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Mali: Incorporating Physical Change to Combat Developing Environmental Problems

Mali, once part of a vast regime that dominated the gold and salt trade throughout Northern Africa, now dwindles as environmental conditions affect economic success. The country has long harnessed the potential to compete with world cereal production; however, rising prices alongside long-term setbacks have halted agriculture to the point of making even self-sufficiency possible. One such problem that has existed as a lingering threat and now more than ever can be overcome is desertification. Mali, a sizable crevice within western Africa, is facing long-term problems with expanding deserts that will continue to encroach onto the countryside until a unified force steps up to stop the advances. Although a clear definition is hardly available NASA defines desertification as “a reduction in the productivity of a land that is not reversible” (Riebeek). While this statement by our country's top scientists may be a distinguished fact, the possibility of reversing this process is all but within our grasp. In response, countries must work together on both a local and national level to institute new agricultural practices that will combat the rising threat of a barren land left to perish.

Desertification, without the interference of humans, is a natural process which has occurred within drylands since the Tertiary geologic period. Soil erosion and periodical climate variations have existed alongside the development of the biological world (4. Desertification). Within Mali specifically the dry season, which is approximately between November and February, blows sand and grit across the country with the harmattan trade wind from the northeast (Weather and Climate). This is a prime example of how natural desertification can occur. With the introduction of humans however, desertification has massively increased due to a farming based civilization (4. Desertification). As many developed nations, such as the United States, gained knowledge of what was happening to the environment, underdeveloped countries, such as Mali, were left without this knowledge and resources to combat it. Underdeveloped countries are now one of the main causes of desertification due to artificial factors such as overgrazing, over cultivation and the exploitation of resources.

Farming still ranks as the dominant profession among the rural poor in Mali. An average family of eleven to twelve people is male dominant and consists of six members under the age of sixteen (Beaman, Dillon). Female children match the number of males found in primary school, at about eighty five percent, but decrease in numbers subsequently due to family priorities which account for a higher percentage of male literacy (Africa:: Mali). Education tapers after secondary school as school prices increase and become a luxury to families that can afford the service while balancing farm expenses. Because of this, more than one-fifth of school-aged children do not attend school; without a formal education and available funds, children are taught the trade which has encompassed their families for generations: subsistence farming (Mali Overview).

Subsistence farming is the practice of raising crops or livestock to primarily maintain a family, leaving little to no surplus for available sale (subsistence farming). Prior to 1970, traditional subsistence farming preserved high food security throughout the country alongside an excess of food crops for international market. Methods including the use of organic fertilizer and diversifying crops based on local animal husbandry, led to high harvests and adequate environmental conditions. However, in an attempt to boost economy and centralize production, the government encouraged farmers to grow cash crops and abandon traditional practices. Without the necessary subsidies and education, cash crop farms, which began to cover Mali's most favorable land, became ineffective and detrimental towards community trust and environmental welfare. Tasks that were once undertaken by local organizations were adapted towards

new crops, with less neighborhood involvement, and a focus towards individualism. This in turn destroyed important social connections between communities. Desertification, poor soil fertility, and high soil erosion increased in areas that in times prior never suffered these problems (Mali *Berkeley.edu*). With agriculture having such an importance today, the government struggles to balance executive control with national cooperation in order to regain the economic prosperity once enjoyed by society.

Agriculture accounts for seventy percent of the population workforce and thirty-three percent of the gross domestic product. With 1.4 million hectares, an average of 5 hectares per family, predominantly subsistence farmed the bulk populace relies on adequate environmental conditions in order to profit from a season's harvest (Background Note: Mali; Why Mali). The slightest alteration with climate change, drought, and desertification (a long term effect of land degradation) may cause extensive physical damage. One such example, a meager rainfall, will lead to major drought and even greater land degradation as a byproduct (Desertification and Land Degradation). Yet, natural causes are not the only culprit as humanity plays an immense role. An increase in human activity, such as the use of inefficient technology and population pressure, greatly influence an already stressed situation, "More than 12 million hectares of productive land are lost due to desertification every year, the equivalent of losing an area the size of South Africa every decade, according to the Secretariat of the UN Convention to Combat Desertification" (High-level UN Meeting Focuses). The impact of such ample losses annually leads to numerous problems and consequently demands a lower level of living.

Recent reports from the Central Intelligence Agency indicate that desertification is followed by multiple modern global issues. Having the third-highest birth rate, more than three times that of the United States', population increase is a serious crisis within Mali. The economy is not adjusting along with this increase and as population skyrockets, Mali exists as one of the twenty five poorest countries in the world. While the United States' average population increase is only twenty two percent greater than Mali's, the gross domestic product is an eight hundred percent increase (Africa:: Mali). The government will have to boost production of exports and become as self-sufficient as possible in order to increase economic power. This outcome is tough to envision due to the fact that the typical Malian farmer produces cotton, a cash crop, which sells poorly on the world market (Background Note: Mali). Worldwide competition causes price fluctuations that only add to the setback of inferior environmental conditions. High hopes are set for maximum rainfall knowing that these results will leave the country either in joyous revelation or with empty stomachs. Major droughts, such as the drought in 1981-1984, cause massive social disruption as deprived environmental services deem impoverished people helpless until conditions improve (Desertification and Land). Lower yields due to these hindrances result in increased food aid, a program in which developed countries concentrate their funding towards immediate care of a country rather than agricultural development. This focus on short term assistance leaves future generations without the knowledge necessary for potential success.

Areas that were once prosperous continue to decline and drag entire communities into debt. For example, an increase in desertification reduces the possible arable farmland and, in turn, moderates the total possible products brought to market. A family put into this situation would now have insufficient amounts of food to live off of for the time being and ultimately no money to pay for seed the next growing season. If the family is able to finance enough for the next season, the seeds will be inferior to growing a maximum capacity. This is due to the use of low budget seeds rather than ones, for example, that are genetically engineered (Thurow, Kilman 68). Therefore, the farm land will further degrade as less organic products provide nutrients; this never-ending cycle will force the family to move onto more suitable land as the one they once had is now lost to desertification. An increased amount of people encroaching on an already fragile territory will result in both greater degradation and higher poverty. These situations will worsen, especially for subsistence farmers, as this cycle continues with numerous families, accounting for a gradual decrease in overall productivity within a region. Many of these problems can be prevented if the necessary adjustments, such as improved inter-cropping and crop rotation, are enacted.

With the implementation of new sustainable practices, the financial status of the majority of farmers will increase. A surplus in nutrients found in farmland will sanction for better harvests. Better harvests output abundant crops which will able farmers to sell surplus on the market for a profit. Extra revenue can be used as an investment towards new technologies such as fertilizer, machinery, and genetically engineered seeds. By using superior materials overall yield will increase, allowing for greater security in additional sectors. Large scale problems such as hygiene, water attainment (for both health and agriculture purposes), and desertification can be combatted with improved techniques that were previously inaccessible due to financial absence. Alongside environmental prosperity communities will benefit as private subsidies, provided from spare funds, will help additional farmers. Subsidies become imperative as they help to tackle inevitable obstacles that cripple underdeveloped countries that cannot afford to combat desertification. Modern day problems like food insecurity will stand vulnerable if assets are driven towards contemporary agricultural procedures.

Since the populous majority is locked within traditional practices, the solution lies with increasing productivity of ideas already familiar to farmers through scientific research. Past failures on account of a weak infrastructure and government initiative prove that such radical changes will result in mediocre outcomes. A turn towards scientifically enhanced traditional ways will allow farmers to build upon a base of knowledge with increased productivity. Intercropping and crop rotation have always been used, but have not yet been effectively utilized. An increase of these practices alongside improved inter-community communication will allow for superior harvests throughout the country.

Intercropping is the practice of planting multiple varieties of plants within a proximity at which one affects the other. If utilized in the right conditions, a symbiotic relationship will form between the neighboring plants allowing both to prosper. Although the outcome is beneficial, certain characteristics such as plant architecture, growth formations, root depths, and maturity rates must be taken into consideration. Vegetation that requires increased amounts of sunlight can help shade those that require less. Roots at different depths can ensure that competition for space is minimal and full growing potential is met. Planting one crop that will mature before another will lessen the amount of rivalry over essential nutrients necessary during the end stages of a crops life (Intercropping). With all of these considerations taken into account, research can help bring the right combinations together based on environmental circumstances.

Cotton is comparable to most plants in its necessity of nitrogen to allow an effective harvest. Intercropping of nitrogen producing legumes will allow farmers to limit the amount of fertilizer they apply while effectively decreasing pollution due to the use of an organic solution. A recent study between different legumes and cotton shows that soybeans will grow more efficiently without fertilizer among cotton, which would not require farmers to squander crucial income (Mkandawire, Likoswe). If the correct formations of cotton and soybeans were to be achieved, the excess nitrogen could influence a more sustainable growth within cotton plants and allow for a cost effective way to replenish nutrients within soil. Similarly, this intercropping will allow for a greater food security (soybean meal) and increased capital (cotton exports). As harvests increase, farmland will contain abundant supplements that will establish new forms of vegetation in surrounding areas and decrease soil erosion and land depreciation. A new method of intercropping along with a proven crop rotation system will allow for these greater yields and an enriched ecosystem with immense diversity.

Lack of biodiversity can lead to poor soil fertility, water management, and increased erosion. By rotating different vegetation within an area, unique attributes of each crop will enhance nutrients and combat mutual problems within harvests such as pest infestation (Peel). Correct crop rotation must be researched appropriately for each area located in Mali due to varied soil composition in the north to south. Water is an important factor as the North Guinea south receives plentiful rain while the Saharan north receives

limited rainfall (Coulibaly). Crop rotation's benefits are well worth the effort and should be expanded beyond today's limitations.

Allowing intercropping with a practice of crop rotation will also help in reducing land degradation. If two diverse varieties were planted on rotation with another pair equally as profitable yet biologically distinct, nutrients would annually vary while allowing for a symbiotic relationship within the harvest year. In other words, annual rotation would result in a greater variety of nutrients as compared to merely growing two crops subsequently each year. Since there remains to be a symbiotic pair for each harvest, both plants will benefit each other as previously stated. This cycle, if properly investigated, can lead to greater diversification and lower desertification as an end result. Although they would be beneficial, commencing these studies could be problematic in the way that local and national initiatives are not yet interconnected. This can lead to improper communication between farmers and the government.

Additionally, this transformation from the current way of life to a more sustainable one will take time. Much like buying a hybrid car, the initiative will cost a lot up front but will return in economic and biological profit over time. Also, while the majority of farmers will see improved financial circumstances a slight minority might not. Like any plan, there are special situations bound to happen which will result in undesirable conditions. One example is if an organization that is funding a specific group of farmers goes bankrupt and does not provide the necessary equipment one growing season. This could potentially lead to a starving family as well as distrust in the project at hand. The federal government can set up insurances for these types of circumstances and provide a fail-safe solution. Alongside such insurances, the federal government can also lead many programs aimed at battling desertification.

The TerrAfrica Initiative is one of numerous organizations leading the fight for a decrease in land degradation in Sub-Saharan Africa. By scaling up Sustainable Land Management (SLM), TerrAfrica hopes to reverse recent trends and address major obstacles that stand in the way of economic growth. This initiative includes three main components that each country must complete in order for sustainable productivity to be achieved (Overview- Land Degradation).

The first step requires the development of African-Owned coalitions at regional and global levels to envision a common goal and agree upon SLM strategies. They will create advocacy within different parts of the community and settle upon specific conditions that all parties will support (Overview- Land Degradation). This step is crucial in order to gain any progress; without knowledge regarding these movements, people cannot place their support and unify. Education is a key part to any initiative and gaining support fuels a powerhouse of what changes are to come.

The second step involves gaining a full report on damage extent in order to support decision-making for policies and programs that should be enabled. An assessment of already existing conditions will immensely help in the evaluation of what areas must be assisted (Overview- Land Degradation). Once public and national awareness are raised, studies must be conducted in order to resolve in depth solutions towards drawbacks. Although not acting on this problem yet, this step institutes a blueprint for future projects.

The remaining task focuses on enabling operations, of which there are forty to date, and mainstreaming SLM into development strategies. At both national and multi-national/regional levels, operations go underway to help all parts of this intertwined society to increase productivity. Investments are authorized and performed on all government levels in the hope that all procedures come together in a positive outcome (Overview- Land Degradation). This is the stage in which the outcome of operations provides hard data proving the initiative successful or unsuccessful. If the plan is deemed successful, increased investments and global recognition will allow for greater change in increased areas.

Overall, local and national governments in Mali must step up and increase awareness for the loss of biodiversity and sustainable land that affect environmental resources. Although ensuring environmental sustainability is one of the millennium development goals (Goal 7) provided by the United Nations (UN), greater support and rapid initiative must occur throughout the upcoming years (Goal 7: Ensure). Local governments must organize communities which in turn will provide information necessary for accurate assessment and actions created on the national level. The national government can steer developing programs to greater interconnect numerous communities and create new economic bonds which will prosper from each other. The local government in turn will take these recommendations, report them to communities and further more to farmers which occupy the primary workforce. As this trend continues, local governments will improve social and economic bonds between one another and better communicate between rising challenges such as desertification. General livelihood, such as food security and economic independence, will improve and living conditions will benefit from the increase of capital flowing throughout local communities.

To gain beneficial results there are numerous strategies that all parts of Mali can enact. Individual farmers can start experimentation with crops alien to their knowledge, but with specific government instructions, and see which prosper alongside their own. This information can be gathered by local agricultural groups that analyze specific areas and see which crops provide benefits for both economic and environmental problems. These groups can then open markets to the purchase of specific seeds on a higher production and make sure equal distribution is available. Federal organizations can gather local information and provide adequate infrastructure for the safe travel of equipment and produce as well as financial help. This cycle gives roles for all parts of the government as well as communities and is one example of what programs such as the TerrAfrica Initiative are trying to accomplish. If such concepts commenced on a grand scale land degradation would be heavily reduced and desertification would slowly decline.

While desertification is an escalating problem, actions are being placed within the country in an attempt to counter damage produced so far. Solutions such as the TerrAfrica Initiative are promising a brighter future with a well laid plan to success. New customs for traditional practices, such as intercropping and crop rotation, have the potential to lead a country that is predominantly poor into an economic powerhouse in the future. However, the government must fund scientific research and organize coalitions that will work hand in hand on the local, national, multi-national and regional level. As awareness is increased and investments are placed, local farmers will gain support for beneficial ways of life that promote their own economic and social welfare as well as their environments. Should desertification gain a foothold on society, or will society put their foot down and challenge it?

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