Agricultural Aviation a Strategy for Sustainable Food Production in Nigeria - Lessons from Brazil

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ABSTRACT

This paper presents a sweeping comparison of Nigeria and Brazil on their agricultural development performances with emphasis on agricultural aviation. Brazil is the fifth largest country in the world with 207.7 million people (2017 estimate); whereas Nigeria is the most populous country in Africa with 188.7 million people (2017 estimate). Both countries were known to have good soil which enhances agriculture but at different level of tilling. However, Brazil has outperformed Nigeria most especially in agricultural development with the approach of agricultural aviation, and has earned world status; while Nigeria still struggles with low agricultural productivity with old technological involvement. Brazil has large land mass with over 31% of land used in tilling. This study examines the use of aviation in agriculture which increases the productivity of farm produce in Brazil, and with a view to identifying the lessons for the improvement of agricultural development in Nigeria. This comparative study finds out lessons Nigeria can derive from Brazil in pursuing a sustainable agricultural development through suggestions regarding agricultural aviation.

Keywords: Agriculture; Aviation; Development; Brazil; Nigeria

(For proof only)
INTRODUCTION

During the pre and post colonial era in Nigeria, agriculture formed the means of livelihood of the people and a strong factor for the rise of states just as the case of many countries in the world (Lawal, 1997). Before the oil boom in the 1970s, Nigeria was strongly an agrarian nation. The form of agriculture practiced and the crops planted were determined by the nature of soil and the terrain of the region. Shifting cultivation and crop rotation characterized agricultural practices in pre-colonial Nigeria, owing primarily to land tenure practice and lack of knowledge of highly mechanized farming (Ehimore, 2009). Usually in the past, farmers depended on implements such as digging stick, hoe, cutlass and sickles. The common crops produced based on territorial specialization included, yam, okra, vegetables, maize, cocoyam, cassava, plantains, bananas, kolanuts, cocoa, oil palm and forestry products (Fasinmirin and Braga, 2009).

Nigerian economy similar to the Brazilian, during the first decade after independence was purely an agricultural economy because agriculture served as the mainstay for economic growth (Ogen, 2003). Nigeria occupied the leading position in the export of major commodities such as cotton, groundnut, rubber, hides and skins (Alkali, 1997). The FAOSTAT (1999) showed that Nigeria was the leading country in cassava production around the world with over 30 million tons annually as at 1998 followed by Brazil with over 19 million tons. Grains such as maize and sorghum, as well as groundnut were major foreign exchange earner for Nigeria. Nigeria had the highest oil palm production around the world but did not maximize her potentials from the very important crop until Venezuela (Fasinmirin and Braga, 2009) and Brazil took over as the world leader in oil palm production.

Recently, agriculture in Brazil was a result of state intervention and protection policies as well as private sector participation (Ogen, 2007). Agriculture continued to play a significant role in the Brazilian economy through fiscal incentives, special credit facilities, and most especially the introduction of agricultural aviation which strongly promoted greater efficiency and huge productivity. Agricultural aviation is an aspect of general aviation.

General aviation is the largest segment of aviation based on number of aircraft, number of pilots, and number of airports and communities served. It is a $40 billion industry that generates over $100 billion annually in economic activity. Because of its efficiency and productivity, general aviation has become an important business tool. The majority of hours flown by general aviation aircraft are for business and commercial purposes.

CONCEPTUAL CLARIFICATION

General Aviation

There is no legal definition of general aviation. It is defined with respect to the application of aviation, for instance in agriculture, photography, security and monitoring, traffic monitoring, and others. General aviation is the aerial application plane that treats one out of every five tillable acres of land, which facilitates greater food production and keeps the cost of food low. It is the land developer making survey flights and the police officer observing traffic. It is the family on a vacation trip and the air ambulance flying a mercy mission. It is the relaxation flight. It is the air taxi bringing passengers to the airline or picking them up at the terminal to whisk them to a distant off-airline point. It is the spare part flown in to keep an assembly line running. It is the pilot ferrying people, mail, and supplies from towns to wilderness areas.

According to Quantick (1985), agricultural aviation is a branch of commercial aviation, which performs the essential task in production, and protection of the world’s food and fiber crops. Aerial application is also used in areas such as insect control, fighting forest fires, and protection of biological resources.
For this study, the definition of general aviation as the aerial application plane that treats one out of every five tillable acres of land, which facilitates greater food production and keeps the cost of food low, will be adopted. It is important to note that in the industrialized countries, 80% of spraying is performed from air, and there are approximately 30,000 agricultural aircrafts in the world.

**Aircraft Usage on Aerial Application**

Any use of an aircraft for work purposes related to the production of foods and fibers or to health control measures, in which the aircraft is replacing farm implements or ground vehicles for the particular task accomplished is referred to as aerial application of aircraft. This includes fire-fighting operations and the distribution of chemicals or seeds in agriculture, reforestation, and insect control. Approximately 4,000 aircraft are used for aerial application in the Japan, China, and Russia. The majority are single-engine piston aircraft.

**Agricultural Aircraft**

Agricultural aircraft is an aircraft that has been built or converted for agricultural use usually for the application of pesticides, fertilizer, and planting of specialized crops (hydro-seeding). Before mid-1920s, a number of individuals began to experiment with uses of flight technology that would later become important parts of general aviation. For example, the first uses of airplanes for crop treatment, aerial surveying, and corporate flying all dated before the mid-1920s. Alfred Zimmermann, a German forester in Detershagen, was the first to identify the ‘Agricultural aviation’ as a means of combating crop pests (Quantick, 1985).

**History of the Agricultural Aircraft**

Alfred Zimmermann described the use of aircraft in the application of pesticide (in this case lime-water) in the control of the nun moth (black arc moth) in the European forests in his patent letter, dated 29 March 1911. Although his approach was visionary, suitable aircraft and trained pilots who were able to perform this task were only available after the World War I. In many countries, experiments were conducted in the 1920s, and practical results were recorded by Neillie and Houster (August 1921) in the U.S.A., and Professor V. F. Boldyrev (July 1922) in the U.S.S.R (Quantick, 1985).

In the 1940s, more effective insecticides and fungicides were developed, and aerial application of fertilizers was developed by government research in New Zealand and Australia. There have been some significant changes in Agricultural Aviation Industry in the last 20 years. Aircrafts are getting bigger, while turbine power is becoming available for fixed wing aircraft. Ag-1 was the first specially designed aircraft to distribute agricultural chemicals developed in 1949-50 at the Texas A.&M. Aircraft Research Centre. The project was initiated by the National Flying Farmers Association, and was carried out under the sponsorship of the Civil Aeronautics Administration, the U.S. Department of Agriculture and the Texas A.&M. College System. Ag-2 and Ag-3 are other experimental aircrafts followed Ag-1. These aircrafts incorporated pilot safety characteristics with regard to field of view and structural arrangements for protection of the pilot in crashes (Quantick, 1985).

In 1960s, the DH82 Tiger Moths were replaced by such aircraft as CA28 Ceres and Transavia PL12 Airtruck, Cessna 188, Piper PA 25 Pawnee, DHC-2 Beaver, G-164 Ag Cat, and the Snow Commander S-2D, to name the most numerous (Aerial Agricultural Association of Australia, 2005). By the mid 1970s, the Cessna 188 Ag Wagon (230hp), Ag Truck (300hp) or Ag Husky (310hp), became the leading models followed by the Piper PA 25 Pawnee Brave (285 & 300hp). The DHC-2 Beaver (450hp) and PAC Fletcher FU 24 dominated the fertiliser spreading business (Aerial Agricultural Association of Australia, 2005; Antunissi, 2015). The hopper size varied from 750L on the Ag Wagon to 1000L on
the Ag Husky and from 550L on the PA-25 to 850L on the PA36. In the design of these aircrafts greater attention is paid to pilot safety. The FU24 has a dry solids capacity of just over 1000 kg (Aerial Agricultural Association of Australia, 2005; Antuniassi, 2015).

The US manufactured Air Tractor and Ayres Thrush models were introduced next. The Air Tractor AT301/2, 401/2, 501/s and 802 model numbering system followed the hopper size in US gallons. The first turbine-engined model was the 400, powered by a Pratt and Whitney Canada PT6A-15 Ag engine with a reversible pitch propeller. A P&WC PT 6A-35 Ag turboprop engine of 750hp powers the AT-502 introduced in the late 1980s. The Ayres Thrush models are descended from the Rockwell Thrush Commander and consist of the Thrush S2R-600 (1340) powered by a P & WR-1340 radial engine; the Bull Thrush S2R-1820 and the Turbo Thrush S2R with options of a P&W PT 6A-15, -34 and -65 turboprop engines or Garrett TPE 331-10. There are also several models of helicopters, used for spraying, spreading and stock mustering including the Bell 47 and 206, Hiller 12 E, Hughes 269 and Robinson R-22 (Aerial Agricultural Association of Australia, 2005; Antuniassi, 2015).

The techniques of aerial applications are becoming refined (Antuniassi, 2015). In Japan, due to the departure of younger generation from the farming communities, around 10 years ago, Yamaha company started to develop the unmanned helicopters to compensate for the shortage of land workers. These helicopters are intended to be more flexible and precise during spraying. Today, Yamaha helicopters have extended its applications area to include the insect pest control of rice paddies, soybeans, and wheat. Yamaha unmanned industrial helicopters is anticipated as a solution for various problems facing the farming communities in Japan and as a contributor to raising the level of food self-sufficiency (Wong, 2001)

AGRICULTURAL AVIATION IN BRAZIL

In Brazil agriculture generates about one-third of its export earnings as it is the world’s largest exporter of soybeans and the largest producer of sugarcane, coffee, cotton, maize, various beans, rice, and manioc, or cassava. According to Antuniassi (2015), Brazil has experienced an enormous investment and expansion in agriculture over the last 5 years with the opening up of large farms in various regions of the country. As an example, according to Deral (2013), the total production of soybeans in Brazil increased by 27.5% from 2009 to 2013, while the average growth in total production for this crop worldwide was only 8.9%. Just from 2012–2013, soybean crops increased by 5.1%, compared with a global increase of 2.7%. This process has led to a demand for timely delivery of crop protection products against key pests and diseases, for which there has been a remarkable tendency of farmers to choose aerial application as a tool to treat their crops.

In order to meet the demand in agriculture, the Brazilian agricultural aviation industry has grown steadily. There are 231 companies offering aerial application according to data published by the “Agronautas” web page. This number increased by 2.7% in the first half of 2014, when six new companies were launched into the market. On average, this sector has been growing by 6% per year. At the end of 2013, 1925 aircraft were registered, of which 61.7% were Brazilian-made aircraft manufactured by Embraer, the main model being the Ipanema EMB-202A. The other 738 aircraft manufactured mainly by Air Tractor (USA). Over the last five years on average, 95 new aircraft have been added each year (Antuniassi, 2015).

Furthermore, most aerial sprays are applied at volume rates from 10 to 30 L/ha, applying very fine to medium quality sprays. Also, rotating sprayers are very popular in Brazil as they enable the spray volume to be lowered to less than 20 L/ha, while applications with volume rates above 20 L/ha are done mainly with hollow cone nozzles. In 2014, around 50% of...
the 100 aircraft were sold to private owners. Farmers are now heavily investing in aerial application as a means to treat their crops. This is a change from supply companies that provide a contract service to farmers, although rural entrepreneurs have also realized that aerial application is an indispensable tool. More than 30% of the Brazilian agricultural aircraft are registered by private operators, showing that, indeed, agribusiness entrepreneurs are purchasing their own aircraft (Antuniassi, 2015).

According to the National Union of Agricultural Aviation, the Brazilian agricultural aviation accounts for 23.8% of the total area of crops on which pesticides are applied, corresponding to more than 70 million hectares treated per year in the country. This average considers all the main crops using aerial applications. The highest share percentage is in cotton, with 35.7% of the applications made by air. Another important share is for rice, where one third of the applications (33.3%) are made by aircraft. On soybean 41 million hectares are treated per year by air, representing 56.8% of the area applied annually by Brazilian agricultural aviation. Most of the aerial applications on crops like soybean, cotton, and corn are primarily with insecticides and fungicides. For the sugarcane market, growth regulators also have an important market share of the applications. The size of fields that favour aerial application is variable across the country. It is therefore recommended for Nigeria that:

1. There is need to review the land use act so that large areas can be set aside for cultivation.
2. There is also need to implement new strategies for the chemical treatment of the crops, seeking to combine the best agricultural practices for the environment and the agriculture sustainability to the enhancement of operational capacity and field efficiency provided by the agricultural aviation.
3. Agricultural aviation piloting should be added to the courses offered at Nigerian Aviation Academy.
4. Agricultural aviation as a course should be added into the curriculum of Nigerian tertiary institutions offering transport related courses, and researches supported by research foundations.
5. Nigerian airlines and private agricultural companies should partner on ensuring the achievement of agricultural aviation.
6. Nigerian airports that are underutilized should be equipped and be used for training technicians and engineers on how to service and design aircrafts for agricultural aviation.
7. As evident from the history of agricultural aircraft on the predominant usage of helicopters in agriculture, helicopters can also be used as starting in Nigeria.

REFERENCES


