumulation of organic material is concentrated in the top layer. Dominant climate factors are temperature and rainfall rate. As moving to the cooler regions, levels of organic matter and N also become higher. In one area, if the annual temperatures average fall to 10ºC cooler, the level of organic matter and N will increase 2 to 3 times . When the effective humidity increases, levels of organic matter and N also increases. All these things show that there are constrains to soil organisms activity.

Soil texture also plays a role. The higher the percentage of clay, the higher content of organic matter and soil N, if the other conditions the same. Sandy soil allows optimal oxidation, which makes the organic material depleted faster too.

On the ground with poor drainage where the is excess water, oxidation is hampered by poor aeration conditions. This excess causes the levels of organic matter and soil N are higher than in the soil with proper aeration. Besides those factors, soil and vegetation cover of the lime in the soil also affects soil organic matter levels. Forest vegetation will be different with pasture and farmland. These factors are interrelated, so it is difficult to define them separately (Hakim et al, 1986).

3.1.5. Role of Organic Materials for Soil

The important role of organic materials to create soil fertility. The role of soil organic matter is related to changes in soil properties, namely physical, biological, and chemical properties of soil. Organic material is the soil-forming granulator and very important in the formation of stable soil aggregates. Organic materials are the best solid materials that can aggregate the soil. Through the addition of organic material, soil that has heavy structures, can turn into crumb structure which are relatively light. Vertical movement of water or infiltration can be improved, and the soil can absorb water more quickly so that the surface water flow and erosion is minimized. Similarly, the soil aeration will be the better because the soil pore space (porosity) increases due to aggregate formation. Organic materials are commonly found in surface soil. The amount is usually not large, only about 3-5% but their influence on soil properties is huge. About half of the cations exchange capacity is derived from organic materials. These cations are the source of plant nutrients. Besides that, the organic material is a source of energy for most soil organisms. The role of organic materials is determined by their source and composition, the speed of the decomposition, and the results from the decomposition itself.

3.1.6 Organic Materials Influence on Soil Physical Properties

- **Increase the capacity of the soil to retain water**. This can be attributed to the nature of the polarity of the negatively charged water, and the subsequent positive associated with soil particles and organic materials. Groundwater affects soil microorganisms and plants on the soil. Optimum water content for plants and microorganisms is 0.5 bar / atmosphere.
- Turn soil color to brown or black. This increases the absorption of solar radiation energy which then **affect the temperature of the soil.**

· **Stimulate soil granulation aggregate** and stabilize it

- **Lower plasticity, cohesion and other bad qualities of clay**. One of the roles of organic material is as Granulator, which to improve soil structure. According to Arsyad (1989) the role of organic material in a stable aggregate formation occurs because the soil easily form complex materials with organic materials. This effectively takes place through mechanisms:

– Addition of organic matter can increase soil microorganism populations, such as mushrooms and truffles, because organic materials are used by soil microorganisms as a constituent body and energy sources. Fungi such as Miselia or Hifa are able to form the loose soil into aggregate grains, while the bacteria function similarly as aggregator cement.

– Improvement of chemical clay beads through the bond portions of the organic compounds that form long chains.

– Increment of physical prime grains by miselia fungus and actinomycetes. In this way the formation of structures without the clay fraction may occur in soil.

– Improvement of chemically clay beads through a bond between the negative clay with the negative (karbosil) of organic compounds with the intermediate base and hydrogen bonding.

– Improvement chemically clay beads through a bond between the clay and the negative positive part of the organic compounds form the polymer chain.

3.1.7 Organic Matter Influence in Soil Chemical Properties

- **Enhance absorption and cation exchange capacity (CEC)**. About half of the cation exchange capacity (CEC) derived from soil organic matter. Organic materials can increase the cation exchange capacity of two to thirty times larger than colloidal minerals, which include 30 to 90% of the energy absorption of a mineral soil. Increased CEC due to the addition of organic materials due to decay of organic material will produce humus (organic colloids) which enable the surface to hold nutrients and water. **Thus, it can be said that the provision of organic material can save water and fertilizer are provided in the ground**. Increasing CEC increase soil's ability to withstand nutrient elements.

- **Elements N, P, S are bound in organic form or in the body of microorganisms** to avoid being washed away by water, and to make the elements readily available after the watering process. Unlike commercial fertilizers which are usually added in significant amounts because it is water soluble, which after rain will experience very high loss, nutrients stored in organic residues did not dissolve in water until the nutrients released by microbiological processes. Thus, nutrient lost due to washing is not as serious as what happened to commercial fertilizers. As a result, nitrogen content in the soil is maintained at intermediate level, reducing the risk of lack or too much nitrogen. Organic material directly serves as a nutrient enhancer of N, P, K to the plants due to the mineralization by microorganisms. Mineralization is the opposite of immobilization. Mineralization is the transformation by microorganisms from an element in the organic material into inorganic, such as nitrogen in the proteins into ammonium or nitrite. By mineralization, nutrients become available for plants.

- **Increasing the easily exchangeable cations and dissolving some of the mineral nutrients by acid humus**. Organic material can sustain the supply and availability of nutrients with a simple cation exchange. Nitrogen, phosphorus and sulfur bound in the form of organic humus and acid decomposition of organic material will extract nutrients from the minerals rock.
- **Affect the acidity or pH**. The addition of organic materials can increase or even decrease the pH of soil, this depends on the type of soil and organic material added. Decrease in soil pH due to addition of organic material can occur due to decomposition of organic material produces many dominant acids. While an increase in pH due to addition of organic material that occurs in acid soil where soil aluminum content is high, due to organic material of Al as a compound binding complex that no longer hydrolyzed.

The role of organic matter to improve soil chemical properties cannot be separated in terms of the decomposition of organic materials, because this process changes the chemical composition of organic material from the complex compound into simpler compounds. The process that occurs in the decomposition are : transformation of plant or animal remains by soil microorganism or other enzymes, increment of organisms biomass, the accumulation of nutrients, and final release of nutrients to air or soil. Accumulation of plant and animal residues in soil organic matter consisted of carbohydrates, lignin, tannins, fats,oils, wax, resin, compound N, pigments,and minerals,can add nutrient elements in soil.

3.1.8 Influence of Organic Materials in Soil Biology Nature

- **Increase number and activity of soil organisms metabolism**. In general, the provision of organic materials can improve the growth and activity of microorganisms. Organic material is a source of energy and food for the microorganisms that live in the soil. Soil microorganisms interact with their need for organic materials organic materials which provide carbon as an energy source for growth.
- **Increase micro organisms activities in assisting micro decomposition of organic material**. Fresh organic material added to the soil will be digested by the various existing micro-organism in soil and subsequently decomposed, if environmental factors support the process. Decomposition means that the reforms undertaken by a number of microorganisms (biological elements in the soil) of complex compounds into simpler compounds. The results of the decomposition of more stable compounds called humus. The more organic material is the more micro population in the soil body.

3.1.9 Role of Organic Materials for Plants.

Organic materials play a crucial role in the soil because organic materials derived from plants that remained, containing nutrient elements needed for plant growth. Organic matter affects soil structure and tend to keep or improve the desired physical condition. There are direct effects of organic material to the plant, but mainly organic materials affects plants through changes in soil characteristics and features.

3.1.10 Direct Influence of Organic Materials in Plants

- Through the study found that some growth substances and vitamins can be absorbed directly from organic material and can stimulate plant growth. In the past, many researchers think that only amino acids, alanine, and glycine are absorbable by plants. Absorption of such N compounds was relatively lower than other N forms. No doubt now that the organic material contains a number of growth substances and vitamins, and at certain times **can stimulate the growth of plants and microbes**.
- This organic material is an inorganic source of nutrients for plants. So the growth rate of plants for a prolonged period is parallel to the supply of organic and inorganic

nutrients. This indicates that the major direct role of organic materials is to supply nutrients for plants. The addition of organic matter into the soil to add nutrients both macro and micro are needed by plants, so that fertilization with inorganic fertilizers used by farmers can be reduced in quantity because the plants have a nutrient elements from organic materials added to soil it. **Plant nutrient efficiency increases when the soil surface covered with organic material**.

3.1.11 Indirect influence of Organic Materials in Plants

Contribution of organic materials on plant growth is its impact on the physical properties, chemical and biological from the ground. Soil organic matter mostly affects the physics, biology and chemistry of the soil. Organic material has a chemical role in providing N, P and S for the plant's role in influencing the biological activity and micro-fauna micro-flora organisms, and a physical role in improving soil structure and others.

This will affect the growth of plants growing on the soil. The magnitude of this effect varies depending on changes in each environmental factor. In connection with the results of decomposition of organic material and humus properties it can be said that the organic material will greatly affect the nature and characteristics of the soil. Indirect role of organic material for the plant including:

- Increasing the availability of water for plants. Organic materials can increase the water holding capacity due to soil organic matter, especially who have been minted with the ratio C / N levels of C 20 and 57% water can absorb 2-4 times of its weight. Because of the water content, the organic material that has become especially humus can be a buffer for the availability of water.
- Improving soil structure Soil organic material containing loose structure, and when mixed with minerals will provide crumb structure and easy to do the processing. Such soil structure is the physical nature of the good soil for plant growth media.. Textured clay soil, sand, or a clot will provide physical properties better when mixed with organic materials.
- Reduce erosion
- Stabilizing the temperature. Organic materials can absorb the high heat and can also be a heat insulator because it has a heat conductivity is low, so that the

optimum temperature needed by plants for growth can be properly fulfilled.

- Increasing the efficiency of fertilization

In general, the provision of organic materials can increase plant growth and production. Similarly, the role in tackling soil erosion and land productivity. The addition of organic material would be better if accompanied by appropriate planting patterns, such as crop patterns between the inter-cropping system. Proper management of land will promote soil and water conservation, which in the end will benefit the human.

3.2 Compost – An Introduction

3.2.1 Compost definition

Compost or humus is the remains of living beings who have experienced decay, the shape has changed, such as land and odorless. Compost contain a complete NPK nutrients though a small percentage. Compost also contains other compounds that are beneficial to plants.

3.2.2 Compost benefits – overall

Compost is like a multivitamin for the soil and plants. Compost to improve the physical and chemical nature of the soil. The compost will restore soil fertility. Hard soil becomes more friable. Poor soil will become fertile. Acid soil will become more neutral. Compost plants that were growing better crops and better quality than plants without compost.

3.2.2.1 Compost benefits – details

a. Organic materials in the process of mineralization would release the complete plant nutrients (N, P, K, Ca, Mg, S, and micro-nutrient) in the number of uncertain and relatively small.

b. Can improve soil structure, causing the land to be light to be processed and easily penetrated by roots

c. More easily cultivated land to land heavy

d. Increasing the holding power of water (water holding capacity). So that the soil's ability to provide water to more. More soil water humidity maintained

e. Better soil permeability. Reduce the permeability of coarse-textured soil (sandy), otherwise increase the permeability of the soil is very soft-textured (clay)

f. Increasing KPK (cation exchange capacity) so that the cation binding ability is increased. When given high doses of nutrients, they are not easily washed away

g. Improve the soil biological life (both higher animals and lower levels) to be better because of the availability of food is more secure.

h. Can enhance prop (capacity buffering) of shocks drastic change soil properties.

i. Microbes contain sufficient amounts of a role in the process of decomposition of organic materials.

3.2.3 Compost disadvantages

a. Organic materials which have C / N is high means that there are raw. Immature compost (C / high N) is considered harmful, because when given directly into the soil organic matter is attacked by microbes (bacteria and fungi) to obtain energy. So high population microbes also requires nutrients for plants and the plants reproduce. Nutrients that should be used by the plants used by microbes change. In other words microbes compete with crops for nutrients that fight there. Nutrients become unavailable due to change of inorganic compounds into organic compounds microbes network, this is called nutrient immobilization. Immobilization occurrence of plant nutrients often causes symptoms of deficiency. The more organic raw materials are given to the higher ground to attack the population, the more nutrients will experience immobilization. However microbes later when the dead will experience a immobilized nutrient decomposition is transformed into available again. So is the binding immobilization nutrients available to not available within a period not too long relative

b. Organic materials derived from municipal waste or industrial waste microbes often contain pathogens and heavy metals are a bad influence for plants, animals and humans

3.2.4 Compost raw materials

In principle, all materials derived from living organisms or organic materials can be composted it. Seresah, leaves, grass trimmings, twigs, and the rest of the wood can be composted it. Manure, animals, even human waste could be composted it. Composting of manure is better known by the term manure. Time of food and animal carcasses can also be composted. There are material-compost is easy in his, there is a rather simple ingredients, and there are difficult to compost it. Most organic materials, compost is easy in his. Rather difficult material in a compost-include: hard wood, stems, and bamboo. Materials are difficult to compost including wood very hard, bones, hair, horns, and fur.

3.2.5 Reasons to compost raw materials

Plants can not absorb nutrients from organic materials that are still raw, no matter the form and origin. Manure fresh nutrient can not be absorbed by the plants it. Moreover, the remaining plants still in good shape also can not be absorbed its nutrients by plants. Compost is 'half-baked' is not good for plants. Organic material must composted to 'mature' to get its nutrients absorbed by plants. The principle is the plants absorb nutrients from the soil, therefore, should be returned to the land and given to the ground again.

3.2.6 Ways to make compost

Making compost is easy. Naturally organic material will experience decay into compost, but might take a long time between half to one year depending on the material and condition. In order composting process can take place more quickly need additional treatment.

Composting can be accelerated by adding the activator or compost innoculum or Decomposer Agent. This activator is a micro-organism (microbe) that works to accelerate decay of organic material into compost. Soft organic material and its size small enough to be my compost without having conducted the census. But a large organic material and hard, should be chopped first. Compost activator should be mixed evenly throughout the organic material to composting process going better and faster.

Materials to be composted must also contain enough water. Water is very necessary for living micro-organism in the compost activators. Dry material is more difficult to compost. However, too much moisture of content will also hinder the process of composting. So the content must be moisty. Materials must also contain enough air. Like water, the air is needed for micro-organism lives compost activator.

To protect the compost from a poor external environment, compost should be covered. Cover or enclosure is to protect the materials or micro-organism from the rain, the sun, evaporation, and temperature changes.

Material aged for some time to mature compost. Long it takes between 2 weeks to 6 weeks depending on the material composted. The soft materials can be composted in a short time, 2 - 3 weeks. Hard materials need 4 to 6 weeks. Characteristic mature compost is the shape has changed to be more soft, dark brown color, not foul-smelling, and easily crushed / crumbs.

3.2.7 Ways to use compost

Mature compost can be directly used for crops. There is no limit how many doses of compost materials given to the plants. Generally more compost give better results. But if the compost will be used for breeding or to plant in a pot / poly bag, the compost should be mixed soil with a ratio of one part compost: three sections of land.

Compost can be given as the sole source of additional nutrients, or more commonly known by the term organic farming. Compost should be given in sufficient numbers, so plants can grow better. Compost can also be provided with artificial chemical fertilizers. Chemical fertilizers can be reduced and replaced in part with the addition of compost.

Compost can be given to any plant, ranging from farm crops, horticulture, plantations, ornamental plants, fruits, vegetables, and forestry. For example to crop: rice paddy fields, dry land rice, maize, cassava, beans, cabbage, potatoes, rubber, coffee, oil palm, cocoa, sugar cane, Aglonema, waves of love, mango, acacia, and others.

The use of fertilizers in the world continues to increase in accordance with the increase of agricultural area, population, rising levels of intensification and more diverse use of fertilizer as an attempt to increase agricultural output. Environmental experts concerned with the use of mineral fertilizers will increase the level of soil pollution that ultimately affect human health.

Based on this growing reason, we need to reduce the use of mineral fertilizers and for making fertilizer factories in the world is reduced or stopped altogether so that people can avoid calamity pollution. Efforts to plant cultivation with organic farming is an attempt to get food without the use of inorganic fertilizers. With this system the plant is expected to be able to live without any input from the outside so that the plant life there is a closed life cycle.

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Chapter 4
PRODUCTION AND APPLICATION

4.1 Patent Pending

Currently the Production Method mentioned here is being registered to receive patent in China on behalf of the main author. The main reason to register the production method is to ensure the legality and feasibility of this method. The other main reason is to protect the consumers who will use the product as well as to protect the dissemination of corporate values throughout the mainland China. The corporate value in specific is the social responsibility to teach users how to produce their own Decomposer Agent.

The mentioned corporate value might seem contra-productive, but it is the author conviction that the organic fertilizers market in China is still very premature, thus need a domino effect to actually open and educate the market. By dissemination of non-confidential trade-secrets and key information, the market will expand and mature by the time commencement of commercial phase. The detail about business plan including marketing plan will be discussed in the later chapters.

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4.2. Production Method – DA

There are several production methods that can be used to produce and reproduce DA. The following method is based on experiments and implementations results in the Hand a Hand Project of Student in Free Enterprise at Nanjing University of Information Science and Technology. The project itself consisted five parts which will use five products respectively altogether to maximize the success of agricultural endeavors. DA is the first products of these five.

The ingredients are :

1 liter of DA seed

3 kg rice

¼ kg sugar , ¼ kg shrimp

5 liter water

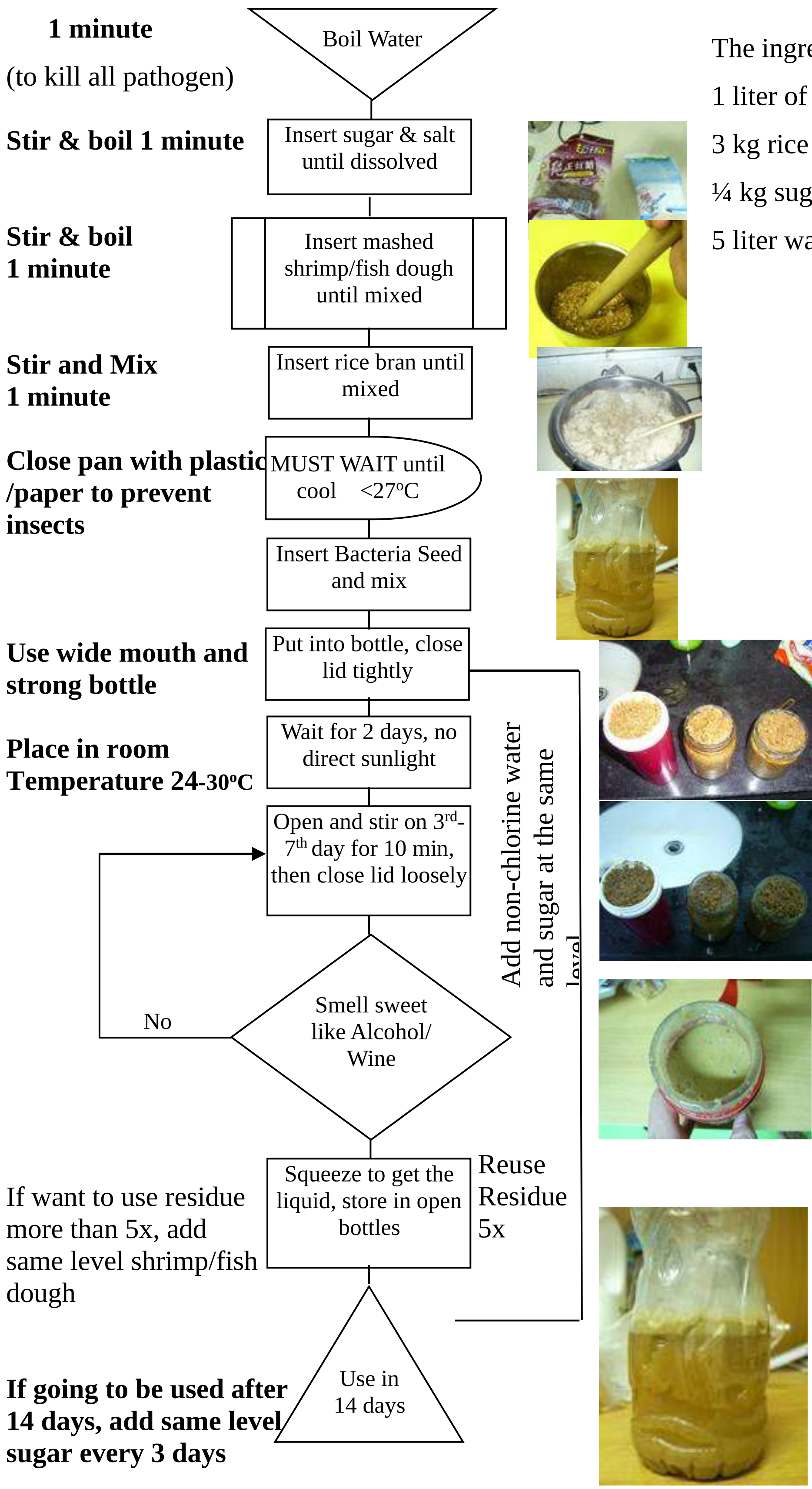


Diagram 1 Method to Reproduce DA

4.3 Production Method – Super Compost

Ingredients :

Manure or protein or meat	: 700 kg
Rice Bran or grain bran	: 100 kg
Rice Straw or woodmill dust	: 100 kg
Leaves (non hard nor shiny)	: 100kg
DA	: 1 liter
Sugar (red, white, or rock)	: 250gram
Water (chlorine-free)	: 100 liter

Procedures :

1. Slice all leaves, straw and all raw materials to the size of nails at the largest.
2. Mix manure, rice bran, rice straw, and leaves, evenly.
3. Mix DA and sugar with the water.
4. Spray the DA water to the manure dough.
5. Maintain the water level at 30% (grab a handful of dough, and release it. If it stay together in one pack , it means the dough has too much water. If it crumbles, it means the dough has too less water.
6. Put the wet dough on dry floor, maximum height is 20cm.
7. Cover the wet dough with tarpauline or sacks
8. Check the temperature of the dough twice a day. If it gets more than 40^{o}C (as hot as the lukewarm water), roll over and mix the dough until it cools off, then put the cover back
9. Wait for 3-7 days until the color of the materials in the dough become black or dark brown. While waiting, check the temperature and do the previous step if it gets more than 40^{o}C.

4.4 Application Method – Soil

Depending on the soil degradation and the soil Ph (Acidity) the application amount can vary. A rough guide is shown below. DA is diluted (DDA) 1:100 with water, add 1 kg of sugar, and wait an overnight, then spray on soil. Do not apply with pesticides or fungicides.

Humus Content of Soil	Application Frequency	AD REQUIRED Litres/hectare	AD OPTIMUM Litres/hectare
Humus level 5% + Ph 7	Annually	1	20
Humus level 3%, Ph 6	1st Year	4	80
	2nd Year	3	60
	3rd Year	2	40
Low organic Content Ph 5	1st Year	5	100
	2nd Year	5	100
	3rd Year	5	100

4.5 Application Method – Crops

4.5.1 Tilling

Application Method – Plants : Land Tiling

Type of Plants	Application Frequency	PA Dosage (l/ha)	DPA Application Method
Cereals (wheat, rice, etc)	Once a week	10	Spray DPA
Fruits (grape, tomato, orange, etc)	Once a week	10	Spray DPA
Plantation crops(sugar, tobacco, etc)	Once a week	10	Spray DPA
Vegetables (potato, cucumber, etc)	Once a week	10	Spray DPA
Ornamental plants	Once a week	10	Spray DPA

4.5.2 Seeding

EM is added to seed coating treatments to enhance seed germination and seedling survival

Type of Plants	Application Frequency	PA Dosage (l/ha)	DPA Application Method
Cereals (wheat, rice, etc)	Once a week	5	Spray DPA
Fruits (grape, tomato, orange, etc)	Once a week	5	Spray DPA
Plantation crops(sugar, tobacco, etc)	Once a week	5	Spray DPA
Vegetables (potato, cucumber, etc)	Once a week	5	Spray DPA
Ornamental plants	Once a week	5	Spray DPA

4.5.3. Application Method – Plants : Nurturing

DDA is applied either by boom sprayer unit or injected into the irrigation water to the crops at varying timing and frequency during the growth cycle of the crops (20l/ha).

Type of Plants	Application Frequency	PA Dosage (l/ha)	DPA Application Method
Cereals (wheat, rice, etc)	Once 1-2 weeks	5-10	Spray DPA
Fruits (grape, tomato, orange, etc)	Once a week	5-10	Spray DPA
Plantation crops(corn, tobacco, etc)	Once 5-7 days	5-10	Spray DPA
Vegetables (potato, cucumber, etc)	Once 5-7 days	5-10	Spray DPA
Ornamental plants	Once 3-4 days	5-7	Spray DPA

4.5.4 Crop residues.

The crops residues are sprayed with the diluted DA just prior to cultivation (20l/ha)

4.5.5 Weed seed

During cultivation diluted DA is sometimes sprayed on the soil surface to induce weed seed germination, which can be then cultivated to develop a “clean” seedbed (20l/ha).

4.4.6 Weeding

Spraying equipment has been mounted on weeding equipment to apply DDA during the weeding phase of the crops, as the weeds are undercut they receive DA, and are speedily recycled back as organic matter to the soil (20l/ha).

Onions and some other crops are sprayed with DDA to enhance storage of the crop (0.1%)

4.7. Application method-chicken, pig, sheep and cattle

Pastures are sprayed with DDA during grazing. When grazing DDA is sprayed onto herbage (20 litres/ha DDA)

4.8. Application method- Probiotic medicine

Administered as an oral drench combined with other ingredients such as cider vinegar (DA combined with garlic and cider vinegar). (dosed at 5-20ml per animal depending on size of animal).

4.9. Application method- Fisheries

Application Method –Water Animal : Pond Preparation

Period	Application Length	PA Dosage (l/ha)	Application Method
After harvest	Two weeks	10	Pour PA directly, wait for 2 weeks, and dry the pond
Drying	One week	-	Hoe or plow the soil
Watering	One week	10	Pour PA directly, wait for 1 week, then spread the seedlings

Application Method –Water Animal : Feeding

Animal Age	Application Frequency	PA Dosage l/ha	DPA Application Method
1 month	Once a week	5	Pour DPA directly
2-3 month	Once a week	10	Pour DPA directly
When stressed or less appetite	As necessary	20	Pour DPA directly

4.10. Application method-Waste treatments and environment

Application Method – Organic Waste Processing

Mix PA and molasses and water with ratio 1:1:5, and called Molasses Mixed Probiotic Agent (MMPA)

Type of Organic Waste	Application Period	PA Dosage l/ton	MMPA Application Method
Liquid	3-7 days	1	Pour MMPA directly, mix using Aerator/Blower
Solid	4-7 days	10	Pour MMPA directly, mix well, maintain 30% moisture, cover with sacks, check daily. Poke mixture if >40°C. Wait until smell like wine

4.11. Application method- Super Compost

It is best to mix the super compost with the soil before seeding period, 1-2 tons per hectare depends on the soil condition. In nurturing period, spread super compost to the top soil 500 kg per hectare.

4.12. Application method- Organic Pesticides

Fermented plant extract (FPE) or Organic Pesticide is made using garlic, tobacco, mimba and chili, boiled together, cooled down until really cool, then mixed with DA. Used in circumstances when disease and pest pressure is high (20l/ha).

4.13. Comparison of organic fertilizer potency with and without DA

A research report from Indonesia conducted by Phimmasone Sisouvanh in 2011 [18] on tomato clearly indicated increase of yields almost four folds of fruit weight per plant, five folds of fruits numbers per plant, and three folds of fruit weight, when given proper treatment of fertilizers combination between chemical fertilizer, compost and DA altogether in different compositions.

Treatments		Number of fruit per plant		Fresh weigh of fruit per plant		Average fresh weight of fruit	
		Straw	Peat	Straw	Peat	Straw	Peat
				..........g/plant..........			
Inorganic fertilizer (Urea-SP-KCl, g/pot)	Compost (g/pot)						
0-0-0	0	2.67	2.67	26.68	26.68	10.13cdf	10.13
0-0-0	200	6.67	5.00	171.15	98.43	26.25a	20.68
0-0-0	400	8.33	5.33	170.36	133.34	20.29ab	25.23
2.53-1.68-3	0	10.00	10.00	242.64	242.64	24.96a	24.96
2.53-1.68-3	200	12.33	10.67	301.49	240.01	24.46ab	22.66
2.53-1.68-3	400	17.00	15.00	406.36	321.13	23.63ab	21.20
4.68-3.12-6.52	0	10.00	10.00	154.94	154.94	15.45bcd	15.45
4.68-3.12-6.52	200	12.33	8.33	207.32	200.71	17.17abcd	22.63
4.68-3.12-6.52	400	15.67	9.67	339.72	188.53	21.59ab	20.29
7.2-4.8-10	0	2.33	2.33	19.86	19.86	8.66f	8.66
7.2-4.8-10	200	6.33	6.67	121.99	75.76	18.95abc	11.05
7.2-4.8-10	400	13.33	9.00	233.44	152.34	17.32abcd	16.87

Table 5 Effects of DA to the Tomato

Below is the Table 6 consisting microorganism found in the compost which also similar with the microorganism exist in DA

Actinomycetes
Actinobifida ahromogena
Microbispora bispora
Micorpolyspora faeni
Nocardia sp.
Pseudocardia thermophilia
Streptomyces rectus
S. thermofuscus
S. theromviolaceus
S. thermovulgaris
S. violaceus-ruber
Thermoactinomyces sacchari
T. vulgaris
Thermomonospora curvata
T. viridis

Fungi
Aspergillus fumigates
Humicola grisea
H. insolens
H. lanuginose
Malbranchea pulchella
Myriococcum thermophilum
Paecilomyces variotti
Papulospora thermophilia
Scytalidium thermophilim
Sporotrichum thermophile
B. subtillis
Clostridium thermocellum
Escherichia coli
Flavobacterium sp.

Bacteria
Alcaligenes faecalis
Bacillus brevis
B. circulans complex
B. coagulans type A
B. coagulans type B
B. licheniformis
B. megaterium
B. pumilus
B. sphaericus
B. stearothermphilus

Pseudomonas sp. Serratia sp.
Thermus sp.

Source: Palmisano and Bartaz (1996)

4.14. Economical analysis of farming with and without DA

A study conducted in Sri Lanka by U.R Sangakarra in 1996 [19] provide a clear description on what is the economical benefit implementation of DA (EM) in a farm. Below are the comparison tables of the results

Table 7 **Effect of EM and Organic Amendments on Yields of Sweet Potato and Bush Bean over Three Years in Organic Farming Systems.**

Treatments	Sweet potato (kg/ha)				Bush bean (kg/ha)			
	Year1	Year2	Year3	Sx	Year1	Year2	Year3	Sx
Legume leaves	5125	5580	6204	46.2	2240	3172	4250	51.5
Rice straw	4404	4884	5256	21.5	1985	2440	3216	30.4
Cattle manure	5590	5985	6704	58.2	2408	3208	4415	40.2
Legume leaves+EM	6056	6104	8456	90.6	2885	3942	5240	45.9
Rice straw+EM	5196	5420	6994	75.8	2425	3204	4450	68.2
Cattle manure+EM	6584	6658	7040	50.5	3036	4108	5426	71.5
Control	3400	3156	3090	86.4	1485	1304	1299	42.9
Sx	124.7	86.8	140.4		156.4	99.5	80.4	

Table 8 **Effect of EM and Organic Amendments on the Benefit:Cost Analysis of Sweet Potato Yields and Sales over Three Years in Organic Farming Systems.**

Costs, Income and Benefits	Control (untreated)		Organic inputs		Organic inputs+EM	
	Year1	Year3	Year1	Year3	Year1	Year3
Costs						
Labor (100 SLR/day)	24,000	24,000	24,000	24,000	24,000	24,000
Planting	500	500	500	500	500	500
Organic materials			12,000	12,000	12,000	12,000
EM purchase					1,500	1,500
EM application					2,500	2,500
Total costs	24,500	24,500	36,500	36,500	40,500	40,500
Cost over control			12,000	12,000	16,000	16,000
Cost of using EM					4,000	4,000
Income						
Produce (25 SLR/kg)	48,000	37,080	60,475	72,650	71,340	97,960
Income over control			12,475	35,570	23,340	60,880
Income from EM					10,865	25,310
Benefit: Cost (B:C)						
B:C over control			1.04	2.96	1.46	3.80
B:C from using EM					2.72	6.33

SLR = Sri Lankan Rupee. Exchange rate: $1.00 USD = Rs 48 SLR.

Cost and income from organic systems are based on the mean costs and returns of three organic amendments, i.e., legume leaves, rice straw and cattle manure.

Table 9 **Effect of EM and Organic Amendments on the Benefit : Cost Analysis of Bush Bean Yields and Sales over Three Years in Organic Farming Systems.**

Costs, Income and Benefits	Control (untreated)		Organic inputs		Organic inputs+EM	
	Year1	Year3	Year1	Year3	Year1	Year3
Costs						
Labor (100 SLR/day)	30,000	30,000	30,000	30,000	30,000	30,000
Planting	1,500	1,500	1,500	1,500	1,500	1,500
Organic materials			12,000	12,000	12,000	12,000
EM purchase					1,500	1,500
EM application					2,500	2,500
Total costs	31,500	31,500	43,500	43,500	47,500	47,500
Cost over control			12,000	12,000	16,000	16,000
Cost of using EM					4,000	4,000
Income						
Produce (25 SLR/kg)	37,125	32,475	55,275	99,000	69,550	125,960
Income over control			18,150	66,525	32,425	93,485
Income from EM					14,275	26,960
Benefit:Cost (B:C)						
B:C over control			1.51	5.54	2.03	5.84
B:C from using EM					3.57	6.74

SLR = Sri Lankan Rupee. Exchange rate: $1.00 USD = Rs 48 SLR.
Cost and income from organic systems are based on the mean costs and returns of three organic amendments, i.e., legume leaves, rice straw and cattle manure.

From the above tables, it can be concluded that by adding organic fertilizers, net income will increase 1.5 folds in the first year, and progress to 5.5 folds in the third year. By adding organic fertilizers and DA, net income will increase 2 folds in the first year, and progress to 5.8 folds in the third year.

The research result however, is subjective to soil's condition, weather, type of plants, and other normal agricultural treatments. The result is to be used as an illustration on how addition of DA might increase the net income of farmers.

Another study conducted by ENACTUS NUIST - HaHa Team lead by Gatot G in 2012 in Pukou chicken poulty also indicates that eggs produced by hens treated with DA, have 15% higher protein level, increased yellow yolk, tastier yolk, stronger and darker eggshell, easier to open boiled-eggs. Other noticeable effects of DA upon the chicken are, the furs become smoother and denser, the appetite increased, the feeding speed increased, and the activeness increased.

Chapter 5

MARKET RESEARCH

5.1 Research Method

Market research was, is being, and will be conducted through non structured interview, semi structured interview, structured interview, literature researches, data collection, data cross-check with field trips, and samples measurement. The subjects are farmers, breeders, business persons, and governmental agencies. List of all the subjects is on the Appendix

The selected research method is mixed method between quantitative and qualitative method. Quantitative data are acquired from Nanjing Government while qualitative data is acquired from interviews with the farmers.

Picture 7 Pancheng Village

Picture 8 Pancheng Village Farmers selling grapes

5.2. Interviews

Semi-structured interviews (field trip visits by SIFE members) were held with a group of grape farmers and chicken breeders from the Pukou area to ask about their farm practices and needs. Responses obtained from the farmers were cross checked with experts in the farm practices such as professors and practitioners, with governmental data as well as with literature review. The information will be written in this thesis when they have been confirmed by at least two sources.

Picture 9 ENACTUS Team members interviewing a chicken breeder

Generally, farmers in the study area consider organic farming ways to be one of the most time-consuming and labor intensive aspects of their work. In 2010, another research was conducted in the vineyards and encouraged farmers to use organic fertilizers especially the chicken dung. The result was very good since the crops show significant improvement and the fruits taste had become much more appealing for the market. However the production and application way was time consuming and the cost of chicken dung increased ever since the method was introduced. Now, the farmers who are also laborers in factories in the area, seems reluctant to use the methods again since it takes away part of their working time in factories.

Less labor intensive ways of producing fertilizer would be very interesting for these farmers, especially if the new techniques provided additional benefits such as a convenient source of income. The grape farmers are also interested in a liquid fertilizer that can be used as a major ingredient for organic pesticides, but they would appreciate the opportunity to test DA on their farms before they made any commitments.

Picture 10 ENACTUS Project Leader Applying DA to the Green Pepper

Interviews with the farmers confirmed that organic matter inputs are usually obtained on farm or from farms in neighboring villages. While some farmers have access to manure from large farms, others lack information about sources of organic fertilizers such as manure or straw or other organic waste. Most farmers got information about manure from their family and friends and some got information from other farmers in their farmer groups[4].

. According to the farmers it would be impractical to transport manure, straw and compost long distances because they do not have trucks and must depend on hand-tractors and carts. This would make it difficult for them to buy inputs from distant villages, so they prefer to buy from other farmers in the local area or have the organic matters delivered to them.

On the other hand, DA is relatively new and unheard. The price also has not been established well among most farmers. Organic farms such as BioFarm, which is the oldest organically certified farm in Shanghai and a four star farm in ChangJiaGang also never use DA although shows great interest in applying DA in a controlled test area.

Picture 11 ChangJiaGang Integrated Farm - ENACTUS NUIST

Chicken breeders in study area are also interested in using DA to enhance their yields since DA has been known beneficial on animals. It can be fed to the animals by mixing it in the water or food. The odor produced in the barn can also be reduced by proper application. Currently the breeders are interested in application on meat and egg chicken producers. No contracts have been signed yet, but the application has been initiated.

Picture 12 ENACTUS project leader in a chicken barn in Pukou Village

5.3. Data and Result

Data collection and survey about distribution channels were conducted by ENACTUS members from field trips, internet surfing and non-confidential official government data from literature such as published journals and books

Generally, farmers in the study area acquire fertilizers and other farming provisions from the surrounding stores in study area. The price of the provisions fluctuates according to market price. Despite of governmental support and control, the price tends to rise up following international market price. The same phenomenon also happen to chicken feed and medicines.

Survey on several online websites such as Alibaba, Taobao, PaiPai, and Baidu indicates that adoption of similar competing products in China is very limited to minority of organic farmers and hobbyist. The reasons of this limited and slow adoption have been mentioned in Chapter 2 particularly in part 2.2.1. Challenges and Problems.

Picture 13 Screenshots of Alibaba and Baidu

5.4 Actions to Respond Research Findings

All the problems create barriers but also chances for new players. Survey conducted by ENACTUS shows that current products similar to DA are now considered as expensive and unproven despite many proofs in various regions have shown potency of DA in farming, and other environmental purposes. To overcome, a comprehensive marketing plan is required which will be discussed further on Chapter 6..

There will be three scales of business strategies to run. Pilot Scale Business Strategy, Small Business Strategy, and Full Commercial Business Strategy. Investors who wish to run this line of business may choose one of the scalable business strategy mentioned in Chapter 7. Each of the scale will have their own financial analyses, but Pilot Scale Financial Analysis will be discussed in Chapter 8. The reason it is discussed separately is the limitations of resources for in-depth discussions of the other two business strategies, which require much more data, resources, time, and manpower to conduct a comprehensive Small Business Strategy or Full Commercial Business Strategy.

5.5 Potential markets

China has large market potential for fertilizer. In 2005, 47.66 Mt of fertilizers were used in China, including 22.29 Mt of nitrogenous fertilizer, 7.44 Mt of phosphate fertilizer and 4.90 Mt of potash fertilizer (CSSB 2006).). China is pursuing food security target in 2030, but may encounter many obstacles to fulfill this forecast such as the inconsistent government policy, price control, no strict quality control, rise of fake fertilizers in the market, rigid regulations, ineffective monitoring, weak regulations enforcement, uneducated consumers. (Sam Portch, 1997).

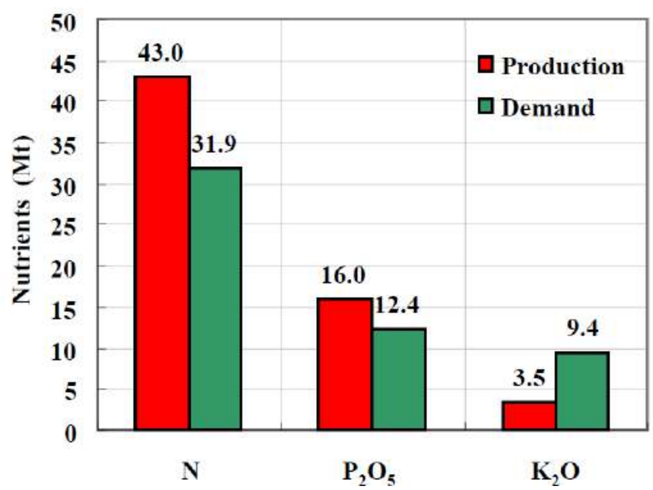


Figure 2 Chemical Fertilizer Production and Demand in China in 2010

With the increasing demand of fertilizers, the demand for organic fertilizers will also increase. DA as one of organic fertilizers will experience increased demand. In addition , DA as one of the catalyst to enhance potency and effectiveness of chemical fertilizers will see more demand from users who wish to optimize the value of their chemical fertilizers.

5.5.1 Increasing Population and Food Demand

The per capita grain production will be around 360 kg in the period 2000–2030 and reach 470 kg in 2050. Li et al (2001) predicted, that “In 2030, China must have at least 72 million tons of NPK fertilizer to meet the demand of food production and agricultural development

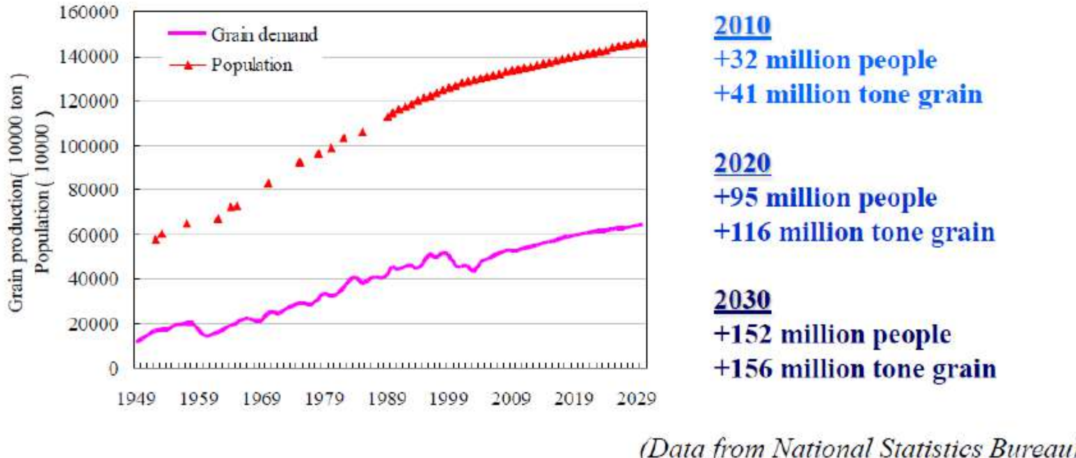


Figure 3 Grain Production and Population Forecast from 2010 to 2030

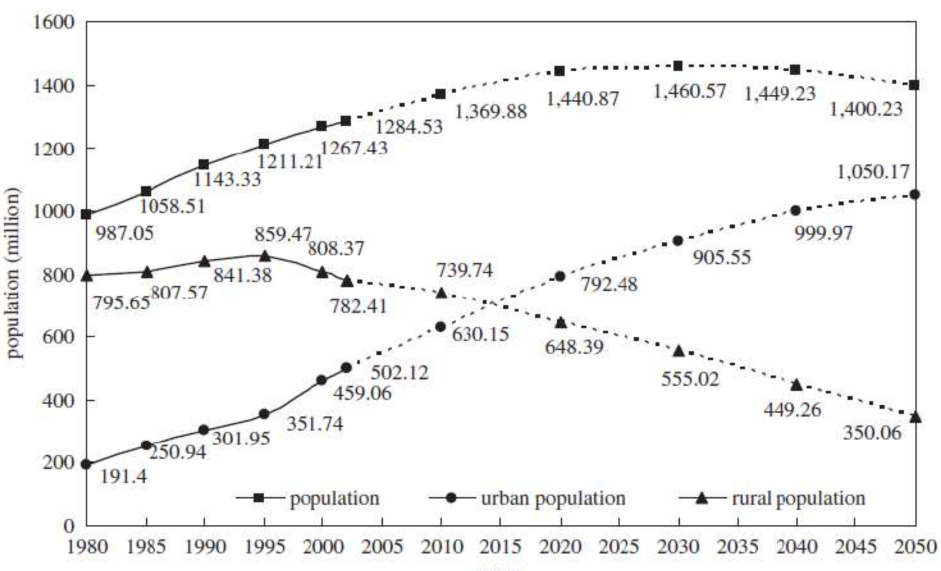


Figure 4 Total, rural and urban population of China, 1980-2050 (Yan et al, 2006)

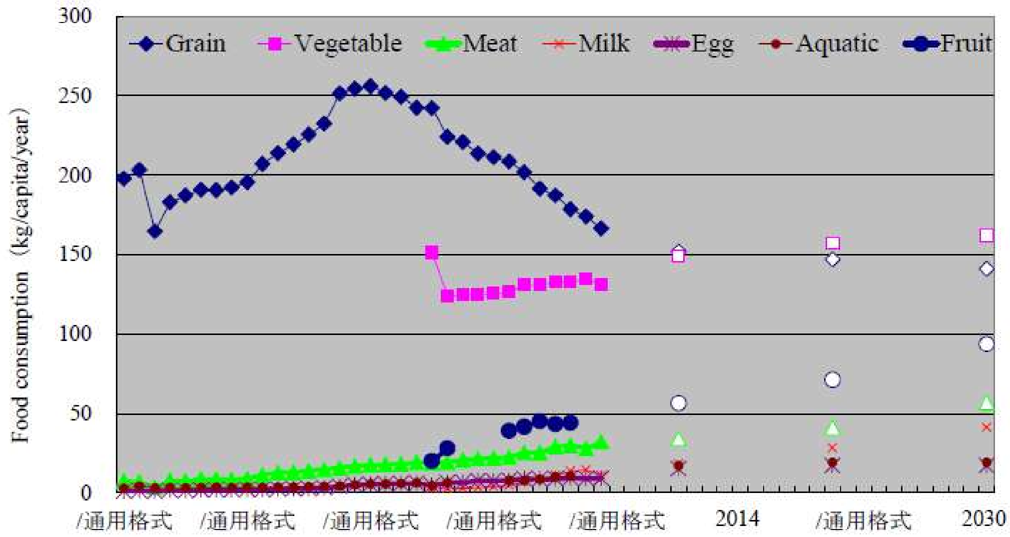


Figure 5 China Food Demand Forecast (Yanfeng Wang, unpublished)

The contribution of fertilizers to yield in China is still low. The average contribution made by fertilizers to grain yield is only 46.43%, and that is increased approximately 8.84 tonnes a per tonne of fertilizer used (Peng 2000). Based on this contribution to yield, fertilizer consumption will be increased by at least 10.22–11.08 Mt to support a 100 Mt increase in grain yield during the twenty-first century.

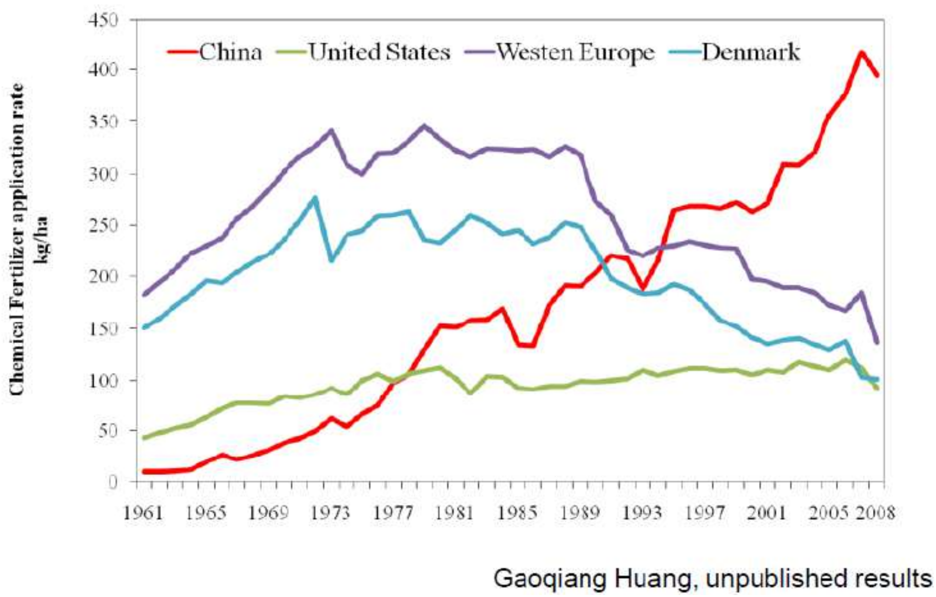


Figure 6 Fertilizer Consumption

By applying DA in the grain field, the yield will increase. In other word, less chemical fertilizers are needed to achieve the same amount of crops.

5.5.2 Increasing Cash Crops Production

Farmers are moving toward higher profit crops rather than just staple food production. As can be seen from the below figure on the right side, staple food requires more fertilizers than staple food. This creates more demand for fertilizers and its supportive products. Data from statistic biro shows that more than 50% of fertilizers in China are being used in cash crop production.

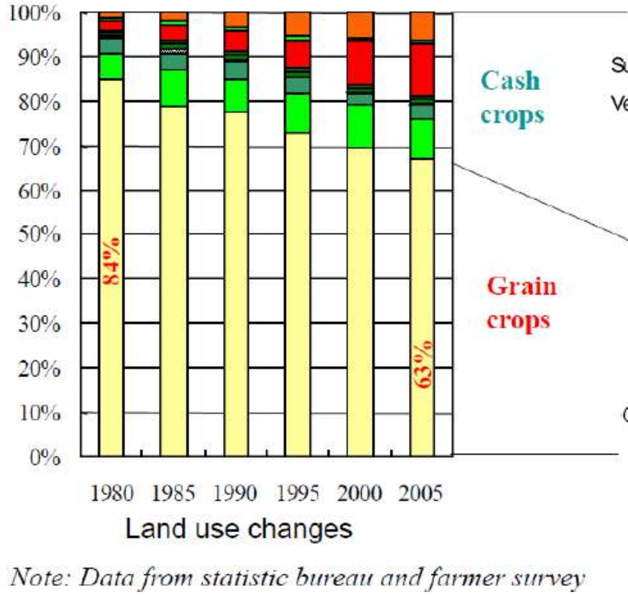


Figure 7

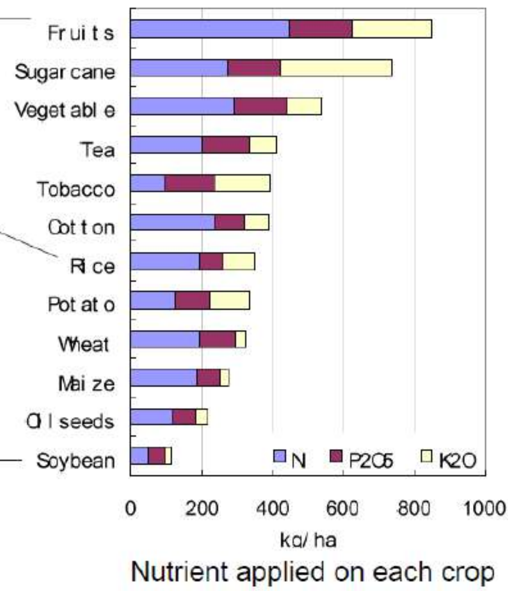


Figure 8

Together with the increment of planting area that mostly are populated with non-staple food, the demand for fertilizer increase dramatically, and tend to increase more along with the population increment.

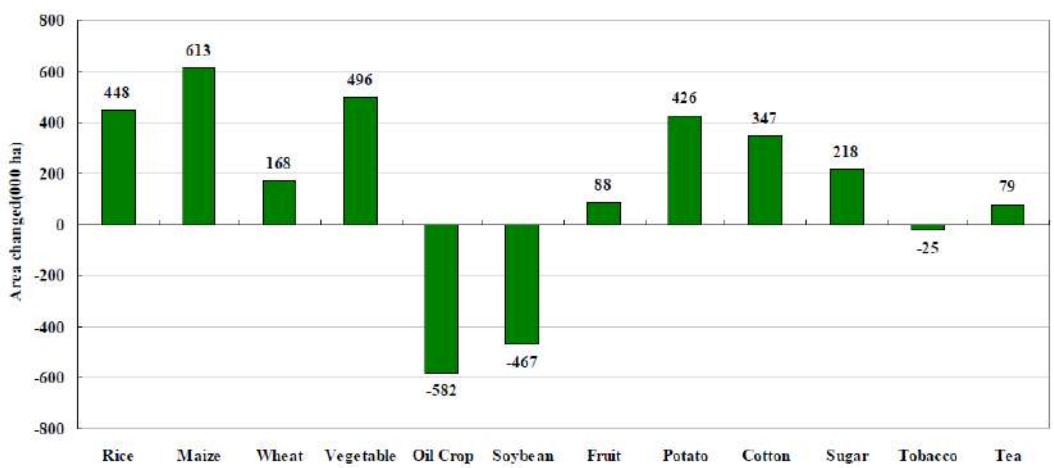
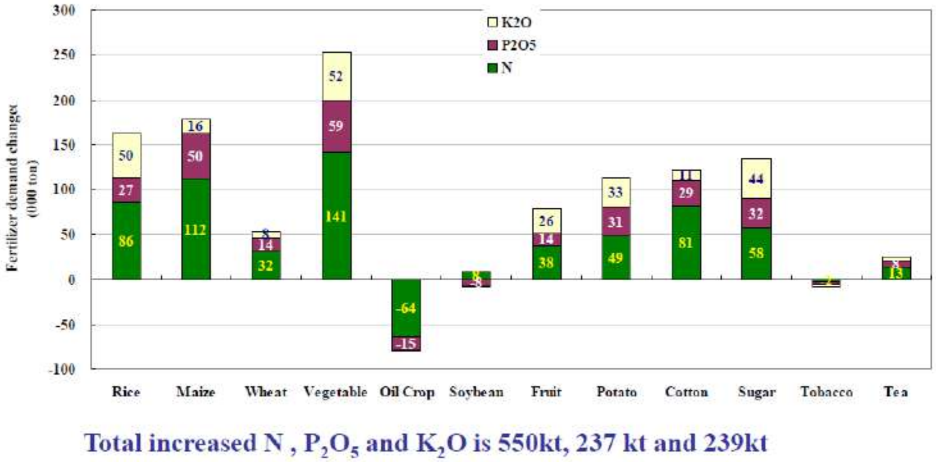


Figure 9 Planting Area Changes in China in 2005 and 2006



Note: Calculated based on the crop based experts model of China

Figure 10 Fertilizer Demand Changes in 2005 and 2006

Application of DA in cash crops cultivation will increase 10% to 200% from original crops level. These result can be seen within one to five crops cycle. Thus, immediate result can be seen relatively quick and will open another market for DA application.

5.5.3 Increasing Animal Production

Animal husbandry is one of two biggest contributors of agricultural output value. Altogether with arable farming, they contribute more than 90% of the entire value. Animal husbandry is also one of the biggest direct and indirect consumers of fertilizers since animals need food from staple and non-staple food.

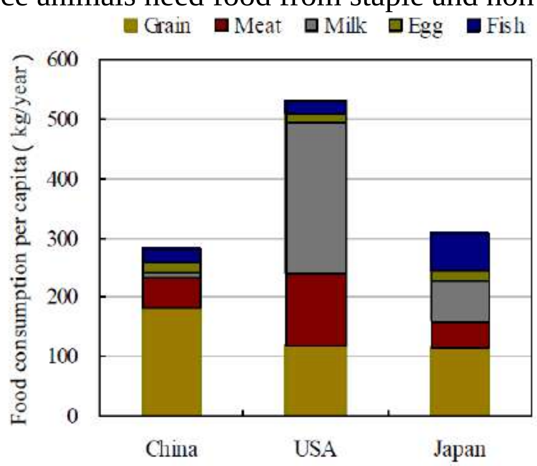


Figure 11 Food consumption in different country

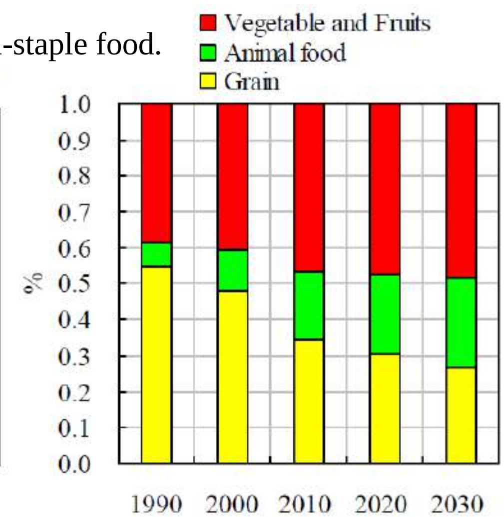


Figure 12 Food demand in China

Note: Data came from the Statistics Bureau of China and FAO
Forecasted data from the reference of Liu Jiang (2000); Xu Shiwei (2003)

Compared with 1980, grain production increased 89%, while the production of meat, egg, and milk increased 6.4 , 11.2 , and 20.8 times respectively in 2005

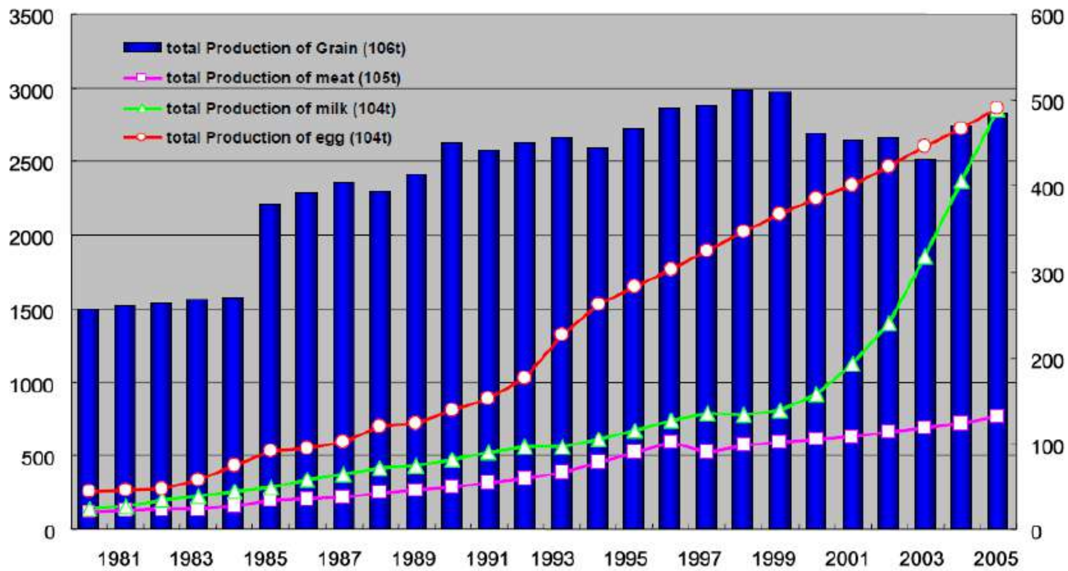


Figure 13 Trends of grain production, meat production, milk production and egg production

Data from China statistic bureau

5.5.4. Increasing Production of Bio-Energy Crops

Recent oil price spike followed by other energy sources price spike, has triggered large demand of renewable fuels from industry and commercial users. These fuels are mostly derived from staple and non-staple food, which in the end also trigger higher demand for more fertilizers.

	2010 (Mt) (Biofuel accounting for 1% of total energy demand)			2020(Mt) (Biofuel accounting for 4% of total energy demand)		
	Biofuel Production	Crop demand	Fertilizer demand	Biofuel Production	Crop demand	Fertilizer demand
Ethanol	2	5.76 corn	0.77	10	28.8 corn	3.48
Diesel	0.5	3.68 soybean	0.49	2	14.7 soybean	1.96
Sum	2.5	9.44	1.26	12	43.5	5.44

Table 10 Biofuel Production, Crop Demand and Fertilixer Demand

Data source:
Medium term forecast for biofuel development,
- China reform and development committee, 2006

DA contains microorganisms that can prolong retention of the nutrition from the chemical fertilizer in the soil such as Phosphate. DA also contains microorganisms that acquire Nitrogen from the air to be used in the soil. Thus DA can increase soil fertility, improve soil structures, and enhance plants nutrition absorption. Application of DA in Bio-Energy crops will economically-environmentally-socially benefit farmers, buyers, industry, and governments

5.5.5 Food Security Policy

Basic principles of sustainable agriculture are to maintain a sufficiency of land for agriculture, to guarantee food security, to improve current living standards, to safeguard the development of future generations and to establish harmonious mechanisms for agriculture and economic development that ensure a prosperous rural society (Schaller 1993). Its general goals are to (i) increase grain yield, ensure food security and eliminate famine, (ii) increase peasants' income, eliminate poverty and stimulate comprehensive agricultural development, and (iii) use and protect natural resources and the agricultural environment while improving the natural environment for present and future generations.

With 22% of the global population but less than 7% of the global cultivated land, China is confronted with challenges in agricultural development [21]. The recent achievements in increasing grain yield have been realized with high costs to natural resources and environment. This presents a new challenge for China's sustainable agriculture. At present, the concepts and principles of sustainable agricultural development have been included and expressed in a national sustainable development strategy (e.g. China's Agenda 21) and the plan for national economic and social development [3]

The essential goals of China's sustainable agricultural development, widely accepted in China at present, are food security, employment, natural resource conservation and environmental protection. The main components can be generalized as sustainability of the agricultural production, the rural economy, the agro-ecosystems and the rural society.

In recent decades, demands for food quantity and quality have been increased sharply in China due to the improvement of people's living standards and continuous economic growth. The potential for increased agricultural production is constrained mainly by the extreme shortage of water and cultivated land [3]

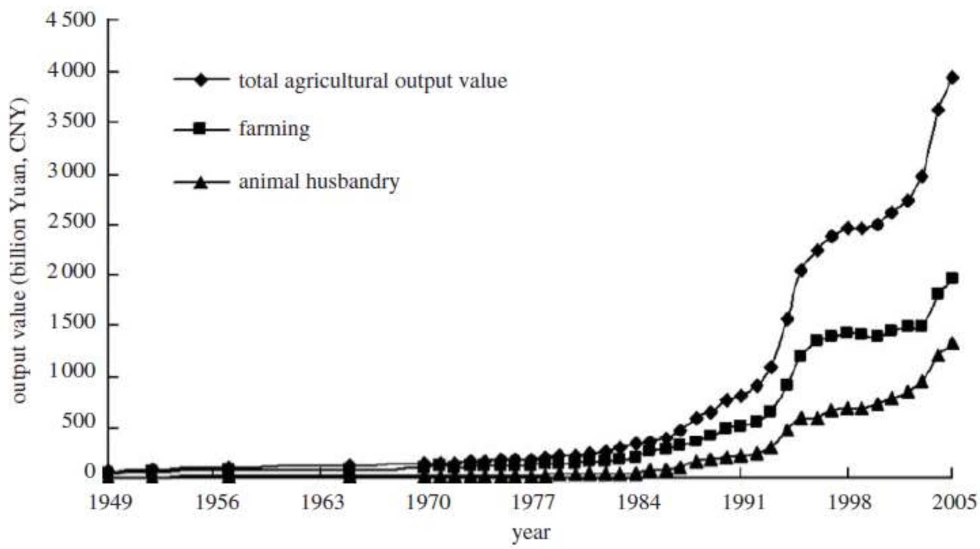


Figure 14. Incremental growth in output value of China's agriculture, 1949–2005.

This food security policy provides policy advantages for the DA market in the future. The China government policy implies support for adoption of DA in the agriculture as a part of the fertilizer components to achieve food security

5.5.6 Environmental Friendly Policy

The Central Government of China has adopted sustainable environment policy and urges local governments to do according to the policy, however the adoption of the policy might need several years if not decades to be fully implemented. For example, the GaoChun district government in Nanjing does not permit heavy industry to setup a factory in the area. As for the other districts such as Luhe and Jianning, the policy might not be adopted immediately since there are already many heavy industry factories in their respective regions. Until the permits are expired, the authorities can only limit the pollution level on the already established companies and enforce the new regulation toward new business. Such similar things also exist in the agricultural sector where the government is encouraging all the agricultural stakeholders to adopt environmentally friendly means to produce, harvest, distribute, process, sell, and waste the by-products.

5.6 Trading and market structures in China

Currently China has adopted nearly semi-free market for fertilizers. Subsidy and price control is still applied in certain parts of the market. Noticeable progress toward freer market in adopted since 1998 with Major Reform Measures in Document 39 "Notice on Deepening Reform of Fertilizer Circulation System", and in Document 31 "Decision of Further Deepening Reform of Fertilizer Circulation System by the State Council [22]. Below are the freely interpreted keypoints of the documents, courtesy of SINOFERT :

Document 39 :

1, Self Purchase and Self Sale. Cancel the mandatory production and unified distribution. Manufacturing and operational enterprises are free to purchase and sell fertilizer.

2. Broaden the channel of fertilizer circulation. Fertilizer manufacturing enterprises, agricultural material companies at all levels, and 3 stations of agriculture are clients with each other China National Chemicals Import and Export Corporation (predecessor of Sinochem) is entitled to domestic trade operation right of fertilizer.

3. Improve the price management of fertilizer. Set up market price formation mechanism under the guidance of the government : Ex-factory price of fertilizer is the guidance price of the government; limitations are removed on the retail price of fertilizer; and Price Department Sector of provincial level could set a price ceiling on some types of product when necessary.

4. Improve fertilizer import agency system. Imported fertilizer of all types by trades and channels are subject to import quota administration; appropriately increase import agency channel of fertilizer by giving China Agricultural Production Material Group, in addition to Sinochem, the operation right of fertilizer import agency.

5. Establish reserve system of disaster relief fertilizer (has set up off-season commercial reserve system of fertilizer since 2004)

Document 31 :

10. Eliminate the restrictions on the ownership of fertilizer operational enterprises. Qualified market entities are allowed to enter into the fertilizer circulation system to participate in the operation and compete fairly, such as enterprises of all kinds of ownership, farmer specialized cooperatives, individual industrial, and commercial

households.

11. Encourage chain and intensive operation. The country encourages large fertilizer manufactiuring and circulation enterprises as well as social capital with some power and scalre to integrate the resource, and develop chain and intensive operation through merger and acquisition

So far, China's fertilizer circulation system is in the phase which has various entities and models, market pricing, and autonomous operation. The major problems now are how to build a highly efficient, low-cost, and well developed distribution system.

The three common distribution structures are :

1. Key Customer, will be approached using Direct Sale method toward large industrial clients and large commercial planting families.

2. Conventional Distribution Network, will be approached using Conventional Distribution method toward distributors of all levels and planting families.

3. Agricultural Material Supermarket, will be approached using Retail method toward end farmers and hobbyist

Chapter 6

MARKETING STRATEGY

The overall marketing strategy will involve funneling strategy as described with a diagram below :

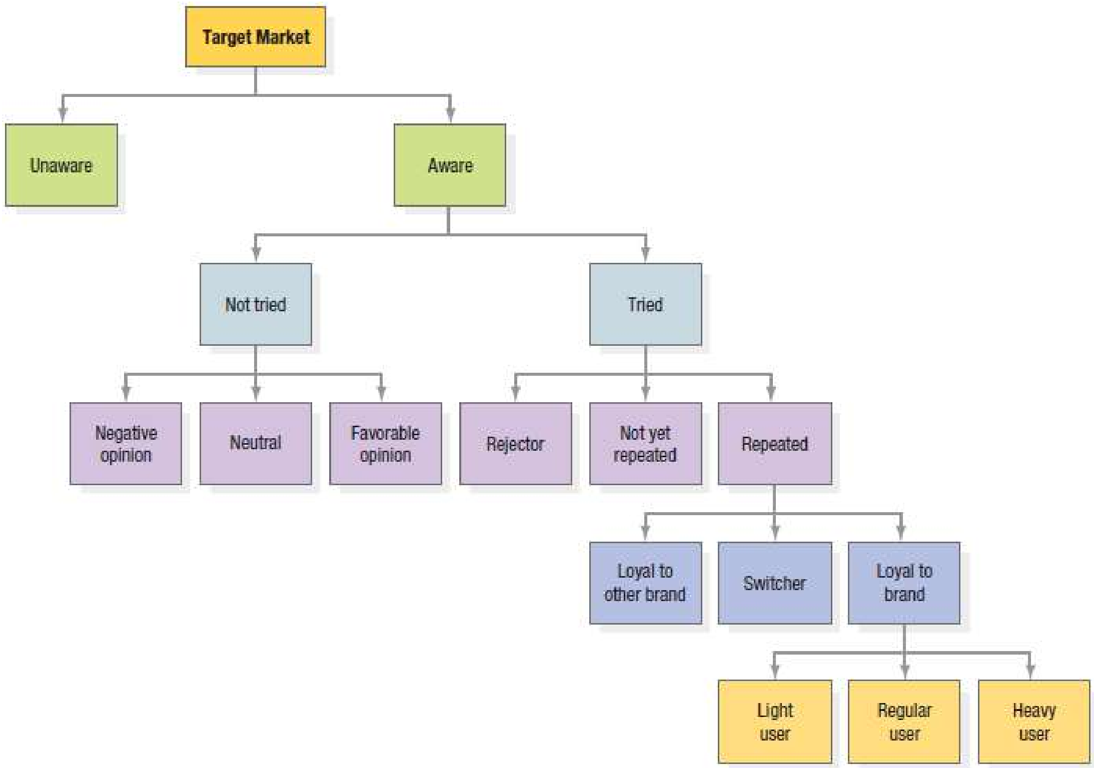


Diagram 2 Funneling Strategy

The market need to be educated to make them aware of the product, persuaded to try the product, trained to use to product in such a way the consumers want to repeat the order, conditioned to have a full satisfaction toward the product and result, then become the regular user.

The marketing department will be loosely divided into two major segments : Business and Retail. Retail users include end users, hobbyist, Business-to-Consumer Internet buyers, and retail networks. Business users will include industrial clients, large commercial planting families, and Business-to-Business Internet buyers.

The marketing department will use the three common distribution methods mentioned in the previous chapter, and enhance it with the service and training.

Segmentation variables in considerations are :

Demographic
1. *Industry:* Which industries should we serve?
2. *Company size:* What size companies should we serve?
3. *Location:* What geographical areas should we serve?
Operating Variables
4. *Technology:* What customer technologies should we focus on?
5. *User or nonuser status:* Should we serve heavy users, medium users, light users, or nonusers?
6. *Customer capabilities:* Should we serve customers needing many or few services?
Purchasing Approaches
7. *Purchasing-function organization:* Should we serve companies with a highly centralized or decentralized purchasing organization?
8. *Power structure:* Should we serve companies that are engineering dominated, financially dominated, and so on?
9. *Nature of existing relationship:* Should we serve companies with which we have strong relationships or simply go after the most desirable companies?
10. *General purchasing policies:* Should we serve companies that prefer leasing? Service contract? Systems purchases? Sealed bidding?
11. *Purchasing criteria:* Should we serve companies that are seeking quality? Service? Price?
Situational Factors
12. *Urgency:* Should we serve companies that need quick and sudden delivery or service?
13. *Specific application:* Should we focus on a certain application of our product rather than all applications?
14. *Size or order:* Should we focus on large or small orders?
Personal Characteristics
15. *Buyer-seller similarity:* Should we serve companies whose people and values are similar to ours?
16. *Attitude toward risk:* Should we serve risk-taking or risk-avoiding customers?
17. *Loyalty:* Should we serve companies that show high loyalty to their suppliers?

6.1 Full Commercial Scale Business Strategy

6.1.1 Setup Strategy

To start a commercially profitable company, funds of ¥20.000.000 is required. To reach economical scale of production, comprehensive efforts using expansive spiral methods are absolutely necessary. By expanding the scale into economical, the sustainability of the company can be maintained and expanded in the future. Advertising, branding, positioning of products in the market are a few of actions to be taken during this phase.

6.1.2. Full Commercial Phase Keys to Success

To ensure the proposed company will prosper, the following things are necessary to be done :

1. Efficiently and effectively maintain production line capacity and speed to meet demand.
2. Maintain inventory as efficiently and profitably as possible. Strive to reduce down time and stoppages.

3. Operate the facility operation as efficiently and safely as possible using every method to increase profits yet maintain a high concern for the environment.
4. Maintain family-like atmosphere for all associated with SIR, team-members and customers alike.
5. Gather support from users, government authorities, neighborhood, and investors.

6.2 Small Scale Business Strategy

6.2.1. Setup Strategy

The principals seek ¥1.500.000 net from Venture Capital or other investors with the same vision. In small scale business phase, funds will be used to finance lab testing, market research, build small-scale automated production facility, quality control process, products R&D, marketing and distribution channels creation. The phase will take place from one to two years after the Pilot Project Phase

6.2.2 Small Scale - Keys to Success

To ensure the proposed company will prosper, the following things are necessary to be done :

1. Production standardization
2. Market research
3. Laboratory test
4. Field Test
5. Government approval, Venture Capital of at ¥1.500.000

6.3 Pilot Scale Business Strategy

6.3.1 Setup Strategy

The principals seek ¥100.000 net in investor funds. In Pilot Project phase, the first funds will be utilized to build field-laboratory. At NUIST, the construction phase involves complying with current state ordinances, installing manual processing facilities, submitting a financial instrument, obtaining production devices, buy safety equipments, and completing site development. This will require between one to three months

6.3.2 Pilot Scale - Keys to Success

1. Concentrate on finding and testing most effective and efficient methods to produce samples.
2. Comprehensive time-scheduling for team-members to ensure continous production.
3. Complete documentation on process, testing and results.
4. Approach to NUIST, market, dining hall and other authorities to provide continuous supply of organic waste and permits
5. Identify market needs and response, get funding of ¥25.000

6.4 Market Segmentation Target

SIR marketing and field-implementation personnel will contact organic farms, non-organic farms, plantations, garden, parks to promote all line of products and provide technical assistance in deploying them accordingly.

Market Segment will be based on :

1. Geographical location.

   Eastern China in the first five years, from Nanjing then expand to other regions in Jiangsu Province, then expand to all eastern provinces. After five years, expansion will be directed toward central and western China

2. Density

   Target and distribution centers will be located in the agricultural centers in Eastern China suburb or rural. In the urban areas where demand of organic fertilizers are high, distribution centers will also be established.

3. Application Area

   In the first five years, target area will be focused on agricultural areas especially farming, fisheries, animal husbandry, and its related products. After five years, other target areas will be explored including waste processing, environmental recovery, and pharmacy.

4. Business Scales

In the first five years, agricultural industry with less than 10hectares of land or working area will be the main focus. During those five years, other market segments will also be explored and probed

5. Buying power

In the first five years, non-premium non-bulk products will be available for most users. For industrial users, premium or bulk purchases will be available.

		Buyclasses		
		New Task	**Modified Rebuy**	**Straight Rebuy**
Buyphases	1. Problem recognition	Yes	Maybe	No
	2. General need description	Yes	Maybe	No
	3. Product specification	Yes	Yes	Yes
	4. Supplier search	Yes	Maybe	No
	5. Proposal solicitation	Yes	Maybe	No
	6. Supplier selection	Yes	Maybe	No
	7. Order-routine specification	Yes	Maybe	No
	8. Performance review	Yes	Yes	Yes

Table 11 Buying Classification

Chapter 7
FINANCIAL ANALYSIS

This financial analyis is based on data taken from Nanjing Facts Yearbook 2005-2006 issued by Nanjing Government. Included in this analysis are the market size, startup cost, sales forecast, and proforma profit and loss. From the analysis, Break Even point, NPV and ROI can be deduced and formulated. Thus, a potential investor can make an assesment on how long the investment will coup up, how big the risks are, and how profitable the investment will be.

7.1 Market Size

Index	Unit	2006	2005
Total Arable Farming Area	0000 Mu	89.23	107.91
Total Used Arable Farming Area	**0000 Mu**	**36.72**	**35.40**
Production per Mu	kg	503.00	499.00
Total Production	**ton**	**184,714.00**	**176,544.00**
Total Fisheries Area	**0000 Mu**	**13.08**	**13.08**
Total Fisheries Production	**ton**	**37,530.00**	**35,150.00**

DA Needed per year	**000 L**	5,913.84	5,818.80
Price per L	Yuan	1.00	1.00
Market Size	**000 Yuan**	**5,913.84**	**5,818.80**
Super Compost Needed per year	**000 kg**	18,360.00	35,400.00
Price per kg	Yuan	2.00	2.00
Market Size	**000 Yuan**	**36,720.00**	**70,800.00**
Super BioChar Needed per year	**000 kg**	3,672.00	3,540.00
Price per kg	Yuan	5.00	5.00
Market Size	**000 Yuan**	**18,360.00**	**17,700.00**
Super Organic Pesticides Needed per year	**000 kg**	1,836.00	1,770.00
Price per kg	Yuan	10.00	10.00
Market Size	**000 Yuan**	**18,360.00**	**17,700.00**

Table 12 Market Size

DA Assumption : Farming : 1 Mu needs 7.2 L / year ; Fisheries : 1 Mu needs 25 L / year

Super Compost Assumption : 1 Mu needs 50kg per year

Super BioChar Assumption : 1 Mu needs 10 kg per year

Super Organic Pesticides Assumption : 1 Mu needs 5 L per year

7.2 Startup Cost

Fundings are expected mainly from private investments, government funding, and loans. Preferrably, source of fundings are from verified clean financial sources to avoid bad press in the future.

The amount of 415,000 Yuan required in the below table is required annualy, and will be considered as loans that needs to be paid back to the the lender in five years. In reality, the investments are not returned to the investors, instead they will get the payback including interst and bonus as dividend in return of their investments in five years time span.

Being an investor doesn't mean automatically the investor owns a share in the company ownership. Company ownership transfer or acquisition is a different part of offer, and not included in this Feasibility Study.

Start-up (annually in the first five years)	
Types	**Amount（000 RMB）**
Startup Expenses	
Legal Permits and Certification	20
Field Labs - Land Rent (100 square m)	60
Equipments	80
Workers Salaries	125
Raw Materials	40
Promotions	40
Unexpected Matters	5
Total Start-up Expenses	**370**
Startup Assets	
Cash Required	20
Other Current Assets	5
Vehicles	20
Total Start-up Assets	**45**
Total Start-up Expenses	**415**

Table

Start-up Funding	
Types	**Amount（000 RMB）**
Start-up Expenses to Fund	370
Start-up Assets to Fund	45
Total Funding Required	**415**
Liabilities and Capital	
Liabilities	
Current Borrowing	0
Long-term Liabilities	0
Accounts Payable (Outstanding Bills)	0
Other Current Liabilities	0
Total Liabilities	0
Capital	
Planned Investment	20
Investment Amount	200
Donation	10
Government Grant	200
Initial Seed	20
Additional Investment Requirement	10
Total Planned Investment	**460**
Loss at Start-up (Start-up Expenses)	**370**
Total Capital	**90**
Total Capital and Liabilities	**90**
Total Funding Needed	**370**

7.3 Sales Forecast

Sales Forecast (in 0000RMB) for Nanjing and Jiangsu Area

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	Phase 1	**Phase 1**	**Phase 1**	**Phase 1**	**Phase 2**	**Phase 2**	**Phase 2**	**Phase 2**	**Phase 2**	**Phase 2**
Sales Potential in Units										
Decomposer Agent (000 L)	1,183	1,478	1,971	2,957	5,914	6,505	7,806	9,368	11,241	13,489
Super Compost (000 kg)			1,836	2,040	2,295	2,623	3,060	3,672	4,590	6,120
Super BioChar (000 kg)					367	408	459	525	612	734
Super Organic Pesticides (000 kg)							184	204	230	262
Total Sales Potential in Units	**1,183**	**1,478**	**3,807**	**4,997**	**8,576**	**9,536**	**11,509**	**13,768**	**16,673**	**20,606**
Unit Prices in Yuan										
Decomposer Agent Price	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.4
Super Compost Price	-	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Super Biochar Price	-	-	-	-	5.0	5.0	5.5	5.5	6.0	6.0
Super Organic Pesticides Price	-	-	-	-	-	-	10.0	10.0	11.0	11.0
Sales (in 000 Yuan)										
Decomposer Agent	1,183	1,478	2,168	3,253	7,097	7,806	10,148	12,178	15,737	18,885
Super Compost			3,672	4,080	4,590	5,246	6,120	7,344	9,180	12,240
Super BioChar					1,836	2,040	2,525	2,885	3,672	4,406
Super Organic Pesticides							1,836	2,040	2,525	2,885
Total Sales	**1,183**	**1,478**	**5,840**	**7,333**	**13,523**	**15,092**	**20,629**	**24,447**	**31,114**	**38,416**
Direct Cost of Goods Sold (in 000 Yuan)										
Decomposer Agent	296	370	542	813	1,774	1,952	2,537	3,044	3,934	4,721
Super Compost			1,102	1,224	1,377	1,574	1,836	2,203	2,754	3,672
Super BioChar					643	714	884	1,010	1,285	1,542
Super Organic Pesticides							734	816	1,111	1,269
Total Direct Unit Cost	**296**	**370**	**1,644**	**2,037**	**3,794**	**4,239**	**5,991**	**7,073**	**9,084**	**11,205**

Phase 1 : Penetrate Nanjing Area **Phase 2 : Penetrate Jiangsu Area** **Phase 3 : Penetrate National Coverage**

Table 15 Sales Forecast

7.4 Profit and Loss Forecast

Pro Forma Profit and Loss for Nanjing and Jiangsu Area										
	2014 Phase 1	**2015 Phase 1**	**2016 Phase 1**	**2017 Phase 1**	**2018 Phase 2**	**2019 Phase 2**	**2020 Phase 2**	**2021 Phase 2**	**2022 Phase 2**	**2023 Phase 2**
Sales (in 000 Yuan)	1,182.77	1,478.46	5,840.41	7,332.61	13,522.61	15,091.98	20,628.65	24,446.92	31,113.94	38,416.47
Direct Costs of Goods	295.69	369.62	1,643.70	2,037.15	3,793.75	4,239.28	5,991.01	7,073.44	9,084.34	11,204.93
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Gross Margin	**887.08**	**1,108.85**	**4,196.71**	**5,295.46**	**9,728.86**	**10,852.70**	**14,637.64**	**17,373.48**	**22,029.60**	**27,211.53**
Gross Margin %	0.75	0.75	0.72	0.72	0.72	0.72	0.71	0.71	0.71	0.71
Expenses (in 000 Yuan)										
Payroll	125	125	150	180.00	216.00	259.20	311.04	373.25	447.90	537.48
Marketing & Other Expenses	177.42	221.77	876.06	1,099.89	2,028.39	2,263.80	3,094.30	3,667.04	4,667.09	5,762.47
Research and Development	44.35	55.44	209.84	264.77	486.44	542.64	731.88	868.67	1,101.48	1,360.58
Depreciation	16.00	16.00	32.00	32.00	48.00	32.00	48.00	32.00	32.00	32.00
Truck Rental	84.48	105.60	271.95	356.92	612.57	681.15	822.06	983.44	1190.89	1471.85
Utilities	153.76	192.20	494.95	649.60	1114.89	1239.69	1496.15	1789.85	2167.43	2678.77
Insurance	1.18	1.48	5.84	7.33	13.52	15.09	20.63	24.45	31.11	38.42
Telephone	2.40	2.64	2.90	3.19	3.51	3.87	4.25	4.68	5.14	5.66
Payroll Taxes	12.5	12.50	15.00	18.00	21.60	25.92	31.10	37.32	44.79	53.75
Other	5	6	7.20	8.64	10.37	12.44	14.93	17.92	21.50	25.80
Bonus and incentives	22.18	27.72	104.92	132.39	243.22	271.32	365.94	434.34	550.74	680.29
	----------	----------	----------	---------	-----------	----------	----------	----------	----------	-----------
Total Operating Expenses	**644.27**	**766.35**	**2,170.65**	**2,752.74**	**4,798.52**	**5,347.11**	**6,940.29**	**8,232.95**	**10,260.08**	**12,647.06**
Profit Prior Interest&Taxes	**242.80**	**342.49**	**2,026.05**	**2,542.72**	**4,930.34**	**5,505.59**	**7,697.35**	**9,140.53**	**11,769.52**	**14,564.48**
Interest Expense	25.90	51.80	77.70	103.60	129.50	155.40	181.30	207.20	233.10	259.00
Loans Payback	74.00	148.00	222.00	296.00	370.00	370.00	370.00	370.00	370.00	370.00
Taxes Incurred	36.42	51.37	303.91	381.41	739.55	825.84	1,154.60	1,371.08	1,765.43	2,184.67
	----------	----------	----------	---------	-----------	----------	----------	----------	----------	-----------
	-	-	-	--		-	-	-	-	
Net Income	**106.48**	**91.32**	**1,422.44**	**1,761.71**	**3,691.29**	**4,154.35**	**5,991.45**	**7,192.25**	**9,400.99**	**11,750.81**

Phase 1 : Penetrate Nanjing Area **Phase 2 : Penetrate Jiangsu Area** **Phase 3 : Penetrate National Coverage**

Table 16 Profit and Loss Forecast

7.5 Break Even Point (BEP)

7.5.1 Definition

Break-even is the point of zero loss or profit. At break-even point, the revenues of the business are equal its total costs and its contribution margin equals its total fixed costs. Break-even point can be calculated by equation method, formula: contribution method or graphical method. The equation method is based on the cost-volume-profit (CVP)

px = vx + FC + Profit

Where,

p is the price per unit,

x is the number of units,

v is variable cost per unit and

FC is total fixed cost.

7.5.2 Calculation - BEP in Sales Units

The BEP Calculation is used to set a guideline amount of products this company must sell the goods to the market. Thus, this company can measure its performances. There will be three scenarios provided, namely : the Zero Profit, Ten Percent Profit, and Twenty Percent Profits.

The Fixed Cost and Variable Cost are taken from the Sales Forecast Table in Chapter 7 , part 7.3. The amount of each product need to be sold, is based on the percentage of its contribution in Sales Forecast revenue.

7.5.2.1 Calculation - BEP in Sales Units – Zero Profit Margin

Break Even Point Calulation at Zero Profit										
	2014 Phase 1	**2015 Phase 1**	**2016 Phase 1**	**2017 Phase 1**	**2018 Phase 2**	**2019 Phase 2**	**2020 Phase 2**	**2021 Phase 2**	**2022 Phase 2**	**2023 Phase 2**
Direct Cost of Goods Sold (000 Yuan)	295.69	369.62	1,643.70	2,037.15	3,793.75	4,239.28	5,991.01	7,073.44	9,084.34	11,204.93
Total Operating Expenses (000 Yuan)	644.27	766.35	2,170.65	2,752.74	4,798.52	5,347.11	6,940.29	8,232.95	10,260.08	12,647.06
Profit relative to expenses (000 Yuan)	-	-	-	-	-	-	-	-	-	-
Total Costs (in 0,000 Yuan)	**939.96**	**1,135.97**	**3,814.36**	**4,789.89**	**8,592.27**	**9,586.39**	**12,931.30**	**15,306.39**	**19,344.42**	**23,851.99**
Share of Sales Contribution (in %)										
Decomposer Agent	100%	100%	37%	44%	52%	52%	49%	50%	51%	49%
Super Compost			63%	56%	34%	35%	30%	30%	30%	32%
Super BioChar					14%	14%	12%	12%	12%	11%
Super Organic Pesticides							9%	8%	8%	8%
Total Direct Unit Cost	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Unit Prices (in Yuan)										
Decomposer Agent Price	1.00	1.00	1.10	1.10	1.20	1.20	1.30	1.30	1.40	1.40
Super Compost Price	-	-	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Super Biochar Price	-	-	-	-	5.00	5.00	5.50	5.50	6.00	6.00
Super Organic Pesticides Price	-	-	-	-	-	-	10.00	10.00	11.00	11.00
Unit Sales Needed to BEP (000 Units)										
Decomposer Agent (in 000 Liter)	939.96	1,135.97	1,287.44	1,931.55	3,757.66	4,132.10	4,893.45	5,865.07	6,988.87	8,375.19
Super Compost (in 000 kg)			1,199.09	1,332.59	1,458.24	1,666.03	1,918.20	2,299.07	2,853.73	3,799.78
Super BioChar (in 000 kg)					233.32	259.16	287.73	328.44	380.50	455.97
Super Organic Pesticides (in 000 Liter)							115.09	127.73	142.69	162.85
Total Sales Needed to BEP (in 000 Units)	**939.96**	**1,135.97**	**2,486.52**	**3,264.15**	**5,449.22**	**6,057.29**	**7,214.46**	**8,620.30**	**10,365.78**	**12,793.79**

Table 17 Break Even Point Calculation at Zero Profit

7.5.2.2 Calculation - BEP in Sales Units – Ten Percent Profit

Break Even Point Calulation at Ten Percent Profit										
	2014 Phase 1	**2015 Phase 1**	**2016 Phase 1**	**2017 Phase 1**	**2018 Phase 2**	**2019 Phase 2**	**2020 Phase 2**	**2021 Phase 2**	**2022 Phase 2**	**2023 Phase 2**
Direct Cost of Goods Sold(000 Yuan)	295.69	369.62	1,643.70	2,037.15	3,793.75	4,239.28	5,991.01	7,073.44	9,084.34	11,204.93
Total Operating Expenses (000 Yuan)	644.27	766.35	2,170.65	2,752.74	4,798.52	5,347.11	6,940.29	8,232.95	10,260.08	12,647.06
Profit 10% from expenses(000 Yuan)	94.00	113.60	381.44	478.99	859.23	958.64	1,293.13	1,530.64	1,934.44	2,385.20
Total Costs (in 000 Yuan)	**1,033.96**	**1,249.57**	**4,195.79**	**5,268.88**	**9,451.50**	**10,545.03**	**14,224.43**	**16,837.03**	**21,278.86**	**26,237.19**
Share of Sales Contribution (in %)										
Decomposer Agent	100%	100%	37%	44%	52%	52%	49%	50%	51%	49%
Super Compost			63%	56%	34%	35%	30%	30%	30%	32%
Super BioChar					14%	14%	12%	12%	12%	11%
Super Organic Pesticides							9%	8%	8%	8%
Total Direct Unit Cost	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Unit Prices (in Yuan)										
Decomposer Agent Price	1.00	1.00	1.10	1.10	1.20	1.20	1.30	1.30	1.40	1.40
Super Compost Price	-	-	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Super Biochar Price	-	-	-	-	5.00	5.00	5.50	5.50	6.00	6.00
Super Organic Pesticides Price	-	-	-	-	-	-	10.00	10.00	11.00	11.00
Unit Sales Needed to BEP(000 Unit)										
Decomposer Agent (in 000 Liter)	1,033.96	1,249.57	1,416.18	2,124.71	4,133.42	4,545.31	5,382.79	6,451.58	7,687.75	9,212.70
Super Compost (in 000 kg)			1,319.00	1,465.85	1,604.07	1,832.64	2,110.02	2,528.97	3,139.11	4,179.76
Super BioChar (in 000 kg)					256.65	285.08	316.50	361.28	418.55	501.57
Super Organic Pesticides (000 Liter)							126.60	140.50	156.96	179.13
Total Sales Needed to BEP (000 Units)	**1,033.96**	**1,249.57**	**2,735.18**	**3,590.56**	**5,994.14**	**6,663.02**	**7,935.91**	**9,482.33**	**11,402.36**	**14,073.17**

Table 18 Break Even Point Calculation at Ten Percent Profit

7.5.2.3 Calculation - BEP in Sales Units – Twenty Percent Profit

Break Even Point Calulation at Twenty Percent Profit										
	2014 Phase 1	**2015 Phase 1**	**2016 Phase 1**	**2017 Phase 1**	**2018 Phase 2**	**2019 Phase 2**	**2020 Phase 2**	**2021 Phase 2**	**2022 Phase 2**	**2023 Phase 2**
Direct Cost of Goods Sold (000 Yuan)	295.69	369.62	1,643.70	2,037.15	3,793.75	4,239.28	5,991.01	7,073.44	9,084.34	11,204.93
Total Operating Expenses (000 Yuan)	644.27	766.35	2,170.65	2,752.74	4,798.52	5,347.11	6,940.29	8,232.95	10,260.08	12,647.06
Profit 20% from expenses (000 Yuan)	187.99	227.19	762.87	957.98	1,718.45	1,917.28	2,586.26	3,061.28	3,868.88	4,770.40
Total Costs (in 0,000 Yuan)	**1,127.96**	**1,363.16**	**4,577.23**	**5,747.87**	**10,310.73**	**11,503.67**	**15,517.56**	**18,367.67**	**23,213.30**	**28,622.39**
Share of Sales Contribution (in %)										
Decomposer Agent	100%	100%	37%	44%	52%	52%	49%	50%	51%	49%
Super Compost			63%	56%	34%	35%	30%	30%	30%	32%
Super BioChar					14%	14%	12%	12%	12%	11%
Super Organic Pesticides							9%	8%	8%	8%
Total Direct Unit Cost	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Unit Prices (in Yuan)										
Decomposer Agent Price	1.00	1.00	1.10	1.10	1.20	1.20	1.30	1.30	1.40	1.40
Super Compost Price	-	-	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Super Biochar Price	-	-	-	-	5.00	5.00	5.50	5.50	6.00	6.00
Super Organic Pesticides Price	-	-	-	-	-	-	10.00	10.00	11.00	11.00
Unit Sales Needed to BEP(000 Unit)										
Decomposer Agent (in 000 Liter)	1,127.96	1,363.16	1,544.93	2,317.86	4,509.19	4,958.52	5,872.14	7,038.09	8,386.64	10,050.22
Super Compost (in 000 kg)			1,438.90	1,599.11	1,749.89	1,999.24	2,301.83	2,758.88	3,424.48	4,559.74
Super BioChar (in 000 kg)					279.98	310.99	345.28	394.13	456.60	547.17
Super Organic Pesticides (000 Liter)							138.11	153.27	171.22	195.42
Total Sales Needed to BEP (in 000 Units)	**1,127.96**	**1,363.16**	**2,983.83**	**3,916.98**	**6,539.06**	**7,268.75**	**8,657.36**	**10,344.36**	**12,438.94**	**15,352.55**

Table 19 Break Even Point Calculation atTwenty Percent Profit

7.6. Opportunity Cost

$FV = PV . (1+n.i)$

In this investment scheme, the company will return one fifth of the investment to the investors every year. So, if the investor put 4,150,000 RMB in the beginning of the cooperation, then he will get 830,000 RMB per year for five years from the company. In total the investors will get their entire 4,150,000 RMB in the end of five years. The interest rate used is higher than the 2013 Industrial Commerce Bank of China and Bank of China credit interest which range from 6%-6.55%. Below is the calculation as the reference for the investors if he invests his money in the bank with 7% of interest.

$$FV_{2014} = Principal_{2014} + Interest\ 1 + Interest\ 2 + Interest\ 3 + Interest\ 4 + Interest\ 5$$

$$= 415 + (415*0.07) + (332*0.07) + (249*0.07) + (166*0.07) + (83*0.07)$$

$$= 560.25$$

To compensate opportunity cost, the company offers several types of profit sharing ranging from 2.5% to 10 % from the net profit after tax to all investors in proportion of their remaining investments in the company. Thus, the investors will receive the following profit share :

(000 RMB)	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Net Profit	97.48	73.32	1,395.44	1,725.71	3,646.29	4,109.35	5,946.45	7,147.25	9,355.99	12,120.81
Profit Sharing :										
Value 2.5%	2.44	1.83	34.89	43.14	91.16	102.73	148.66	178.68	233.90	303.02
Value 5 %	4.87	3.67	69.77	86.29	182.31	205.47	297.32	357.36	467.80	606.04
Value 7.5%	7.31	5.50	104.66	129.43	273.47	308.20	445.98	536.04	701.70	909.06
Value 10%	9.75	7.33	139.54	172.57	364.63	410.94	594.64	714.72	935.60	1,212.08

Table 20 Profit Sharing

7.7 Net Present Value

The present value calculation of the company is based from the Proforma of Profit and Loss table. The chosen values as the assets of the company include : cash, receivables, prepaid expenses, equipments. The chosen values as the investments are the remaining investments in the company's account. The future value of assets then will be converted into present value of assets. The future value of investments will also be converted into present value of investments. Thus, we can get the NPV estimation by deducting present value of investments from present value of assets. The interest rate is 7% which is assumed to be the Minimum Attractive Rate of Return (MARR)

NPV = Cash Flow – Investments

$$\mathbf{PV = \frac{FV}{(1+i)^n}}$$

$$\mathbf{PV_{2014}} = \frac{83}{(1+0.07)^1} + \frac{83}{(1+0.07)^2} + \frac{83}{(1+0.07)^3} + \frac{83}{(1+0.07)^4} + \frac{83}{(1+0.07)^5}$$

= 364.14 (000 RMB)

Present Value of Investment

Investment (000 RMB)	Year 1	Year 2	Year 3	Year 4	Year 5	Total PV
415	83	77.57	72.495	67.753	63.32	364.14
1,000	200	186.9	174.69	163.26	152.58	877.44
5,000	1000	934.6	873.44	816.3	762.9	4387.21
20,000	4000	3738	3493.8	3265.2	3051.6	17548.85
30,000	6000	5607	5240.6	4897.8	4577.4	26323.27
100,000	20000	18692	17469	16326	15258	87744.23

Table 21 Present Value of Investment

Net Present Value of Investment						**Capital Cost (MARR)**	**7%**			
(in 000 Yuan)	**2014 Phase 1**	**2015 Phase 1**	**2016 Phase 1**	**2017 Phase 1**	**2018 Phase 2**	**2019 Phase 2**	**2020 Phase 2**	**2021 Phase 2**	**2022 Phase 2**	**2023 Phase 2**
Investment Cost	415.00	830.00	1,162.00	1,411.00	1,577.00	1,660.00	1,660.00	1,660.00	1,660.00	1,660.00
Paid back investment cost		83.00	166.00	249.00	332.00	415.00	415.00	415.00	415.00	415.00
Net Investment Cost	415.00	747.00	996.00	1,162.00	1,245.00	1,245.00	1,245.00	1,245.00	1,245.00	1,245.00
Net Present Value of Investment Cost	**415.00**	**698.13**	**869.94**	**948.54**	**949.80**	**887.67**	**829.60**	**775.32**	**724.60**	**677.20**
Profit	97.48	73.32	1,395.44	1,725.71	3,646.29	4,109.35	5,946.45	7,147.25	9,355.99	12,120.81
Net Present Value of Profit	**97.48**	**68.52**	**1,218.84**	**1,408.69**	**2,781.73**	**2,929.91**	**3,962.37**	**4,450.95**	**5,445.27**	**6,592.92**
Net Present Value of Investment	**- 317.52**	**- 629.61**	**348.89**	**460.16**	**1,831.93**	**2,042.25**	**3,132.77**	**3,675.62**	**4,720.67**	**5,915.72**

Table 22 Net Present Value of Investment

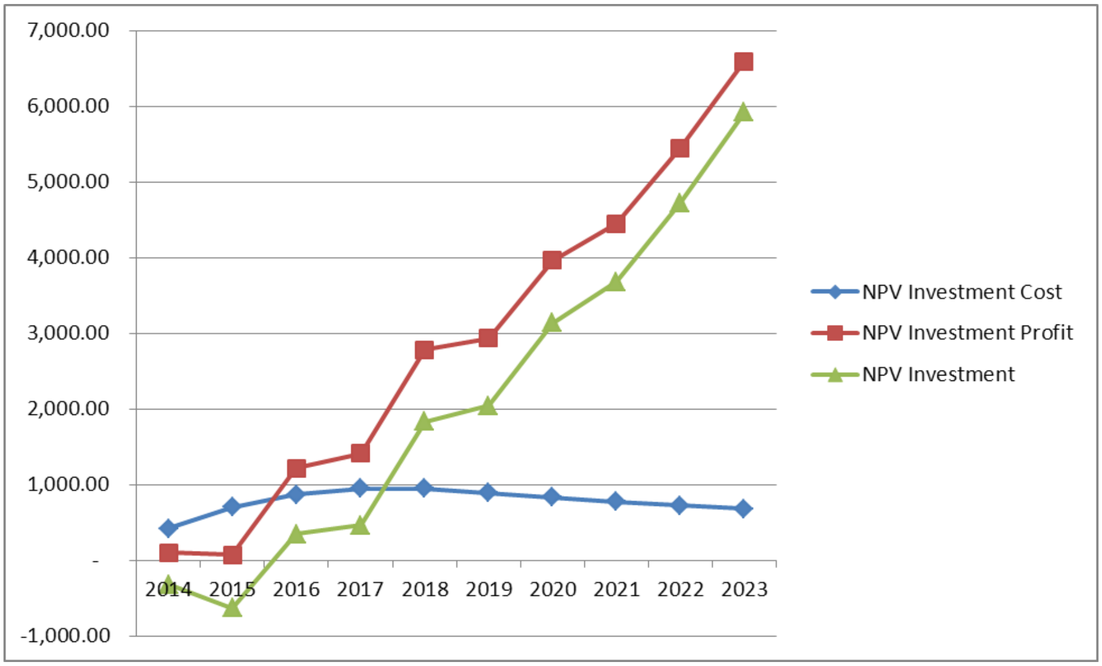

Figure 15 Net Present Value of Cost, Profit and Investment

If the NPV(*i*) is positive for a single project, the project should be accepted, since a positive NPV means that the project has greater equivalent value of inflows than outflows and therefore makes a profit [23]

According to Park (2002) the decision rule for NPV is:

If NPV > 0, accept the investment;

If NPV = 0, remain indifferent to the investment;

If NPV < 0, reject the investment

The graphs tells that this project has a very promising future since the Investment Cost tends to decline in the long run while the Profit increases through time. This trend might reach its peak in 2030 with one condition : continuous innovation of cost and service to stay ahead of competitors.

After the peak, the profits estimatedly will decline and reach its stable level in 2040 while the market keep expanding producing similar or bigger profits, yet smaller margins per product sold. This phenomenon is noted and explained as the LongTail phenomenon.

7.8 Return of Investment (ROI)

Return on investment (ROI) is a financial metric for evaluating the financial consequences of individual investments and actions. ROI is usually used to evaluate capital acquisitions, projects, programs, and initiatives of many kinds, as well as more traditional financial investments in stock shares or the use of venture capital. Simple ROI compares the magnitude and timing of investment gains directly with the magnitude and timing of costs. A high ROI means that gains compare favorably to costs.

Encyclopedia of Business Terms and Methods, ISBN 978-1-929500-10-9. Revised 2013-05-25.

Figure 16 Return of Investment Concept

The metric addresses questions like these: How much we receive for what we spend? Do expected returns outweigh the expected costs? Do the expected returns justify the expected costs? ROI commonly compares returns to costs by constructing a ratio, or percentage. Usually, a calculated ratio greater than 0.00 (> 0%) means that returns are larger than costs. A negative result means the costs outweigh returns. Returns here refers to profit or gain or margin. Costs here refers to expenses or spending.

ROI cannot describe uncertainty or risk. ROI simply shows how returns compare to costs if the hoped for results arrive. A prudent analyst must also assess the probabilities of different ROI outcomes, and wise decision makers must consider both the magnitude of the metric and the risks that go with it. Decision makers must search practical suggestions from the analyst to improve return on investment by reducing costs, increasing gains, or accelerating gains.

There are two common methods of ROI : Simple ROI and Discounted ROI. Simple ROI is calculated by comparing the total return to total investments. Discounted

ROI is calculated by comparing the Net Present Value of Profit to Net Present Value of Cost

$$\text{Simple ROI} = \frac{\text{Total Return}}{\text{Total Cost}} = \frac{\text{Profit - Cost}}{\text{Cost}}$$

$$\text{Discounted ROI} = \frac{\text{NPV of Profit}}{\text{NPV of Cost}}$$

In this Feasibility Study, only simple ROI is used because the author assumed the interest rate of China will not be more than 7% for the next 10 years.

Return of Investment - Simple Calculation							Capital Cost		7%	
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
(in 000 Yuan)	**Phase 1**	**Phase 1**	**Phase 1**	**Phase 1**	**Phase 2**	**Phase 2**	**Phase 2**	**Phase 2**	**Phase 2**	**Phase 2**
Investment Cost	415.00	830.00	1,162.00	1,411.00	1,577.00	1,660.00	1,660.00	1,660.00	1,660.00	1,660.00
Paid back investment cost		83.00	166.00	249.00	332.00	415.00	415.00	415.00	415.00	415.00
Net Investment Cost	**415.00**	**747.00**	**996.00**	**1,162.00**	**1,245.00**	**1,245.00**	**1,245.00**	**1,245.00**	**1,245.00**	**1,245.00**
Profit	**97.48**	**73.32**	**1,395.44**	**1,725.71**	**3,646.29**	**4,109.35**	**5,946.45**	**7,147.25**	**9,355.99**	**12,120.81**
Simple ROI	**- 0.77**	**- 0.90**	**0.40**	**0.49**	**1.93**	**2.30**	**3.78**	**4.74**	**6.51**	**8.74**

Table 23 Return of Investment – Simple Calculation

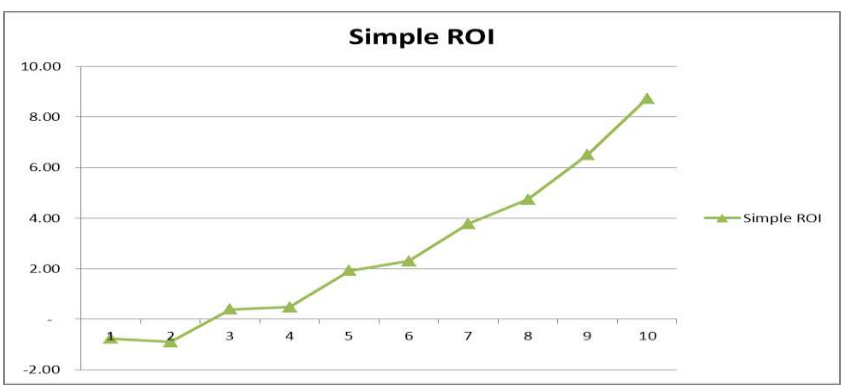

Figure 17 Return of Investment – Simple Calculation

From the table and graph, an investor may conclude that this project is very feasible and bring more financial gain than the bank interest rate can give

7.9 Benefit to Cost Ratio (B/C Ratio)

The benefit-cost method is often used to measure feasibility of projects. The method compares project benefits to the project cost. For the project to be feasible, the benefits have to be larger than the cost. By definition, project benefits are all good consequences of the project to the stakeholders - financial and non-financial, and project cost is the disbursement paid by the stakeholders – financial and non-financial.[24]. This feasibility study only covers benefit and cost by financial measurement

Park (2002) describes benefit-cost analysis as “a decision-making tool used to systematically develop useful information about the desirable and undesirable effects of public projects”. He defines three types of benefit-cost analysis problems:
1. Maximizing the benefits for any given set of cost;
2. Maximizing the net benefits when both benefits and costs vary;
3. Minimizing cost to achieve any given level of benefits.

The profitability of a project can be expressed by comparing the benefits (B) of the project to the cost (C) of the project by taking the ratio B/C, i.e. the Benefit-Cost ratio. The ratio is calculated as:

$$\frac{B}{C} = \frac{\sum_{n=0}^{N} b_n (1+i)^{-n}}{\sum_{n=0}^{N} c_n (1+i)^{-n}}$$

Where

b_n = Benefits at the end of period n, $b_n \geq 0$;

c_n = Costs (expenses or spending) at the end of period n, $b_n \geq 0$;

N = Project life;

i = Interest Rate

B/C Ratio can also be calculated by taking the net present value of expected future cash flows from the investment and dividing by the investment's original cost. A ratio above one indicates that the investment will be profitable while a ratio below one means that it will not. A cost-benefit ratio is also called a profitability index.

Benefit to Cost Ratio - Operational Forecast										
	2014 Phase 1	**2015 Phase 1**	**2016 Phase 1**	**2017 Phase 1**	**2018 Phase 2**	**2019 Phase 2**	**2020 Phase 2**	**2021 Phase 2**	**2022 Phase 2**	**2023 Phase 2**
Total Operating Expenses(000 Yuan)	644.27	766.35	2,170.65	2,752.74	4,798.52	5,347.11	6,940.29	8,232.95	10,260.08	12,647.06
Profit Before Interest & Taxes (000 Yuan)	242.80	342.49	2,026.05	2,542.72	4,930.34	5,505.59	7,697.35	9,140.53	11,769.52	14,564.48
B/C Ratio	**0.38**	**0.45**	**0.93**	**0.92**	**1.03**	**1.03**	**1.11**	**1.11**	**1.15**	**1.15**

Table 24 Benefit to Cost Ratio - Operational Forecast

Benefit to Cost Ratio - Investment										
(in 000 Yuan)	**2014 Phase 1**	**2015 Phase 1**	**2016 Phase 1**	**2017 Phase 1**	**2018 Phase 2**	**2019 Phase 2**	**2020 Phase 2**	**2021 Phase 2**	**2022 Phase 2**	**2023 Phase 2**
Net Present Value of Investment Cost	415.00	698.13	869.94	948.54	949.80	887.67	829.60	775.32	724.60	677.20
Net Present Value of Profit	97.48	68.52	1,218.84	1,408.69	2,781.73	2,929.91	3,962.37	4,450.95	5,445.27	6,592.92
B/C Ratio	**0.23**	**0.10**	**1.40**	**1.49**	**2.93**	**3.30**	**4.78**	**5.74**	**7.51**	**9.74**

Table 25 Benefit to Cost Ratio - Investment

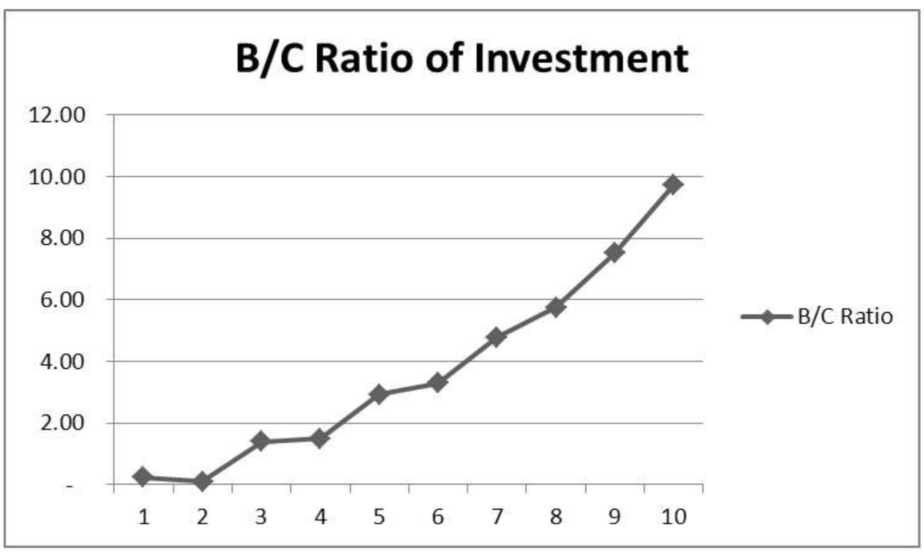

Figure 18 Benefit to Cost Ratio - Investment

From the graphs and table, profitability rate tends to increase in the future. From the B/C Ratio of Investment, an investor should be able to determine that this project profitable

7.10 Internal Rate Return

The internal rate of return on an investment or project is the "annualized effective compounded return rate" or "rate of return" that makes the net present value (NPV as NET*1/(1+IRR)^year) of all cash flows (both positive and negative) from a particular investment equal to zero. It can also be defined as the discount rate at which the present value of all future cash flow is equal to the initial investment or in other words the rate at which an investment breaks even [25]

In more specific terms, the IRR of an investment is the discount rate at which the net present value of costs (negative cash flows) of the investment equals the net present value of the benefits (positive cash flows) of the investment.

IRR calculations are commonly used to evaluate the desirability of investments or projects. The higher a project's IRR, the more desirable it is to undertake the project. Assuming all projects require the same amount of up-front investment, the project with the highest IRR would be considered the best and undertaken first. . For example, a corporation will evaluate an investment in a new plant versus an extension of an existing plant based on the IRR of each project. In such a case, each new capital project must produce an IRR that is higher than the company's cost of capital. Once this hurdle is surpassed, the project with the highest IRR would be the wiser investment, all other things being equal - including risk.

A firm (or individual) should, in theory, undertake all projects or investments available with IRRs that exceed the cost of capital. Investment may be limited by availability of funds to the firm and/or by the firm's capacity or ability to manage numerous projects.

Given a collection of pairs (time, cash flow) involved in a project, the internal rate of return follows from the net present value as a function of the rate of return. A rate of return for which this function is zero is an internal rate of return.

Given the (period, cash flow) pairs (n, C_n) where n is a positive integer, the total number of periods N, and the net present value NPV, the internal rate of return is given by r in:

$$\mathrm{NPV} = \sum_{n=0}^{N} \frac{C_n}{(1+r)^n} = 0$$

The period is usually given in years, but the calculation may be made simpler if r is calculated using the period in which the majority of the problem is defined (e.g., using months if most of the cash flows occur at monthly intervals) and converted to a yearly period thereafter.

Any fixed time can be used in place of the present (e.g., the end of one interval of an annuity); the value obtained is zero if and only if the NPV is zero.

In the case that the cash flows are random variables, such as in the case of a life annuity, the expected values are put into the above formula. Often, the value of r cannot be found analytically. In this case, numerical methods or graphical methods must be used. (Wikipedia, June 2013)

Using the secant method, r is given by

$$r_{n+1} = r_n - \mathrm{NPV}_n \left(\frac{r_n - r_{n-1}}{\mathrm{NPV}_n - \mathrm{NPV}_{n-1}} \right)$$

where r_n is considered the n^{th} approximation of the IRR.

This r can be found to an arbitrary degree of accuracy. An accuracy of 0.00001% is provided by Microsoft Excel.

The convergence behavior of the sequence is governed by the following:

- If the function $\mathrm{NPV}(i)$ has a single real root r, then the sequence will converge reproducibly towards r.
- If the function $\mathrm{NPV}(i)$ has n real roots $r_1, r_2, \ldots, r_n$, then the sequence will converge to one of the roots and changing the values of the initial pairs may change the root to which it converges.
- If function $\mathrm{NPV}(i)$ has no real roots, then the sequence will tend towards +∞.

  Having $r_1 > r_0$ when $\mathrm{NPV}_0 > 0$ or $r_1 < r_0$ when $\mathrm{NPV}_0 < 0$ may speed up convergence of r_n to r.

The IRR calculation produces rate :

94 %

This rate means the bank interest rate needs to climb up to 94% before this project profit lost its attractiveness

7.11 Payback Period

Payback period of this project is five years for each investor. Every investors will get 20% of their investment every year until the fifth year.

Chapter 8
SUMMARY AND CONCLUSIONS

8.1 Summary of Findings

International food availability and price is uncertain due to many factors, including energy price volatility, natural disasters, climate change, disrupted distribution channels, fertilizers' price, and imperfect market.. Food security has been the first priority of China since 70 years ago, yet faces many problems. One of the causes chosen as the topic for this feasibility study is fertilizers availability and price

To answer fertilizers availability problem, farmers can make their own fertilizers. The problem with the self-production fertilizers is the time, energy and resources needed sometimes more than the acceptable price willing to be paid by the farmers themselves. Here lies the challenge to help farmers to reduce time, reduce complicated efforts, and reduce resources needed to produce their own fertilizers.

Helping these farmers create business opportunities. One of the opportunities are Decomposer Agent (DA) manufacturing. DA can speed the time needed to make organic fertilizers, reduce complicated procedures, improve the quality of the produced fertilizers, while at the same time can function as a type of organic fertilizers itself.

The answer to help farmers is to make a DA manufacturing factory. But before can reach to a decision to make or not make, a feasibility study is required.

When the research was conducted, the researcher found that Nanjing, and Jiangsu area is one of the suitable area for the factory location. The raw materials, market, and labors are abundantly available in this region. Conventional and organical agriculture practices in China also leave rooms for improvement if DA is applied. The demand for fertilizers is also high since Jiangsu is one of the food producers regions for the entire China. The distribution channel is alredy mature and improving. The fertilizers price follow the world price but subsidized by the government.

Advancement of back-to-nature farming techniques and sustainable environment policy from the government, bring tremendous boost for environmental friendly agricultural products. DA as one of the said products, can also benefit from this condition.

Simple production methods, easy application procedures, and wide range of usage of DA, makes it a promising new product that can be further developed and integrated to other fields including farming, fisheries, animan husbandry, forestry, plantation, environment recovery, and medicines. At the same time, the wideness also open new markets and possibilities for DA, although further research must be conducted prior to entering new application fields for the sake of efficiency and effectiveness.

Market research indicates that China has a huge market for DA, currently left almost untapped unexplored. To fully utilize this market, the company requires a concerted effort of marketing, user education, social programs, good manufacturing process, and policy support. The research also suggests China market will still expand more than 10% annually which means the market for DA also expands greatly. A national level of DA provider is necessary to support the demand from increasing population, food demand, food production, animal production and government green-policy.

Good and sound marketing strategy is essential to tap the market. There are three business strategies that can be employed and resized according to the real condition in the market. The company can choose to employ one of the strategies for the entire market, or to adopt one of the strategies for a certain market segment. Full Commercial Scale business strategy is to be used when the company has reached at least provincial scale in the terms of capital, distribution channel, and production capacity. Small Scale business strategy will be used once the company need to satisfy deman from farmers in district or city scale. Pilot Scale business strategy will be selected from the beginning of the company, or will be reused again when a new line of product is being introduced.

Financial analysis is one of the measures to know how feasible and beneficial this project will be in the future. All forecasts were compiled with one simple rule : estimate expense as large as possible, income as small as possible, and not too optimistic . Thus the forecasts are very conservative and prudent. Even so, the financial analysis shows that the creation of organic fertilizers in Nanjing, is feasible and beneficial.

8.2 Conclusions

Conclusively this feasibility study indicates that setting up a new organic fertilizer factory in Nanjing, can answer the existing organic fertilizers demand, boost production level, enhance agricultural product quality, provide fertilizers alternatives for agricultural sectors, open new economy channels for the citizens, and bring revenues for the government in the future.

Realization of the factory will bring sustainable profits yet responsible to the company, shareholders, investors, and all stakeholders. The environment as a whole will benefit from its product and by-products.

The company will be run a social enterprise with three basic principles : profitable, sustainable and humane. All the products and services developed and managed by the company in the future, will have to meet this criteria.

8.3 Investor Offer

The company offers all investors to be part of the agricultural sector transformation in China and get financial benefits at the same time. An investor can select an investment package of 10,000 RMB, 25,000 RMB, 50,000 RMB, 100,000 RMB, 250,000 RMB or 500,000 RMB. Each package will have five years life span, which means in every year during the five years life span, the investor will receive twenty percent (20%) of his investment. During the five years, the investor will also receive the interest of seven percent (7%) as the compensation for opportunity cost he missed if he put the money in the bank. In addition, during the payback period, all the investors will get profit sharing from the company ranging from 2.5% to 7.5 % according to the proportion of their investments.

The funding needed by the company will be announced to the public, and the investor candidates who wish to take part in the funding will enlist in website. The candidates must sign an agreement stating the investment source is not from illegal sources and will have to meet the law of China. The investments terms and conditions will be detailed in a separate agreement. The financial reports will be provided openly and timely in the websites and emails.

8.4 Limitations of This Study

There are several limitations of this study. The first criticism is the technical aspects presented here are mostly derived from Indonesia whom then were modified to match China climate and condition. Although the techniques have been proven for many decades, yet when applied in a different climate and condition, the results vary from what commonly known in Indonesia.

The second limitation is the data, which is the based of the quantitative study. The data were derived from secondary data such as Nanjing Governmental Facts Year Book, Millenium Development Goal Yearly report from United Nations, and World Prices Index from World Bank. The data have not been verified nor crosschecked entirely and officially with other peer official sources.

The third limitation is the assumptions were made on the ground that China economy and policy will not change in the future, which currently under massive changes due to internal and external factors.

However, there are also several strengths to compesante the limitations. First the mixed research methods used in this feasibility study brings various perspectives, supplement analysis, and augment result sturdiness.

Second the analysis are very conservative in forecasting and estimating. Although the data were taken from secondary data, but then compared unofficially with field results from practicioners to get the average.

Third strength is the assumptions were made on the ground that China already established guidelines on how the economy and policy will be made and implemented in the future. These guidelines from time to time change relatively toward free market known and adapted in business in most countries.

8.5 Recommendations for Future Research

This study reveals that Nanjing is feasible for the construction of a new organic fertilizer plant. However, there is no study yet on how to integrate the resources available – organic and non organic agricultural - to maximize the result of agricultural while maintaining the sustainable. Therefore a further study will be very beneficial.

Appendix

农作物播种面积与产量(一)

指标		计量单位	2006年	2005年	2006年为2005年%
农作物总播种面积		万亩	89.23	107.91	82.7
一、粮食作物合计	面积	万亩	36.72	35.40	103.7
	单产	公斤	503.00	499.00	100.8
	总产	吨	184714.00	176544.00	104.6
(一)夏收粮食	面积	万亩	4.68	2.10	222.9
	单产	公斤	283.00	263.00	107.6
	总产	吨	13258.00	5532.00	239.7
1、小麦	面积	万亩	4.44	1.90	233.7
	单产	公斤	290.00	267.00	108.6
	总产	吨	12873.00	5067.00	254.1
2、大麦	面积	万亩	0.05	0.06	83.3
	单产	公斤	264.00	230.00	114.8
	总产	吨	119.00	138.00	86.2
3、蚕豌豆	面积	万亩	0.19	0.14	135.7
	单产	公斤	140.00	226.00	61.9
	总产	吨	266.00	327.00	81.3
(二)秋收粮食	面积	万亩	32.04	31.47	101.8
	单产	公斤	535.00	526.00	101.7
	总产	吨	171456.00	165516.00	103.6
1、稻谷	面积	万亩	29.86	30.76	97.1
	单产	公斤	549.00	527.00	104.2
	总产	吨	163998.00	162132.00	101.2

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农作物播种面积与产量(三)

指标		计量单位	2006年	2005年	2006年为2005年%
5、薯类(五折一)	面积	万亩	0.61	0.78	78.2
	单产	公斤	350.00	359.00	97.5
	总产	吨	2135.00	2800.00	76.3
二、油料合计	面积	万亩	23.03	26.62	86.5
	单产	公斤	175.00	175.00	100.0
	总产	吨	40339.00	46528.00	86.7
其中:油菜籽	面积	万亩	22.76	26.28	86.6
	单产	公斤	176.00	175.00	100.6
	总产	吨	40064.00	45990.00	87.1
三、棉花	面积	万亩	0.10	0.05	200.0
	单产	公斤	105.00	105.00	100.0
	总产	吨	105.00	53.00	198.1
四、糖料	面积	万亩	0.03	0.05	60.0
	单产	公斤	2300.00	2650.00	86.8
	总产	吨	690.00	1325.00	52.1
五、瓜类	面积	万亩	0.43	0.55	78.2
	单产	公斤	1614.00	1775.00	90.9
	总产	吨	6940.00	9760.00	71.1
六、蔬菜	面积	万亩	8.42	23.92	35.2
	单产	公斤	2504.00	1600.00	156.5
	总产	吨	210869.00	382720.00	55.1

渔业生产情况

指　标	计量单位	2006年	2005年	2006年为2005年%
一、渔业村	个	3.00	3.00	100.0
二、渔业户数	户	1080.00	1080.00	100.0
三、渔业人口	人	3200.00	3100.00	103.2
四、渔业劳动力	人	23600.00	21600.00	109.3
五、淡水养殖面积	万亩	13.08	13.08	100.0
其中:精养塘	万亩	4.86	4.86	100.0
鱼种池	万亩	0.45	0.45	100.0
六、淡水产品产量	吨	37530.00	35150.00	106.8
其中:养殖产量	吨	35140.00	32950.00	106.6
七、生产鱼苗	亿尾	3.00	2.80	107.1
八、生产鱼种	吨	4800.00	4600.00	104.3
九、珍珠产量	公斤	30000.00	30000.00	100.0
十、投放淡水鱼种	吨	6950.00	6800.00	102.2
十一、甲鱼养殖产量	公斤	80000.00	80000.00	100.0
十二、牛蛙养殖产量	吨	0.00	0.00	
十三、在淡水产品产量中				
1、鱼类	吨	23070.00	21650.00	106.6
2、虾类	吨	3770.00	3535.00	106.6
3、蟹类	吨	8320.00	7750.00	107.4
4、贝类	吨	2040.00	1890.00	107.9
5、其他	吨	330.00	325.00	101.5

农作物播种面积与产量(二)

指　标		计量单位	2006年	2005年	2006年为2005年%
(1)中稻	面积	万亩	1.22	1.48	82.4
	单产	公斤	531.00	521.00	101.9
	总产	吨	6478.00	7707.00	84.1
(2)单晚	面积	万亩	28.64	29.28	97.8
	单产	公斤	550.00	527.00	104.4
	总产	吨	157520.00	154425.00	102.0
(3)后季稻	面积	万亩	0.00	0.00	
	单产	公斤	0.00	0.00	
	总产	吨	0.00	0.00	
水稻中:籼稻	面积	万亩	1.08	1.11	97.3
	单产	公斤	505.00	520.00	97.1
	总产	吨	5459.00	5772.00	94.6
2、玉米	面积	万亩	0.62	0.71	87.3
	单产	公斤	490.00	477.00	102.7
	总产	吨	3038.00	3384.00	89.8
3、大豆	面积	万亩	0.89	0.96	92.7
	单产	公斤	250.00	270.00	92.6
	总产	吨	2225.00	2592.00	85.8
4、其他秋粮	面积	万亩	0.06	0.09	66.7
	单产	公斤	100.00	115.00	87.0
	总产	吨	60.00	104.00	57.7

2006年农林牧渔业增加值增幅

计量单位：万元、%

县区	林业			牧业		
	2006年	2005年	增幅	2006年	2005年	增幅
南京市	10449	9835	6.24	121441	126674	-4.28
浦口区	3101	2550	21.61	24867	24500	1.50
江宁区	1777	2083	-14.69	23381	24686	-5.29
六合区	3097	2961	4.59	28132	28307	-0.62
溧水县	1221	1105	10.50	15857	16669	-4.87
高淳县	897	782	14.71	15768	17085	-7.71

2006年农林牧渔业增加值增幅

计量单位：万元、%

县区	渔业			农林牧渔服务业		
	2006年	2005年	增幅	2006年	2005年	增幅
南京市	175496	152227	15.29	28234	25818	9.36
浦口区	20965	18450	13.63	4597	3890	18.17
江宁区	46784	40490	15.54	5825	6000	-2.92
六合区	26407	22875	15.44	4728	4019	17.64
溧水县	18139	17050	6.39	9480	8560	10.75
高淳县	58395	48556	20.26	2425	2202	10.13

2006年农林牧渔业总产值(按照现行价格计算)

单位:万元、%

县区	农林牧渔及服务业产值合计			农业		
	2006年	2005年	增幅	2006年	2005年	增幅
南京市	1650559	1553837	6.22	900794	854544	5.41
浦口区	249880	229522	8.87	129562	124384	4.16
江宁区	374932	353616	6.03	200197	193128	3.66
六合区	364709	335463	8.72	223527	198398	12.67
溧水县	239790	225285	6.44	139515	130554	6.86
高淳县	284833	271011	5.10	117719	119179	-1.23

2006年农林牧渔业总产值(按照现行价格计算)

单位:万元、%

县区	林业			牧业		
	2006年	2005年	增幅	2006年	2005年	增幅
南京市	20641	19637	5.11	334556	338746	-1.24
浦口区	4826	4236	13.93	63503	55721	13.97
江宁区	3112	3459	-10.03	75393	75982	-0.78
六合区	7926	7579	4.58	72297	76843	-5.92
溧水县	2405	2185	10.07	44071	43012	2.46
高淳县	1665	1451	14.75	45800	49665	-7.78

2006年农林牧渔业总产值(按照现行价格计算)

单位:万元、%

县区	渔业			农林牧渔业服务业		
	2006年	2005年	增幅	2006年	2005年	增幅
南京市	341662	293414	16.44	52906	47496	11.39
浦口区	43194	37381	15.55	8795	7800	12.76
江宁区	86055	71807	19.84	10175	9240	10.12
六合区	50959	44143	15.44	10000	8500	17.65
溧水县	36999	34134	8.39	16800	15400	9.09
高淳县	115343	96919	19.01	4306	3797	13.41

2006年农林牧渔业总产值(按照不变价格计算)

单位:万元、%

县区	农林牧渔及服务业产值合计			农业		
	2006年	2005年	增幅	2006年	2005年	增幅
南京市	748606	718980	4.12	368002	360616	2.05
浦口区	131260	118714	10.57	68452	63134	8.42
江宁区	162492	158898	2.26	76443	77618	-1.51
六合区	169423	162121	4.50	90558	85738	5.62
溧水县	114131	106724	6.94	53678	50464	6.37
高淳县	106934	106201	0.69	36367	40410	-10.00

2006年农林牧渔业总产值(按照不变价格计算)

单位:万元、%

县区	林业			牧业		
	2006年	2005年	增幅	2006年	2005年	增幅
南京市	11140	10589	5.20	155806	156965	-0.74
浦口区	2440	2299	6.13	30612	26808	14.19
江宁区	1689	1874	-9.87	32677	35223	-7.23
六合区	4517	4181	8.04	37896	39503	-4.07
溧水县	1418	1220	16.23	20740	19376	7.04
高淳县	659	583	13.04	19162	20065	-4.50

2006年农林牧渔业总产值(按照不变价格计算)

单位:万元、%

县区	渔业			农林牧渔业服务业		
	2006年	2005年	增幅	2006年	2005年	增幅
南京市	169974	150278	13.11	43684	40532	7.78
浦口区	22950	20973	9.43	6806	5500	23.75
江宁区	45883	38383	19.54	5800	5800	0.00
六合区	26452	24199	9.31	10000	8500	17.65
溧水县	21495	20264	6.07	16800	15400	9.09
高淳县	48058	41346	16.23	2688	3797	-29.21

References

1. “Global Monitoring Report 2012: Food Prices, Nutrition, and the Millennium Development Goals “, World Bank.
2. Donald Mitchell, “A Note on Rising Food Prices” World Bank - Development Economics Group (DEC) July 1, 2008. World Bank Policy Research Working Paper No. 4682
3. Jingzu Zhao, “Opportunities and Challenges of Agricultural in China”, 2008. p. 893-904
4. Andrew Wilson, “Market Development Feasibility Study – Biogas Slurry in Vientiane Capital Region, Laos DPR”, November 2008.
5. Gatot Gunarso et al, “ENACTUS Nanjing University of Information Science and Technology – 2013 Annual Project Report – Delivered at China National Exposition, Beijing 16-18 May 2013 ”, 2013, p . 2-3
6. “Calculating Compost Need”, Lestari Mandiri Farmers Organization, 2008, http://www.lestarimandiri.org/id/pupuk-organik/230-menghitung-kebutuhan-kompos.html
7. “Making Organic Fertilizer”, Lestari Mandiri Farmers Organization, 2008, http://lestarimandiri.org/id/pupuk-organik/pembuatan-pupuk-organik.html
8. “Market Overview”, CBF China Bio-Fertilizer AG, 2005, http://www.chinabiofertilizer.com/sales_marketing.php
9. Gatot Gunarso et al “SIFE NUIST – 2012 Annual Project Report – Delivered at SIFE NUIST Annual Meeting”
10. “WRAP BSI PAS-100 : 2011 Standard for Compost Materials”, British Standards Institution , 2011, http://www.wrap.org.uk/content/bsi-pas-100-compost-specification
11. “Fertilizers and their Use. A Pocket Guide for Extension Officers. English 2000”, International Fertilizer Industry Association 2000.
12. “IFA World Fertilizer Manual”, International Fertilizer Industry Association, 1992, p.8-9
13. “Monthly world prices of commodities and indices”, World Bank 2000-2011 http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934-1304428586133/pink_data_a.xlsx

14. “Fertilizer Use in Chinese Agriculture” Organization for Economic Cooperation and Development, June 2006, www.oecd.org/tad/agricultural-policies/36943447.pdf
15. Cayuela 1997
16. International Conference on Kyusei Nature Farming papers, http://www.infrc.or.jp/english/KNF_Data_Base_Web/index.html
17. Rhainds 2002
18. “Combined Use of Inorganic and Organic Fertilizers for Tomato Yield and Fertility of Oxisols”, Phimmasone Sisouvanh , 2011, Bogor Institute of Agriculture (Institut Pertanian Bogor)
19. (U.R Sangakarra, 1996)
20. (Schaller, 1993 ;)
21. Smill, 1995 ; Brown&Halweil, 1998 ; Liu & Lu 2001
22. “Market Introduction Evolution for Fertilizer”, SINOFERT, 2008
23. (Park, 2002).
24. (Sullivan et al., 2006)
25. “Internal Rate or Return” , http://en.wikipedia.org/wiki/Internal_rate_of_return Wikipedia, June 2013
26. “Internal Rate or Return” www.investopedia.com/terms/i/irr.asp , Investopedia, June 2013.