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AGRICULTURE INNOVATION ECOSYSTEM AND FOOD SECURITY: STRATEGY OF ADOPTION OFAGRICULTURE MECHANIZATION IN DEVELOPING COUNTRIES THROUGH "BELT AND ROAD" INITIATIVE CHINA

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Abstract

In this article, we study the influence of Agriculture Innovation ecosystem on food security through the contribution of Belt and Road Initiative. We identify strategy which foster agriculture mechanization adoption in developing countries. The innovation ecosystem is the large and diverse range of resources and participants that are necessary and contribute to continuous innovation in an economy. These include investors, entrepreneurs, technical and business development service providers, and researchers amongst others. We engage with agriculture Innovation Ecosystems thinking to consider the ways in which it might enhance efforts to create multi-actor, cross-sectoral innovation that are capable of supporting transitions to sustainable agricultural systems across multiple scale, hence achieving food security (Pigford, Hickey, & Klerkx, 2018). According to the world health organization (WHO) in the state of food security and nutrition in the world 2018, new evidence this year corroborates the rise in world hunger observed in this report last year, sending a warning that more action is needed if we aspire to end world hunger and malnutrition in all its forms by 2030. Through the "belt and road" initiative by the Chinese government, many international students got the opportunity to study in China, and act as a bridge between their respective countries and China (Yu, Qian, & Liu, 2019). In addition, as home country of great number of manufacturing companies, China promote agriculture mechanization and provide agricultural machinery to belt and road countries (de Soyres, Mulabdic, Murray, Rocha, & Ruta, 2019). These strategies have an impact in achieving food security worldwide (Zhang, Zhang, Tian, Liu, & Zhang, 2018). We speak of food security "when all people, at all times, have economic, social and ary preferences to enable them to live active and healthy lives" stated by Food and Agriculture organization. For this research, we attempted to show how "belt and road" initiative contribute to food security.

Keywords: Agriculture Innovation ecosystem, Agricultural mechanization, China, belt and road, food security.

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1. Introduction

Now more than ever the question of food security is one that must be addressed. The agriculture value chain system worldwide encounters many challenges, ranges from access to land and it utilization, post-harvest lost and food waste, use of chemicals and access to machineries. Recent researches underlying agriculture ecosystem identify agricultural innovation as a system which is about people, the knowledge, technology, infrastructure and cultures they have created or learned, who they work with, and what new ideas they are experimenting with. The approach represents a major change in the way that the production of knowledge is viewed, and thus supported. To sustainably meet the increasing demand for food (FAO, 2014, 2016) and achieve food security, agricultural systems will need to transition away from the many common and traditional practices and adopt better management systems (Pigford et al., 2018). To achieve food security, agricultural production should double, significantly surpassing population growth. However, with around 821 million in 2017, compared to around 804 million people hungry in 2016 (UN, 2017) in the world, global food security remains a big challenge. China as a rising economy put in place the «belt and road » initiative in an effort to strengthen international relations and play an active role in solving global issues including hunger which is of the seventeen (17) United Nations (UN) sustainable development goals. This strategy includes promotion of agriculture mechanization and engaging with international talents among other plans. Few decades ago developing region, have seen labor-saving technologies adopted at unprecedented levels. Intensification of production systems created power bottlenecks around the land preparation, harvesting and threshing operations. Alleviating the power bottlenecks with the adoption of mechanical technologies helped enhance agricultural productivity and lowered the unit cost of crop production even in the densely populated countries of Asia, with china as a leading country.

1.1. China “belt and road” initiative

Currently, since the “belt and road” of the People republic of china is ongoing, is it challenging to find empirical theory that can systematically show the effect of globalization and food security. Therefore, we rely on current implementation road map of “belt and road”, governments’ policies, previous research and books in the area of globalization and food security and make a qualitative analysis to deduce the relation between them.

Figure 1 China Belt And Road Initiatives , source of Geopolitical Intelligence Space

Launched in 2013 as “one belt, one road” initiative (BRI), it involves China underwriting billions of dollars of infrastructure investment in countries along the old Silk Road. The ambition is immense. China is spending roughly $150billion a year in the 68 countries that have signed up to the scheme.

Figure 2 Objectives of Belt and road initiatives of China

In 2018 the initiative has attracted the largest number of foreign dignitaries to Beijing since the Olympic Games in 2008. The BRI is much more than a series of oneoff infrastructure projects. It is a well elaborated project seeking to establish connectivity between Asia, Europe and Africa and in that way to increase trade, development and prosperity. It has five key goals; shown in the diagram below.

1.2. Agriculture innovation ecosystem

Transitions to more sustainable agriculture require the formation of innovation niches (Elzen et al., 2012; Meynard et al., 2017). Agriculture innovation ecosystem (Innovation niches) are defined as the spaces that allow actors to experiment, innovate and create new technologies, practices and institutions that can support transitions to sustainable agriculture by enabling interactions across boundaries (e.g. sectoral, organizational, professional, disciplinary, cultural, etc.) in agricultural systems (Elzen et al., 2012; Meynard et al., 2017; Schot and Geels, 2008). They can facilitate the collective action of diverse actors (often in new combinations) for developing new modes of production, new institutional arrangements and new organizational systems to better support systemic learning, adjusting and adapting (Elzen et al., 2012; Meynard et al., 2012; Meynard et al., 2017). In practice, innovation niches can be identified as spaces (i.e. physical, ecological, technological and virtual) where stakeholders come together to define shared objectives and engage in social learning to support an innovation process (Meynard et al., 2017).

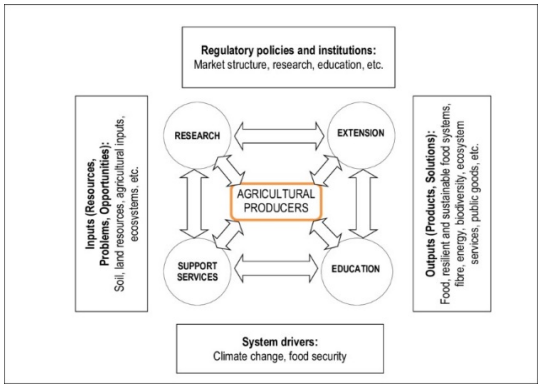

Figure 3 Agriculture innovation ecosystem

Innovation niches are nested within larger regimes (the status quo of dominant systems they aim to change) and socio-technical landscapes (exogenous developments that influence niche development) (Grin et al., 2010; Schot and Geels, 2008; Elzen et al., 2012), but these levels should be seen as analytical constructs because in reality there is no dichotomous struggle between niche and regime, instead transition processes run across multiple scales (e.g. geographic, ecological, technological, etc.) (Ingram, 2015, 2018; Hermans et al., 2016; Svensson and Nikoleris, 2018; de Haan and Rotmans, 2018).

Transitions occur when the creation and broader scaling of innovations established at the innovation niche level interact with current regimes, ideally leading to the opening of existing regimes and transforming them (Hinrichs, 2014; Wigboldus et al., 2016; Ingram, 2018). This perspective implies that agricultural innovation is a process in which co-evolution of technology, practices and institutions takes place at multiple and sometimes overlapping scales (e.g. farm, supply chain, policy system, sector, region, country) (Hermans et al., 2016; Wigboldus et al., 2016). Yet, innovation is not guaranteed, and the mere existence of a niche does not automatically transform a regime, drawing attention to the complex and heterogeneous factors that contribute to entrenched agricultural regimes and lock-in (Ingram, 2015; Wigboldus et al., 2016; Vanloqueren and Baret, 2009). Nonetheless, proponents of sustainability transitions argue that innovation niches can be built to facilitate linkages to support opportunities to innovate in radical ways to help solve complex issues (Geels, 2002; Schot and Geels, 2008), which may also take place through purposeful design (Elzen and Bos, 2016). Thus, there are ongoing questions about the architecture required to support the design and further development of successful agricultural innovation niches (Elzen et al., 2012; Meynard et al., 2017; Prost et al., 2017). The above table shows they share some theoretical foundations and converge on the notion that there is a need to foster innovation environments where scientists, policymakers, producers, end-users and entrepreneurs can mobilize their collective knowledge to innovate (Klerkx et al., 2010; Oksanen and Hautamäki, 2015).

	Agricultural innovation systems[a]	Innovation ecosystems[b]
Historic emergence	2000s	2000 s
Disciplinary focus	Agriculture	Business and management
Theoretical foundations	National systems of innovation; Technology transfer; Farming systems; Capacity building; Extension	National systems of innovation; Business ecosystems; Entrepreneurship
Types of issues	Economic; Socio-technological; Value chains	Economic; Value creation; Sustainable development
System conceptualization	One (sub)sectoral system with embedded systems	System of systems each with embedded systems
Focus	Multi-stakeholder processes for problem solving	Multi-stakeholder processes for value co-creation
Actors	Farm-centered: universities, firms, non-profits, decision makers, government institutions, financial markets, farmers; public sector bias	Firm-centered: entrepreneurs, universities, firms, non-profits, decision makers, government institutions, financial markets, end-users, venture capitalists
Groups of actors	Multiple actors; Innovation platforms (also known as hubs and clusters); Communities of practice; Co-innovation	Multiple actors in co-operation and competition; Innovation communities (also known as platforms, hubs and clusters); Co-evolution
Scale (system boundaries)	Crop; Sector; Region; Country	Local to global; Cut across multiple organizations, functions and industries
Level of analysis	Institutional: Actors and networks and the rules that govern their interaction. Infrastructural: the physical and knowledge infrastructure involved in innovation	Ecosystem: Integrated system of systems (no actor or system is greater than another)
Role of policy	To strengthen enabling environments and counteract disabling environments To create enabling environments and foster innovation communities	

Table 1 Characteristics of agricultural innovation systems and innovation ecosystem

[a] Adapted from Foran et al., 2014; Hall, 2007; Klerkx et al., 2012; World Bank, 2012; Schut et al., 2016. [b] Adapted from de Vasconcelos Gomes et al., 2016, Jackson, 2011; Oh et al., 2016, Oksanen and Hautamäki, 2015

1.3. Agriculture mechanization and food security foster by the People Republic of China

Mechanized agriculture is the process of using agricultural machinery to mechanize the work of agriculture, greatly increasing farm worker productivity.

Tractors in use in selected countries ('000 Units)

Country	1965	1970	1975	1980	1985	1990	1995	2000	2005	2007
Japan	60	278	721.09	1 471.4	1 853.6	2 142.2	2 123	2 027.67	1 910.7	1 877
China	73	126.4	346.8	747.9	861.4	824.1	685.2	989.1	1 410.6	2 063.5
Thailand	5	7	7	18	31.4	57.7	148.8	439.1	780	830
India	48	100	227.7	382.9	607.8	988.1	1 354.9	2091	2 789	3 149
Kazakhstan	-	-	-	-	-	-	170.1	52.1	44.1	40.2
Egypt	14.5	17.3	21.5	36	51.9	57	89.1	86.3	98.1	102.6
Côte d'Ivoire	0.7	1.4	2.2	3.7	4.3	4.8	5.3	8.4	9.3	9.4
Nigeria	1	2.9	5.7	8.4	11.1	13.9	16.7	19.4	23	24.8
Kenya	5.7	7.3	6	6.5	9	10	11.2	12.2	13.4	14
Tanzania	16.8	17	13.6	10	8	7.4	7.5	16.3	21.5	21.5
U S A	4 800	5 270	5 120	4 726	4 670	4 426.7	4 344.1	4 503.6	4 470.9	4 389.8
Honduras	0.4	1.7	2.8	3.3	3.9	4.5	5	5.2	5.3	5.3
Brazil	114	165.9	323.1	545.2	666.3	728.8	791.2	797.5	789.6	776.9

Source: FAOSTAT-Agriculture website

Table 2 status of agricultural mechanization in some selected countries, source FOASTAT Agriculture website

The disparity is huge between those countries, and we can observe that the productivity of the countries with more machineries are much higher than others and contributes to achieving food security. Beginning in 2003, the Government of Ghana started to reemphasize the importance of mechanization, directly engaged in tractor imports, and established subsidized agricultural mechanization service centers in the last a few years. Several African countries are considering similar mechanization policies. In Nigeria, for example, the government is the primary importer of tractors, which were sold at subsidized prices to farmers (PropCom, 2012). Similarly, the Government of Tanzania has sold more than 5000 sets of imported agricultural machinery at subsidized prices since 2009 (Lyimo, 2011). The government of Mali imported 400 tractors from India in 2006; DRC imported

920 sets of tractor and farm equipment; and Cameroon planned to import 1000 tractors from India in 2013, all at the subsidized prices (FAO, 2013a). Many of these imports and associated policies are facilitated by lines of credit from the emerging economies such as Brazil, China and India. The records of the Export-Import Bank of India show that Angola, Benin, Burkina Faso, Burundi, Chad, Guinea Bissau and Swaziland have received similar lines of credit ranging from $4 million to $50 million from India to purchase agricultural machinery (pipeline and operative, as of August 2013). China's exports of agricultural machinery have increased in value from $410,000 in 1994 to nearly $65 million in 2008, with much of the increase driven by large tractor exports and 11% of such exports going to Africa (FAO, 2013a). While exports through these credit arrangements with African countries' governments are encouraging these countries to increase agricultural machinery imports, it is a question whether it also presents potential challenges for these countries to be able to establish a private sector-led sustainable supply chain for agricultural mechanization (X. Diao, Cossar, Houssou, & Kolavalli, 2014).

2. Research methodology

Based on the theoretical framework of governments' policies, existing accredited agencies research and scholars work, we conducted this study. In order to gather this data, the main method of research employed was a comprehensive literature review. The study proposes statement is to how innovation ecosystem contribute to food security through belt and road initiative of the people republic of China. Also understand the different strategies used in executing this initiative and analyze their effectiveness. According to the results, the work conducts discussions, mainly including how the following aspect in agriculture mechanization through "belt and road" initiative and agriculture innovation ecosystem lead to the achievement of food security.

2.1. Purpose of the study

This research is to analyze and deduce the impact of the "belt and road" initiative on the cause of global food security foster by agriculture mechanization. This study will be guided by three main objectives:

- To understand the "belt and road" initiative of the People republic of China.
- Observe the impact of agriculture innovation ecosystem and food security, identify the advantages and disadvantages if any.
- To analyze the linkages agriculture mechanization and food security in Belt and Road countries as well as the scale and agricultural practices and implications on food security in this part of the world.

2.2. "Belt and roads" projects

(Yu et al., 2019) Domestically, China has announced that BRI is a positive enterprise of connectivity driven by a benign nation. Abroad, precisely in the western nations suspicions abound that china's economic situation is driving BRI. (de Soyres et al., 2019) Though views might differ and opinions about can be mitigated, all must acknowledge the positive impact of the undergoing projects on food security. The "belt and road" initiative

involves reaching out to countries in Africa, Europe, America and other parts of Asia. Some of the majors projects implemented so far are:

Investments

Year	Investor	Quantity ($ million)	Transaction party	Sector	Subsecto
2015	China General Nuclear	5960	Edra	Energy	Electricity
2016	State Grid	4490	CPFL	Energy	Electricity
2016	Three Gorges	3660	/	Energy	Hydro
2013	Zhejiang Hengyi	3440	/	Energy	Oil
2014	CNPC	3000	Refineria del Pacifico	Energy	Oil

Construction contracts

Year	Contractor	Quantity ($ million)	Transaction party	Sector	Subsector	Country
2014	China Railway Construction	6810	/	Transport	Rail	Nigeria
2013	China National Nuclear	6500	/	Energy	Nuclear	Pakistan
2015	China National Nuclear	4700	Nucleoeletrica	Energy	Nuclear	Argentina
2015	China Energy Engineering	3660	EISA	Energy	Hydro	Argentina
2015	China Railway Construction	3510	/	Transport	Rail	Nigeria

Source: The American Enterprise Institute. Deloitte Insights | deloitte.com/insights

Table 3 source deloitte.com

3. Discussions

Agriculture Innovation ecosystem appears to play an important role in achieving food security, as it enables a system where different actors develop their full potential and contribute to the increase of agriculture commodities. In other words, perceiving food security as a policy framework is an example of what James Ferguson (1994) calls "an antipolitical device". Transforming the symptom of poverty, it puts an end to politics. Instead, hunger and poverty by extension must be integrated into the specific economic systems of production, according to the modes of representation and powers in place (George, 1984). In 1996, the World Food Summit made a statement in Rome. Commitment Four states "we will strive to ensure that food and agricultural policies and trade as a whole promote food security for all through a fair and market-oriented global trading system" (ibid.). FAO, 1996). With a dynamic demographics, China's economic growth over the past three decades has been tremendous, making the country largely food self-sufficient. They set the example to use their own equipment to mechanized agriculture and through the belt symptom of poverty, it puts an end to politics. Instead, hunger and poverty by extension must be integrated into the specific economic systems of production, according to the modes of representation and powers in place (George, 1984).

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4. Conclusion

In sum, following the above, innovation ecosystem is a key factor in achieving food security worldwide and the "belt and road" initiation (BRI) enhance this impact. Many cooperation agreements between China and many countries have been signed since the launch of the initiative. The benefits of this cooperation are so far numerous. Innovation Ecosystems thinking may offer a useful umbrella concept that is appropriate for the wider multi functionality of agricultural systems, with the potential to better support economic development worldwide and achieve food security. Through our brief comparison it has become clear that, China "belt and road initiative" is key to Agriculture Innovation Ecosystems through is contribution on mechanization of agriculture worldwide. Agriculture Innovation Ecosystems thinking appears to complement and build on the established foundations achieving food security and to enhance the conceptualization of more sustainable agricultural systems. However, it is still important to be conscious of inflation treats and political instability. Also there is need to for Chinese companies to design agriculture machineries that are more suitable for small size farms. In addition, the mechanization of agriculture is clearly of great significance food security because enable the drastic increase in productivity and eliminate food value along the agriculture value chain. But, manufacturing companies must ensure that the equipment are environmental friendly and are not harmful to human health in the long run.

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