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REALIZING AGRICULTURE'S TRUE REVOLUTION FOR SUSTAINABLE DEVELOPMENT IN THE CARIBBEAN REGION: LESSONS FROM THE GREEN REVOLUTION

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Introduction

Agriculture is one of the most important areas for sustainable national development, human security and the well-being of any and every society. The world in which we live is facing an enormous challenge in feeding itself. Millions of people are going hungry and dying as a result of improper nutrition. Our agricultural and food production system worldwide is therefore under considerable pressure to be improved in order to better cater for an ever increasing population with fewer natural resources. While everyday advances and innovations produce positive prospects for increasing food production, the fundamental challenges of hunger, poverty, improper nutrition and the degradation of our environment as a result of our present agricultural system still persistently remain! This raises serious concerns not just about the issue of food production, but rather, the system of food production that is in place today across the countries of our world, including our countries in the Caribbean region.

The Green Revolution

The Green Revolution has been reincarnated many times over, according to this scientist. Since the 1950s, we have heard terms such as the - “**real green revolution**”, “**greener revolution**”, an “**evergreen revolution**”, a “**blue revolution**”, and an “**African green revolution**” to name a few. These terms all originated from the “Green Revolution” which was initially born out of the realization of the unique importance of agriculture and food production to feed the world. The fundamental premise for the Green Revolution was simply to grow more primary staple crops (for example - wheat, rice and maize) by intensifying their agricultural systems in areas where returns would be high (Pingali 2012). The green revolution is defined by Dr. Norman Borlaug as: “**Food is the moral right of all that are born into this world**”. He also believed that “**we cannot build a peaceful world on empty stomachs and human misery**”.

The Green Revolution shaped its interventions around a few main components:

1. The development and use of improved varieties/hybridized seeds. Improving inputs within the agricultural system was the basis for the corresponding improvement in productivity. In fact, the productivity gains from crop germplasm improvement alone are estimated to have averaged 1% per annum for wheat (across all regions), 0.8% for rice, 0.7% for maize, 0.5% for sorghum and 0.6% for millets (Everson and Gollin 2003).

2. Increased irrigation. In this context, increased emphasizes the building of infrastructure to facilitate and support a consistent irrigation supply; including - capital investments in the construction of dams, aquifers, channels and other water works.

3. The development and use of synthetic agro-chemical inputs. An estimated 30-50% of crop yields are attributed to natural and synthetic commercial fertilizer, making this input strategically important to food production. The Green Revolution capitalized on the expanding petroleum industry in utilizing its by-products and outputs to produce valuable fertilizer products. This is perhaps best seen with the production of nitrogen fertilizers. Leveraging economies of scale to produce a diversified product portfolio made the economic model more competitive and allowed fertilizers to be made available at competitive prices which were further supported by subsidies.

4. The modernization of agricultural management, techniques and technologies. And I must say here, that the most substantive factor in the Green Revolution was perhaps the focus on human talent/capacity and the better coordination of the increased number of inputs within the production system, such as mechanization. This demonstrated to the world that agriculture was in fact a very knowledge-intensive industry and put immense focus on knowledge creation and its leveraging for development as a strategic asset for improved agriculture.

The economic model of the Green Revolution was a resource-based one which specifically targeted improvements in the factors of production on a quality and quantity basis. The demonstrated potential of agriculture as an economic system to impact on these two primary objectives (quality and quantity) remains the defining merit of the Green Revolution, despite its short-comings. What is of great significance, is that - the world saw that agriculture was most definitely capable, and up to the challenge of feeding the world. That the global community could collectively agree that agriculture, amidst all other economic sectors is unique in solving or at least playing a major role in solving the world's major challenges was outstanding! Prof. Sankat therefore sometimes likes to refer to agriculture as 'green gold' because of its value and its potential to alleviate some of the major challenges of our society including starvation, poverty and improper nutrition.

The Green Revolution had on the world, it also resulted in several negative impacts.

Agriculture as green gold

The world saw that agriculture was most definitely capable, and up to the challenge of feeding the world. That the global community could collectively agree that agriculture, amidst all other economic sectors is unique in solving or at least playing a major role in solving the world's major challenges was outstanding!

The lessons learnt from the Green Revolution

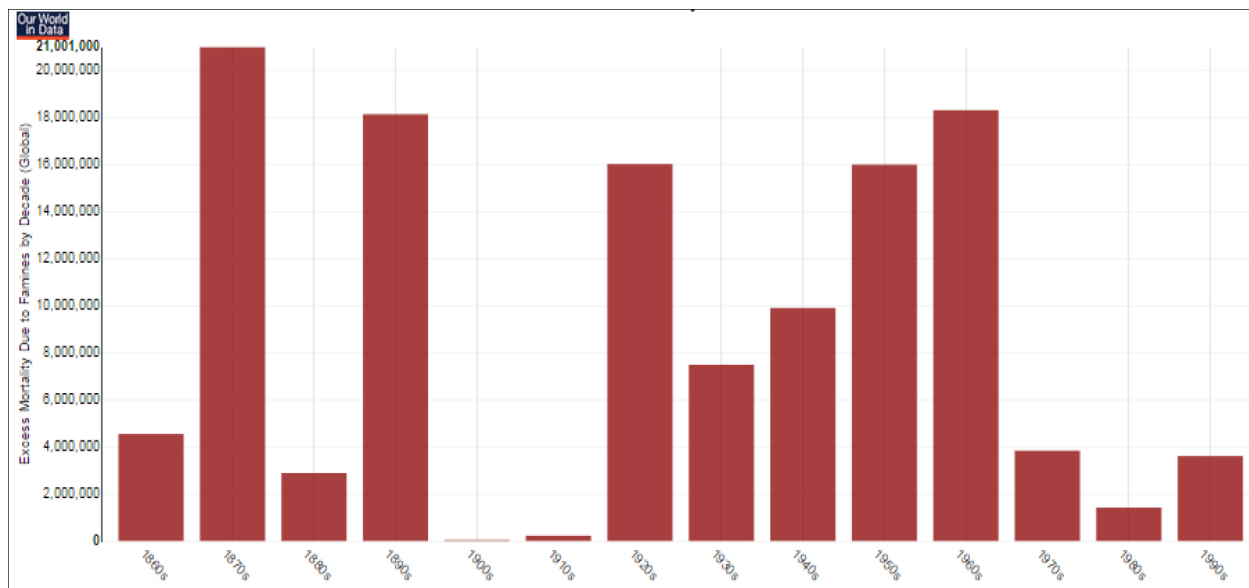
The lessons to be learnt from the Green Revolution as we attempt to shape a sustainable future for the countries of our region are divided in four categories.

Lesson 1: Food Nutrition & Health

In 1960, the discussion on food and health focused on the fact that many were starving and this was associated primarily with poor economic access to, and availability of food.

Figure 1 shows that there were very high levels of mortality as a result of famine in the 1950s and 1960s which not only supports this view, but also gives the rationale for the need for the Green Revolution to reduce deaths due to famine; indicative of improved food availability and access post 1960s.

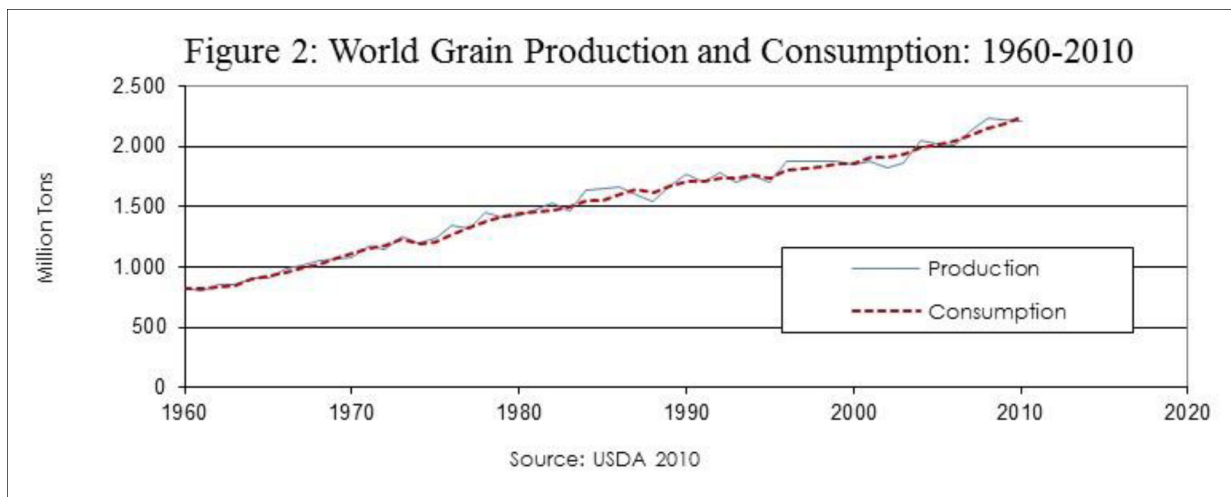
Figure 1: Mortalities due to Famines



Source: *Our World in Data 2015*

Increase of World Grain Production & Consumption

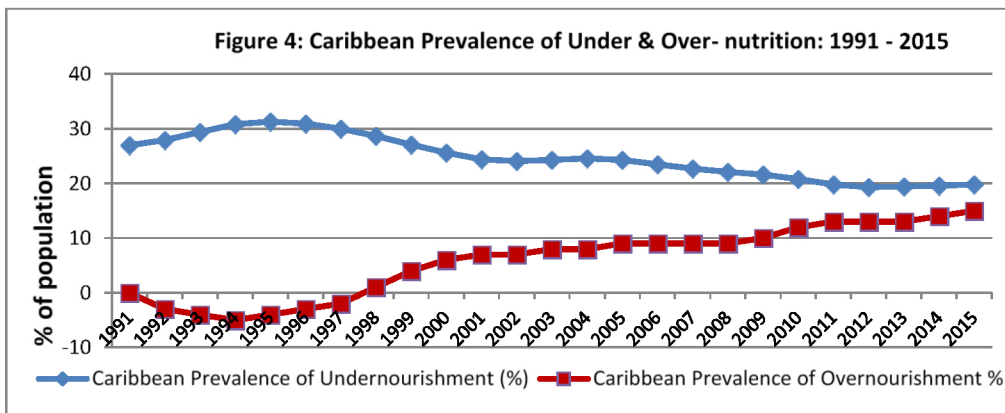
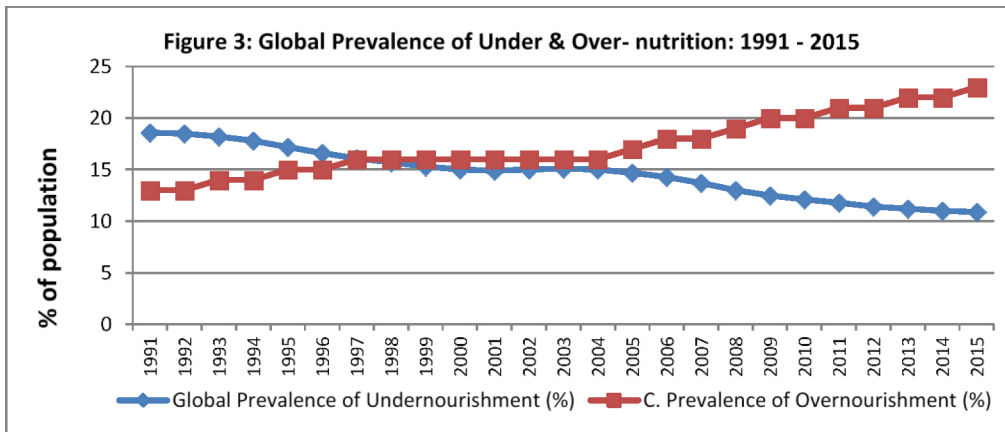
World grain (wheat, rice and maize) production grew as a result of the Green Revolution to meet and often exceed consumption (see figure 2). Production grew at a rate of 36% over the 1960s, which was the most notable increase, followed by 24% in the 1970s and 14% in the 1980s. The State of Punjab in India became known as India's 'Bread Basket' and the backbone of the national food system even though it represented only 1.5% of the total geographical area of the country. The desire to increase production was achieved. In fact, today, the value of total agricultural output (all food and non-food crop and livestock commodities) in real terms is almost 3 times that of 1961 – an average increase of 2.3% per annum, and has surpassed global population growth of 1.7% per annum (FAO 2008).



Malnutrition remains the World's Most Serious Health Problem:

Malnutrition (composite of both under- and over-nutrition) can be described as the condition that develops when the body does not get the right amount of vitamins, minerals, and other nutrients needed to maintain healthy tissues and organ function. **Under-nutrition** occurs when the human body consumes too few essential nutrients or uses nutrients rapidly before they can be replaced. In contrast, **over-nutrition** results from excessive food intake relative to dietary nutrient requirements and is associated with an obesogenic agri-food production, supply and distribution environment. It is interesting to note that the problem of over-nutrition is increasing in countries where a few decades ago, under-nutrition and hunger were most endemic; and to the extent that they occur simultaneously amongst the poor (Chopra et al 2002).

Malnutrition is a Global and Caribbean concern and the data supports this phenomenon both globally and in the Caribbean region. Figure 3 and Figure 4 show that although under-nutrition has reduced; over-nutrition has increased significantly. It stands to reason also that at the present rate, the Caribbean is expected to see a similar convergence and inclination to over-nutrition and its associated spike in chronic, non-communicable diseases. This does not mean that under-nutrition will be eliminated, but rather that the coexistence of the two will become more common.



Source: FAO Stat 2015

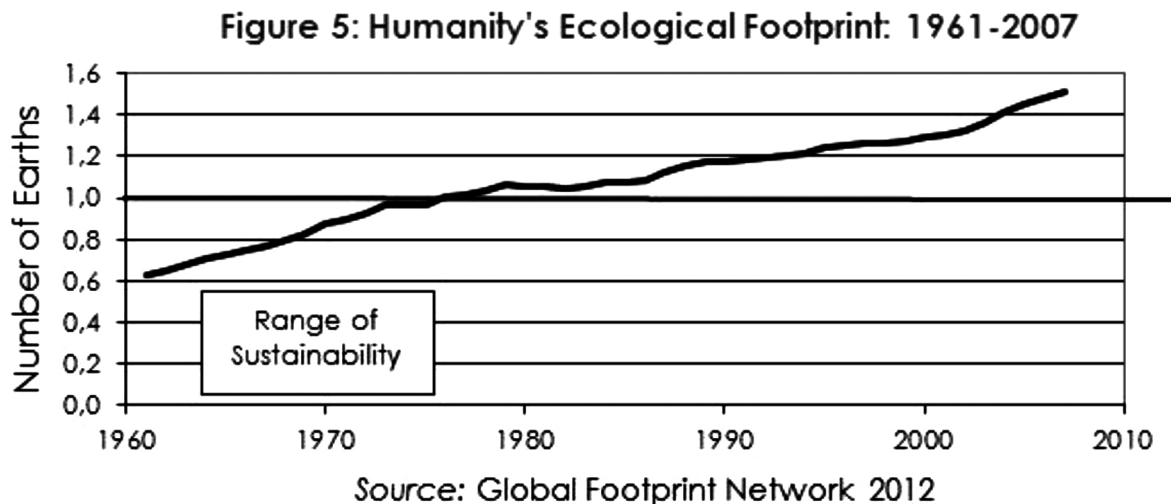
What was once an issue of under-nutrition has become one of over-nutrition. Nutrition, and specifically the nutritive quality of food rather than minimum calorie and protein intake, should thus be the main focus of our agricultural systems in the Caribbean. In other words, it is the nutritive content of food that is most essential to human health and therefore, this should be the developmental focus for our agri-food production systems. This must be our target; we must aim for our agricultural system to not only be more productive, but of equal importance, our agricultural systems must also improve the health of our people.

Lesson 2: Ecological Economic Impact

The impact of the intensive system of agriculture coming out of the Green Revolution produced substantial negative impacts – directly and indirectly. These negative impacts were primarily caused by high energy consumption and the inappropriate use of agrochemicals which, besides the direct effects on human lives, polluted waterways, and destroyed soils and upset ecosystems (World Development Report 2008 and Shiva 1989). These myriad adverse impacts point to the economic dimension of the environment which is the ecological/environmental systems and associated services of nature which supports life and our existence on this planet.

The Green Revolution & its Ecological Footprint

Figure 5 shows that there has been a steady increase in humanity's ecological footprint since 1961 – correlating with the transition to the system of agriculture we have characterized under the Green Revolution. Measured in number of Earths, a value of 1.0 means that the world economy used the equivalent of what the Earth can sustainably provide in a year. As seen in the figure 5, this was reached around 1976. That means that in 2007, the demands of the world economy on environmental/natural services was already more than 50% what could be sustainably supplied – a value equivalent to 1.51 Earths.



Degradation of our Natural Capital

This outlook does not bode well for many of the important ecological goods and services – the natural capital - upon which agricultural systems and life are dependent:

1. For example our Biodiversity has been negatively impacted by the industrial agricultural system that has become characterized with the Green Revolution. Since the beginning of this century about 75% of the genetic diversity of agricultural crops have been lost, with crop genetic resources being destroyed at the rate of 1-2% every year. For livestock, an estimated 5% is being lost each year (Shand, 2015). These are potential sources of food, jobs, cures for terminal diseases and revenue being forever lost.

2. In another instance, water is an important resource that has been negatively impacted by the industrial agricultural system. According to the Water Research Institution (2015) agriculture accounts for more than 70% of all human water withdrawal (WRI, 2015). More than 25% of the world's agriculture is being grown in areas of high water stress (WRI, 2015). This is more acute when looking at irrigated agriculture where about 56% of irrigated areas are under high or extremely high water stress (WRI, 2015). Now, irrigated agriculture is and will become more important to boosting as well as stabilizing agricultural productivity given increased variability in rainfall. For the Caribbean, where most countries, with the exception of a few such as Dominica, are water deficit (i.e. water extraction exceeds replenishment) this leaves almost no room to manoeuvre or to adapt to future challenges. Coupled with the projected increases in agriculture's water demand the situation as it relates to water seems challenging to say the least. This means,

that as we look to the future we must adopt a fundamentally different outlook on irrigation (infrastructure and systems) than those common to the Green Revolution.

The degradation of our natural resources/systems like our biodiversity and the inefficient use of water due to our system of agriculture and food production is a major loss to development, and this in itself to my mind demonstrates that the present economic system is in no way sustainable.

Deforestation increasing in the Amazon Rainforest

The deforestation that is taking place in the Amazon Rainforest today. A rainforest that comprises the largest and most biodiverse area of tropical rainforest in the world, and one that passes through nine nations, including Suriname. Looking forward, we in the Caribbean region must therefore endeavour to let agriculture be a net contributor to bio-capacity rather than a net extractor.

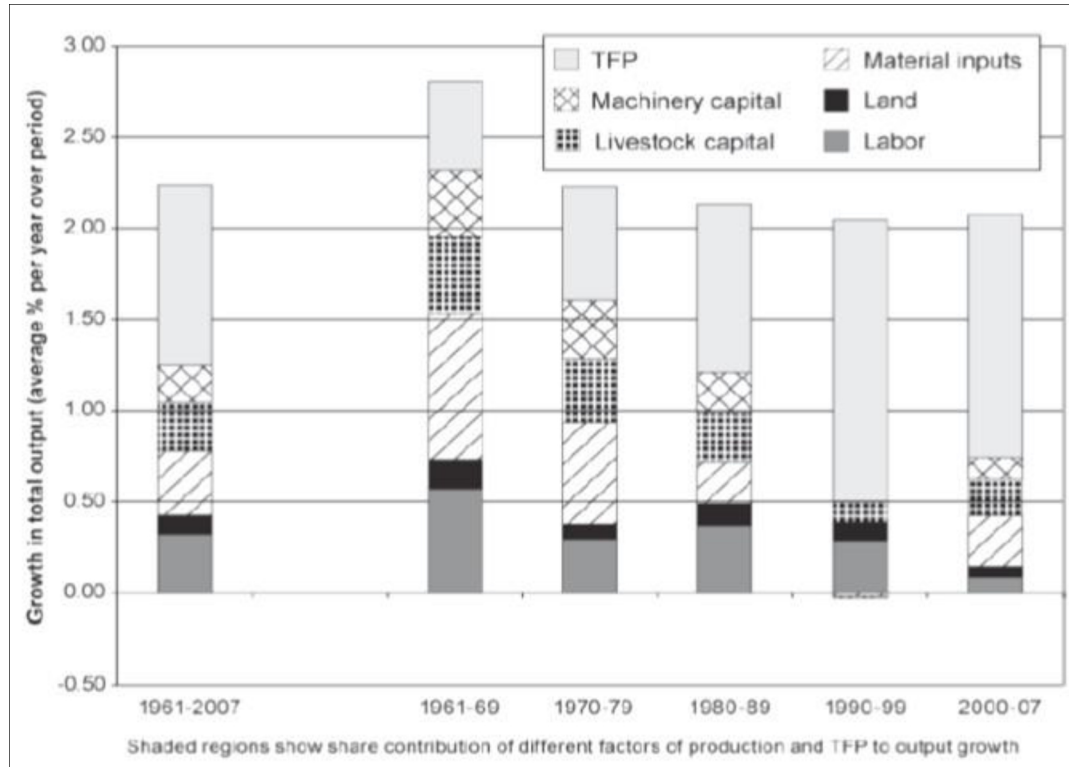
Lesson 3: Productivity & Economic Growth

A primary premise for the Green Revolution was to increase agricultural productivity – essentially, producing more in the same space. This requires efficiency gains from technological advancement, learning and knowledge leveraging (Total Factor Productivity/TFP) to produce economic gains contributing to economic growth through improved comparative advantages for local manufacturing and export. While discussions on contributors to economic growth regarding the Green Revolution typically highlight the benefits of hybrid/miracle seeds, fertilizers and capital formation, it is really the latter - the Total Factor Productivity – that is the main driver or real star of economic growth because it reflects the ability to learn, to improve and to innovate in an economic system. Conservative estimates suggest that Total Factor Productivity accounts for as much as 60% of the real, sustainable growth within economies (Easterly and Levine 2001).

Global Sources of Agricultural Growth

Figure 6 presents the sources of agricultural growth by decade, showing the contribution of Total Factor Productivity and the productivity contributions of five major input categories: land, labour, livestock capital, machinery capital, and material inputs (Fuglie 2010).

Figure 6: Global Sources of Growth in Agricultural Productivity – TFP and Input Sources: 1960-2007



Source: Fuglie, 2010

Growth in material inputs (especially in fertilizers), labour, livestock capital and machinery capital were the predominant input contributors to agricultural growth in the 1961-1969 period. These were the principal elements of the Green Revolution which when coupled with improved varieties, produced the impressive yield rates previously discussed. However, the effect on productivity growth diminished gradually towards the 1990s. This may be associated with their inappropriate and inefficient use as this period correlates with the increasing ecological footprint of agriculture. However, material inputs make resurgence in the 2000s – perhaps correlating with the development of more recent bio-technological improvements.

Land productivity has been a consistently minor contributor to overall TFP, experiencing notable falls (e.g. 1970s and 2000s). This correlates with soil degradation from intensive systems and inappropriate practices associated with the Green Revolution.

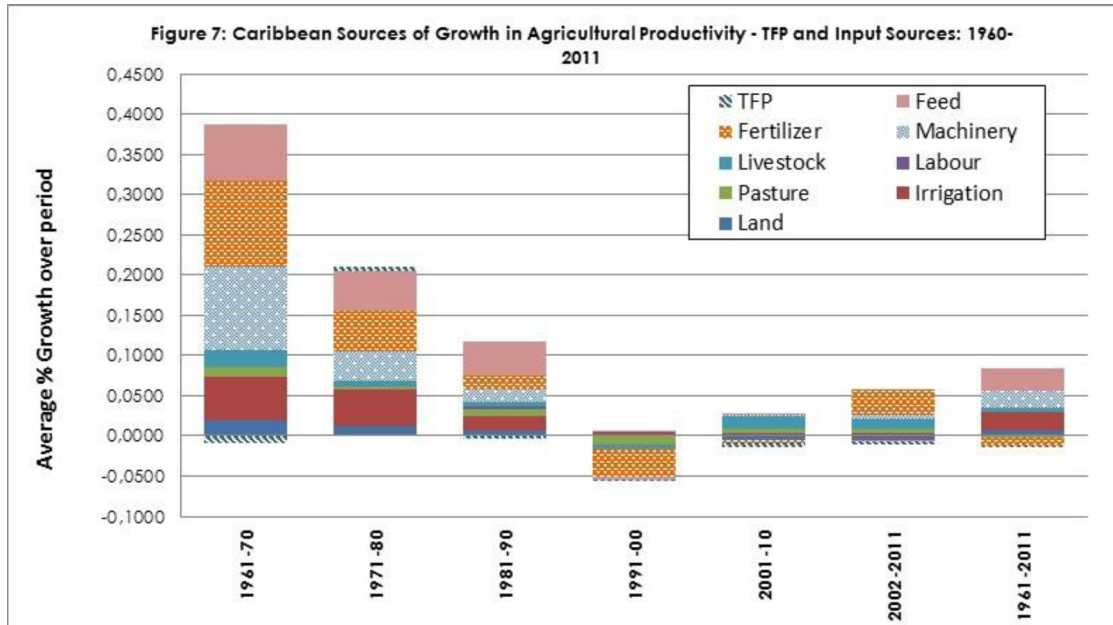
There has been a substantial decrease in the rate of agricultural capital formation (represented by machinery capital and livestock capital) between 1961 and 2007. This suggests that utility-maximizing investors (including farmers) found more lucrative alternatives for capital (particularly between 1981 and 1999) other than in agriculture. This makes sustainable capital formation for agriculture an important need as we try to realize agriculture’s true revolution for sustainable development.

The biggest star of global agricultural growth has been TFP which progressively grew to be the dominant factor in productivity growth from the 1960s to the 1990s. This means that TFP, i.e.

know-how and resource-use efficiencies have in fact been the predominant issue in agricultural growth.

Caribbean Sources of Growth in Agriculture Productivity

Figure 7, illustrates the scenario in the Caribbean region. It shows that investment in machinery, fertilizer, feed and irrigation in the 1960s supported development in the 1980s. However, labour and TFP constituted very little or no elements in agricultural growth from 1960 to 2011, the two elements that should have in fact demonstrated in gains toward sustainable growth.

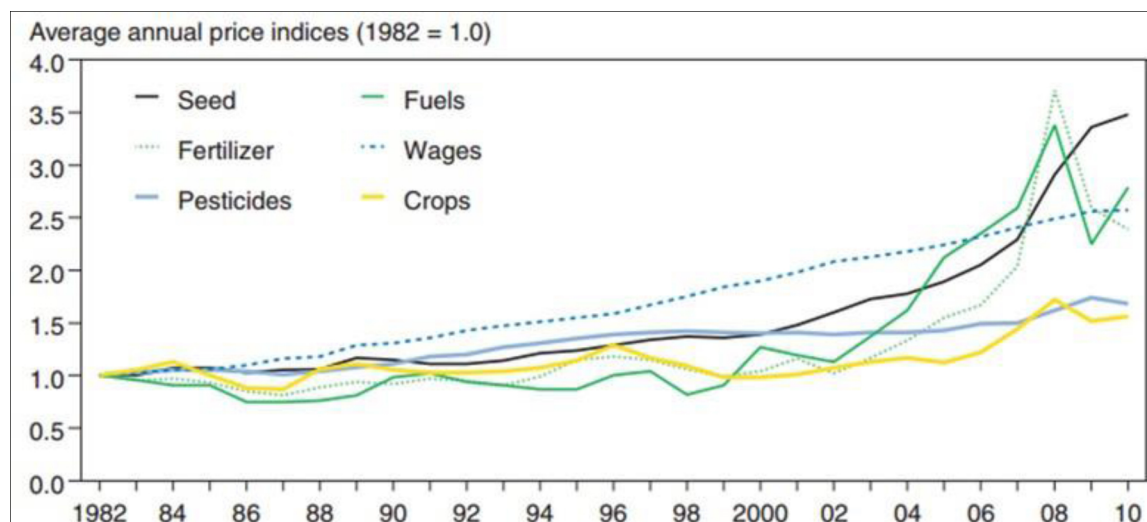


In general, resource intensification spurred agricultural growth in the Caribbean with capital formation (machinery, irrigation) and fertilizer and feed being the main drivers. However, their diminishing profile in the portfolio into the 1970s, 1980s and 1990s suggest that there is poor reinvestment into and management for development in the sector in this period. When we consider that these inputs were, and still are largely imported, it is not surprising that agriculture remains so chronically vulnerable to macro-economic risks (therefore business as usual within our present agricultural intensification model will not work!).

Global Price Indices

Figure 8 shows that even though crop prices have an overall positive trend, it does not account for increases in major input costs – especially seed, fertilizer and fuel prices. These are primarily imported by developing countries such as our countries in the Caribbean and contribute significantly to agriculture’s negative trade balance.

Figure 8: Global Price indices for Seed, Fertilizer, Pesticides, Fuels, Wages and Crops: 1982-2010



Source: USDA, NASS 2012

Everson and Fuglie (2010) further emphasized that TFP performance in developing-country agriculture was strongly correlated with national investments in technology capital – that is, a country’s ability to develop and extend improved agricultural technology to farmers. They found that countries that failed to establish adequate agricultural research and extension institutions and extend basic education to rural areas were stuck in low-productive agriculture and were falling further behind the rest of the world (Everson and Fuglie 2010). To emphasize this point, Bizzari (2013) also comments that agricultural research and development will be more effective when youth and women are well-represented and well equipped to adopt/leverage agricultural research for development (ARD) products and services.

According to Prof Sankat as Principal of The UWI St. Augustine Campus, this is indeed a critical modality for growth and development as we endeavour to realize agriculture’s true revolution for sustainable development in the Caribbean region.

Lesson 4: Socio-economic & Political Governance

The Green Revolution was framed within a neo-liberal logic of scale and specialization that tied farms and agri-food into an industrial/bio-science dynamic (Van der Ploeg and Marsden 2008).

Agriculture as Big Business:

The Green Revolution showed agriculture as big business and had a suitably high profile with transnational financing and investment from the likes of the Rockefeller and Ford Foundations, Bayer, Dupont and Monsanto amongst others. Financial backing grew especially in the 1970s with a budget of US\$20.06 million in 1972 from 16 donors, growing by 687% to US\$157.95 million in 1981 from 40 donors (Shiva 1991). This was motivated by expanded avenues for investment in areas that yielded economic gains.

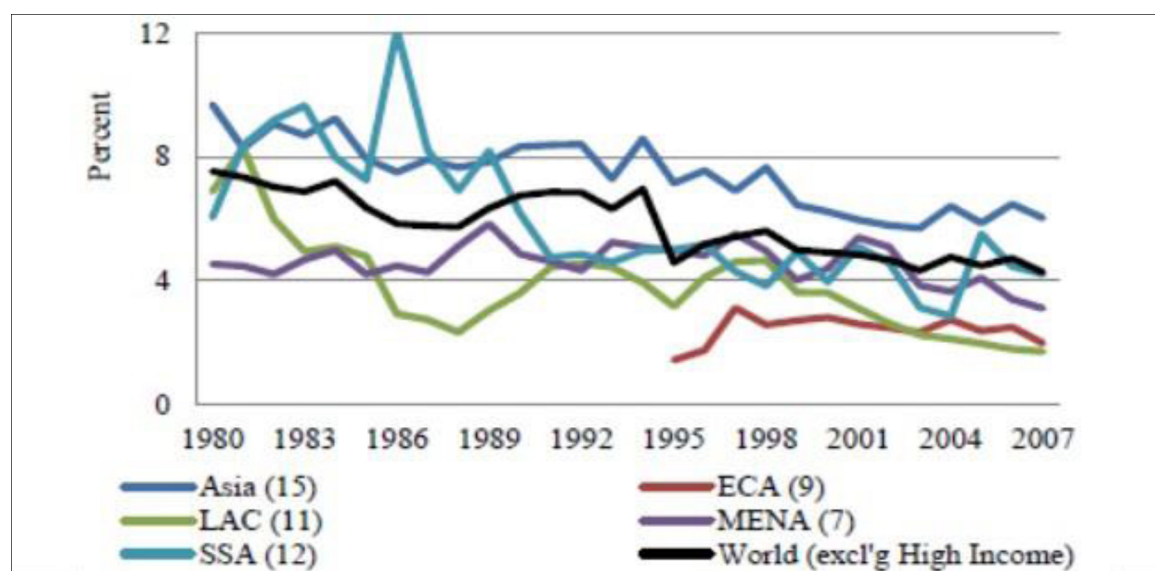
These were identified as - research and development and knowledge management, capital formation, improved inputs and labour. As the saying goes, “you need to speak the language that people will understand” and economic gain is that language; and over the last half century politicians and business folk alike have been listening. To this end, the Green Revolution benefited

tremendously from political, institutional and private-sector support. This was the partnership which the agricultural sector longed for, and needed - public-private partnership. What created and supported this partnership was a clear development plan showing the sustainable economic gain across the socio-cultural and economic dimensions of agriculture and how they will in fact be sustained. However, it is the absence of this type of plan in the Caribbean that still continues to produce the kind of “start-and-stop” macro-climate for agriculture that we see in our region. This is perhaps best seen in investment in agricultural research and development.

Financial Resources to Agriculture by Region

Figure 9 shows that investment into agricultural research and development, by Latin America & the Caribbean (LAC) in particular has not kept pace with the requirements for realizing the kind of real economic gains that other territories have seen.

**Figure 9: Financial Resources to Agriculture in the LAC relative to other Regions:
Agriculture share of Total Government Expenditures (1980 – 2007) by Area**



Key: LAC – Latin America and the Caribbean; SSA – Sub-Saharan Africa; ECA – Europe and Central Asia; MENA – Middle East and North Africa

Source: Lowder Carisma 2011

Persistent constraints need consistent attention and this is a demand of the political and institutional commitment to agriculture. This should be a poignant message to Ministers of Agriculture and other agricultural planners throughout the Caribbean region for the coming decade. If our region is to see sustainable agricultural systems implemented for the benefit of our people, we must invest in agricultural research and development.

The Way Forward

Agriculture’s True Revolution will come from an ecological modernization, so we need to shift gears and embrace new thinking and new paradigms which will bring new solutions for sustainable

agricultural development in the Caribbean region. And as Prof. Sankat reflected upon these lessons, he could not help but imagine some of the possibilities for the Caribbean region as it relates to agriculture and food production.

According to him, we need to start with the realization that agriculture's true revolution will come from an ecological modernization. Ecological modernization is a system-based approach which looks to the inter-connections between policy formation, the economy and the natural environment with the intention of transitioning operating systems to forms that are in line with the natural ecological process (Orssatto and Clegg 1999). It focuses on industrial ecology as the operating premise for economic activity so that there is maximum use of resources, however, with minimal disruption to the environment. We therefore must change the whole philosophy of how food is produced, distributed, sold and consumed to address vulnerabilities created by the present agri-food economy.

The Case of Southern Ethiopia: Making Agriculture Ecologically Sound

We can make agriculture more ecologically sound by adopting farming models that add value to ecosystem products. Agricultural systems that produce positive contributions to bio-capacity and the associated ecosystem goods and services. A notable example of one of the observed sustainable farming systems showcasing how this bio-capacity is used together with local biodiversity can be found in Southern Ethiopia where a five thousand year-old farming system was given new life by adapting these principles for production of Ethiopian banana, coffee, honey, timber, highland sheep and a variety of crops (Horlings and Marsden 2011). It follows an inter-cropping system which creates a more drought-resistant and nutrient-rich bio-space for other crops as well as reduces soil erosion and degradation. This limits the need for synthetic fertilizer, weedicides and pesticides. Further, Ethiopian banana is a crop capable of producing over 5.6 tons per hectare/year in agro-forests, making it a great option for sustainable food production. In fact, it is regarded locally as being capable of producing more food-stuff per unit area than most cereals.

This is a model of creating an indigenous agro-ecosystem that works for sustaining the natural resource base for agriculture which is an irreplaceable asset. Moreover it is feasible at commercial levels. For example, Pretty and Hine (2001), in a study of 208 agro-ecological projects in 52 countries, found that commercial farmers had improved profitability, crop productivity, increased water use efficiency, carbon sequestration and reduced their use of pesticide as a result of adopting more sustainable farming systems and not adoption of sustainable practices– note the difference. Important to each of these systems were better use of nature to increase total farm production and improvements in per hectare yield of staples through the introduction of new regenerative elements into farm systems.

Value-Creation vs. Value-Extraction

We can focus on value-creation as opposed to value-extractive agricultural economies. In any economic system, value creation is what matters – specifically, finding the most cost-effective way of generating that value. Value-creating agricultural economies are those that create and/or enhance endemic/indigenous value systems. Ensuring that benefits are accrued to those who need

it most should also be emphasized. Localized value-adding opportunities at the farm level help the farmer to create value chains/systems where primary actors are the primary beneficiaries.

But in order for this to work, we must take into consideration a couple factors.

- First, we must minimize food wastage in the agricultural economy. In a world where as much as 925 million people are hungry (Bread for the World Institute 2011) we throw away 33% of the food produced. In other words, on average, every one of us throws away 70 kg of food a year. In total, this is roughly 1.3 billion tonnes of food each year – an amount that can feed as much as 3 billion people worldwide. If we can think of the food product being thrown away in terms of the water, fuel and energy, labour, ecosystem products and other inputs put into the production process I think that we can all agree that this pattern cannot continue. With a population of about 15.6 million, the Caribbean Region has some 6.7 million persons (43%) who are undernourished and at risk of hunger (ECLAC 2006). Thus, curbing food wastage can have substantial impact on a sustainable development agenda. This will involve a number of interventions aimed at improving food procurement, storage and distribution/redistribution systems, market/supply coordination, mitigating natural hazards as well as consumer education for better utilization of food.

- Second, we must craft new value propositions around core strengths. Yes, we are characterized as small island developing states (SIDS) with a limited resource base, but that does not mean that we have no resources to work with. In agriculture, this means an enhanced business savviness to leverage and/or craft new value propositions around new and interesting products and services for agriculture that are being created anyway. There are a few major areas where the Caribbean can put its focus. For instance, we can focus on under-developed resources with complementarities for agriculture. I speak specifically to culture, heritage, geographic location, biodiversity, as well as product value equity as seriously under-leveraged resources. Leveraging these additional resources can be a game-changer for the Caribbean. In agriculture this can be the difference between “traditional farming”, for example, and “organic farming”; or the difference between “local farming” and cultural/natural heritage-based agro-tourism. To those of us familiar with it, it may seem a simple thing, but when shaped into the appropriate value proposition - it is a fresh, exciting product. For example, both organic products and agro-tourism are picking up pace globally in generating alternative income sources for agriculture. Since 2000, organic product sales have more than tripled from US\$18 billion with healthy growth reported in the United States, Canada, Asia and Latin America (Triple Pundit 2010). In 2013 it was recorded as a US\$72 billion industry by the Organic Monitor. Similarly, agritourism presents an opportunity to leverage historical and socio-cultural resources which are under-developed as a tourism product (natural heritage, biodiversity, culinary, herbal and naturopathic products) especially as it relates to predominant global trends in experiential and wellness travel. One study found that there is a global increase in the number of experiential travelers, especially among the post-World War 2 baby boomers and that on average travelers interested in culture and history spend as much as 45% more per trip per person (Nissenson 2004). Similarly, Wellness Tourism is another niche in experiential travel where spending is on average 130% more than the typical tourist (Hotelnewsnow.com 2015). It is no wonder then that this niche was valued at an estimated US\$3.4 trillion in 2013 (Reuters 2014) with growth forecasts of 9% per annum through 2017- that is 50% faster than the overall tourism industry (Amster 2013). People, food, culture and nature are amongst the top elements in this niche, which offers tremendous complementarities with agriculture. What is

lacking is better specification of the value proposition, publicity and improved sector-specific support and management.

A persistently under-utilized area for crafting new value propositions and overcoming the resource challenges associated with them is collaborative development. The premise is simple - pool resources and competences to satisfy a collective interest. The basic economic framework for doing so already exists for the Caribbean in the form of CARICOM and CARIFORUM. This could easily facilitate collective financing of value-creating initiatives and would be especially useful in scaling-up unique value propositions which may exist in a particular country or group of countries. Some of the key operational elements to look at include - Market Infrastructure for High Value Products. For example Trinitario fine-flavoured cacao, which can be found in several Caribbean countries. The world cocoa market distinguishes between two broad categories of cocoa beans: ordinary or bulk beans (around 85% of all cocoa worldwide) and fine flavour beans, which are the defining component of high quality chocolate. Together, Latin America and the Caribbean produce 80% of the world's fine flavour cocoa and, with six of the recognized 17 countries in the world that produce and export the exotic product being from the Caribbean (Carib-Export 2011). In addition to producing beans for export, economies that may be reached by collective action could make value-added opportunities more cost-competitive; especially in organic, fair trade and other high-end markets. In addition to cacao, fishery and seafood products, essential oils, condiments and specialty wines are also prime candidates for this market segment.

Value-Creation Propositions

As one of the biodiversity 'hot spots' of the world, leveraging endemic species should be an important feature of our development strategy for agricultural enterprise and agribusiness development. For example, the recent development of patents for anti-cancer compounds from the Guinea hen weed (*Petiveria alliacea*) and the Jamaica ball moss (*Tillandsia recurvata*) demonstrate untapped avenues for product development.

What is primarily lacking is a structured, coordinated approach to identifying and evaluating medicinal, functional, nutritive and other beneficial attributes of our native biodiversity to guide product development around a more secure competitive advantage. Important commercial areas that Caribbean economies should consider include specialty chemicals, industrial enzymes, biopesticides, essential oils and the incorporation of components of biological material into high-value commercial products in food and food supplements, as well as personal care products (Tzotzos 2012).

Options for Agri-Financing

There are many options for Agri-Financing, options ranging from public-private financing (PPF), the creation of investment funds as well as crowdfunding. What is important for agriculture is not which to use but how best to use all of them.

There are also new alternative financing mechanisms that can be used at the level of development groups and Civil Society Organizations to effect national impact. For example, crowdfunding is being suggested as an option for treating with the Euro \$3.5 billion debt of Greece. If that is the case, then surely localized projects for creating livelihood options and even agricultural research and development that can be leveraged through collective commons are possible. Another

example: one simple father-son Australian duo was able to raise a record-breaking US\$10 million dollars over the course of a few days for their innovative, new Flow™ Hive body on the Indiegogo crowdfunding platform. They had an initial target of US\$70,000 which was reached in 8 minutes (CNN Money 2015).

This example is particularly meaningful for the Caribbean because it shows that the real needs, and the competence to implement are sound value propositions. And while donor funding has always been important to agricultural development, it must be noted that with the mounting global economic vulnerability, it is uncertain the extent to which this funding will last. This means that instead of settling into a state of complacency, Caribbean economies need to maximize the efficiency with which donor funding/ official development financing (ODF) is used.

Conclusion

While agriculture in the 21st century must be a partnership and a shared responsibility between all relevant stakeholders including – governments, the private sector, civil society, research centers and universities etc., I do believe that it is the responsibility primarily of the governments of our region to create a facilitating environment. It is only when national/regional policies bring convergence to food and agricultural production, nutrition and health, the environment and our socio-economic conditions, we can build a future for generations to come.

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TFP is the portion of output not explained by the amount of inputs used in production. It is thus reflective of efficiency gains associated with how well inputs are utilized (i.e. process innovations).

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