

Considering Religious and Cultural Aspects of Food and Agriculture when Seeking to Introduce or Develop GMOs

Alexandra Coe

Goucher College

Culture, religion, and technology have shaped the development of society since the dawn of time. This article examines sacredness and happiness—as the common values all religions and cultures share—as the lens of weighing and balancing the perceived risk and benefits associated with agricultural biotechnology. The future of agbiotech rests in true cooperative engagement across all sectors of the agricultural network to address most of these conflicts, and this requires a strong religious and cultural understanding of how biotechnology might play into a region's agricultural landscape. Shifting the focus to regional, small-scale agricultural challenges that support traditional food-ways and small-scale farmers could be one critical way to achieve this shift.

Key words: culture, genetically modified organisms, papaya, religion, small farmers, sustainable agriculture, taro.

Introduction

This article could begin with definitions of the meaning of religion and the understanding of culture; however, the scope of these two concepts in the global arena is daunting. It is difficult to provide a comprehensive definition of religion or culture since different definitions are used for different purposes. When looking at religious and cultural relationships with genetically modified organisms (GMOs), the most important thing to understand is that the beliefs, habits, and rituals attached to religion and culture, are so deeply rooted that these undercurrents of human thought possess the power to decide if something is acceptable or unexceptionable in an instant. The speed at which religion and culture can deem something welcomed or unwelcomed is why it is critical to understand the potential religious and cultural interpretations of agricultural biotechnology (agbiotech) before the opposition begins. It is prudent, and possibly preferable, to engage in this understanding on the front end of research and development. The future of agbiotech rests in true cooperative engagement across all sectors of the agricultural network, and this requires a firm religious and cultural understanding of how biotechnology might play into a region's agricultural landscape.

One advantage agbiotech has in the area of religion and culture is that the technology is so new that only in the last 15 years have large religious organizations gathered together to debate the religious acceptance or rejection of agbiotech (Sorondo, 2004). The debate still continues, but generally religious acceptance has occurred across major religious organizations. The greatest challenge of religious and cultural assessments will be in determining whether a particular agbiotech is

being evaluated within the dialogue of true religious and cultural paradigms or if it is being influenced by the current wave of anti-GMO propaganda.

One cannot ignore the current debate around GMOs when considering religious and cultural interpretations. This controversy does not seem to have specific cultural or religious undertones at all, even though some non-governmental organizations (NGOs) claim a religious affiliation. Interestingly enough, it is fueled by things less understood, such as fear, manipulation, and false information. Most of the opposition comes from the developed world, while most of the perceived need is for the undeveloped world, but recently the even the undeveloped world has joined in public protest against GMOs. Why this is happening is the most important question to consider.

Some of this controversy is influenced by the perceived failure of the green revolution of the late 1960s; although significantly increasing agricultural yield for many, the green revolution did not reach all regions of the globe nor was it successful everywhere. Promises of feeding the planet were not realized, as poverty and famine continued. Many view the green revolution as a failure to the people and to the environment, as well as for its excessive use of chemical fertilizers and pesticides and various forms of monoculture. The green revolution was the invasion of big agriculture and the destruction of the small family farm.

Agbiotech made some of the same promises, and the recent food crisis in 2008 proved to many that 15 years of growing GMOs was not the solution to hunger. Having observed this growing opposition to GMOs for

many years, I believe this event sparked the widespread GMO opposition we see today.

Unfortunately, this view that agbiotech is just a continuation of all that was negative about the green revolution limits the potential benefits GMOs could provide for many crops threatened by current regional agricultural challenges, such as climate change. To further complicate the potential, well-funded NGOs fuel the controversy and increase the number of the ‘passionately misinformed’ (Coe, 2009). Religious and cultural aspects can be highly emotionally fueled on their own, but if additionally influenced by the current misinformation surrounding GMOs, they will increase barriers, unless different methodologies and assessments for the introduction of GMOs are implemented.

If agbiotech is going to be a vital tool for sustainable agriculture, something must shift the global GMO myth paradigm. The prevailing global myths about GMOs must be dispelled prior to entering an understanding of regional religious and culturally rooted challenges. Key to the assessments of the potential impact of the introduction or import of GMOs is the creation of culturally relevant educational information to balance the anti-GMO message. One critical way to achieve this could be to shift the focus to regional, small-scale agricultural challenges that support traditional foodways and small-scale farmers. It is within this more regional focus that the importance of religious and cultural aspects of agriculture will have the greatest significance and, also within this focus, better application of the science of agbiotech can occur.

Why do religion and culture play such an important role in the future developments of GMOs? Looking back on human history, the food supply has always somehow been related to the divine or intimately weaved within the cultural fabric of societies. Religion and culture mix and separate within modern human paradigms at an ever-changing rate; even today, one might suggest that in the modern world culture is ever transforming and emerging. Therefore, creating a new culture that understands agbiotech and is truly served by it is essential, as well as understanding how current and future technologies fit into more traditional cultural systems.

To attempt to grasp how to approach this, it is important to simplify the concepts of religion and culture and the dynamics that fueled these aspects of human existence within a framework that can apply specifically to the issues that need to be addressed when looking at their relevance to the regulation, production, and import of GMOs. It is important to try to differentiate between

religion and culture by stating that *religion* primarily addresses concerns over whether something violates the laws set forth by God, while *culture* addresses those behaviors and practices that people adhere to as part of their individual and collective identity, as well as daily habits and rituals. It serves this understanding to define ethics as that barometer of morality that exists within religion and culture equally; however, to separate this, it is important to present core concepts that exist in religion and culture yet are completely outside the scope of ethics.

It can be extremely difficult to separate ethics, religion, and culture, as so many aspects of them are intertwined. Yet, in order to move forward with an understanding of how to evaluate agbiotech in respect to religion and culture, it is necessary to find a place where religion and culture share themes that can be applied to almost any society. Those themes are the concepts of sacredness and the desire for happiness and well-being. Although the true understanding of individual religious and cultural relationships with the introduction of agbiotech cannot be distilled completely to those two concepts, some of the answers to the big questions about agbiotech can truly be answered when evaluated within the scope of sacredness and happiness. This article examines sacredness and happiness—as the common values all religions and cultures share—as the lens of weighing and balancing the perceived risks and benefits associated with agbiotech.

Methodologies

Current methods to evaluate the risk and benefits of GM crops are not looking at culture or religion. Current methodologies function under a premise that GMOs will increase yield, that GM crops are safe to eat, and that there is no significant difference between GM crops and their conventional counterparts. Also within this assumption it is held that GMOs pose no threat to human or animal health and are environmentally safe. These things may not matter when looking at the religious and cultural assessment. Simple things—like seed being handed down generation after generation, a crop looking just like the crop that the grandparents grew, the fact that a new GMO is not grown following the traditional farming methods of a region, or that it might be rejected by a protective god—may instantly negate all of these current methodologies that have generally become accepted within the industry and within governments.

Although there is certainly some *on the ground* collection of data by organizations such as the Food and Agriculture Organization of the United Nations (FAO)—who have a large collection of case studies from agricultural regions across the globe—this impressive and important data overlooks important cultural markers as they pertain to regional agriculture. Understanding the culture of agriculture is the most critical data collection area for the future of agbiotech.

Culture, of course, is the realm of the anthropologists, and there is no shortage of them observing trends in food production and regional agriculture. Agbiotech companies would serve themselves well by building partnerships with anthropologists. Many are already involved with these areas and can easily gather culturally relevant data on the relationship between culture, religion, and agriculture in any particular region. This understanding will aid in determining which crops are best suited for the current agricultural landscape that exists in any individual region and form a cost-effective route for data collection.

Prior methodologies fall short of gathering this valid data. The most often used methodology is democratic engagement, involving summits and other formal conferences of stakeholders said to be representative of particular topics of the events. Although this form of interaction does create a certain type of data, it fails to have the ability to consider cultural or religious aspects of agriculture. Many of these forms of democratic engagement seem more like business deals, as closed door treaties are signed, policy written, and companies and countries negotiate agriculture's future. Unfortunately, many people affected by major agricultural issues cannot afford to attend these expensive summits and conferences, therefore how can they be truly democratic? This is why direct regional engagement is critical to future methodologies of assessment.

Conferences do provide a successful method for assessing broad-base analysis, particularly with the bodies of the world's major religious authorities. They allow the gathering of key minds within religious authority to evaluate agbiotech under a single lens—religion. Most of these conferences look at agbiotech's role in feeding the hungry with only some consideration as to the effects GMOs have on the health of human beings and on the health of the environment. Religious acceptance by the major religious sectors can be the first step towards regional partnerships and opening doors to engagement that begins the cultural dialogue.

It is important to note that, just as some religious opposition is obvious (such as religious groups who do not eat swine would universally oppose the use of swine genes in agbiotech), once cultural data is collected, patterns will emerge that will reveal obvious barriers. It is not all about risk. Interestingly enough, under Jewish dietary laws (called *Kasrut*), safety is not necessarily an overriding factor when determining if something is kosher. Also under Jewish law, the healthiness of food is also not necessarily a factor when determining if food is kosher. One would think health and safety would be part of some cultural role connection to happiness and well-being, but this may not be the case. An Islamic evaluation of agbiotech tends to view halal food under a much broader scope than Christianity or Judaism, using the objectives of the *Shari'ah*, which are the benefits of protection and preservation of the religion, life, of intellect, of progeny, of property, and of the environment (Abu-Sway, 1998).

The current methodology that has the most negative impact on considering religious and cultural aspects is the typical business model for agbiotech to gain access to new markets. Being extremely top-down, corporations submit scientific data directly to government (basically supporting the industry assumptions previously stated), and regulators with little dialectic engagement with the communities directly engaged or affected will approve or disapprove the access. If access is approved, many governments tell their farmers that they are to plant this crop. If access is denied, farmers who want to try the seeds are forbidden. In addition, in the past, many non-indigenous GM crops were brought in and planted by foreign farmers managed by corporate interests; rarely was the local farmer growing the crop. In the case of Bt cotton in India—where local farmers were included—yield and quality fell short of expectations. Since culture was not even considered within these examples, the success or failure of the introduction of agbiotech seems entirely economic or yet another broken promise by seed companies. Greater small farmer engagement is critical to the successful introduction and acceptance of technologies as well as understanding the role agriculture plays in a society's cultural framework.

In many regions, residents feel that the introduction of agbiotech is in some way a deal between corporations and governments to surrender regional farmers to corporate interests. Equitable inclusion of farmers in research and innovation is essential to future assessments. Embracing regional farmers and allowing traditional knowledge to influence the technology will help agbiotech companies understand the essential place it has in



Figure 1. Small farmer/consumer linkage.

regional sustainable agriculture. The farmer is the link to acceptance by the consumer (Figure 1). By engaging regional farmers in educating the agbiotech industry on the regional culture of agriculture, agbiotech can learn how the technology can honor the sacred and provide happiness and well-being for the farmer and consumer alike.

Assessment

Current assessments, like methodologies, focus on safety, productivity, and risk to health and environment. Few of these assessments include the informed consent of farmers; even though some may be involved in the industrialized methods used to produce the crop, they are not equal partners in creating their own agricultural future.

Small farmers have the most potential for feeding a hungry planet. The future of agbiotech lies in understanding the needs of the regional farmer and in supporting a type of agriculture that is consistent with promoting social equity; this is how people feed themselves as opposed to the current concept that large corporations must feed the world. Feeding the world should no longer be the goal, but providing communities with tools and pathways for sustainable agriculture should be. The future of GM crops lies in discovering how the science can be applied in such a way that it allows for the regional development of food security. The main purpose of gathering this data is to reveal the pathway to sustainable agriculture for regional communities. Equity with farming communities will not only solve some of the world's most pressing agricultural issues

but also will create a pathway out of poverty for many small farming communities.

Agbiotech has the greatest potential to help achieve this success, but it must be in the spirit of building partnerships and engaging farmers as equals. One good example of this is the publicly funded recombinant biotechnology crop, *Phaseolus vulgaris*, in Brazil (Aragão & Faria, 2009; Bonfim, Faria, Nogueira, Mendes, & Aragão, 2007). During this data-gathering process, it will become essential to evaluate current agbiotech products and the current plant knowledge base to determine how they fit in a regions models for sustainable agriculture. By understanding the culture of agriculture and how people relate to food regionally, the potential of the science being placed more in the hands of the people with this assessment approach will find its natural place.

The type of data that builds these critical partnerships can only be collected through a participant style of engagement and not just interviews and short interactions. The agricultural system must be observed because it is only through that type of engaged observation that the nuances of religious and cultural aspects of agriculture reveal themselves. Below is a possible list of methodologies for data collection.

1. Engage regional farmers in the gathering of data on agricultural systems, including crop data. Any farming study should cover at least a three-year cycle in order to understand regional systems as well as environmental and other influences.
2. Create a list of potential threatened, culturally significant crops.
3. Record regional agriculture challenges and current methods used to address them.
4. Conduct an environmental impact study on regional agriculture methods.
5. Complete an expanded study of any specific religious or culturally significant crop.
6. Look for social inequity and distribution factors that prevent true implementation of new technologies.

Most importantly, gathering useful data for religious and cultural understanding of the region's agriculture requires asking the right questions. Whether assessing the regional agriculture or evaluating the technology, the essential religious/cultural question is: *Can agbiotech improve agriculture in a region while respecting that which is sacred and promoting health and well-being within the community?* Some initial questions that help in gathering the right type of data to answer this essential question might be as follow.

What are the regional challenges of agriculture and what is being done currently to address them? Does a possible threat to regional and culturally significant foods by the introduction of GM crops exist? What can a specific biotechnology contribute to the improvement and sustainability of the regional agriculture? Are there similar cultural regions that have benefitted from a particular GMO? How will the region, community, and farmers benefit from the introduction of a particular GMO? What are the current agricultural methodologies and techniques utilized? Are any of these incompatible with GMO agricultural systems? Are there other means of genetic introduction that improve access or may have a lower cost before embarking on R&D for GM solutions? Might a mixture of approaches create the desired result? Are there other changes in the process and systems of regional agriculture that should be implemented first? And, most difficult question to answer honestly: is the technology needed?

Biotechnology is science in its purest form and must distinguish itself as a science apart from industrialized agriculture. Right now, for many, agbiotech is industrialized agriculture. Agbiotech must be viewed as a tool that can be used to improve agriculture and preserve the future of the food supply. Until agbiotech changes the media and worldwide perception of the science, pathways for approval and importation of GM products will continue to be delayed and rejected, leading to negative consequences for many agricultural products and the people that could benefit from the science.

Hawaii provides an excellent case study for how the collection of data based on the methodologies presented could create greater acceptance and understanding of potentially beneficial crops. This example looks at both levels of stakeholder engagement—the farmer and the consumer—and shows how the culture of agriculture affects the acceptance of one GM crop (papaya) and the rejection of another (taro).

Papaya

The potential threat of the spread of papaya ring spot virus (PRSV) was identified in 1978. If the virus reached Puna, the major agricultural region for papaya (Gonsalves, 1998; Gonsalves, Tripathi, Carr, & Suzuki, 2010; Gonsalves, Vegas, Prasartsee, Drew, Suzuki, & Tripathi, 2006), the spread of this disease would cripple the papaya industry in Hawaii and affect the lives of many farmers and the future of papaya farming in Hawaii. A group of scientists embarked on a proactive research process to find a solution. The scientists first

tried classic breeding methods using cross-pollination but could not get a resistant strain. PRSV is spread by aphids, yet increased pesticide use was not proving to be effective and was exposing farmers to increased risk. This research was being conducted at the dawn of modern agbiotech and the concept of pathogen-driven resistance, which states that a transgenic plant that expressed a transgene of pathogen would be resistant to that given pathogen (Gonzales et al., 1998). This is attempted with the resulting production of one strain showing resistance to PRSV. To keep costs down and speed the success, the one resistant plant was cloned for field testing. Successful field testing resulted in the distribution of free seeds to farmers. Scientist then collected data from papaya farmers through surveys concerning their satisfaction and adoption of these new genetically modified varieties. GM papaya was successfully adopted by Hawaiian farmers, and papaya (*Carica papaya*) became the first horticultural fruit crop on the market that was produced by agricultural biotechnology. GM papaya has been grown in Hawaii since the mid-1980s with little opposition. Hawaiian papaya is sold and eaten by millions of people across the United States.

Taro

As early as 1980 and confirmed in 2009, documentation states that the Hawaiian taro plant is susceptible to no less than 23 pathogens, the most serious of which is the fungal disease caused by *Phytophthora colocasiae*, commonly known as leaf blight. Dithane-M45 is the fungicide recommended to deal with these outbreaks. The material safety data sheet issued by Dow Agro-Sciences on Dithane-M45 fungicide states clearly that not only is this fungicide toxic to aquatic organisms, but it causes cancer and birth defects in laboratory testing. It would appear on the surface that not only the taro farmers would immediately benefit from the introduction of GM leaf-blight-resistant taro by not having to use this fungicide, but in addition, the Hawaiian aquatic ecosystem would benefit by minimizing the use of this fungicide. Looking at the success of papaya, why does the resistance to taro exist?

Risk, safety, and bio-security assessments have been completed on GM taro, but resistance to the crop still exists. Is this rejection fueled by the global anti-GMO movement? Is it deeply rooted in the agricultural practices of Hawaii and the sacred relationship to the taro plant? Is it possible that the apparent religious and cultural resistance to taro is simply a convenient reason for what is truly an expression of anger because of the way

other GM crops have invaded the landscape of Hawaii? In taro's case, it's all three.

The main resistance to GM taro rests in the sacred relationship between the plant and the native Hawaiians' belief that taro is the incarnation of their ancestors. To change the genetics of Hawaiian taro is to alter that which is divine. Taro is a sacred gift to the people, and as a gift, it must remain unchanged. This is the core belief system both religiously and culturally between Hawaiians and taro. Nothing about that will change—ever.

Additional resistance rests within the farming methods and traditions with taro that do not apply to papaya. Taro is planted by almost all families in Hawaii. Taro saplings are shared among neighbors and families. Hawaiian children are taught how to cultivate taro as part of understanding their culture. They are taught how to plant, nurture, harvest, pound, and make poi from the crop. This closeness to taro cannot be separated from larger-scale production of taro because the family farmer and the production farmer have the same responsibility of nurturing the ancestors through taro farming. There is also a core element of farming that is critical; when a plant suffers, it is speaking. This is a language only farmers and those connected to plants understand. The plant is communicating that something is out of balance. For the indigenous farmer, this is a sacred communication that must be honored. GM intervention at this juncture is seen as merely a bandage, not a solution to the underlying problems that address the future security of taro in Hawaii. The failure to understand the totality of the agricultural systems of Hawaii created an environment where the benefits of GM taro could not even be considered.

The final aspect of GM taro resistance rests in the fact that GM taro is not the first GM crop to upset the Hawaiians. Hawaii is blessed with some of the most fertile soil on the planet and this, to the Hawaiians, is their source of life. Religiously, the Hawaiian Islands themselves are sacred—the mountains, the plants, and even the rocks contained the souls of the ancestors. To not understand and respect this is to threaten the very existence of every native Hawaiian.

The island of Kauai has some of the most fertile soil on the planet; it has been a hotbed for GMO conflict in recent years. Plots of land on the west side of the island have been used for seed production for GM corn and other crops for years. Pesticide and herbicide runoff and airborne spraying have been blamed for illness and environmental degradation. Lawsuits filed against agbiotech companies continue, and outrage over the use

of Hawaiian land for corporate profit fuels the opposition. Taro appears to be the final sacred straw. This failure to understand the religious and cultural beliefs surrounding the agriculture of the native Hawaiians was short-sighted. Many biotech companies only saw fertile lands for their own profits. So now, Hawaii is a hotbed for the rejection of GMOs that could actually contribute in a very positive way to the environmental sustainability of Hawaii. Now farmers refuse to plant it and consumers refuse to eat it mainly because the cultural and religious aspects of this crop were ignored.

The importance of regional dialogue and regional understanding of agriculture for the future implementation of GMOs cannot be too greatly emphasized at this point. In today's world, the ability of agbiotech to hold the keys to creating sustainable regional agriculture and solve some of the most pressing issues that threaten agriculture today—decreased water supplies, salt intrusion, and soil degradation, to name a few—cannot be neglected as a critical part of the puzzle for feeding a hungry planet. This future potential will only be realized through embracing agricultural knowledge of small-holder regional farmers and engaging their equal participation in solving regional agricultural challenges. Otherwise, there will be many locations like Hawaii that jeopardize the introduction of a technology that can potentially preserve culturally significant foods and provide food sovereignty and security for many people.

Administrative Consequences

Information dissemination and implementation rests largely on biotech companies taking the initiative in creating the platform for this dialogue. Cultural agricultural knowledge and techniques need to be communicated to the research and development sector, and applicable biotechnology needs to be accessed according to cultural practices to maximize acceptance and benefit. There exist two key cultural stakeholders in this process—the farmer growing the food and the consumer eating the food. Each of these requires a different process for assessment and information gathering, and each of these require separate outreach and educational engagements. Barriers may lie in one or both of these groups, but understanding where and why they exist is critical for successful introduction and application of agbiotech. The future of agricultural biotechnology rests in addressing the most pressing regional challenges as they relate to hunger, poverty, biodiversity, and regional diets (Figure 2). Through culturally sensitive education and public outreach utilizing regionally focused media-

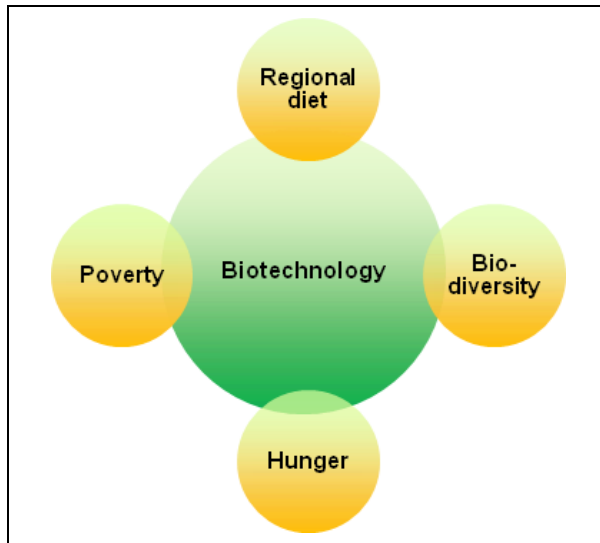


Figure 2. Focus areas for cultural acceptance.

driven campaigns, companies can seek to involve, inform, and educate the public about the importance of GMOs in the effort to contribute to food sovereignty and security challenges.

Agbiotech is a product, and just like any product, it needs to be evaluated and rebranded to reach its greatest marketing potential. Products that support sacredness, happiness, and well-being are the products that will be part of the sustainable future. Answering the following question is critical: *can agbiotech improve agriculture in a region while respecting that which is sacred and promoting health and well-being within the community?* If the answer is no, then what has been created needs to be abandoned, and a renewed focus must ensure that the power that rests in plant biotechnology is a form of knowledge bestowed to do that which is the highest and greatest good. If the planet is truly sacred, and is here so that we may create happiness and well-being for all of its inhabitants, why are toxic things still made and known carcinogens put in the environment? This is not our sustainable future. Whatever the image of agbiotech is right now is the result of behaviors of many individuals who have neglected to ask if their actions are honoring that which is sacred and that which promotes the health and well-being of the people. To continue down this path is to deny agbiotech its highest and greatest good.

Summary

Understanding of regional values of sacredness and happiness can assist in weighing and balancing the per-

ceived risk and benefits associated with agricultural biotechnology. The future of agbiotech rests in true cooperative engagement across all sectors of the agricultural network to address most of these conflicts, and this requires a strong religious and cultural understanding of how biotechnology might play into a region's agricultural landscape.

Agbiotech companies must respect and document traditional regional farming methods. Acknowledge that farming is deeply rooted in the very fabric of culture, so agbiotech must be presented as a tool for sustainable agriculture that can assist food security for threatened regionally significant crops. As a tool, it must engage the regional knowledge and practices already applied to agriculture. GMO introduction should enhance the cultural dynamics of farming in the region.

Through cultural dialogue, the agbiotech industry must seek to gain a full understanding of how regional culture and religion might influence the acceptance or rejection of a particular biotechnology. Skilled cultural experts with the ability to identify cultural markers that will influence introduction need to be utilized. This information is the first step towards developing better regional public relations campaigns that can openly present the benefits of agbiotech through engaging essential stakeholders.

Create educational material for the farmer and consumer that aid in the understanding of the science of agbiotech. Gather culturally relevant data based on regionally engaged dialogue to assist in this development. Know the right questions to ask—collaborate with farmers to create culturally relevant public affairs outreach to consumers.

Culturally-based agricultural knowledge and techniques need to be communicated to the research and development sector, and biotechnology needs to be accessed according to cultural practices to maximize acceptance. Corporations and governments must have full transparency in the review of GMOs. New business models need to be evaluated, as new opportunities for smaller regional biotech companies will emerge as more cultural data is collected that deal with regional food problems and focus on culturally significant foods.

Companies should assess whether agbiotech improves agriculture in the region while respecting that which is sacred and promoting health and well-being within the community.

References

- Abu-Sway, M. (1998). *Towards an Islamic jurisprudence of the environment* (based on a lecture given at the Belfast Mosque in February 1998). *Fiqh al-Bi'ah fil-Islam*.
- Aragão, F.J.L., & Faria, J.C. (2009). First transgenic geminivirus-resistant plant in the field. *Nature Biotechnology*, 27, 1086-1088.
- Bonfim, K., Faria, J.C., Nogueira, E.O.P.L., Mendes, É.A., & Aragão, F.J.L. (2007). RNAi-mediated resistance to bean golden mosaic virus in genetically engineered common bean (*Phaseolus vulgaris*). *Molecular Plant-Microbe Interactions*, 20(6), 717-726.
- Coe, A. (2009, May). *Public affairs education and the rethinking of the dialogue surrounding genetically modified crops*. Paper presented at *Food, famine and future technologies: Ethical dilemmas in a hungry world*, Appignani Bioethics Center under the auspices of the United Nations Headquarters, New York City.
- Gonsalves, D. (1998). Control of papaya ringspot virus in papaya: A case study. *Annual Review of Phytopathology*, 36, 415-437.
- Gonsalves, D., Tripathi, S., Carr, J.B., & Suzuki, J.Y. (2010). Papaya ringspot virus. *The Plant Health Instructor*, DOI: 10.1094/PHI-I-2010-1004-01.
- Gonsalves, D., Vegas, A., Prasartsee, V., Drew, R., Suzuki, J.Y., & Tripathi, S. (2006). Developing papaya to control papaya ringspot virus by transgenic resistance, intergeneric hybridization, and tolerance breeding. *Plant Breeding Reviews*, 26, 35-78.
- Sorondo, B.M.S. (2004, September 24). *Feeding a hungry world: The moral imperative of biotechnology*. Presentation made at the same-named conference organized by the US Embassy to the Holy See in cooperation with the Pontifical Academy of Sciences at the Pontifical Gregorian University, Rome, Italy. Available on the World Wide Web: <http://www.agbio-world.org/biotech-info/religion/sorondo.html>.