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Guano Exploitation in Madagascar

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GUANO EXPLOITATION IN MADAGASCAR

INTRODUCTION

Agriculture In Madagascar

Agriculture in Madagascar continues to remain largely undeveloped. Out of the eighty percent of Malagasy individuals that live in rural areas an overwhelming sixty five percent practice subsistence agriculture. With respect to the country as a whole this means that out of Madagascar's 58.2 million hectares of available land only 5.2 percent (3 million hectares) are farmed. And out of these 3 million hectares only 67% are cultivated permanently and only 11% are fertilized.

While there are several reasons for why Madagascar's agriculture has remained largely undeveloped and for why Madagascar continues to rely on imported crops to meet its population's needs, one of the main causes can be attributed to the lack of fertilizer use. Many Malagasy farmers simply don't understand the need to use fertilizers. Among other reasons, this can be explained by a heavy reliance on tavy (slash and burn agriculture). And out of those who do use fertilizers, many use traditional soil enrichers, such as, cow and pig manure. The use of the aforementioned traditional fertilizers yields better agricultural results than using no fertilizer at all. Unfortunately, however, over the years as Madagascar's population has increased the efficacy of these conventional products has diminished. In short, it appears that Madagascar's traditional farming methods are no longer enough to meet all of its agricultural needs (Rakouth).

Introduction of My ISP Topic

I came to Madagascar thinking that I was going to explore the impact of chemical fertilizers in Madagascar's agricultural development. However after speaking to several different farmers, I came to the conclusion that chemical fertilizers in Madagascar are used by too small of a group to warrant any significant results.

Deterred from pursuing my original ISP idea, I began exploring other kinds of fertilizers. It was at this point in the process of identifying an ISP topic that I came across guano, an organic fertilizer derived from the dried droppings of birds (usually sea birds) and bats . Although guano has been harvested and used in many different countries for centuries, the organic fertalizer has just recently been developed and sold in Madagascar by way of a company called Guanomad. The novelty of the product imediately captivated my interest in examining its role in the the livelihood of malagasy farmers. However as I began conducting my research and interacting with farmers and Guanomad representatives alike, I came to see guano as more than just a fertalizer. My ISP research with respect to guano has placed the organic fertalizer at the center of a complex web of interrelated environmental, cultural and economic interactions. In this paper I propose to shed light on these relationships.

METHODOLOGY

The basis of this research was derived from a series of observational anecdotes, interviews, and materials obtained from Guanomad. Ten initial days were spent in Tana conducting preliminary research, building rapport with Guanomad, interviewing an agricultural engineer and economist (neither of whom are associated with Guanomad), and attempting to interview several different Guanomad representatives (an agricultural technician, the company's commercial director, and the company's director of production.)

One week was spent on the road with a Guanomad crew doing cave prospections in the Ihosy region. During this week I sat in on meetings with Guanomad established contacts (These were trusted people in the local vicinity to whom residents from Ihosy and other nearby regions knew to go to with information about the location of a new potentially rich guano cave.), did courtesy visits to the mayor's and fokontany president's offices, observed negotiations between Guanomad representatives, raiamandreny and fokonolona and attempted to see a total of six different caves.

One day was spent in Maroarina, a village near Fianarantsoa where I participated in the harvest of rice field that had been grown with Guanomad donated fertilizer and interviewed two farmers. I had gone there with the purpose of interviewing more farmers, but because of the unforeseen rice festival that was going on, this simply was not possible.

Three final days were spent in Tana meeting with a bat expert, a rural development specialist, and conducting some final Gunanomad representative interviews.

GUANO IN MADAGASCAR

Madagascar has two main sources of guano, its sea bird guano found in the Barren Islands (more specifically Andrano, Androtra, Lava and Maroantaly)located just off of the country's northwestern coast and its bat guano deposits located in coastal Toliary and Morondava caves (Figure 1) (Andrianarimanga, Lanto). When we think about what makes the existence of guano fertilizer in Madagascar possible we automatically think of Guanomad, the company that produces it, and maybe the farmers that use the soil enricher. (For a product to exist there has to be a demand for it.) However, a closer analysis of guano as a product reveals that there are a lot more players involved in its existence than initially meets the eye. Before farmers can have access to guano, for example, it is important to realize that there are individuals who must harvest and produce the product. But, even before the farmers and workers that extract guano from the Barren Islands and caves, we have to think about the biological and, or environmental process that must take place for there to even be something Guanomad can develop as a marketable product. This next section explores the science behind the formation of guano.

GUANO BEGINNINGS

Even in the early formation of guano there are interesting relationships to observe between the primary producers of the product, birds and bats, the nutrient rich food they eat, and the biological and environmental changes that must occur before the droppings of these animals can become the guano that Guanomad is interested in harvesting.

Bat Guano

Bat guano begins as plant life. These plants are eaten by insects, which are then eaten by bats. Later, once digestion has taken place, the bats relieve themselves onto the cave floor. There the nutrient bat droppings are consumed by guano beetles and decomposing microbes. This process helps to eliminate most viruses that might have passed from a bat to its fecal matter and further serves to enrich the guano with a beneficial microbial flora (Goodman, Lanto).

Sea Bird Guano

By comparison, sea bird guano begins as sea water characterized by 0.07ppm of phosphorus, which is absorbed by phytoplankton. These phytoplankton are eaten by zooplankton, which are eaten by fish, which are later eaten by sea birds. Through the food chain process the small amounts of phosphorous in seawater is concentrated and released onto the Barren Islands in the form of sea bird droppings and dead bird carcasses. When it rains the soluble materials from the bird droppings and dead carcasses (H3PO4) and the soluble materials in the rich calcium carbonate sand (CaO.H2O) leach out and react with one another to form Ca3(PO4)2, Ca3HPO4, or CaH(PO4)2, the base of calcium and phosphate rich sea bird guano. As more bird droppings accumulate above this layer of guano, often on top of a layer of sand, and it rains more soluble materials from the new bird droppings and dead carcasses (H3PO4) and more soluble materials from the calcium carbonate sand (CaO.H2O) leach out and percolate through the soil. When this happens depending on the depth of the older phosphate guano

deposits, the phosphate levels in the already existing guano may increase (Andrianarimanga; Guozhong, Bingquan, and Songqing; Rabemanantsoa).

FINDING EXPLOITATION SITES

Once guano has been formed, before exploitation of the natural fertilizer can occur, guano rich sites must first be located. In the case of Madagascar Barren Island's, previous chemical analyses of the guano have already identified Nosy Andrano, Androtra, Lava and Maroantaly as key collection sites. However, at least in the case of Madagascar's bat guano reserves, simply having guano reserves doesn't necessarily mean that you have exploitable guano. Naturally caves have smaller guano reserves than islands. This indicates that even if Guanomad already has caves that they are using for guano extraction, to continuously sell bat derived guano and keep their business running, Guanomad must constantly find new exploitable caves.

Unfortunately for Guanomad, because bat caves are often very isolated, even with a general knowledge of the area, they are often very difficult to find. To help them in their cave finding process Guanomad has developed close relationships with local people. Preliminary courtesy visits to mayor and fokontany president offices, friendly exchanges with lay Malagasy persons they may casually encounter in the region, and general knowledge of Guanomad as an established company has allowed the fertilizer business to identify a string of contact persons that individuals in the local community and nearby areas know to go to with knowledge of bat caves and small guano samples. Assuming that this string of contact persons is well established,

knowledge with respect to the location of a cave will slowly make its way to Guanomad's regional distribution director. When this Guanomad representative has received news of several different potentially exploitable caves, he or she will make a phone call to Guanomad's main office in Tana to arrange for a cave prospection in his or her designated region.

A typical cave prospection mission begins with Guanomad meeting their local contacts to come up with a convenient schedule that will allow them to visit as many high quality guano caves as possible. Once a program has been created, Guanomad relies on their local contacts to direct them to the remote villages where knowledge of the newly exploitable bat caves originated. In each rural community the Guanomad team will meet with the villagers (fokonolona) and their local authorities (andraiamandreny) to explain the purpose of their visit. During these meetings the Guanomad team will inform the village's inhabitants that they are interested in possibly exploiting guano from the village's cave(s) and that they would like to collect some guano samples to run chemical tests. These chemical tests will be used to determine the guanos quality and whether or not exploitation efforts should follow.

The Tandroy, Sakalava, and Bara Ethnic Groups: A Little About The People Guanomad Works With To Extract Bat Guano

As aforementioned, high quality bat guano caves are generally found in the regions of Tuleara and Morandava. These regions are the home of the Tandroy and Sakalava people. Guanomad does most of their work in these areas, but an increasing demand for bat guano has also led Guanomad to venture to other parts of Madagascar, namely Ihosy, which is where the Bara people live. All of these ethnic groups are linked together by the worship of zanahary (god being(s) and creator(s)) and ancestors that are often believed to inhabit caves. The knowledge

that a cave is inhabited by a zanahary and, or ancestor(s) can comes from stories that have been passed through generations, or as in the case of the Bara people in Ihosy the ongoing practice of using caves as family tombs . The worship of these aforementioned beings occurs through sacrificial ceremonies, often involving the slaughter of an omby (a cow), and the offering of traditional honey and tokah (a red alcoholic beverage) items. The traditional beliefs of these ethnic groups are also characterized by a lot of fady (taboos) designating what one can and can't do to ensure the happiness of the zanahary and ancestors.

Another common characteristic of the Trandoy, Sakalava, and Bara ethnic groups is their livelihood. Although they all practice some cultivation of cassava, millet, maize, and sweet potatoes because of their extremely dry environment where there is little rainfall; the Tandroy, Sakalava and Bara people are largely pastoralists (cattle herders). This brings an interesting mix into what we may refer to as the Guanomad success equation. When we think about guano as a product in Madagascar we tend to think about the impact that the product has on the agriculture and livelihood of farmers. However, we never think about how guano may influence the lives of cattle herders . To better understand Guanomad's relationship with respect to the Tandroy, Sakalava and Bara and vice versa, it is helpful to think about what each group can gain from one another.

Guanomad's desire to work with Tandroy, Sakalava, and Bara people comes from their interest in acquiring bat guano. These aforementioned groups of people know where to find the caves that Guanomad needs to produce the product they sell. Logically, since the Tandroy, Sakalava, and Bara people aren't cultivators Guanomad's fertilizer isn't of much use to them. What they can benefit from, however, are the jobs and roads that Guanomad's presence in their

community is capable of bringing. When Guanomad harvests guano from caves in addition to giving villagers some money, they often employ local people to help with collection of the product and build roads. In the short term these roads are used to transport the guano back to Guanomad's headquarters where it can be processed. However, in the long term these roads arguably increase access of these isolated communities to an education, medical care, jobs in town, etc, and open doors to interaction with society at large.

While the Tandroy, Sakalava, and Bara people have a lot to gain from their relationship with Guanomad it is also important to look at what is at stake. Guanomad's desire to extract guano from caves in all of these aforementioned regions can be seen by the fokonolona (inhabitants) of many villages who use the caverns as places of veneration for zanahary and ancestors as taboo. Eventhough Tandroy, Sakalava and Bara people are aware of the benefits that they can profit from by collaborating with Guanomad to let them harvest the product from their caves, fear of upsetting their zanahary and ancestors often prevents them from agreeing to let Guanomad even visit their sacred caverns. Sometimes this fear can be eliminated if Guanomad agrees to adhere to the fomba (rituals) of the specific region. Although rituals can vary between regions and villages, from my conversations with Guanomad representatives, it would appear that the fomba Guanomad usually participates in consists of spilling a few drops of honey or toka by the caves entrance and agreeing not to touch any of the venerated objects in the caves interior. Then later once the guano has been removed from the cave, before it is transported to a new location, Guanomad has also reported participating in omby sacrifices. Omby sacrifices in these regions, among other reasons, are done to demand the approval and support of the zanahary and ancestors.

Agreeing to participate in fomba, however doesn't always give Guanomad access to caves. There are also some instances, as was observed in the case of Ihosy, where the taboo of extracting guano from a family tomb is so strong that no amount of convincing or adhering to fomba will persuade the villagers to lead Guanomad to their caves. In these situations Guanomad has no choice but to find other locations to do their exploitation.

Interestingly enough, religious beliefs aren't the only block Guanomad representatives have encountered when doing business with villagers. An insider versus outsider outlook also seems to have some bearing. Most caves in Ihosy are used as tombs. However, in one instance during the cave prospection I did with Guanomad where it wasn't a question of fady, the villagers of Ambaho would not agree under any circumstance to lead us to their cave because they were afraid of us. Guanomad offered them a small monetary incentive to try to get them to change their minds, but this only scared the villagers of Ambaho more and for one reason or another led them to confess that they thought we were affiliated with the dahalo (cattle thieves). As pastoralists, for them the dahalo is a huge threat. When I asked the Guanomad representatives what had been the reason behind the villagers' quick judgment they said that to the fokonolona their coming from Tana meant they were vazah (foreigners). Even though both the Guanomad representatives and the villagers were Malagasy, the fact that the Guanomad representatives spoke a different Malagasy dialect and had a lighter skin tone, as far as the villagers were concerned, meant that they were not to be trusted. Initially this explanation made me feel like I was to blame for Guanomad's inability to gain access to the cave. I am after all a Caucasian woman. In comparison to the Tana Guanomad representatives my skin tone is even lighter. However, the Guanomad team assured me that this was not the case. To validate their point they

proceeded to explain that during previous cave prospections, when I hadn't been part of their team, they had received similar responses.

GUANO HARVESTING: A LITTLE ABOUT GUANOMAD'S RELATIONSHIP WITH THE VEZO PEOPLE

As aforementioned, Guano exploitation sites have already been identified on the Barren Islands. This eliminates the need to work with the local people to find sea bird guano deposits. However, that is not to say that Guanomad doesn't have a relationship with the Vezo people, fishermen and women who use the islands as bases for their fishing activities. As in the case of the harvest of bat guano from caves Guanomad could use some help extracting sea bird guano. When fishing isn't favorable this translates into an opportunity for the Vezo people to make some extra cash. Guanomad is able to collect the sea bird guano they need and the Vezo are able to use the money they gained from (1) helping Guanomad collect guano and (2) from increased fish sales (A lot of the Guanomad representatives based on the Barren Islands like to purchase fresh fish from the Vezo.) to help develop their traditional fishing practices. All parties are able to profit from the liaison, such which translates into an ideal reciprocal relationship.

THE EXPLOITATION PROCESS

Once an extraction site has been identified harvesting can take place. This next section of my ISP paper provides some insight into how the exploitation of bat and sea bird is carried out.

Bat Guano

We can think of bat guano in caves as part of three main layers of varying depth that sit on a dirt based floor. The first layer is composed of fresh bat droppings, while the second and third layers exist in a powder like state that resembles soil. Because the second and third layers are difficult to distinguish from one another (due to the reworking of insects and microrganisms) they are usually treated as one stratum. Assuming samples have been tested and there is no problem with the product the harvest of guano can commence. Collection of bat guano begins with the gathering of the first layer. Shovels are used to make small piles of the bat manure, which are then scooped and placed into large rice bags. The collection procedure for the second and third layers is essentially identical to the process used in the collection of the first guano strata. The only difference is in the care that is given to not collect the soil that is found directly below the third strata of guano. If there is suspicion that the third layer of guano might contain soil, a couple of drops of a 30% hydrochloric solution (HCl) can be applied. In the presence of soil the HCl solution will fizz. At this point, if bubbles are observed, the harvesting of guano is postponed and samples are sent to a lab for analysis. Treating the situation as if there were no problem, once all the guano has been collected and put into rice bags that are then placed onto trucks, they are transported to Guanomad's treatment center. Here the guano undergoes further tests intended to determine its chemical make-up. If the guano has the chemical makeup of the natural fertilizer that Guanomad sells under the name Guanomad the manure is sifted, weighed and then placed in 2, 5, and 50 kilogram (kg) bags, which are ready to be sold. On the other hand, if there is some inconsistency with respect to element percentages, the bat derived soil enricher is mixed with other guano manures until the desired chemical composition is achieved.

The packing of the product follows thereafter (For a summary of this process please refer to Figure 4.).

Sea Bird Guano

Upon setting base on the island, the first step of the sea bird guano extraction process is to remove all the vegetation in the immediate collection site. Under this visible layer of vegetation there are three different earth layers: the superficial layer (This first layer is composed largely of a rich calcium carbonate shell filled sand topped by soil and varies anywhere from to 1 meters in depth.), the phosphate rich layer (This second layer which is beige or light brown in color and varies from 0.20 to 4m is composed of a relatively hard shell filled sand and calcified seabird guano), and the sedimentary rock layer (This layer is composed of calcified sand, shells, and corals that form the base of the island.) Step two consists of the uncovering of the first earth layer to reveal the second layer. The purpose of this, which occurs through the digging of a hole, is to get to the calcified seabird excrements, the guano. Once the phosphate rich layer is exposed, which can be identified by its distinguished egg imprints, a sample is taken and chemical tests are run to determine the products chemical composition. Assuming that there isn't a problem with the product, the extraction process can continue. Pickaxes are used to break the solid guano into blocks that can be transported by boats to Guanomad's treatment center. Here the guano is crushed into powder and sifted. The end result is a sea bird guano powder composed of particles of 50 microns. After more tests to ensure the product's quality the seabird derived guano is weighed and put into standard 50 kg bags that are sold under the name Guanobarren. (For a summary of this process refer to Figure 5.)

The exploitation processes described above explains how two out of the three products sold by Guanomad are made. Guanomad's third product called Guanotsar is a combination of the other two fertilizers. For the exact chemical makeup of this product please refer to Figure 7. Note that the chemical makeup of the bat guano used in the creation of this product differs from the chemical composition of Guanomad. This is because Guanomad consists primarily of guano collected from the second and third strata. The guano in Guanotsar, on the otherhand, is usually composed of fresh guano taken from the first strata. The bat guano derived from the first strata has not undergone the mineralization process that characterizes the second and third strata. Therefore it is not as rich and necessitates being mixed with another fertilizer. Also note that the diagram has Guanobarren listed as natural phosphate. This is simply a choice of language on Guanomad' s part.

GUANOMADS PRODUCTS (EXPLAINED FURTHER)

Suitable for every kind of plant, all three of Guanomad's products have a similar purpose: to improve yield, production, soil structure, fertility, plant aspect, quality, taste, help with culture protection, root development and promote faster growth. Furthermore, all of Guanomads products are free of chemicals and considered to be 100 % biological and natural. This said, however, because of their different chemical compositions each fertilizer has a different strength (Figures 2, 3, 4).

<u>What Distinguishes Each Product From the Other?</u>

Guanomad, developed in 2006 and composed solely of bat excrements is rich in Nitrogen, Phosphorus, and Potassium (N-P-K), the three primary macronutrients, and Calcium

and Magnesium (Ca and Mg), very important secondary elements that help to maintain a stable soil ph. Another important characteristic of bat guano is its live micro bacterial flora which helps with (1) plant absorption of nutrients present in the bat guano and (2) prevention against certain plant diseases and funguses. (For a more detailed breakup of all of the elements found in this product please refer to Figure 2.)

Guanobarren, which came into existence in 2009 and is derived from sea bird droppings is very rich in Calcium and Phosphorous. This fertilizer's high levels of calcium, which are known to regulate soil ph, make it an ideal choice when it comes to planting on acidic tropical soils. However compared to Guanomad it is not nearly as plentiful in Nitrogen or Potassium or as effective in building the natural immunity of plants. (For a more detailed breakdown of the elements in this fertilizer please refer to Figure 3).

Because of this fertilizer's low N and K value, for optimal plant growth, if someone is interested in having organic products, it is recommended that this product be mixed with compost and/ or cow and pig manure. If having a completely organic harvest isn't so important, the addition of urea is also suggested. The addition of compost, cow, and or pig manure to the Guanobarren is supposed to increase potassium levels, while the adding of urea is supposed to result in greater nitrogen levels.

Guanomad's third product Guanotsar that was put out on the market in 2010 and is a combination of Guanomad's sea bird guano (Guanobarren) and Guanomad's bat guano (Guanomad) has a higher phosphate and potassium content than each of the other two fertilizers have on their own. Also useful with respect to fostering plant resistance against funguses and nematodes, a characteristic of Guanomad that Guanobarren lacks, Guanostar can be thought of as

the optimal fertilizer. (For a more detailed understanding of the composition of this third fertilizer please refer to Figure 4).

How Do Guanomad's Products Compare To Chemical And Other Organic Fertilizers?

Now that we have looked at how Guanomad's products compare to each other, it is important to understand how they compare to other fertilizers. This will help us better understand how Guanomad markets their products.

Guanomad VS. Chemical Fertilizers

Both chemical and natural fertilizers will provide plants with NPK, which respectively give plants their green color, promote root and flower development, and the growth of stems. The main difference between Guanomad's fertilizers and chemical based soil enrichers is the rate and state in which minerals are made available to plants.

Plants absorb nutrients as mineral salts that have been dissolved in water. The NPK elements derived from chemical fertilizers are available to be used by plants immediately in an unfixed state. This often makes it difficult for plants to use volatile elements like N that will evaporate before they can fully be absorbed and can lead to overdose of NPK (known to burn plant roots and harm beneficial microorganisms). Different from chemical fertilizers, before the elements in Guanomad's fertilizers can be used by plants; they must first be broken down (by microorganisms in the soil) to a mineral state. This breaking down process fixes the minerals in the soil enicher (making it easier for plants to easily absorb and use the minerals.) while also ensuring that plants don't receive more NPK than they need. As a result, overtime the use of

guano based fertilizers enhances soil structure and ability to maintain moisture, while the use of chemical fertilizers tends to lead to hard, poor, acidic soils with an impoverished texture.

Furthermore, chemical fertilizers don't have any secondary elements, such as, Ca, (which helps with stem development, maturation of fruits) Zn (which improves growth), Cu (which helps with potash and nitrogen absorption) and Mg, (which helps with chlorophyll formation, phosphorous absorption and the stabilization and maintenance of soil ph), or anti nematode and fungi properties. In fact chemical fertilizers make plants more prone to illnesses. In addition using Guanomad fertilizers is said to make plants and fruits both taste better and last longer than when using chemical fertilizers. Last, but not least Guanomad's products are also considerably cheaper. While chemical fertilizers can sell for 2,000 or 3,000 ariary a pound, Guanomad's products only cost 920 ariary per pound.

In the beginning using both chemical and Guanomad fertilizers will yield similar results in terms of crop output. If we look at rice for example, both fertilizers are capable of yielding an approximate amount of 6 tons per hectare. However, after the first two years because of the way that chemical fertilizers negatively impact soil, a field which has been enriched with chemical NPK will only be capable of yielding 2-3 tons of rice. By comparison, the yield capacity of a field that has been fertilized with Guanomad products remains unchanged.

Another disadvantage of using chemical fertilizers is their impact on the environment. Through runoff chemical fertilizers can enter lakes, rivers and leach into the water table. As nitrogen turns into nitrites and nitrates it has the potential to destroy natural ecosystems. Natural fertilizers like Guanomad can also pollute sources of water, but on a much smaller scale.

Guanomad VS. Other Natural Fertilizers

. In comparison to other natural fertilizers Guanomad's fertilizers (in particular Guanomad and Guanotsar) are said to be better because of their ability to provide plants with a balanced amount of NPK and secondary elements (Ca, Mg, Cu, Zn, Mn). Other natural fertilizers such as animal based soil enrichers and compost have high levels of N but fairly low levels of P and K and no secondary elements. Furthermore because bat guano has already undergone some mineralization in the cave in comparison to compost and animal based manure it can also more easily be assimilated. In addition Guanomad's products also contain microbial flora and have the ability to help plants defend against funguses and nematodes, yet another two things that more traditional fertilizers lack. Last but not least using animal fertilizers (this refers mainly to pig fertilizer) can lead to the transmission of intestinal parasites, more specifically cistercircosis.

If we were to compare Guanomad's products with more traditional fertilizes on the field (more specifically a rice field), Guanomad's fertilizers have a 6 ton per hectare production capacity, while more traditional fertilizers only have a yield of 2 to 3 tons per hectare. The statistics on Guanomad's success with respect to agriculture aren't just based on test runs done by the company. Farmers all over Madagascar who have used the product have personally noted an increase in production, quality of crops and soil, and plant resistance. (Figures 12-16 provide some specific examples of how the use of Guanomad's products has ameliorated agriculture in several different communes of Madagascar).

HOW DOES GUANOMAD MARKET ITS PRODUCTS?

Given all the positive characteristics described one would think that Guanomad's products market themselves, and to a certain extent they do. However, given the tendency of Malagasy farmers to not use fertilizers or understand the need to use soil enrichers, Guanomad has taken a more active approach to raising awareness about their fertilizers. Since its development in 2005 Guanomad has appeared on radio stations, in commercials, in posters found in fokontany, district, and regional offices, on billboards and on signs intended to lead customers to Guanomad distribution centers. All of these have definitely made an impact with respect to getting more people interested in the fertilizer, however, Guanomad's most effective way of reaching farmers continues to be through their on-site visits and demonstrations. To give you an idea of Guanomad's success thus far, even if not all farmers use Guanomad,I was informed that 70% of Madagascar's farmer population has some knowledge of who Guanomad is and what the fertilizers they sell are all about.

Marketing Guanomad Via Demonstration Sites:

When Guanomad goes into different villages to market their product besides giving a bit of background to explain why their product is better than using chemical fertilizers, traditional cow and pig manures, and tavy, they usually set up a demonstration site. According to the Guanomad representatives that I have spoken to this is really the only way to convince farmers of the agricultural advantages that Guanomad products can offer. Usually farmers have become so ingrained in the traditional agricultural practices that have been passed down through the generations, explained Madame Lanto, Director of Production at Guanomad, that they are extremely reluctant to try something new until they see for themselves that the product works. Knowing all of this Guanomad will go into a village and take a vote with respect to the kinds of crops that the farmers would like the company to help them plant using donated guano fertilizer.

The expectation is that once the farmers see how many more tons of crops they can harvest by using Guanomad fertilizer they will be persuaded to buy their products.

How Do Farmer's Receive Guanomad's Products?

Guanomad's products may be a lot cheaper than chemical fertilizer, but for some farmers 920 ariary for a pound of soil enricher is still too expensive. This said, while farmers are often persuaded to buy Guanomad products in an effort to save money they don't necessarily buy the suggested amount or apply the product as directed by Guanomad.

Guanomad suggests that their fertilizers be used every time new crops are planted and have set strict guidelines for how many pounds of fertilizer to use for what cultures. That is not to say that Guanomad doesn't support the mixing of their fertilizer with more traditional soil enrichers. Guanomad understands that it is difficult for farmers to fertilize entire fields using bat and or sea bird guano, which is why they have also come up with guidelines for mixing fertilizers with cow or pig manure. However, farmers have the tendency to use even less of the Guanomad products than is recommended in the guidelines for mixed fertilizers. And this is just one of the ways that farmers have reduced the amount of Guanomad that they purchase. In the village of Maroarina located in the Firantsoa Region, for example, rather than fertilizing fields before every new season to further minimize the amount of Guanomad that is purchased farmers have (1) resorted to using fertilizer once every two harvests and (2) have only applied Guanomad at pivotal points in a plants life, such as during seeding or when transferring rice plants from the rice nursery to the field. Nevertheless the farmers I spoke to were still very happy with the results they had obtained. Despite their cutting corners they had still managed to see a 30% increqse in this year's rice harvest.

There Is More To Guanomad Then Its Fertilizers

The last couple of sections have been focusing on Guanomad's success strictly with respect to its guano based products. This section will explore Guanomad as more than just a soil enricher company.

There is no denying that when Guanomad goes into different villages their purpose is to market their Guanomad products. However it appears that the presence of Guanomad technicians in rural villages can also have secondary affects. With respect to the village of Maroarina I noticed that in addition to being users of Guanomad the farmers there were completely against the use of tavy. As far as they were concerned it didn't do anything for the soil and negatively impacted the flora and fauna. I'm not saying that this is just due to Guanomad's presence in their community. I spent too little time and spoke to too few farmers to state this for sure. However, as Guanomad goes into different villages and explains how their product compares to other fertilizers, that tavy doesn't work and that one needs to use fertilizers to have a good yield it is important to consider that in addition to raising awareness about the fertilizers that Guanomad sells, they are promoting better more environmentally sound general farming practices. In the end even if the farmers that Guanomad has addressed don't end up buying Guanomad products because of a lack of money at least they are able to walk away with knowledge of how to improve their yield and preserve their natural surroundings.

To further develop this idea that the presence of Guanomad's agricultural technicians in villages extends beyond the use of Guanomad's products I want to state that while sensibilizing farmers to use Guanomad fertilizers to more efficiently plant rice, the company has also instructed farmers on how to use the SRI method. The combined result of applying these methods to agriculture in 2009 resulted in Madagascar not having to import any rice from abroad

as it had in the past. Unfortunately because of the crisis, this success did not carry over to 2010. Hopefully, 2011's agricultural yield will resemble more closely the success that was achieved before the crisis.

In conclusion, while Guanomad's main objective as a business is to sell as much fertilizer as it can it is important to acknowledge that it has also done a lot for Madagascar not only in terms of donating their product to farmers, but also in terms of raising awareness about the need to use fertilizer and take advantage of better general farming approaches. It is still early for us to be able to comment on Guanomad's potential to help Madagascar advance agriculturally and economically. Nevertheless, it would appear that a lot of progress has been made in the last five years since the company came into existence. Let us hope that this trend continues.

GUANOMAD' S IMPACT ON THE ENVIRONOMENT: A DIFFERENT TAKE ON THE COMPANY'S ACTIVITIES

All of the previous sections of this ISP paint Guanomad in a very positive light. They are a conscious company that helps develop rural communities, provides jobs, increases agricultural production and promotes more efficient farming practices, all while protecting the environment, or so it appears. The application of Guanomad products to crops may protect rivers, lakes and the water table from being contaminated by chemicals and stabilizes soil structure, but how does Guanomad's exploitation of guano affect wildlife? Guanomad talks endlessly about the way it is positively impacting Madagascar, but gives very little attention to how their extraction of guano from caves or the Barren Islands is affecting fauna and flora.

When I asked Guanomad how their extracting of guano in caves was impacting bats they told me that they unfortunately couldn't give me any specifics. Their reason being that they had just hired someone from the ECC to do an environmental impact statement and that the document wasn't ready. The main problem with this is that Guanomad has been around and has actively been exploiting guano since 2005. How were they allowed to exploit and sell their product without authorization from ONE?

Surprisingly, Guanomad does have an impact statement with respect to their actions in the Barren Island. However, as far as I can tell, and I am by no means an expert, this document is very vague and appears to be incomplete .

To try to get a more well rounded view of Guanomad as a company and have at least some understanding of how their actions are impacting bats in caves and sea turtles and coral reefs in the Barren Islands I decided to contact a member of the local scientific community. The next paragraphs summarize what I learned.

GUANOMAD AND BAT GUANO

When analyzing Guanomad's exploitation efforts in caves there are a lot of different things to look at. You have the bats, the invertebrates that live on the guano produced by the bats, fossils and climatic records that can become preserved in bat guano, and the workers involved in the extraction of guano. No studies have been done on this matter in Madagascar so there is no way to tell for sure how Guanomad actions impact all of these different actors, but the effect is surely negative.

Guanomad and Bats

Bats are very social creatures. During the day when Guanomad goes into caves and the bats are "sleeping" there are also a lot of interactions that take place. This said when Guanomad enters caves to extract guano in addition to disturbing the bat's sleeping patterns they are preventing very important bat communication from taking place and influencing their social behavior. Considering that some Malagasy people eat bat, it is also likely that during the exploitation process some of these bats are killed and eaten. There are some very rare species of bats in Madagascar that can be specific to one cave and if Guanomad isn't careful their reckless actions can lead to their extinction.

Guanomad and Invertebrates

The same goes for the endemic invertebrates that characterize many guano caves. When Gunaomad sterilizes the caves of guano, which serves as these insect's food source these insects are left with nothing and essentially starve to death. Rare species whose extinction could have been prevented are potentially wiped out every time Guanomad exploits a new cavern.

Guanomad and Climatic /Fossil Records

In addition to negatively impacting bats and invertebrates the removal of guano from caves eliminates climatic and fossil records. When bat droppings fall down to the cave floor they form strata. These strata can contain the fossilized remains of ancient creatures and/ or information about the fruits and insects (flora and fauna) the bats have eaten that can be studied to determine climate changes. When Guanomad extracts guano from caves reconstructing history using these paleontological records is no longer possible.

Guanomad and Its Workers

When analyzing the relationship between Guanomad's exploitation efforts and the environment, in addition to examining how this affects the wildlife, it is important to also explore the liaison between the workers directly involved and their surroundings. Are there hazards to working in a guano cave, and if so what precautions have been taken to minimize the risks? According to the bat specialist I was able to speak to there are three main dangers to consider when working with guano: (1) diseases that might have passed from the bats to their fecal matter (Many illnesses have been known to pass from bats to their urine and droppings.) ,(2) viruses that might be in the animal remains that got imbedded in the guano (Viruses from past living things have been known to last for hundreds of years), and (3) Histoplasmosis (fungal spores that have been known to occur in Madagascar and can cause respiratory problems that are very difficult and costly to treat). The fact that Guanomad is in the process of doing an environmental impact statement just now makes it hard to imagine that these hazards were properly examined. This seems to confer with the fact that Guanomad doesn't treat the fertilizer at all and there was never any mention of an autoclave (a machine that kills viruses and other disease causing agents through use of intense heat). Given all of the aforementioned risks the scientist I was able to converse with was also surprised that Guanomad had hired someone from ECC to do their environmental impact statement. ECC subcontracts bat ecologists, not virologists and to have a complete impact statement it would make more sense to go to an organization that could subcontract both types of specialists. This is a very serious issue because if contaminated product is sold it can affect the population at large, especially if the virus in question can be transferred to food matter or infiltrate the water table.

GUANOMAD AND SEA BIRD GUANO

Despite having an impact statement with respect to their seabird guano exploitation efforts Guanomad's presence and environmental impact on the Barren Islands is just as questionable. Before Guanomad decided that they were going to exploit the Barren Islands for guano, for example, the bat specialist I interviewed told me that the Barren Islands were under consideration to become a National Park. Whatever came of that plan of action seems to be a mystery. The next paragraphs examine the questionability of Guanomad's environmental impact in greater detail.

Environmental Impact of Sea Bird Guano Exploitation

With respect to the extraction of sea bird guano we can look at (1) the direct impact that the exploitation of guano has on the ecosystems of the Barren Islands, which refers to the removal of the vegetative layer located above the sand buried guano and related biota (The impact statement doesn't mention any animal or insect life that will be affected by this.) (2) the destruction of paleontological records regarding the birds that created the guano (also not mentioned in the impact statement), the affect that being exposed to guano has on the workers, (also missing from the impact statement) as well as the way in which Guanomad's boats, cars, and workers have affected the local environment. The direct exploitation of guano destroys the Islands' scenery, vegetation, and terrestrial environment, while the destruction of paleontological records by removing guano makes it impossible to study the droppings of the extinct birds to learn more about the soil enricher's creators. And being exposed to guano that contains viruses simply put is a health concern. (There is nothing more to say about this than what was already mentioned above). Indirectly, on the other hand, the exploitation of guano on the islands can lead

to the deterioration of air, water, soil, and life quality. This is the direct result of building barracks and fires using wood form trees that have been cut down, generating trash, making noise and using light that disturbs nocturnal animals, using cars and boats that release fumes into the air and oil and other hydrocarbons into the water, etc. Furthermore, workers presence on the island can result in nesting sea turtles being disturbed and/ or eaten.

According to Guanomad's impact statement, the company can lessen its effect on the scenery of the Barren Islands by replacing the guano that has been extracted with red feralitic soil and the removed vegetation with a fast growing plant species. Furthermore, the contractor hired to examine Guanomad's carbon foot (impact) has stated that to lessen their effect Guanomad should mandate that the removal of the vegetative layer found above the guano deposits using fire is prohibited. This is known to decrease the ability of plants and soil to regenerate. And with respect to Guanomad's setting base on the island their environmental impact can be reduced by prohibiting their workers from cutting trees, by ensuring that all boats and cars are well maintained, by restricting boat use to a specific area of the island, by having the workers eat together (this will reduce the number of cooking fires), teaching workers to respect the fauna, and limiting the amount of time spent on the island. Additionally it was also suggested that Guanomad closely monitor their environmental impact and act accordingly to decrease any damage.

Regarding Guanomad's exploitation efforts with respect to bat guano I was most surprised that there was no impact statement. However, concerning exploitation of guano in the Barren Islands I was incredibly surprised by the impact statement's lack of specificity and quick uncalculated suggestions to decrease environmental impact. For example, when the impact

statement discusses the need to remove the vegetative layer located above the sand buried guano, there is no mention of how this will affect the wild life and there is just no way that the destruction of this plant layer has no impact on at least some living creatures. In addition there is no consideration given to guano as a paleontological record or to worker risk of acquiring viruses, yet another two very important things that I believe should have been key points in the document. And when the contractor discusses methods that Guanomad can implement to ameliorate their impact on the island I was shocked to hear that it was suggested that Guanomad replace the guano they harvested with red soil and the vegetation they removed with fast growing plants. These so called bettering actions seem to have impacts of their own. Where is this red soil going to come from, how is it going to be transported to the island and how will it affect the growth of plants, and the ability of the insects and island's microorganism to thrive? How is introducing new fast growing plant species going to influence the endemic plants on the island? Could it become an invasive species? These are all questions that must be addressed before any of these plans are carried out and I believe the impact statement does a very poor job of doing this.

HOW WAS GUANOMAD ALLOWED TO EXPLOIT AND SELL GUANO?

Given Guanomads lack of an impact statement with respect to their extractionof bat guano and its weak impact statement regarding their exploitation efforts in the Barren Islands it is unimaginable to think how Guanomad has been able to get away with harvesting and selling guano since 2005.