Global Agricultural Revolutions, Trade, Policies and Vision

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By

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Cambridge
Scholars
Publishing

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This book first published 2019

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN (10): 1-5275-3154-6
ISBN (13): 978-1-5275-3154-3

Dedicated to My Parents

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PREFACE

The perceived limits to producing food for a growing global population have been a source of debate and preoccupation for ages. Both experts and the public have been vigilant when regarding the world food situation and outlook. The global agricultural vision has recently moved from eliminating hunger and poverty to a new focus on food security, nutritional security, climate change and economic opportunity. The overall approach can be classified into four strands: food for peace, food for growth, food for the planet, and food for health. This book discusses global agricultural revolutions and visions both in general and from regional, continental and national perspectives, with a particular focus on the World Trade Organization and markets. It will serve as inspiration for historians, practitioners, global institutions; WTO, World Bank, IMF and policy-makers in the field of global agriculture in determining a roadmap for global leaders in years to come.

ACKNOWLEDGEMENTS

This work would not have been possible without the support and encouragement of Dr. C.H. Rao, Director, NAARM. This research was supported by, ICAR and SERB, DST, Government of India. I thank my colleagues T.K. Immanuel Raj, Ganesh Gouda I. Patil, B Ganesh Kumar, P. Shinoj, MNV Prasad Gajula, S.M. Jainuddin, Anjani Sneha Vajrala who provided insight and expertise that greatly assisted the research,

I thank the support of Sweety Sharma, Sai Priyanka, Deepika, P Srinivas and Sweta Mishra for their contribution in the book editing.

I am grateful to all of those with whom I have had the pleasure to work during this and other related projects. Each of the person has provided me extensive personal and professional guidance and taught me a great deal about both scientific research and life in general.

Nobody has been more important to me in the pursuit of this project than the brothers, sisters and members of my family. I would like to thank my parents, whose love and guidance are with me in whatever I pursue. They are the ultimate role models.

CHAPTER ONE

GLOBAL AGRICULTURE: VISION AND APPROACHES

Abstract

The perceived limits to producing food for a growing global population have been a source of debate and preoccupations down through the ages. Experts and the public alike seem to alternate between pessimism and optimism, anxiety and complacency, about the world food situation and outlook. Agriculture in the 21st century has multiple challenges. Globally, agriculture it seems is back on the development agenda to meeting the Millennium Development Goals. This chapter analyzes and traces insights of past and present global agriculture and frames a new vision of it. The status of global agriculture in general and continents' and country-wise policies in particular from 61 countries of 6 continents were collected and insights are analyzed. These continent-wide policies can safeguard each country's independence. The New Vision for Agriculture calls for a new approach. The new approach of global leaders is aligned around the New Vision for Agriculture. Development of a "Road map for Achievement of the Vision" is providing a framework for action and collaboration of global leaders. These include exchanging ideas, collaborating with international scientists and agricultural institutions as part of the solution. The study found that agriculture must be on the global agenda in future and all countries should fix a minimum support price policy, which must be world prices plus 20% extra. The "double by 2050" analysis from the United Nations Food and Agriculture Organization revealed that food production in the developing countries would need to almost double. Developing countries have witnessed higher demands (2025) for wheat, maize, soybean, pig meat, poultry meat, sheep meat, beef and veal, whereas developed countries have witnessed higher demands for sugar. The globe has to develop a new strategy and global policies to meet the requirements of the rice quantity. The future task of CGIAR and FAO is to act as an intelligent think tank to acquaint and analyze global research knowledge on future

technologies, inventions, income models, latitude-based science, space technologies, farm computer, global agricultural growth and policy coordination, climate financing, genetically modified crops on Mars, understanding too many variable effects on agriculture, digital agriculture, industrial farming, international agricultural education and transfer to capacity building of the NARES System.

Keywords: Continents, Global agriculture, New Vision, Policies

Introduction

The perceived limits to producing food for a growing global population have been a source of debate and preoccupation down through the ages. Already in the third century AD, Tertullian, a church leader, raised the issue (Alexandratos, 1997). The debate gathered momentum in the late 18th century, following Malthus, and more recently with Paul Ehrlich's "Population Bomb". Alexandratos and Bruinsma (2012) reported that world food production grew faster than the population. Agriculture in the 21st century has multiple challenges. It has to produce more food and fiber to feed a growing population with a smaller rural labor force, more feed stocks for a potentially huge bioenergy market, contribute to overall development in the many agriculture dependent developing countries, produce more efficient and sustainable production methods and adapt to climate change (FAO, 2012). In the face of climate change, global political and food insecurity, volatility of global market prices and the resurgence of health crises, only an ambitious, continent-wide policy can safeguard each country's independence. Experts and the public alike seem to alternate between pessimism and optimism, anxiety and complacency, about the world food situation and outlook. For the past few decades, the rate of growth in world food production in both developed and developing countries has exceeded the population growth rate. During the 1970s and 1980s the food situation improved tremendously (Mrityunjay and Singh, 2008). But by the 1980s and 1990s the increasing scarcity of land and water resources, environmental degradation, and loss of biodiversity had begun to limit the expansion of food production in both developed and developing countries (Dastagiri, 1998).

World Watch Institute (2004) reports that increases in food production, per hectare of land, have not kept pace with increases in the population, and the planet has virtually no more arable land or fresh water to spare. The FAO (2011) emphasizes that agricultural investment is essential to promoting agricultural growth, reducing poverty and hunger, and promoting

environmental sustainability. Reports on global food security in 2011 by the IFPRI (2011) and other reports of the FAO (2012), the World Bank (2011), and the International Fund for Agricultural Development (2011), all highlighted the need for governments to ensure responsible investment in agriculture.

Global food security – or, in more traditional terminology, world hunger remains a serious concern. However, even at the global level, current food supplies are sufficient to nourish the world population. Food insecurity, therefore, results from uneven distribution. In the coming decades, calorific production is projected to further outpace population growth (Valentin, 2011). Global food crises are turning out to be far too frequent to be any longer dismissed as a freakish phenomenon. A spike in the prices of agricultural commodities is again looming, threatening a repetition of the 2007-2008 global food crisis when international prices skyrocketed to their highest in 30 years (Caliber, 2012).

The International Monetary Fund (IMF)'s food price index rose by over 80 per cent between the start of 2007 and mid-2008. Severe drought in the United States, flooding in several parts of Europe, a massive shortfall of rain in Africa and India are feared to lead to huge loss of output and a scramble for markets and supplies (Subramaniam, 2012). As in many other parts of the world, soaring food prices during the period 2007-08, had major impacts on the countries of Southeast Asia.

Globally, agriculture seems to be back on the development agenda, seen as a key to spurring growth and reducing poverty, and as a key route to meeting the Millennium Development Goals. The U.S. Global Research Program, which is a consortium of 13 federal agencies, published a report in December 2015 that said climate change is very likely to affect global, regional, and local food security by disrupting food availability, decreasing access to food, and making utilization more difficult (Kimberly, 2016). In the face of climate change, global political and food insecurity, volatility of global market prices and the resurgence of health crises, only an ambitious, continent–wide policy can safeguard each country's independence. The main focus of the study is to analyze global agricultural policies, visualize global agriculture and frame a new vision for the growth and development of global agriculture. The main objectives of this chapter are:

1. to analyze and trace insights of past and present global agriculture;
2. to visualize global future agriculture; and

3. to frame research vision and approaches and suggest polices for global agriculture.

Data and Methodology

The study is based on meta-analysis of global agricultural policies and vision framework. The status of global agricultural policies in general, and continents and country-wise in particular, from 61 major countries of 6 continents' policies and insights were analyzed. The continents namely, European Union (29 countries), North America (3 countries namely, the USA, Mexico and Canada), Asia (13 countries including China), South America (8 countries), Africa (7 countries), and Australia were purposefully selected to analyze and to trace insights of past and present agricultural policies.

The data and information on global agricultural policies were collected from UNO, FAO, IFPRI, World Bank, WEF, OECD, CGIAR reports and other secondary and published secondary sources and websites. The secondary data related to demand (consumption) and supply (production) of major agricultural crops namely, rice, wheat, maize soybean, pig meat, poultry meat, sheep meat, beef and veal meat were collected from OECD-FAO Agricultural Outlook 2016-2025 and growth rates were estimated. A continent-wide policy can safeguard each country's independence. The continent-wise policies are critically appraised and compared with one another and best policies are arrived at. The global vision of agriculture projected by the UNO, FAO and CGIAR were collected and a new research vision and approach was framed. Finally, suggestions are made to integrate global agricultural policies for the future. The study used the Delphi survey method to validate the results obtained through secondary data (Dalkey and Helmer, 1963). It also suggests the best future global agricultural policies.

Results and Discussion

The UN global key variables beyond 2050 which influence food security are presented in Table 1.1. The UN population projections – from the medium variant of the 2008 indicate that the total world population total could reach 9.15 billion in 2050. Thus, we expect an increase of 2.25 billion over the next 40 years, which is lower than the 3.2 billion increase that materialized between 1970 and 2010. This deceleration will impact world agriculture by lowering its rate of growth compared to the past. According to the Medium Variant projection, world population is expected to peak

around the year 2075 at 9.4 billion and then start declining slowly to 9.2 billion by 2100.

Demand for cereals, for both food and animal feed uses are projected to reach some 3 billion tons by 2050, up from today's nearly 2.1 billion tons. The advent of biofuels has the potential to change some of the projected trends and cause world demand to be higher, depending mainly on energy prices and government policies. The projections show that feeding a world population of 9.1 billion people in 2050 would require raising overall food production by some 70 per cent between 2005-07 and 2050. Production in the developing countries would need to almost double. This implies significant increases in the production of several key commodities. Annual cereal production, for instance, would have to grow by almost one billion tons, meat production by over 200 million tons to a total of 470 million tons in 2050, 72 per cent of which in the developing countries, up from the 58 per cent today. This shows that for the world as a whole, the pressures on agriculture to produce more food for the growing population will decrease beyond 2050 as indicated in projections for the period 2005 to 2050. The results show that global agricultural production would need to grow at 0.4 per cent per year from 2050 to 2080, i.e. less than half the growth rate projected for the period 2005-2007 to 2050.

Table 1.1. Global key variables beyond 2050 which influence food security

Key Variables	2005	2050	2080	2100
Population (million)- UN 2008 revision	6592	9150	9414	9202
Population (million)- UN 2010 revision	6584	9306	9969	10125
Cereals, food (kg/capita)	158	160	161	
Meat, food (kg/capita)	38.7	49.4	55.4	
Oil crops (oil. equiv.), Food (kg/cap)	12.1	16.2	16.9	
Cereals, production (million tons)	2068	3009	3182	
Meat, production (million tons)	258	455	524	

Source: Alexandratos and Bruinsma (2012).

OECD & FAO projections:

The demand (consumption) and supply (production) of major agricultural crops are presented in Table 1.2. The results show that demand for rice in 2025 will be marginally more compared to the supply of rice in the world, whereas demand for wheat, maize and soybean would be moderately higher in developing countries compared to supply. In case of sugar, developed and OECD countries witnessed moderately higher demands than the supply of sugar, while other countries witnessed the reverse trend. The results reveal that growth rate of demands is found to be marginally higher for wheat (1.27%) and sugar (2.49%) compared to supply growth rate in developing countries, whereas in other crops and in other countries it witnessed a reverse trend.

The demand (consumption) and supply (production) of meats for 2025 are presented in Table 1.3. It shows that demand for pig meat, poultry meat, sheep meat, beef and veal were found to be marginally higher in developing countries compared to supply, whereas in developed and OECD countries a reverse trend was observed. The results reveal that growth rate of demands were found to be marginally higher for pig meat, poultry meat, beef and veal compared to supply growth rate in developing countries, whereas other crops and other countries have witnessed a reverse trend in growth rate.

The results found that developing countries have to concentrate and follow strategic action to meet the future demands (2025) of wheat, maize, soybean, pig meat, poultry meat, sheep meat, beef and veal, whereas developed countries have to concentrate more to meet the future sugar demands. The globe has to develop a new strategy and global policies to meet the future requirements of rice. The livestock sector could play an important role in the process of global economic development and can significantly contribute to economic growth, poverty reduction and attainment of the Sustainable Development Goals. Despite the potential contribution of livestock to poverty reduction, the sector seems to be largely neglected by policy makers (FAO, 2008).

Table 1.2: Demand and Supply Projections for Major Agriculture crops (2018-2025) (million tons)

Crops	2018		2025		Growth rate of Projected (%)	
	P	C	P	C	P	C
RICE						
World	517.7	519	562.6	563.2	1.20	1.17
Developed countries	18.4	18.9	19.1	19.4	0.53	0.37
Developing countries	499.3	500.1	543.5	543.8	1.22	1.20
OECD (2)	21.7	22.8	22.1	22.8	0.26	0.00
WHEAT						
World	739.8	740.4	791.3	789.6	0.97	0.92
Developed countries	383.2	273.4	403.3	279.5	0.73	0.32
Developing countries	356.5	467	388	510.1	1.22	1.27
OECD (2)	293.6	225.4	306.6	229.8	0.62	0.28
MAIZE						
World	1048.5	1060.1	1146	1143.4	1.28	1.09
Developed countries	507.9	474.2	541.5	492.2	0.92	0.53
Developing countries	540.5	585.9	604.5	651.2	1.61	1.52
OECD (2)	475.6	491.8	504.8	509.2	0.85	0.50
SOYBEAN						
World	334.72	334.92	393.89	393.87	2.35	2.34
Developed countries	125.97	88.67	135.87	93.41	1.09	0.75
Developing countries	208.76	246.25	258.02	300.46	3.07	2.88
OECD (2)	117.49	88.88	125.13	93.86	0.90	0.78
SUGAR						
World	181.93	178.16	210.03	204.74	2.07	2.01
Developed countries	41.94	46.74	43.95	48.58	0.67	0.55
Developing countries	140	131.42	166.09	156.16	2.47	2.49
OECD (2)	40.56	43.24	42.26	44.92	0.59	0.55

Note: P-Production, C-Consumption, Accessed on 3rd June 2017. Mt-Metric tons.
Source: OECD/FAO (2016), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database).

Table 1.3: Demand and Supply Projections for Meats (2018-2025)

Country	Unit	2018		2025		Growth rate of Projected (%)	
		P	C	P	C	P	C
World							
Beef and Veal	Mt cwe	70.89	70.60	77.77	77.46	1.33	1.33
Pig meat	Mt cwe	121.53	121.34	131.00	130.8	1.08	1.08
Poultry Meat	Mt rtc	119.32	119.32	131.26	131.26	1.37	1.37
Sheep Meat	Mt cwe	15.08	15.11	17.44	17.43	2.10	2.06
Developed countries							
Beef and Veal	Mt cwe	29.78	29.14	31.25	30.50	0.69	0.65
Pig meat	Mt cwe	44.73	41.38	46.08	42.18	0.43	0.27
Poultry Meat	Mt rtc	49.34	46.58	52.58	49.38	0.91	0.84
Sheep Meat	Mt cwe	3.32	2.67	3.61	2.78	1.20	0.58
Developing countries							
Beef and Veal	Mt cwe	41.11	41.46	46.52	46.96	1.78	1.80
Pig meat	Mt cwe	76.80	79.96	84.92	88.62	1.45	1.48
Poultry Meat	Mt rtc	69.98	72.74	78.68	81.87	1.69	1.70
Sheep Meat	Mt cwe	11.75	12.44	13.83	14.65	2.36	2.36
OECD countries							
Beef and Veal	Mt cwe	28.01	26.93	29.21	28.03	0.60	0.57
Pig meat	Mt cwe	42.39	39.64	43.63	40.53	0.41	0.32
Poultry Meat	Mt rtc	47.66	44.67	51.00	47.31	0.97	0.82
Sheep Meat	Mt cwe	2.65	2.00	2.87	2.06	1.15	0.42

Note: P - Production, C - Consumption, Mt cwe - Metric tons at carcass weight equivalent, Mt rtc - Metric tons at ready to cook.

Source: OECD/FAO (2016), "OECD - FAO Agricultural Outlook", OECD Agriculture statistics (database)

Based on these projections, UN and FAO established a vision for agriculture. UN vision: Global agriculture needs a "profound transformation" to fight climate change and protect food security (Harvey, 2016). The New Vision for Agriculture (NVA) calls for a new approach to agriculture that will deliver food security, environmental sustainability and economic opportunity (WEF, 2010).

FAO vision: "Hunger, poverty and climate change need to be tackled together" (FAO, 2016).

The CGIAR (Consultative Group on International Agricultural Research) **and FAO vision** must be global knowledge institutions enabling the National Agricultural Research and Education System (NARES) to adapt to change through continuous innovations.

Keeping in mind the national and global objectives and goals, the researchers and institutions have to plan and learn at the global level and apply at the local level. The researchers have to become familiar with global knowledge on innovations, cutting edge technologies, Global e-Business and policies and teach the scientists in the NARES of different countries to improve their capabilities.

Global agriculture needs a "profound transformation" to fight climate change and protect food security. "Hunger, poverty and climate change need to be tackled together which includes exchanging ideas, collaborating with international scientists and agricultural institutions as a part of the solution. The "double by 2050" analysis was based on cited food-demand projections from the United Nations Food and Agriculture Organization.

Global food systems are increasingly at risk. Rising demand, scarce resources and increased volatility are placing new pressures on an already-stressed agriculture sector. Over 870 million people, many of them small farmers, remain chronically hungry and undernourished (WEF, 2013)**.** In response to this challenge, the New Vision for Agriculture calls for a new approach to agriculture that will deliver food security, environmental sustainability and economic opportunity (WEF, 2010). Achieving this vision requires a comprehensive approach to transforming whole value chains and systems, harnessing the power of market-based solutions, and engaging local and global stakeholders in an unprecedented joint effort (Desmarais and Handy, 2014).

A New Approach:

Global leaders have aligned around the New Vision for Agriculture (NVA). Regional and national leaders have adopted the vision as their own, catalyzing action-oriented partnerships in Asia, Africa and Latin America. These activities have engaged over 250 organizations and activated commitment, collaboration and innovation among a broad network of over 800 leaders. Complementing and accelerating these activities has been supported by global platforms including the G8 and the G20.

Partnerships catalyzed by the NVA include:

Global Partnerships catalyzed by the New Vision for Agriculture are shown in Table 1.4. National-level partnerships in Vietnam, Indonesia and Mexico, and a state-level partnership in Maharashtra, India, a regional partnership in Grow Africa (jointly convened with the African Union, NEPAD and WEF), which has mobilized investment commitments and supported partnerships in alignment with the national plans of seven countries in Sub-Saharan Africa: Burkina Faso, Ethiopia, Ghana, Kenya, Mozambique, Rwanda and Tanzania anchored around government plans, and partnership-based actions on taking stock of new models at the global, regional, and country levels. The New Vision for Agriculture journey is composed of 3 stages:

1. Achieving alignment around a concept and vision for partnership.
2. Proving new concepts by demonstrating success on a small scale, through partnership-based action, starting with pilot projects.
3. Embedding the partnership approach and scaling it through institutions and national programs.

Development of a “Road map for Achievement of the Vision” and providing a framework for action and collaboration, for global leaders.

Table 1.4. Partnerships catalyzed by the New Vision for Agriculture

Levels	Partnership Catalyst	Agency
National level	Indonesia, Vietnam and Mexico	PISAgro in Indonesia, Public-Private Task Force on Sustainable Agricultural Growth in Vietnam, Mexican Agribusiness Partnership for Sustainable Growth (ALMA) in Mexico
State level	Maharashtra, India	Maharashtra State Public-Private Partnership, Government of Maharashtra, India
Regional level	Grow Africa (Sub-Saharan Africa 7 countries viz., Burkina Faso, Ethiopia, Ghana, Kenya, Mozambique, Rwanda and Tanzania)	Jointly convened with the African Union, NEPAD and World Economic Forum

Note: NEPAD-New Partnership for Africa's Development.
Source: World Economic Forum, 2013.

Global Models Transformation in Agriculture

Continent-wise policies such as Europe, North America-US, Mexico, Canada, Asia, Latin America, Africa, Australia and World Government Polices are mentioned in Table 1.5. The results conclude that,

1. The basic changes in Europe models are transformation from supply-driven models of traditional agriculture to demand-driven market-oriented agriculture.
2. The North American Model changes to income supports, countercyclical program, decouple key support programs from production decisions and market-oriented agriculture
3. Australian model is market-oriented agriculture (Low import duties), Targeted payments and Farm Household Allowance Program.
4. The Latin America new twist to the Green Revolution model, with genetically modified (GM) crops and run by transnational corporations.
5. In Africa, agriculture is significantly funded by donors. (USAID, World Bank, Bill Gates Foundation)
6. The successful Asian State Green revolution model focuses more on seed and technologies to increase production.

7. The Bill and Melinda Gates Foundation refreshed its agriculture strategy with a strong focus on agricultural development in Sub-Saharan Africa and South Asia.
8. The Global vision suggests focusing future policies on agriculture as a global agenda and global efforts.

Global Price Policy

Policy measures taken by governments to reduce the impact of higher food prices along with a number of other countries, the seven emerging economies made various policy interventions in response to higher food prices. These measures differ in terms of their orientation: whether policies are directly orientated to affect consumers, producers or trade. The most common policy response taken by the emerging economies – and also worldwide – has been to reduce import tariffs on food products. The next most common response has been to impose export barriers. The measures imposed by India, Russia and Ukraine were particularly significant given the potential quantities involved. Another common response was to release government held stocks, particularly of grains, to the domestic market to ensure supply and reduce upward price pressure. Another response has been to stimulate domestic production by raising minimum prices and expanding input subsidies. Retail price controls have been introduced in China, Russia and Ukraine. China and South Africa made changes to their biofuel policies to reduce pressure on food security. Chile and South Africa provided additional direct transfers to those most vulnerable to the effect of higher food prices: a cash-based transfer in Chile and the provision of food in South Africa.

International policies and factors affecting price and income volatility of farmers.

The reasons for price and income volatility of farmers namely, demand and supply, political and legislative, exchange rate, energy, fertilizer prices, interest rates, WTO, weather and disasters, production technologies, future markets, insurance, promotion of public policies and safety nets.

Table 1.5. Continent-wise agricultural policies which transformed global agriculture

Sl. No	Continent/ Country	Policies and Remarks
1.	European Union (29 countries)	The European Union undertook many measures or policies for the development of the agricultural sector. It has adopted a common agricultural policy for the entire union. It offers direct payment after WTO, direct subsidies, domestic (buying), Border (exports subsidies and import duties), price dismantling and many market support measures.
2	The North American Continent United States of America Mexico Canada	• Farm Bill, 1995 • Direct Payment 2002, 2008 • Counter cyclic payments • Fixed direct payments 1990-2013 • Price loss coverage • Crop Insurance Program • Farm Bill account 489 Billion $ in 2014-18 budget • Focus on Market Income • Zero interest rates to farmers • Majority in the US elections depends on farmers' votes (1.4%).
3	Australia	• Market Oriented Agriculture (Low import duties) • Targeted payments • Disaster Assistance • Tax Concessions • Farm Household Allowance Program
4.	Asia	The successful Asian State Green revolution model focuses more on seed and technologies to increase production and increased market access.
5.	Africa and Sub Saharan 7 countries	In Africa, agriculture depends significantly on aid provided by donors. DFID. USAID, World Bank, OECD, Bill Gates Foundation etc.
6.	South America (8 countries viz., Brazil, Argentina Bolivia, Colombia, Chile, Ecuador Mexico, Uruguay)	• Removed agricultural taxing which resulted in doubled productivity in crops, and tripled productivity in livestock. • Separate ministries MAPA- Commercial Agriculture, MDA-Small Scale Farmers • Rural Credit and MSN Price Guarantee • Agricultural Insurance and Subsidies • Subsidized Credit

7	World Government Policy	The most common policy response taken by the emerging economies and also worldwide has been to reduce or suspend import tariffs on food products.
8.	China	China is the largest producer, consumer, exporter as well as importer of most of the agricultural commodities in the world. It adopted policies such as Market intervention; Tariffs, Tariff rate quotas; and direct payments to help the farmers. It provides 20% of the higher minimum support price (MSP) to crops compared to the average world support price.
9	Global Livestock policy	• The European Union established a body of law and policies namely, Animal Health Law in 2016, New Slaughter Regulation in 2013 etc. • In Africa and sub-Saharan Africa countries livestock policies are namely, Livestock Policy of Tanzania (1983), National Livestock Development Policy of Kenya (1980), Meat Commission in Kenya, livestock development policy in Ethiopia (1992) etc. • In China, livestock policies are: Feed policy in 1999, Consumption rationing policy in 2000, Subsidies to large producers, privatization of livestock sector etc. • In India, livestock polices are: National Livestock Policy (2013), Animal Welfare Act (2011), Prevention of Cruelty to Animals (Regulation of Livestock Markets) Rules (2017) etc. • In the USA: Mandatory Price Reporting (MPR) program in April 2001, The Farm Security and Rural Investment Act of 2002, Farm Act 2008, The Agricultural Act of 2014 (2014 Farm Bill) etc.

Future Task: Global knowledge must pass on to NARES institutions. CGIAR and FAO must acquaint, analyze global research knowledge on future technologies, inventions, income models. Latitude-based science, space technologies, farm computer, and global agricultural growth and policy coordination, climate financing, GM crops on Mars, understanding too many variable effects on agriculture, industrial farming, international agricultural education and transfer to capacity building of NARES System. Digital agriculture, scientific discoveries, big data boom. There must be a research intelligence think tank.

Conclusions

Global agriculture needs a "profound transformation" to fight climate change and protect food security, hunger, poverty. In response to this challenge, the New Vision for Agriculture calls for a new approach. The new approach is that global leaders have aligned around the New Vision for Agriculture. Regional and national leaders have adopted the vision as their own, catalyzing action-oriented partnerships in Asia, Africa and Latin America.

The "double by 2050" analysis from the UNFAO revealed that food production in the developing countries would need to almost double. The results found that developing countries have to concentrate and follow strategic action to meet the future demands (2025) for wheat, maize, soybean, pig meat, poultry meat, sheep meat, beef and veal, whereas developed countries have to concentrate more on meeting future sugar demands. The world has to develop a new strategy and global policies to meet the future requirements for rice. The livestock sector could play an important role in the economic development of the world.

Partnerships catalyzed by the NVA include: National-level partnerships in Vietnam, Indonesia and Mexico, and a state-level partnership in Maharashtra, India, a regional partnership in Grow Africa. Anchored around government plans, the partnerships focus on taking stock of new models at the global, regional, and country levels. The New Vision for Agriculture journey is composed of achieving alignment around a concept and vision for partnership and embedding the partnership approach and scaling it through institutions and national programs. Development of a "Road map for Achievement of the Vision", providing a framework for action and collaboration for global leaders, exchanging ideas, collaborating with international scientists and agricultural institutions is part of the solution.

The basic changes in European models concerning the transformation from supply-driven models of traditional agriculture to the concept of modern agriculture focusing on demand-driven types of market agriculture. The North American Model; the United States, Mexico, and Canada have each made significant changes to their agricultural policies over the past several years particularly in the area of income supports. The Latin America continent was confronted with a new twist to the Green Revolution model, with the introduction of genetically modified crops and run by transnational corporations. In Africa, agriculture is operated by the significance of aid provided by donors. The successful Asian State Green revolution model

focuses more on seed and technologies to increase production. The most common policy response taken by the emerging economies and also worldwide, has been to reduce or suspend import tariffs on food products.

The study suggests that the future task of CGIAR and FAO should act as an intelligence think tank to acquaint, analyze global research knowledge on future technologies, inventions, scientific discoveries and transfer these to capacity building of the NARES System. The study suggests focusing on future policies in agriculture as a global agenda and global efforts. All countries should fix MSP at 20% higher than the world average price.

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CHAPTER TWO

WORLD FOOD PRODUCTION RESEARCH

Experts and the public alike seem to alternate between pessimism and optimism, anxiety and complacency, about the world food situation and outlook. For the past several decades, the rate of growth in world food production in both developed and developing countries has exceeded the population growth rate. World population statistics estimate that, additions to the world population will be around 933 million and 921 million, respectively, during the two decades up to 2010. The growth rate is expected to decline from 2.1% a year during 1985-90 to 1.5% during 2005-2010.

During the 1970s and 1980s the world food situation improved tremendously. But by the 1980s and 1990s, the increasing scarcity of land and water resources, environmental degradation, and loss of biodiversity had begun to limit the expansion of food production in both developed and developing countries.

Economic liberalization and market globalization have opened up unique opportunities for sharing global markets thereby challenging creativeness and technological abilities in achieving comparative advantage and making new inventions. As economies of scale and the multiple effects of technology favor developed countries there is an increasing need for the research scientists of developing countries also to be skilled in developing global competitive technology.

The FAO statistics show that external assistance to the developing countries agricultural sector dropped from US$ 8.25 billion in 1989 to about US$ 4.7 billion in 1994. In other words, developing countries must now increase their degree of self-dependence in agricultural research. For instance, compared to an average allocation of 1.5 to 2.0% of GDP to agricultural research in developed countries, the allocation in developing countries is barely 0.2 to 0.3%. Various international agencies have recommended that the allocation should be enhanced to at least 1.0% of GDP in the developing countries. The global agricultural research system presently encompasses three different, interacting partners:

(i) the International Agricultural Research Centres (IARCS) of the Consultative Group for International Agricultural Research (CGIAR),
(ii) UN organizations, particularly FAO, UNEP, UNDP, World Bank, and
(iii) National Agricultural Research Systems.

A global agricultural research system for the 21st century will depend upon the potential coordinating power of the CGIAR as the principal international component. It can do this through its ability to form international multidisciplinary teams of highly qualified scientists in "centers of excellence" to concentrate on high priority research, also thereby drawing upon appropriate scientific advances from the developed world.

Cooperation and coordination of global research activities are the key elements in all this. The evidence for it is unanimous and overwhelming. It comes from the World Bank, from the International Agricultural Research Centres, from universities and institutes in all parts of the world, and from scores of individual economists, policy makers, scientists, historians, sociologists and environmentalists of every nationality.

Here are some specific comments offered by eminent experts in *The Globalization of Science: the Place of Agricultural Research,* ISNAR, 1997.

President James Wolfenson of the World Bank:

> "Unless we address the issues of sustainable agriculture, we will be unable to accomplish our goals of poverty reduction, food security and sustainable natural resources management. We must give the highest priority to the agriculture and rural sector since their neglect means that neither rural nor urban poverty can be reduced."

Vice President Al Gore of the USA:

> "What is required now are . . . massive efforts to design and then transfer to poor nations the new technologies needed for sustained economic progress."

Ismail Serageldin, Chairman, CGIAR:

> "The World's basic objectives of poverty reduction, food security and sustainable natural resources management cannot be met unless rural well-being in general, and a prosperous private agriculture for small and medium size holdings in particular, are nurtured and improved."

M.S. Swaminathan:

> "To eliminate endemic hunger at the level of the individual it will be necessary to . . . sensitize and mobilize public opinion through the media and to generate appropriate political action."

Julian Cribb:

> "It is possible to improve world awareness in this matter and if we do not attempt to do so then we have failed to discharge our responsibility to future generations and to the planet itself."

Throughout history, yearly crop productivity gains have mostly been small and marginal: about 2 to 15 kg per ha per annum (1% or less). Gains of this order are too small to be of much benefit by themselves. But over the past 40 years, the growth of agricultural productivity, both in terms of yield gains and total production, has been impressive and the yield gains achieved hold promise for making future gains. Achieving the necessary future gains will depend on expanding the knowledge base as well as developing an array of new technologies to support the needs of ever-expanding populations.

Since the early 1980s, continued world population growth has resulted in a gradual reduction in the availability of agriculture land per capita from 0.93 ha in the mid-1970s to a prospective 0.5 ha by 2000. For countries that already have scarce land resources and high population, per capita agricultural land availability has been estimated to be much lower – 0.3 ha in the 1970s and 0.17 ha in the year 2000. In China, per capita land availability is estimated to be as little as 0.1 ha, and 0.11 ha in India by the year 2000.

World cereal yields in 1990-92 averaged 3.84 tons per ha for maize, 3.55 tons for paddy rice, 2.53 tons for sorghum, and 0.78 tons for millet. All of these values are well above the average yields of those crops in the highest producing developing countries and yet far below theoretical yields. There is clearly still room for yield improvement in most of the crops and regions.

Future needs can be achieved with new technologies with the following basic provisos: there will be continued intensification of agriculture; environmental concern can be partly addressed by enhancing and sustaining production on the best lands, thereby reducing mounting pressure on fragile marginal lands; and priority should be given to investment in research to find new pathways for productivity gains.