Food Security and Biotechnology in Africa

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MODULE 5

ETHICS AND WORLD VIEWS IN RELATION TO BIOTECHNOLOGY

Prof. Jerry O. Ugwuanyi / Dr. F. I. Akaneme

University of Nigeria, Nsukka

Module 5 Unit 2: Diversity of Socio-cultural world-views and their impacts on the uptake of biotechnology

Lecture 1: Perception of various religious groups; Christians, Muslims, African Traditional on Biotechnology **(1 hour 20 minutes lecture / Discussion)**

Learning Outcomes

- **Students are expected to understand:**
  - **How different Christian groups perceive biotechnology**
  - **How Muslims (different authorities) perceive biotechnology**
  - **How African Traditional Beliefs perceive biotechnology**

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Ethics in Agriculture and Innovation

Biotechnology is a powerful tool to produce crops and animals with selected traits that aim to benefit farmers and consumers. Similar to other emerging technologies, biotechnology has instigated worldwide debate and confusion as a result of mixed messages from various people - be they scientists, academics, critics, industry, religious representatives or consumer bodies. The worldwide debates on the pros and cons of biotechnology have been likened to a battleground and a prominent place for virtually every ethical concern. It has stirred conflicting ideas and opinions and has polarized sectors not only among stakeholders but even between countries. While agriculture has long been a topic of philosophical, religious and political reflection, it is only in the late 20th century that systematic thinking about the values and norms associated with the food system, such as farming, food processing, distribution, trade, and consumption, began to be discussed in the context of agricultural ethics (CAST, 2005). In addition, by placing biotechnology in the light of globalization, societal debate has moved towards a discussion of ethical and social impacts (Paula, 2001). In 2000, the Council of Europe Parliamentary Assembly recommended that it was increasingly important to include ethical considerations centered on humankind, society and the environment in deliberations regarding developments and applications in biotechnology, life sciences, and technology. A year later, the United Kingdom’s Royal Society Report asserted that “public debate about genetically modified food must take account of wider issues than the science alone” (Kinderlerer and Adcock, 2003).

What is agricultural ethics?

In general, ‘ethics’ is defined as the ideals, values or standards that people use to determine whether their actions are good or bad. It is what society uses to judge whether an issue or thing is acceptable and justifiable and determines responsibility and justice (Thompson, 2001). Ethics provide guidelines that help one decide what the right thing to do is. On one hand, ethics is a set of universal norms that are documented through legal or professional codes of practice, religious texts, literature and philosophy. On the other hand, ethics are values defined by a person or groups that are personal, introspective, and hence, difficult to manage for public discussion (Thompson, 2001). Discussion within the agricultural realm is necessary to determine what is right and wrong, what moral standard is or should be used, and why it is the proper one to justify singular or collective acts. Ethics in agricultural biotechnology therefore encompass value judgments that cover the production, processing, and distribution of food and agricultural products. The Food and Agriculture Organization of the United Nations asserts that ethical values determine its reason for being these being the values for food, enhanced well-being, human health, natural resources, and nature (FAO, 2001). CAST (2005) notes that ultimately the goal of agricultural ethics is to "discover or develop clear, non-contradictory, comprehensive, and universal standards for judging right and wrong actions and policies."

What are some ethical issues raised about agricultural biotechnology?

Many of the ethical issues that form part of the biotechnology debate can apply also to food and agricultural systems in general. Accepting the need to understand and tolerate societal norms or beliefs, many statements of concern are often general and broad with little explanation about what makes them disagreeable or wrong. The following are examples of issues more clearly articulated by Kinderlerer and Adcock (2003); CAST (2005); the Food and Agriculture Organization of the United Nations (2001), and Thompson (2001).

"Playing God"

Genetic modification is said to involve human intervention into creation and hence, is an unnatural act. Often viewed as a religious question, it avers that the technology is "so intrusive to life processes that they amount to a form of disrespect for humanity's proper relationship to nature, a form of playing God" (Comstock cited by CAST, 2005). Some religions ascribe a particular "essence" to each living organism and hence, connect the concept of gene with the idea of essence. Others believe that biotechnology disrupts natural order and violates the limits of what humans are ethically permitted to do. Alternatively, there is the view that science and progress are good things and are God-given faculties to help mankind support life and better manage the environment.

General Welfare and Sustainability

A central issue is whether the technology considers the pursuit of the greatest good together with the concept of sustainability for farmers and the environment. While a technology can provide more food it should not be to the detriment of the environment or to human health or disrupt traditional behavioral systems. In like manner, it is an ethical issue if food that can provide more and better nutrition is not made available to those who need it most. Hence, not to use a technology that has potential to improve the quality of lives of people is also a moral issue. As an environmental issue, questions raised have to do with concerns regarding environmental protection, sustainable use of biodiversity, economic growth and social equity.

Distribution of Benefits and Burdens

A concern particularly in developing countries is the concept of just distribution. Questions have to do with whether the products produced by the technology will be able to provide for those who really need them and whether they will generate wealth for the society as a whole. A technology's ability to increase or decrease the gap between the rich and poor renders it an ethical issue. This includes allegations that products derived from modern biotechnology are being introduced by private companies that have an obligation to make profits. Also up for discussion is whether a technology, while able to increase technical employment might eliminate subsistence labor as a result of replacing cultural operations. Other concerns include exploitation or control over genetic resources, consumers' choice and rights, and use of genetically modified animals.

Religion, Culture and Agricultural Biotechnology

Public acceptance of genetically modified crops is partly rooted in religious views. Overall, however, it appears that mainstream theology in all three main monotheistic religions (Christianity, Judaism and Islam) that has approximately 55% of humanity as adherents, and mostly in the developing countries, increasingly tends towards acceptance of GM technology per se, on performing GM research, and on consumption of GM foods.

The religious sector, notably the Roman Catholic Church and the Muslim faith, have voiced their views on biotechnology. Islamic scholars note that Islam and science are complementary and Islam supports beneficial scientific innovations to address food security (Workshop Proceedings, 2010).

Biotechnology, in particular, becomes an issue when it entails a discourse on food. Any GM food must meet the general criterion of halalan tayyiban which means "permissible from the shariah perspective (halal) and of good quality (tayyib)". In Malaysia, there is a fatwa (religious decree) that states that GM foods with DNA from pigs are haram (not permissible) for Muslims to eat. To date, only this fatwa has been issued (MABIC, 2004).

The Jubilee of the Agricultural World Address of John Paul II in 2000 mentioned that in agricultural production or in the case of biotechnology, it must not be evaluated solely on the basis of immediate economic interest but through rigorous scientific and ethical examination (Vatican, 2000). By October 2004, the Pontifical Council for Justice and Peace released the Compendium of the Social Doctrine of the Church which is an "overview of the fundamental framework of the doctrinal corpus of Catholic social teaching." Biotechnology is mentioned as having powerful social, economic, and political impact but that it should be used with prudence, objectivity, and responsibility (Vatican, 2004).

Within Judaism, the interpretation of life is based on the postulations of different Rabbis, whose moral authority stems from their in-depth understanding of the Divine as contained in the *Torah*, the Hebrew bible, in response to questions of social significance. In a 2005 commentary on GM food technology, Esra Galun, a respected Jewish Professor of Plant Sciences at the Weizmann Institute of Plant Sciences, who is an expert on Jewish religious prescriptions on plants and food crop, recognizes that determining whether it is good to develop genetically modified food crops is fraught with problems. Galun refers to two other Jewish philosophers and religious scholars, E. Goldschmidt and A. Maoz, who submit that, based on Jewish religious laws and traditions, the development of transgenic plants by researchers are permissible if they are not directly prohibited by God and if the research will benefit mankind. Another Jewish Rabbi, Akira Wolff, supports this view when he states that Jewish tradition believes that man was created in God's image and this affords him the opportunity of partnering with God in the perfection of everything in the world. According to him, Jewish law (*Halacha*) accepts genetic engineering to save and prolong human life as well as increase the quality or quantity of the world's food supply. On the biblical prohibition of *Kilayim*, or mixing of different species of animals and plants, Wolff believes that God does not prohibit the genetic modification of food crops. In concluding, Wolff states "man may manipulate the creation (of God) ... [but] all the legally permitted actions must bring the world closer to perfection and not further away".

In contrast, Michael Green, a British based Jewish commentator, who espouses Orthodox Judaism, argues that there is no consensus within Judaism about GM food technology and he cites a prominent Jewish environmental group in the United States, the Teva Learning Centre (TLC), to support his position. The TLC believes that the GM food technology is a violation of *Kilayim*, the mixed breeding of crops or livestock. Green also refers to two bible verses, Leviticus 19:19 and Deuteronomy 22:9–11, where God prohibits the mixing of species, as proofs that God made "distinctions in the natural world", which Jews must not breech by eating GM food or engaging in GM food research. Green believes that genetic engineering in its entirety endangers nature and human beings. Similarly, a Conservative Jewish Rabbi, Lawrence Troster, argues that religious traditions should be more cautious before endorsing genetically modified foods. He calls for an acknowledgement of humankind's "limitations in the face of the depth and grandeur of the order of creation".

The different positions on the issue of GM food technology and GM food products and how they affect the average Jew is discussed by Rabbi Tzvi Freeman. Freeman explicitly states that the controversy about whether Jews can eat GM food or engage in GM research stems from the postulations of two renowned Jewish Rabbis, Moshe Ben Nachman and Yehuda Lowe. According to Freeman, Nachman, a medieval Rabbi, argues that God has given humankind the right to dominate and use any of God's creation "but not to disturb its fundamental nature". However, Lowe, who wrote his own interpretations of the *Torah* about three hundred years after Nachman, argues that "any change that human beings introduce into the world already existed in potential when the world was created. All the humans do is bring that potential into activity". Thus, while acknowledging the divergent Jewish positions on the modification of food crops, Freeman emphasizes the need for Jews to look at the health and environmental implications of GM food technology and through such scrutiny seek answers to the question of whether their introduction into the human food supply is actually beneficial or detrimental to the environment and humankind.

The divergence in the views of these Jewish religious leaders, scholars and commentators shows that there is no universal agreement within Judaism on whether Jews can eat GM food products or engage in research in the area of GM food technology.

Islam

Islam is made up of two major branches, Sunni and Shia, distinguished by some doctrinal and historical differences. However, despite these differences, the rulings on modern biological and technological issues tend to be quite similar. At a seminar in Kuwait on genetics and genetic engineering in October 1998, a group of Muslim intellectuals concluded that although there are fears about the possibility of the harmful effects of GM food technology and GM food products on human beings and the environment, there are no laws within Islam which stop the genetic modification of food crops and animals.The Islamic Organization for Medical Sciences in collaboration with the Islamic Fiqh Academy, Jeddah, the World Health Organization's Eastern Mediterranean Regional Office, Alexandria, and the Islamic Education, Science and Cultural Organisation (ISESCO) organized the seminar. Worthy of note is the involvement of the Islamic Fiqh Academy, which is an Academy for advanced study of Islam and which was established by the Organization of Islamic Conference (OIC) in

1988 and which is administered by a body of Islamic clerics. The above conclusion reflects the widely held views of most scientifically informed Muslim scholars, whether Sunni or Shia. Thus it is noteworthy that scientists in Islamic countries like Egypt and Indonesia (the world's largest Muslim country), are actively manipulating plant genes in a variety of ways. In fact, in 2003, the Indonesian Ulemas Council (MUI) approved the importation and consumption of genetically modified food products by Indonesian Muslims.

Ibrahim Syed, an Islamic cleric and the President of the Islamic Research Foundation International, an amalgamation of different Islamic religious groups, is regarded as a leading expert on the interpretation of the Quran in the light of recent advances in the area of modern technology. He has written about the consensus among Muslim scholars that the *Quranic* verse forbidding man from defacing God's creation "cannot be invoked as a total and radical ban on genetic engineering ... If carried too far, it would conflict with many forms of curative surgery that also entail some change in God's creation". Syed enjoins African and Asian countries, with large Muslim populations, to "reject the propaganda of extremist groups" campaigning against genetic engineering and these new technologies and to embrace them wholeheartedly.

In her own contribution to the discourse, a female Muslim scholar, Fatima Agha al-Hayani, who has written and commented on several aspects of the Islamic religion, contends that Muslims must ensure that genetic modification "may remain mercy-driven" and promote righteousness. She believes GM food technology has the ability "to carry God's work, alleviate hunger and suffering, secure justice and equity for everyone". Therefore, Muslims "must keep up with the new research and discoveries and make connections within the scientific fields".

However, the different perspectives on GM food technology within the Muslim world are obvious in a letter written in October 2006 to the British government by Majid Katme, on behalf of the United Kingdom Islamic Medical Association. Katme, a highly respected personality within the Muslim community in the United Kingdom quotes copiously from the *Quran* and asserts that there is no need for genetic modification of food crops because God created everything perfectly and man does not have any right to manipulate anything that God has created using His divine wisdom. He also states that the *Quran* contains several verses, prohibiting man from tampering with God's creation. He ends the letter by emphasizing the position of members of the United Kingdom Islamic Medical Association that there are no benefits that would accrue to Britain from GM food production. Thus, even within Islam, there is no consensus by religious scholars and commentators on whether the *Quran* accepts genetic modification of food crops and the consumption of GM food products by Muslims.

Christianity

The Catholic Church is the largest Christian denomination in the world, with all significant matters of theology and Canon Law decided within the Vatican, under the ultimate direction of the Pope. Nevertheless, there is flexibility among various bishops and experts that are well tolerated within the greater Church so long as they do not conflict with fundamental teachings. Thus theological matters of social significance, such as GM crops, may follow different paths such as:

(1) a no "official" Vatican position;

(2) a limited "policy statement or interpretation of scripture or traditions;

(3)or formal theological positions, published in the form of Papal encyclicals developed by the Congregation for the Doctrine of the Faith, a Vatican-based body whose role is to provide formal interpretations in the case of socially relevant issues, such as abortion or euthanasia.

In 2003, the head of the Pontifical Council for Justice and Peace, based at the Vatican, Cardinal Renato Martino, asserted that the Catholic Church supports genetic modification of food crops as an answer for world starvation and malnutrition and because "scientific progress was part of the divine plan". Martino's statement aligns with a papal address by John Paul II in November 2000, in which he states the Vatican's support for the use of biotechnology in agricultural production as long as the "research is submitted beforehand to rigorous scientific and ethical examination".

In 2001, the Pontifical Academy of Sciences, (PAS) an influential Catholic organization, published the proceedings of 2 conferences that it organized in 1999 and 2000 on the "Sciences and the future of Mankind". The PAS argues that it is imperative that new or modern technologies be developed to assist in the improvement of agriculture in developing countries as well as help in feeding the world's hungry people who are increasing daily as a result of the rapid expansion of the world's population. The organization is of the opinion that the genetic modification of crops is not a new phenomenon having been in existence for about 10,000 years. However, the organization also advocates for the close cooperation of scientists, governments and farmers to ensure that genetically modified crops are safe for human consumption. From the perspective of the PAS, the benefits of genetically modified crops are immense as they facilitate the actualization of the global goal and desire "to develop plants that can produce larger yields of healthier food under sustainable conditions with an acceptable level of risk". Recently, scientists at a 2009 conference organized by the PAS came to the conclusion that genetically modified crops "offer food safety and security, better health and environmental sustainability" as a solution to the hunger and poverty ravaging different parts of the world.

However, there are certain organizations within the church that are anti GM crops and who espouse positions that are different. One of such "dissident" groups is the St Columban's Mission Society, which is an Order of Catholic Priests. In recent times, the Columban society has criticized the Pontifical Academy of Science for cooperating with the US embassy to the Vatican to host a pro-GM conference entitled "Feeding the World: The Moral Imperative of Biotechnology". Father Sean McDonagh, an Irish Columban Priest and ecologist has been vociferous in arguing against the support of the Vatican and its Pontifical Academy of the Sciences for GM food technology. According to McDonagh, "All the experts at Catholic development agencies have taken the position that this is not the way to address food security, and that there's no magic bullet for hunger.

The Church of England also avers that "human discovery and invention can be thought of as resulting from the exercise of God-given powers of mind and reason". In effect, scientists who are human beings are exercising their qualities as "images of God", who have been divinely endowed to intervene in "natural processes". The Church of England believes that genetically modified crops must be properly labeled so as to afford "consumers a legitimate degree of informed choice". However, there are also differences within the Anglican Church on the issue of GM food technology. While the worldwide head of the church, the Archbishop of Canterbury, is based in England, where he serves as the head of the church in England, there are branches of the Anglican Church in different parts of the world. These national branches are very independent and the congregational meetings of the Presiding Archbishops of the different national branches in England, called the Lambeth Council, simply serve as a means of sustaining the links between these different branches of the worldwide Anglican Communion. In fact, the Archbishop of Canterbury is not in a position to impose the views of the English branch of the church on the other members of the Anglican Communion. A good case in point is a statement credited to a former Anglican Archbishop of Cape Town, Njongonkulu Ndungane, who argues against the introduction of GM foods not only in South Africa but throughout Africa. Ndungane is of the view that Africans do not need genetically engineered food. He believes that it is not safe for human consumption and the African farming systems; would lead to a reduction in jobs, increase African dependence on the countries of the North and destroy biodiversity.

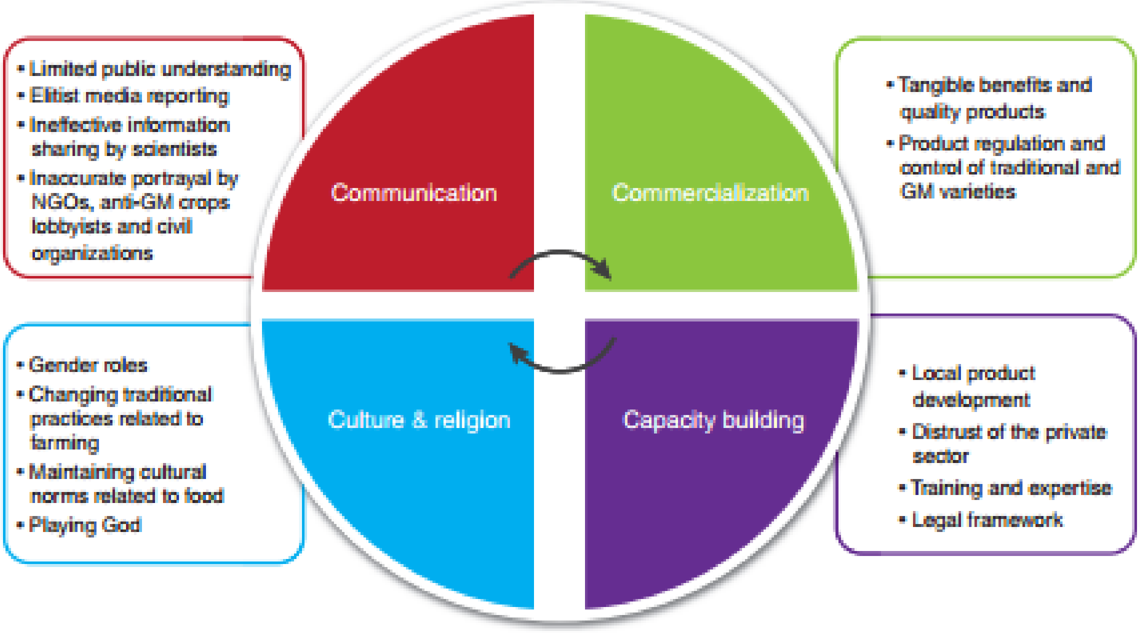
In January 2002, the Conference of European Churches (CEC) presented the outcome of the critical examination of the genetically modified food controversy by its Church and Society Commission. The report shows that these Christian churches agree to the introduction of GM food technology on the premise that it is important to establish a "theology of creation" that properly balances research in the area of biotechnology with a genuine concern for everything created by God, which encompasses the whole of humanity and nature in its entirety. The major highlight of the CEC report is its affirmation that the genetic alteration of plants is consistent with biblical teaching. The report further states that although nature belongs to God, it is not sacred and it can be manipulated for the benefit of humankind.

The World Council of Churches (WCC), avers that it is unethical, from a Christian perspective, for scientists to dabble in the genetic modification of food crops. The WCC avers that "GE messes with life, messes with truth, messes with our common inheritance (i.e. human culture and biodiversity), messes with justice, messes with human health, messes with the lives of peasant farmers in developing countries and the relationship between human beings and other forms of life".

On the bases of the foregoing, it is clear that there is no overarching consensus on the permissibility of GM technology, performing of GM research, or consumption of GM foods within the world's three main monotheistic religious traditions. Overall however, it appears that mainstream theology in the world's monotheistic religions accepts the genetic modification of food crops, performing GM research and consuming GM foods as long as there is adequate scientific, ethical and regulatory scrutiny of research and development of such products, and they are properly labelled.

Thus, questions about the appropriateness of GM food technology that might once have been legislated upon by religious institutions may ultimately be settled by individual consumers, particularly those who face hunger and uncertain food security, while struggling to survive in a harsh, hostile, volatile and increasingly secular world, where life changing decisions are increasingly no longer being left alone in the esoteric world of the divine and the supernatural. This is not helped by the fact that the information provided by governments, the media, industry and scientists on biotechnology confuses the consumers.

(Taken from Omobowale et al 2009)



Factors in the adoption of Agricultural Biotech in sub-saharan Africa

Taken From: Ezezika et al 2012. Nature Biotech 30: 38-40

Moving Forward- How do we deal with ethical issues?

FAO (2001) recognizes that there is no single set of ethical principles sufficient for building a more equitable and ethical food and agricultural system. However, it recommends the following actions that individuals, states, corporations and voluntary organizations in the international community can take:

• Creating the mechanisms to balance interests and resolve conflicts

• Supporting and encouraging broad stakeholder participation in policies, programs, and projects

• Encouraging individuals, communities and nations to engage in dialogue, and ultimately, to do what is ethical

• Developing and disseminating widely the information and analyses necessary to make wise and ethical decisions

• Ensuring that decision-making procedures in international food and agriculture policy are well understood and transparent

• Fostering the use of science and technology in support of a more just and equitable food and agriculture system

• Ensuring that programs, policies, standards and decisions always take ethical considerations into account so as to lead to enhanced well-being, environmental protection and improved health
• Developing codes of ethical conduct where they do not currently exist.
• Periodically reviewing ethical commitments and determining whether or not they are appropriate, in the light of new knowledge and changes in circumstances

CAST (2005) suggests the need to institutionalize agricultural ethics. This involves a deliberate move to include some consideration of ethics in the actions, decisions, and policies that stakeholders in the food system create or support. Each stakeholder has to "accept the fact that that if ethical issues are going to be understood, and if ethical conflicts are going to be resolved, it is our responsibility, within the limits of our place in the system, to understand and contribute."

Conclusion

Despite the diversity of ethical issues in agricultural biotechnology, there is a need to understand beliefs and doctrines as this allows coexistence within and across societies, and prevents social conflict. A technology's acceptance is based not only on technological soundness but on how it is perceived to be socially, politically, and economically feasible from the viewpoint of disparate groups. An understanding of ethics helps determine what information is needed by society and how to deal with different opinions. A process of negotiation based on trust is essential to enable stakeholders to participate in debates and decision making.

References

Council for Agricultural Science and Technology. 2005. Agricultural Ethics. Issue Paper No. 29. Ames, Iowa, USA.

Food and Agriculture Organization of the United Nations. 2001. Report of the Panel of Eminent Experts on Ethics in Food and Agriculture. FAO First Session, September 26-28, 2001. Rome, Italy.

Food and Agriculture Organization of the United Nations. 2001. Ethical issues in food and agriculture. FAO Ethics Series 1. Rome, Italy.

Kinderlerer, Julian and Mike Adcock. 2003. Agricultural biotechnology, policies, ethics, and policy. Working Paper No. 3 prepared for the first meeting of the FANRPAN/IFPRI Regional Policy Dialogue on Biotechnology, Agriculture, and Food Security in Southern

Africa. Johannesburg, South Africa.
Malaysian Biotechnology Centre. 2004. Biotechnology and religion: Are they compatible? BICNews. Petaling Jaya, Malaysia.
Paula, Lino. 2001. Ethics: The key to public acceptance of biotechnology? Biotechnology and Development Monitor. No. 47. The Network University, Amsterdam, the Netherlands.
Proceedings: International Workshop for Islamic Scholars on Agribiotechnology: Shariah Compliance. Georgetown, Penang, Malaysia (1-2 December 2010). Malaysia Biotechnology Information Center: Selangor, Malaysia; International Service for the Acquisition of Agri-biotech Applications (ISAAA): Laguna, Philippines.
Thompson, Paul. 2001. Food and agricultural biotechnology: Incorporating ethical considerations.
http:///www.agriculture.purdue.edu/agbiotech/Thompsonpaper/Thompson3.html.
Vatican. 2000. Jubilee of the Agricultural World. http://www.vatican.va.
Vatican. 2004. Compendium of the Social Doctrine of the Church. http://www.vatican.va.

The three main monotheistic religions and gm food technology: an overview of perspectives

Emmanuel B Omobowale*†1, Peter A Singer†2,3 and Abdallah S Daar†2,4

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Module 5 Unit 2: Diversity of Socio-cultural world-views and their impacts on the uptake of biotechnology

Lecture 2: Traditional beliefs systems that may impact biotech uptake and adoption **(1 hour 20 minutes lecture / Discussion)**

Learning Outcomes

Students are expected to appreciate the impact of the following practices on agricultural innovation (biotechnology adoption) in Africa:

- **Seed systems**

Characteristics of different seed systems

- **Variety selection**
- **Seed production**
- **Seed dissemination, marketing and procurement**
- **Advantages and constraints to the different seed systems**
- **Regulatory frameworks**

Background to seed systems (Taken from Practice Brief No. 6; understanding seed systems used by small farmers in Africa)

Peasant farmers are the main contributors to biodiversity. They preserve, renew and select plant varieties and animal breeds within the social, economic and cultural systems in which they operate. They do not see themselves as owning living things. Their rights are considered as collective and relate to all matter involving the production of food and free access to the genetic resources of the plants they grow. The seeds produced and the informal exchange of those seeds lies at the heart of their contribution to biodiversity. In time some of these seeds have been standardised, improved & distributed through more formal channels. Peasant farmers were the original source of all current improved seeds. In contrast, developments in genetic engineering have led seed manufacturers to focus more on genes than plants. Modified genes are then patented, which privatizes and hampers distribution. These seeds are available only through these corporates, (a third channels driven by biotech companies) and is is at the root of the biotech challenge. Peasants and smallholders in Africa access seeds mostly through traditional routes and more recently, in a limited way through more formal routes.

Farmers, particularly smallholders, use many systems to access seed. It usually starts with plant breeding and promotes materials for formal variety release and maintenance.

Regulations exist in this system to maintain variety identity and purity as well as guarantee physical and physiological and sanitary quality. Seed marketing takes place through officially recognised seed outlets and by way of national agric research systems and relief seed programmes. In this formal system, these is a difference between seed and grain. Formal systems are particularly important where seeds are used to grow crops for commercial purpose- export or further processing- and uniformity and high quality are to be guaranteed. In the informal system, sed related activities tend to be integrated and locally organised and the informal system embraces most of the other ways in which farmers themselves produce, disseminate and procure seed: directly from their own harvest, through barter among friends, neighbours and relatives and through the local grain markets or traders. In other words, the informal sector operates as part of the farmers normal activities rather than as discrete activities. Local technical knowledge and standards guide informal seed system performance. The informal seed system provides most of the seeds used by farmers worldwide,

In east, central and southern Africa the formal and informal systems co-exist. Proponents of the formal system believe that commercial seed production is a prerequisite for sustained increase in crop production through the use of high quality seed of new varieties. Increasingly, there is a realization that farmers are sourcing less and less seed from their classic informal source (own stock) and more from local grain/seed markets. Local markets bring in grains which are subsequently sorted and used by farmers for seed. This is different from commercial formal sector seed which is specially produced as seed on specialized field within the framework of a seed business enterprise.

Informal or Traditional seed systems

- Traditional seeds are selected and preserved in situ in the conditions in which the farmer grows his crops.
  - Seed related activities are integrated and locally organised
  - Seeds produced by the farmers are disseminated by the farmers; directly from their own harvest, through barter, among friends, neighbours & relatives & through local grain markets / traders.
  - These activities are part of grain production and not organised as discrete or independent event.
  - This is particularly the case in vegetative propagated crops such as cassava in which cuttings are obtained free from family, friends, acquaintances or strangers.

- The local grain market is a growth point that is displacing farmer seed.
  - Local markets bring grains that are sorted and used by farmers for seed.
  - This is different from commercial, formal sector seed which is produced on specialised fields within the framework of a seed business enterprise.
  - This channel has evolved and grown as a dependable source for seeds and good way of pushing out new seeds
  - Quality of seed is ascertained on the basis of word of mouth and opinion of grain dealer, or experience of farmer
- are guided by local technical knowledge and standards (farmer integrity, reported seed performance & market forces).
- provides most of the seeds (80% to 100%) used by farmers in most of SS- Africa. Cassava cuttings are obtained nearly 100% on the informal seed system
- proponents of the system consider it the best way to ensure crop resilience and agro-biodiversity and see the formal system as a threat
  - It is a cheap system of obtaining seed
  - It spreads easily and is not subject to tight regulation of formal system
  - It can sustain peasant form of subsistence agriculture

The formal Seed Systems

This can be characterised by a clear chain of activities

- The first step is usually plant breeding and improvement for formal release & maintenance.
  - Where this exists in Africa, it is driven by maize (due to vast need for it, large difference in yield between hybrid & tradition varieties , rapid loss of genetic quality of hybrids under farmer seed management and technical complexity of production of seed)
- Variety identity, purity and physical, physiological and phyto-sanitary quality are maintained through appropriate regulations and breeding
- Seed marketing takes place through officially recognised seed outlets (and by via national /corporate agricultural research systems) subject to applicable regulations.
- In this system, seed is distinguished from grain as such.
- It is especially important when seed is used to grow crops for commercial purposes (e.g., export or further industrial scale processing) and the uniformity and high quality of the product has to be guaranteed

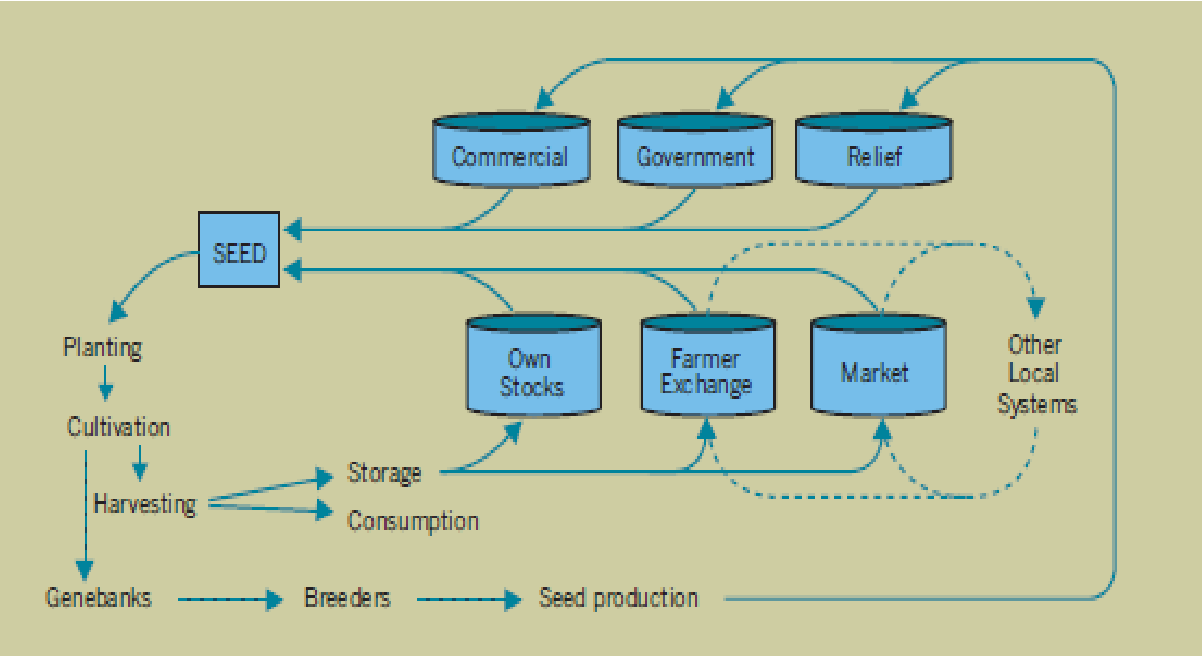
- Proponents of the formal seed system consider it a prerequisite for sustained crop productivity.
  - It is commercially driven with small contribution (less than 20% yet) in Africa seed market

In much of SS- Africa the informal and formal seed systems co-exist; and in between, there is an integrated system that draws from elements of both systems.

Integrated seed system

Integrated seed systems improve the local supply system by borrowing technologies and improvements from the formal and informal sectors.

- Focus is on improving local varieties through breeding and selection and introducing improved seeds from national and international research systems
- This system makes use of locally improved seeds and seeds from the formal system
- It lies between the informal and the formal, introducing both improved varieties and proven quality local varieties
- It has contributed also to supply of quality planting materials including root/tuber, legumes, pulses and other grains and orphan crops that will not feature importantly in the formal and commercial seed system.
- Profit motive is not very strong because of the strong involvement of government and international agricultural centres.
- This system is driving improvement in the informal seed system and together they contribute over 80% of the needed planting materials in SS-Africa



Channels through which farmers source seed are depicted by cylinders. Own seed stock, exchange with others and purchase through local seed/ grain markets constitute informal channels. Commercial seed stockist, government research outlets constitute formal channels. Government and relief (represented by international Agric. centres also play in the integrated system (Taken from *Practice Brief No. 6; understanding seed systems used by small farmers in Africa*)

Distinguishing among the Dimensions of Seed Security: The Seed Security Framework

The concept of seed security embodies several diverse aspects: differentiating among these is crucial to promote those features that foster seed security as well as to anticipate the varied ways in which such security might be threatened. The Seed Security Framework in Table 1 outlines the fundamental elements of seed security: seed has to be available, farmers need to be able to access to it, and the seed quality must be sufficient to promote healthy seed system functioning.

Availability is defined narrowly as whether sufficient quantity of seed of target crops is present within reasonable proximity (spatial availability) and in time for critical sowing periods (temporal availability). It is essentially a geographically-based parameter, and so is independent of the socio-economic status of farmers.

Seed **access** is a parameter specific to farmers or communities. It largely depends upon the assets of the farmer or household in question: whether they have the cash (financial capital) or social networks (social capital) to purchase or barter seed.

Seed **quality** includes two broad aspects: seed quality per se, and variety quality. Seed quality consists of physical, physiological and sanitary attributes (such as the germination rate, and the absence or presence of disease, stones, sand, broken seed or weeds). Variety quality consists of genetic attributes, such as plant type, duration of growth cycle, seed color and shape, palatability and so on

In using the framework, it is important to emphasize that the distinction between availability and access is dependent on scale. At some level, if one is willing to pay enough to transport seed from far enough away, seed is always available. Likewise, the concepts of availability and quality are interrelated. If seed is available which will grow and mature to harvest, but which is of otherwise low quality or of unwanted crops or varieties, this constraint would usually be considered under the quality parameter, but one could question whether appropriate seed is available at all.

Regulatory Frameworks in Seed System for sustainable Agriculture

Access to seeds is at the bottom of food sovereignty; regulations that seek to control availability and free access to seeds is to be seen as attempt to regulate food choices.

The challenge of regulation is to evolve a seed system that guarantees food sovereignty while ensuring access to quality and quantity of food needed by all.

Food sovereignty may be guaranteed by farmer seed independence; keeping seed exchanges between farmers outside regulations that seek to control seed markets through:

- protection of seeds as part of our common heritage,
- recognizing the rights of peasants to develop (in an inclusive manner involving public research or amongst farmers), use and freely exchange their seeds
- generalized marketing of seeds adapted for independent traditional farming, for small-scale & and local supply chains
- rebuilding and expanding local and traditional seed systems managed by farmers
- involvement of peasants' organizations in defining and implementing the rules and laws governing access to genetic resources a

Governments have responsibility to protect farmers and evolve regulatory system that guarantee farmer rights and protect investment etc. on the basis of AU model which is concerned with access to and, protection of the rights of local communities over their biological resource, knowledge & practice

Students are encouraged to read and compare UPOV 1978 and UPOV 1991 as regulatory frameworks

International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) recognizes the contribution that local and indigenous communities /farmers make to the conservation & development of plant genetic resources and entrusts governments with the protection of farmers' rights:

- Rights to save, use, exchange and sell farm-saved seeds and other propagating material
- Right to participate in decision-making regarding the use of plant genetic resources for food and agriculture
- Right to fair and equitable sharing of the benefits arising from their use

In addition to this treaty, there are a number of other legal frameworks that exist to regulate seed availability such as:

- *International Union for the Protection of New Varieties* (UPOV 1978 & 1991),
- *Trade Related Aspects if Intellectual Property* (TRIPS) and
- *World Intellectual Property Organisation* (WIPO)

These may have different attitudes to the regulation envisaged in the ITPGRFA

Module 5 Unit 2: Diversity of Socio-cultural world-views and their impacts on the uptake of biotechnology

Lecture 3: African Traditional Harvest Processing Techniques **(1 hour 20 minutes lecture / Discussion):**

Learning Outcomes

Students are expected to appreciate the traditional practices, and how their use by communities may impact adoption of agricultural innovation (biotechnology adoption) in Africa:

Threshing;
Winnowing;
Roasting;
Smoke drying;
Fermentation; Etc.

Introduction

- In most ecological zones in Africa, crop production is seasonal, rain-fed yet household food security requires year-round and sustainable supply of food.
- Adequate crop and food systems are needed, along with efficient processing & distribution systems, to ensure equitable and adequate supplies
- Agricultural produce are processed differently depending on whether it is grain, legume, root/ tuber, vegetable, fruit or animal (including aquaculture) product and with different communities.
- Production and post-harvest losses (up to 40% loss) are drivers in processing and post-harvest handling innovations

Some traditional food processing techniques

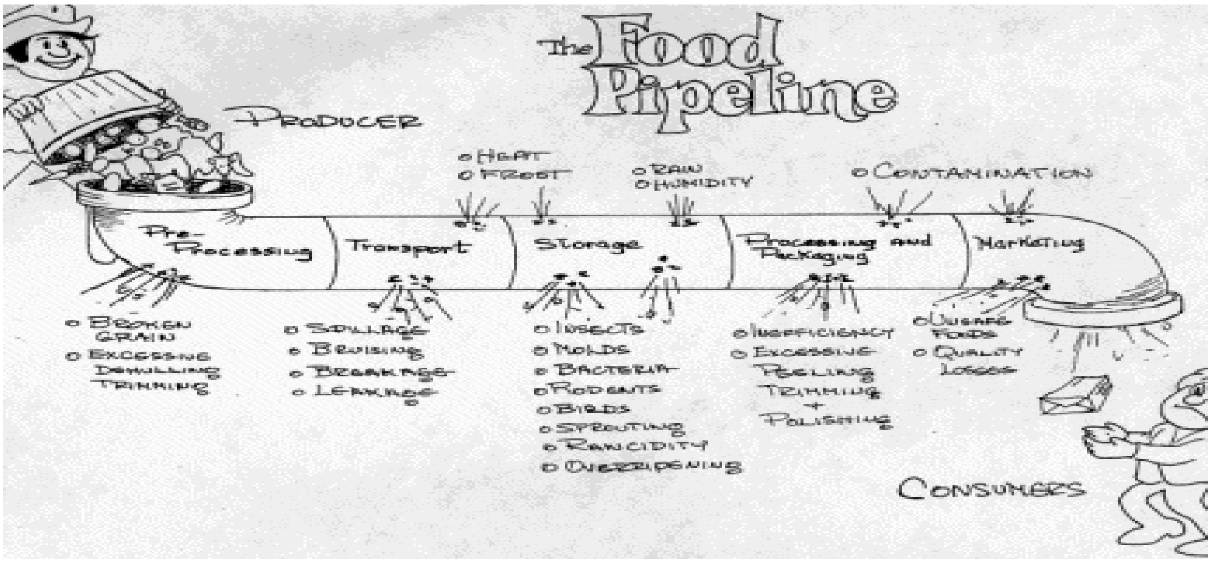
Operation	Objectives	Features
Threshing	To detach grain kernel from panicle	Carried out by trampling on the grain or beating it with sticks. Labour -intensive, inefficient, low capacity may be community based
Winnowing	To separate the chaff from the grain.	Done by throwing the grain into the air. Labour intensive, low capacity, inefficient
Milling	To separate the bran and germ from endosperm	Carried out by pounding in a mortar with pestle or grinding with stone. Laborious, inefficient, limited capacity. Community mechanised mills may exist
Parboiling (e.g. rice)	To facilitate milling and enrich milled rice	Done by steeping paddy rice in cold or warm water followed by steaming in bags in drums. Limited capacity, poor quality product
Drying	To reduce moisture content and extend shelf life.	Product is spread in a thin layer in the open (roadside, rooftop, packed earth etc.) or over fire. Labour intensive, requires considerable space or energy, poor quality
Fermentation	To extend shelf life, inhibit pathogens, impart desirable sensory qualities, improve nutritional value or digestibility	Natural mostly mixed impure culture fermentation with microbial flora selection; labour intensive; crude processes. Limited capacity, variable quality. Trade is limited due to quality inconsistencies. GMP is absent and most

		commercial products are obtained by kitchen technologies. Mostly implemented by women (and in specialized instances by men only)

(These processing techniques have evolved over time. In many communities they have been seen as a way of life. With the introduction of new seed systems and adoption of new process and agricultural technologies, these processes are likely to be challenged. This is not readily clear. But it is to be envisaged that a new practice in which seeds (including patent protected seeds) are purchased from agricultural companies and need to be processed in a manner that precludes contamination of traditional seeds will not be suited for community produce pre-processing. This could pose new challenges for changing agricultural processing techniques. It can also challenge traditional processes in which women implement certain traditional pre-processes).

Properly considered, the post-harvest system should be thought of as encompassing the delivery of a crop from the time and place of harvest to the time and place of consumption, with minimum loss, maximum efficiency and maximum return for all involved" (The Hidden Harvest, 1976). The term "system" denotes a dynamic, complex aggregate of logically interconnected functions or operations within a particular sphere of activity. The term "chain" or "pipeline" highlights the functional succession of various operations but tends to ignore their complex interaction.

In considering the system or the agro-food chain as a whole, harvesting can be seen as the hinge, or as a ridge between the pre-harvest slope, corresponding to production activity and the post-harvest slope, extending from harvesting to consumption. These ideas are illustrated in the following diagrams



The food pipeline: Route of post-harvest losses of food (after Bourne, 1977, cited by FAO Losses along this pipeline can range from below 10% to over 40% depending on the nature of produce

The **post-harvest system** encompasses a sequence of activities and operations that can be divided into two groups:

- technical activities: harvesting, field drying, threshing, cleaning, additional drying, storage, processing;
- economic activities: transporting, marketing, quality control, nutrition, extension, information and communication, administration and management.

Main elements of the post-harvest system

***Harvesting*.** The time of harvesting is determined by the degree of maturity. With cereals and pulses, a distinction should be made between maturity of stalks (straw), ears or seedpods and seeds, for all that affects successive operations, particularly storage and preservation.

Pre-harvest drying, mainly for cereals and pulses. Extended pre-harvest field drying ensures good preservation but also heightens the risk of loss due to attack (birds, rodents, insects) and moulds encouraged by weather conditions, not to mention theft. On the other hand, harvesting before maturity entails the risk of loss through moulds and the decay of some of the seeds.

Transport. Much care is needed in transporting a really mature harvest, in order to prevent detached grain from falling on the road before reaching the storage or threshing place. Collection and initial transport of the harvest thus depend on the place and conditions where it is to be stored, especially with a view to threshing.

Post-harvest drying. The length of time needed for full drying of ears and grains depends considerably on weather and atmospheric conditions. In structures for lengthy drying such as cribs, or even unroofed threshing floors or terraces, the harvest is exposed to wandering livestock and the depredations of birds, rodents or small ruminants. Apart from the actual wastage, the droppings left by these marauders often result in higher losses than what they actually eat. On the other hand, if grain is not dry enough, it is vulnerable to mould and can rot during storage.

Moreover, if grain is too dry it becomes brittle and can crack after threshing, during hulling or milling. This applies especially to rice if milling takes place a long time (two to three months) after the grain has matured, when it can cause heavy losses. During winnowing, broken grain can be removed with the husks and is also more susceptible to certain insects (e.g. flour beetles and weevils). Lastly, if grain is too dry, this means a loss of weight and hence a loss of money at the time of sale.

Threshing. If a harvest is threshed before it is dry enough, this operation will most probably be incomplete. Furthermore, if grain is threshed when it is too damp and then immediately heaped up or stored (in a granary or bags), it will be much more susceptible to attack from micro-organisms, thus limiting its preservation.

Storage. Facilities, hygiene and monitoring must all be adequate for effective, long-term storage. In closed structures (granaries, warehouses, hermetic bins), control of cleanliness, temperature and humidity is particularly important. Damage caused by pests (insects, rodents) and moulds can lead to deterioration of facilities (e.g. mites in wooden posts) and result in losses in quality and food value as well as quantity.

Processing. Excessive hulling or threshing can also result in grain losses, particularly in the case of rice (hulling) which can suffer cracks and lesions. The grain is then not only worth less, but also becomes vulnerable to insects such as the rice moth (Corcyra cephalonica).

Marketing. Marketing is the final and decisive element in the post-harvest system, although it can occur at various points in the agro-food chain, particularly at some stage in processing. Moreover, it cannot be separated from transport, which is an essential link in the system.

Post-harvest losses

"Losses are a measurable reduction in foodstuffs and may affect either quantity or quality" (Tyler and Gilman, 1979). They arise from the fact that freshly harvested agricultural produce is a living thing that breathes and undergoes changes during post-harvest handling.

Loss should not be confused with damage, which is the visible sign of deterioration, for example, chewed grain and can only be partial. Damage restricts the use of a product, whereas loss makes its use impossible.

Some basic definitions are needed before moving on to the various types of loss.
Foodstuff. Products, in the present case crops, edible by human beings; more specifically, the part fit for human consumption. In tropical countries, 75 percent of basic food comes from cereals and pulses. The remaining vegetable-based food is often, especially in wet, wooded zones, supplied by roots and tubers, particularly cassava, yam, taro, plantain, potato and sweet potato. In the food chain, quantities of food are usually expressed in terms of weight but this does not mean that organic structure and nutrients can be ignored.

Grains and seeds. Cereals, pulses and oilseeds grow in most climates and latitudes for human consumption. The main cereals are wheat, maize, rice, barley, sorghum, millet, oats and rye; pulses cover the various species of pea, bean, broad bean and lentil; and oilseeds cover soya, groundnut, sesame, rapeseed and sunflower.

Post-harvest. If harvesting covers the period when the various products grown are removed from the field, after maturity, the post-harvest period runs from exit from the field to the time of culinary preparation. For various reasons, but especially to allow the straw and grain to dry fully, harvesting may be delayed sometimes for months, as happens particularly with maize and rice and in these cases, some people prefer to speak of "post-production" in order to indicate the link between harvesting and post-harvest operations.

Food loss. Food loss refers to total modification or decrease of food quantity or quality which makes it unfit for human consumption.

Types of losses

Moisture content; Damage; Direct and indirect losses; Weight loss; Quality loss; Food loss; Seed viability loss; Commercial loss

Cereals/ Legumes and Pulses

Cereal processing in Africa typically follows the following steps

- harvesting;- Time of harvest depends on degree of maturity. This is important for success of subsequent operations
- pre-drying in the field; Mainly for cereal and pulses; good for successful preservation but increases other risks

- threshing; success increases with dryness of grain prior to harvest and threshing. Labour intensive
- winnowing; Success depend on weather conditions. Labour intensive
- Drying (most important step in grain storage in Africa; is increasingly important in root/ tuber crops, plantains and bananas as well as for meat preservation)
- storage of grain ; mostly done by individual families at home or on the farm, However, communal (cooperative), commercial silos are also beginning to operate in many countries
  - primary processing: cleaning, grinding, hulling, pounding, milling, grinding, tempering, soaking, parboiling, drying, sieving;
  - secondary processing: baking, frying, cooking, extruding, blending, fermenting, roasting;
  - packaging, marketing;
  - utilization by customers

Most of these processes are implemented by women; innovation policies need to address the peculiarities of this group.

Opportunities for post-harvest loss reduction in SS- Africa

- Distribution
  - improving communications to ensure that excess stocks in one area reach another area that is short of commodity;
  - better trading facilities, i.e. more food markets and shops, better stock of valuable preserved foods in village shops, improved market-places and more cooperative-type food shops;
  - promoting equitable distribution to ensure a fair share of food, especially nutritious foods, for high need populations-children, elderly and pregnant and lactating women
- Storage
  - control of rodents
  - control of insects
  - control of fungi
  - control of birds
  - protective measures against monkeys, baboons, porcupines, wild pigs and other destructive animals, even elephants;
  - educating people about safe and hygienic food storage at home.

- Processing and Packaging
    - Loss control measures targeting this segment of the food pipeline can vary with process requirement and methods/ new technologies
- Marketing
    - Loss control needs will depend on the level of processing

Many of these processes are steeped in traditional practices. Changing these processes to accommodate the needs and peculiarities of modern agriculture that will be driven by biotechnology may pose new challenges. What could those be? The class will be encouraged to identify how modern biotech driven practices may force changes in storage procedures.

Example: there is a belief in parts of yam consuming communities that yams produced with chemical (inorganic) fertiliser are not amenable to storage in traditional barns. The belief is that they rot faster. If use of inorganic fertilisers influences storage choices, then aspects of traditional communal barn use will be incompatible with adoption of inorganic fertilisers. This could impact the adoption of tissue culture for the propagation of yams if use of inorganic fertilisers is recommended for the sustainable adoption of tissue culture.

Improving Grain storage

- Improving crop storage comes with cultural challenges for peasant farmers because of the need to adjust cultural processes
- Dry grain well before putting it in storage and keep dry in storage.
- Store only clean grain in clean containers; Keep the grain cool and protect from large changes in outside temperatures.
- Protect the grain from insects and rodents by following the rules for cleanliness and drying and putting the grain into insect/rodent -proof store.
- Waterproofing of buildings and containers as much as possible.
- Check the grain regularly while it is in storage to make sure it is not infested.
- Insecticides (herbal and chemical are also used as possible/ suitable)

Root, Tuber, Vegetables and Plantains/Banana

- These highly perishable crops account for 40% of the energy needs of about 50% of the population of SS- Africa.
- Urbanisation is challenging the supply of these foods due to perishability.
- Improved supply will benefit from minimal processing (e.g., drying) & improvement in transport / supply infrastructure

- Many control measures applicable to grains/ legumes above may also apply to this group of crops

- Perishability of those without dormancy is a major constraint to production.
- For those with considerable dormancy such as yams, coco-yams and sweet potatoes, storage is carried out by individual families. Cassava is simply left in the field until needed. In all cases, post harvest losses can be very high- up to 100%
- Processing is mostly implemented by women, whose needs have to be considered in process improvement efforts to ensure uptake of any innovations.

Food Processing

- Foods are processed to improve their digestibility and appeal.
- To extend availability of foods beyond the area and season of production, thus increasing food security
- To provide consumers diet diversity; access to a wider choice of products & improved nutrition
- The most basic level of processing is preservation, practiced for generations in a variety of forms by families in traditional societies to provide food in times of scarcity
- In urban centres, many people now have access to more convenient commercially processed foods, and many of the traditional ways of contributing to household food security are dying out.
  - urbanisation may support acceptance of biotech products
- Village-based processing includes basic transformation activities such as milling of products for which there is a potential market
- Processing, done on an individual or group basis, provides employment for millions of rural people and is often one of the sources of income for rural women
  - The preparation of gari, a dried fermented cassava product, in West Africa and the smoking of fish are examples of such processes, which transform highly perishable commodities into products that can be transported long distances and stored
- Village groups are now beginning to process fruits and vegetables (those that are amenable to drying)

Food Processing Stages

- Primary processing refers to the immediate post-harvest handling activities.
  - For cereal and legume grains, such activities include drying, threshing or shelling. Such operations reduce the fibre content and may extend the storage life of the foodstuff.
- Secondary processing, or transformation, usually involves some alteration in the form of the foodstuff to facilitate its subsequent use.
  - Cereal and legume grains may be cleaned, graded, tempered or parboiled, dehulled and polished or split into halves.
  - Tubers may be peeled and sliced and then sun dried.
  - Many grains are ground, pounded or milled and sieved to give various grades of meal or flour
- Tertiary processing involves the conversion of uncooked materials into products and food combinations for human consumption.

Adaptation to new food technologies and prospect for agricultural biotech

Capacity to preserve food is directly related to level of technological development.

- Slow progress in upgrading traditional food processing techniques in rural Africa contributes to food insecurity.
- Simple, low-cost, traditional processing techniques are the bedrock of small-scale food processing enterprises that are crucial to rural development as most processing is driven by women.
- Processing is vital to reducing post-harvest food losses and increasing food availability. Growth in this sector has been slow in much of Africa
- The success in adoption of some new food processing technologies suggests ease of adoption of other new technologies if they are properly tailored
- New technologies that grow out of traditional practices have high chance of succeeding
- Some of these successful technologies include
  - mechanization of gari processing,
  - production of instant yam flour or flakes,
  - the production of soy-ogi (a protein-enriched complementary food), etc.
  - acceptance of yam flour as substitute for pounded yam

They have reduced labour, increased food availability, reduced loss and improved family income

References and Further Reading

Cooke, J.G. and Downie R. (2010) Richard DownieAfrican Perspectives on Genetically Modified Crops Assessing the Debate in Zambia, Kenya, and South Africa; A Report of the CSIS Global Food Security Project.

Udeani, CC (2008). Traditional African Spirituality and Ethics - A Panacea to Leadership Crisis and Corruption in Africa? Phronimon 9: 65-72

Gbadegesin, S. (1993) Bioethics and Culture: An African Perspective *Bioethics* 7 *2/1 257-262*

Qiu R. (1993) What has Bioethics to Offer the Developing Countries *Bioethics* 7 *2/1 109125*

http://www.trinity.edu/cbrown/intro/ethical_theories.html

Biotechnology and Bioethics: What is Ethical Biotechnology? http://www.eubios.info/Papers/VCH.htm

What is Bioethics? http://education.llnl.gov/bep/english/10/sEth.html

Weinstein D (1993) Between Kantianism and Consequentialism in T. H. Green's Moral Philosophy *Political Studies,* XLI, 618-635

Metz, T (2009) The Final Ends of Higher Education in Light of an African Moral Theory. Journal of Philosophy of Education, Vol. 43, 179-201

Metz, T (2007) Toward an African Moral Theory *The Journal of Political Philosophy:* 15, 321–341

Metz, T (2010) African and Western Moral Theories in a Bioethical Context *Developing World Bioethics Volume 10:* 49–58 doi:10.1111/j.1471-8847.2009.00273.x

Metz, T (2010) An African Theory of Bioethics: Reply to Macpherson and Macklin *Developing World Bioethics Volume 10:* 158–163 doi:10.1111/j.1471-8847.2010.00289.x

Diniz, D. (2010) Editorial; *BIOETHICS AND CULTURE Developing World Bioethics Volume 10:ii-iii;* doi:10.1111/j.1471-8847.2010.00291.x

Bramer, M. (2010) The Importance of Personal Relationships in Kantian Moral Theory: A Reply to Care Ethics; Hypatia 25: 121-139

Bell D. A. and Metz, T. (2012) Confucianism and *ubuntu*: Reflections on a Dialogue between Chinese and African Traditions *Journal of Chinese Philosophy, Supplement to Volume 38 (2011) 78–95*

Agulanna, C (2007) Moral Thinking in Traditional African Society: A Reconstructive Interpretation Journal of Philosphy and Religion (Assumption University, Thailand). 8, January –June 2007

Ethics in Medicine; http://depts.washington.edu/bioethx/tools/princpl.html
Metz, T (2007) The Motivation for "Toward an African Moral Theory" S. Afr. J. Philos., 26: 331-335

The Nature of Morality: http://home.sandiego.edu/~baber/gender/MoralTheories.html