A Tale of Two Ecosystems
Advances in Agricultural Research on Basic Food Crops in Dry land Ecosystems: Opportunities and Handicaps

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ABSTRACT

This presentation will give a historical introduction and comparison of winter rainfall and summer rainfall ecosystems, including initiation of research and development (R&D.) in each. This will be followed by a brief statement of the components of each of the two systems: biotic, abiotic, socio-economic and socio-political. Commodity crop breeding spearheaded research all the way till the turn of the 21st Century. This was supported by research in crop husbandry, IPM, pathology, soils, water including supplementary irrigation...etc. The paper will touch on genetically modified crops and the role of multinationals in this regard. Handicaps and potentials for futuristic outlook will be discussed.

INTRODUCTION

This is an endeavor to portray a panoramic view of the present state of food and agriculture in two ecosystems in West Asia and North Africa (WANA) region; and in the Sahel zone which includes most parts of the Sudan. The former region has its rains entirely in the winter months, while the Sahel zone is a summer rains ecosystem. The concentration is primarily on two crops, namely wheat and Dura (Sorghum). A preview of climate in both winter and summer rainfall in these two ecosystems is an important background.

On the research and development in the winter-rain system, I have relied heavily on the book entitled “ICARDA25: A Promise of Hope” by Mohamed A. Nour. On the summer rains zone, I acknowledge with gratitude my liberal use of the excellent book “Mechanized Rain-fed Agriculture in the Sudan “by Dr. M.O.H. Karouri. On weather systems in the Sahel region, my primary source came from Professor Abdel Mohsin El Nadi who, generously, supplied me with rich references.

RAINS IN THE TWO ECOSYSTEMS

Summer rains: This rain system, previously called Intertropical Front, is a system of moist winds from the Atlantic and Indian Oceans (Monsoons bring summer rains as they enter the equator in the early summer and move north until they are opposed by cool dry
winds from the north across the Sahara). The balance between the moist and dry winds determines the extent of the Intertropical Convergence Zone (ITCZ) within which various crops can be grown. As the summer months advance, the ITCZ keeps moving north until August to September, reaching the latitudes of Shendi and even further north in some years. From October onwards, hardly any rain falls in the Sahel until the following summer.

**Winter rains:** The WANA region has its rains throughout the winter months, from October to March. The rains come from the Atlantic westerly winds and the Mediterranean. Sometimes snow falls on this region when the winds blow south from East Europe. All annual crops are grown in this season.

**INTERNATIONAL AGRICULTURAL RESEARCH CENTRES**

We need to touch upon a major international research facility, a non-governmental body of closely integrated world centers, 14 of them dealing with almost all the basic food crops and also animals, fisheries, forestry and other related fields. For the aims of this specific topic, the most relevant centres are CIMMYT in Mexico (dealing with wheat and maize), ICRISAT in India (dealing mainly with summer rain-fed crops in semi-arid regions, such as sorghum), ICARDA in Syria (dealing with barley, wheat and other winter crops, particularly in the WANA region). ILRI in Kenya (researching on farm animals especially in Africa) ; World Agro-forestry in Kenya ; fisheries ;and others.

**BASIC FOOD CROPS IN THE TWO ECOSYSTEMS**

**A common feature in both ecosystems is the steep variation in crop yield from one year to the next**

**Winter rain crops:** Both soft and hard wheat constitute the basic staple diet of the WANA population together with lentils, chickpea and other leguminous crops such as faba beans. Meat, especially mutton, is prevalent but, as always, it is available through its high price to the richer sectors of the society. Olives (and its oil) is a basic ingredient in the daily food of all population strata. The WANA region is rich in several species of fruit and vegetable crops which, in varying degrees, go to complement the daily foods of the population. But, wheat is singled out as a key basic food crop.

**Summer rain crops:** Here also I have chosen Dura (sorghum) as the principal basic food crop. Other food crops are grown in rain-fed agriculture, such as pearl millet (Dukhun), sesame, groundnut, sunflower and cotton (for lint and oil). The same crops are also grown under irrigation (except Dukhum) in the Sudan; in which cases, the yields are significantly higher.
The Case of Wheat in WANA and in the Sahel Zone

1. Wheat is the staple grain/flour source for all the WANA region and well beyond. With the seemingly ever-growing population the import gap is ever-widening over local production. In fact, the whole Arab region, including the Sudan, is the largest per capita importer of basic food commodities in the whole world; and the trend is ever-increasing.

2. In Syria, the trend was reversed. Instead of being a net importer of wheat of more than 50% of its needs, and as a direct result of the positive impact of ICARDA’s researches, Syria became a net exporter until the onset of the current war.

3. In the Sahel zone, Ethiopia stands top in production, with Sudan next; the former is rain-fed, whilst Sudan’s wheat is totally irrigated. Comparing production versus import of wheat in Sudan and Egypt (both irrigated) over two years a decade apart, show that both countries are importing wheat increasingly despite the positive impact of research. Bread wheat is being significantly more consumed in both countries, with lesser demand on other cereals such as maize in Egypt and seemingly sorghum in the Sudan.

The Case of Sorghum in the Sahel Zone and in the WANA region

1. Sorghum is the predominant grain staple diet of the Sahel (with pearl millet), mainly in western Sudan. Sorghum is the fifth world cereal crop. Production in Sudan tops the other Sahel zone countries. However, an amazing reality is that it imports sorghum annually, and in fairly huge amounts. In 2000, Sudan imported almost 1,000,000 tones. In 2011, the FAO records show a Sudan import figure of 290,269 tones.

1. This paradox is perhaps explainable by the fact that huge quantities of locally produced sorghum are illicitly smuggled across both eastern and western borders to adjacent countries. After the independence of Southern Sudan, similar smuggling could well take place there too. On the other side, however, food aid, including sorghum coming to the Sudan from philanthropic bodies, such as the UN World Food Programme, on an annual basis is officially recorded. It thus appears in the national and international records as sorghum imports. On the illicit ‘export’ flow, national as well as other world-recognized sources of statistical data such as FAO have no access to these hidden facts. There may be other explanations too.

2. I wish to strongly high-light a growing trend of wheat consumption particularly in the Sudan, and also in other Sahel countries. In the last 2-3 decades, the population in the Sudan, particularly in the urban parts have perceptibly shifted their food habit of eating sorghum–made. Kisra to eating wheat bread. In the same period, the migration to urban cities has increased almost exponentially Although production of wheat in the Sudan has gradually increased, the consumption has, likewise, increased too; but
considerably more. The import in 2000 was about one million tones; but in 2007 and on it rose to over 1.5 million tones. Is this trend likely to increase? All indications point in that direction. This trend is also present in the other Sahel countries as well.

**WHEAT FOR AFRICA DECLARATION**

The International Conference on Wheat for Africa Security met in Addis Ababa (8-12 Oct. 2012). Ministers of Agriculture and Finance from over 25 African countries attended (Sudan included). CIMMYT, ICARDA and IFPRI, of the CGIAR participated together with the Economic Commission of Africa and other regional and international bodies. At the end, the Conference issued a Declaration. The full text can be obtained online or from the participating institutions. It is quoted as follows:-

- recognized the rapidly growing demand for wheat in Africa, linked to population and income growth and a strong urbanization trend”…… leading to a growing food gap….which is met by growing imports reaching over 35 million tons costing over USD 12 billion per year.
- recognized declining self sufficiency in wheat.
- noted that increasing food and wheat prices and improved market access made domestic wheat production profitable..
- recommends including wheat as one of Africa’s strategic products; and take prompt measures to increase decisively wheat production..
- fosters continental cooperation in agric. research and technology of wheat. The Sudan was chosen as one of the main ‘hub’ points where research support is solicited to enhance such researches and to act as a lead centre for cooperation at regional and other levels in wheat research and technology.

**SOME RESEARCH POINTERS**

At random, I have chosen two examples of up-stream and futuristic examples, one in applied science and technology and the other in research.

**Egyptian National Authority for Remote Sensing and Space Science (NARSS)**

Established some thirty years back, this facility serves as an essential routine technological tool in surveying, through remote sensing, all-Egypt to up-date and monitor land-use data and utilization, for both rural and urban planning. On the space research front, NARSS interfaces with similar outfits at national and international locations aiming to keep up-front in various space technologies, including informatics and economic and military purposes.

The Sudan has started such a faculty. I strongly advocate that renewed inputs are made to activate this essential facility; a mandatory step. The well established centre of Egypt would, I am sure, be willing and ready to assist in this regard noting that it has a staff of some 9 Professors, 15 Assistant Professors, over 80 space engineers and some 150 support staff.
Recent Breakthrough in Biotechnology
Dr. Subba Reddy Pall, an entomologist at the University of Kentucky, found in 2014 that transferring an RNA molecule from a mosquito to a crop plant (maize), called RNA interference, gave an added toxicity factor to the plant against specific pests. This discovery, where a genetically induced manipulation by man, has provided lethal resistance to the plant against a pest, is a major breakthrough. Maize in the USA could be protected, thus from a major insect pest which results in serious reduction in yield in some years. Further, honey bee farmers are hopeful that this technology may well rid honey bees from a mite when they suck nectar from a genetically modified plant; a serious killer of bees.

Handicaps to Research and Development (R&D) impacting research and training
• Human
  1. Scarcity or absence of incentives to research scientists and university staff doing research
  2. Rewarding excellence
  3. Participation in conferences globally
  4. Refresher courses and sabbaticals
  5. Free intellectual and scientific climate
  6. Freedom from corruption and nepotism

• Biotic:
  Pests, parasites, pathogens and weeds

• Abiotic:
  Soil adverse factors including degradation; nutrient deficiency; water deficiency or logging, environmental factors …etc.

RECOMMENDATIONS
I recommend to this opening session:
  1. Holding an international Symposium on wheat research in the Sahel zone.
  2. A feasibility study on current trends of growing wheat and other commodity crops by foreign investors for exporting the harvest to their own countries.
  3. An in-depth study workshop to critically analyze the scope or reality that the Sudan can become the food basket of the Arab region; a statement often repeated for over 50 years; and never approaching a beginning!!!!! The reverse seems to be the reality. The Sudan is an increasingly a FOOD IMPORTER.