

Poverty and Agricultural Innovation: A Systematic Literature Review

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Abstract

The world we live is evolving day to day. The economy within the developing and the developed nations are chaotic in nature. Agricultural practices, innovations, and procedures that were used in the past are now being phased out. Agricultural evolution, whether directly or indirectly, aids in the alleviation of poverty on a larger scale. Poverty, as a sustainable development goal, is a burning issue in most developing countries. Upon considering the developing nations, the setbacks in the evolution of the technological innovation in agriculture and the rapid progress in the poverty are caused by many chaotic forms such as war, natural disaster, political volatility etc. The main aim of this research is to assess the literature reviews on Agricultural Innovation and Poverty in a global context. To succeed the goal, the author conducts a systematic literature review in this paper, addressing all important keywords associated with agricultural innovation and poverty from a macro perspective. In conclusion, technological schemes within agricultural innovation are limited across developing countries, despite the fact that it is a critical subject. Overall, there is a deficiency in the availability of a comprehensive analysis of literature with sufficient recognitions to assist researchers in gaining an overview of technological innovation in agriculture and poverty alleviation. The paper expressly recognizes the established flaws and emphasizes the importance of new discovery channels for future study.

Introduction

The world that we live today is demarked on one side with high level of technology along with the presence of abundant commercial good; whereas the other side is observed with severe poverty that exist among the people (World Bank Group, 2016). The agriculture in

the following two decades is becoming boundless in nature, which not only will satisfy the growing demand for food but also alleviate the poverty and thus contribute to fulfill the sustainable development goals (United Nations,2019). Across the global perspective the increase in the supply of agriculture yield can't only be achieved through the expansion of the land or healthy supply of water as both the availability of water and land has become scarce across both Asian and Europe (Hazell & Thurlow,2010). Thus, it is conclusive that the increase in the agricultural yield can be achieved only through the growth of the cultivable. Agriculture has a significant role to play in poverty reduction, since more than three-quarters of the world's poor people live in rural areas, where they depend on agriculture or agricultural-based businesses to make a living (Bekun & Akadiri,2019).

The root cause of poverty that is observed in many rural areas are mainly due to the slashing of the agricultural growth (Weerakoon,2018; CBSL,2019). This is further reinforced by the fact that many agricultural systems in developing countries are more reliant on ineffective conventional approaches (Godoy & Dewbre,2010). The Agricultural development can be accomplished by resolving the current issues surrounding food insecurity (Henegedara,2015), employment opportunities for the rural poor (Cai & Xia,2018), and the conventional technologies and techniques followed in the cultivation (Dhrifi,2013). Significant technological restructuring within the sector will lead to increased productivity, lower chemical concentrations in the manufacturing process, and better resource management. Agricultural technological advancement can benefit both poor and non-poor farmers by providing individuals with different resources, improving productivity, and managing the Agri supply chain.

Methodology

This systematic review of literature employs the content analysis as the approach to accommodate the knowledge on selected significant areas of Poverty an Overview (V1), Agricultural Innovation (V2) Agricultural Innovation and Poverty (V3). The first step in the review was to examine the papers that were important to the thesis. The quest yielded numerous research articles in the specified study areas from a variety of academic and statistical databases, including the Department of Census statistics, IEEE Xplore, Science Direct, Elsevier, and Research Gate, among others. 108 articles/reports were gathered in the first stage based on their titles, abstracts, and keywords. 92 papers/reports were screened for further analysis after each paper was thoroughly scrutinized to remove redundant and insignificant articles to the study. Finally, for the purposes of review, 84

articles/reports were considered. The figure 1 depicts the selection procedure used under the study based on the relevancy to the context selected. The articles that are reviewed under the study are presented at the end in the reference section. Despite the fact that the analysis has thoroughly examined each article, the author of this paper assumes that the actual knowledge gaps that have been overlooked by previous studies are exposed without exhaustion. To uncover the knowledge gap found in the study areas described above, a systematic literature review was conducted. Since poverty and agricultural innovation are concepts that have evolved over time, the articles chosen to span the years 1970 to 2021. Even in the modern era many of the nation still practice the conventional approaches which ever were practiced in the early 18th and 19th centuries. In this paper, the author has conducted a thorough analysis of articles spanning a 50-year period to provide readers with a sufficient understanding of the evolution and transformation of the above-mentioned phenomenon across various countries around the world.

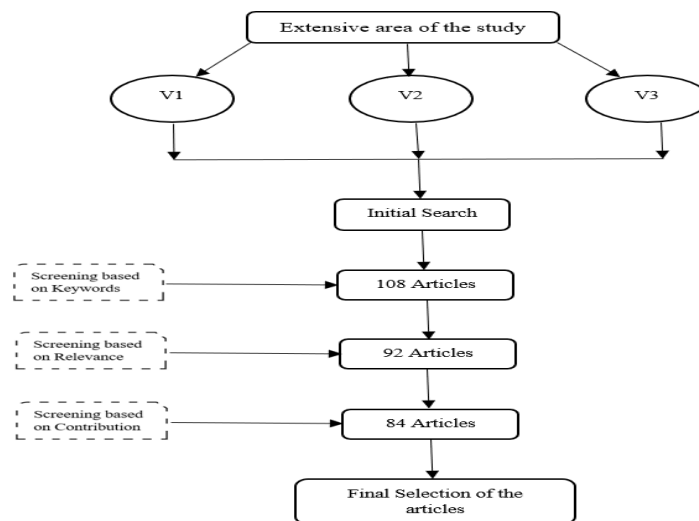


Figure 1 Screening process of systematic review of literature

Source: Author Developed

Results of the Reviewed Studies

All the key articles taken into consideration in the analysis are briefly discussed under the following section.

A. Poverty an Overview

Poverty is considered as a sustainable concept in the modern era. European council in 1975 defines poverty as a concept in which the Individuals or families whose resources are so small as to exclude them from the minimum acceptable way of life of the member state in which they live (Council Decision,1975). Poverty is a measurement of the individual household income benchmarked against the poverty line (Nolan & Whelan,1996); the poverty is termed as the multidimensional concept which comprises health, education, and standard of living as the key determinants (DCS,2019). According to a few other studies, poverty is described as a phenomenon in which individuals fall short in terms of their well-being, income level consumption, human needs, and a variety of other socioeconomic conditions (DCS,2009; DCS,2015; DCS,2016).

Poverty measurement varies depending on individuals, communities, and regions. The key measurement techniques that are reviewed by various philosophers are Poverty Headcount Index which measures the proposition of the population for whom the consumption is lesser than the poverty line, represented as $HCI = NP/N^1$ (Atkinson,1987), The Poverty Gap Index measures the spread of the poor below the poverty line by looking at the average depth of poverty which is represented as $PGI = (1/n) \sum_{i=1}^q [(L-C_i)/L]^2$ (Foster & Shorrocks,1991; HBS,2007), Income Gap Ratio which measures the mean consumption or the income of a poor that is $I = 1 - \mu p / z^3$ (Nair & Haridas,2008) and Foster Greer Thorbecke measures the poverty that exist in a region from the dimension of inequality that exist among the poor within a region that is $FGT2 = 1/N \sum_{i=1}^q [(z-c)/z]^2$ (James , Joel , & Erik,2010).

¹ Np denotes the number of poor and N represents the total population.

² L represents the poverty line, C shows the average consumption expenses per adult equivalent person, i represents the individual persons, n represents the total population, and the q shows the number the persons with average consumption expenses per adult equivalent persons lower than the poverty line.

³ μ^p denotes the mean consumption or income of the poor.

⁴ q represents the total number of poor, the n represents the total population, the c depicts the consumption expenditure.

A bivariate correlation is clear in the literatures based on various factors that affect poverty. The household size, infant and child mortality, child/adult ratio and the consumption or the income greatly leads to the poverty (Musgrove,1980; Visaria,1977; Van de Walle, Dominique, & Martin,1992; Birdsall & Sabot,1991). Various other research findings concludes that gender plays a significant role among the society in

influencing the poverty across both developing and developed nations; poverty remains persistent for women and is considered impermanent for men (Dreze & Sen,1989; Bardhan,1985; Standing,1985; Bennett,1991; Haddad,1991; Behrman,1991). The national studies conducted in various south Asian countries concluded that the old age is a factor that influences poverty; Aging is a determinant that affects both health and economic stability, resulting in a higher likelihood of poverty in such a population (Deaton & Paxson,1991; Ravallion, Gaurav, & Van de Walle,1991). According to the findings of the Economic Research Service in 2003, education is a major contributor to poverty among rural residents; the literature concludes that a lack of education leads to cultural chaos, such as male domination, alcoholism, and domestic violence (Economic Research Service,2003; Cotter,2002).The rise in unemployment within a country has a greater effect on those who are asset less than on those who are asset-based self-employed, so it is clear that unemployment is a serious proposition that leads to poverty⁵ (Udall & Sinclair,1982 ; Furuokaa, Idrisa, Limb, et al.,2019). Furthermore, findings from a few other studies have shown that wage discrimination based on gender, caste, or ethnic group influences productivity or work period, as well as poverty among individuals and communities (Birdsall & Sabot,1991; Osmani, 1991).

B. Agricultural Innovation an Overview

In association with the idea proposed by Lee (2005), agricultural production is a highly decentralized and geographically diversified activity which is moderated by various types of technology and technicality that varies over time. The bio technologies acts as a moderator in certain developed and developing nations to benefit the economy of the nation in a greater scale (Adelaja,2003). The literature review proposed by Ghadim and Pannell (1999), states that agricultural innovation is important for the growth of the agricultural industry as it improves skills and allows for more efficient decision-making; the study results are supported by on-farm trials and experiments. Moreover, a study of several other literatures has suggested that global

⁵ Unemployment rate in USA is 3.9% and the unemployment rate in Asia is 5.7% issues such as deforestation, wetland, and marine system degradation, as well as the booming global demand for food, fiber, and biofuels, have led to the emergence of agricultural innovation to address the issues; therefore, agricultural innovation plays a critical role for emerging economies (Sayer & Cassman,2013; Jayne, Mather, & Mghenyi,2010; Gov.UK,2011). Klerkx, Aarts and Leeuwis (2010) states that the

presence of agricultural innovation systems has become one of the most important phenomena in scrutinizing agricultural technical, economic, and institutional changes; the study findings propose two key types of agricultural systems, viz., a poultry husbandry system and a system that interconnects individual farms across the country to achieve economies of scale. Moreover, according to a few other views, agricultural advancement in the form of biotechnology and precision technology has influenced many institutional changes; agricultural innovation, according to the results of a few other studies, is seen by industrialization, product differentiation, and integration in agriculture, both of which are closely related to human capacity and learning (Sunding and Zilberman, 2001; Zilberman, Schmitz, Casterline, Lichtenberg, et al., 1991).

Hunger and Poverty are the most pressing sustainability issues in the twenty-first century, and they are primarily due to a lack of production in different regions around the world, which is caused by variations in climatic conditions, demand for biofuels, farm produce, and property (Alexandrats & Bruinsma, 2012). Many agricultural innovations have occurred around the world, with Aeroponics, Hydroponics, Aquaponics, Vermiponics, and Bioponics being a few of the key innovations examined by a few scholars in both the European and Asian contexts. The Aeroponics utilizes the substrate culture to cultivate the plants without utilizing the soil. Findings in overall proves that the presence of aeroponic system instead of soil-based cultivation creates a greater potential towards an increase in income along with a reduction in cost of production over quality seeds (Osvald, Petrovic and Demsar, 2001; Buer, et al., 1996; Lakhari, Gao, Syed, et al., 2018; Chadirin, Matsuoka, Suhardiyanto, et al., 2007; Otazu, 2010). The Hydroponics is an approach where the plants are cultivated in a nutrient solution with or without the presence of an insert medium such as the gravel, vermiculite, rockwool, peat moss, saw dust, coir dust, coconut fiber etc. In compared with the soil-based cultivation the hydroponic closed system saves 90% of water, 85% of fertilizer and boost up of 250% in productivity. The findings concludes that the application of the hydroponic system not only serve the farmers to earn greater yield in a shorter period but also helps the farmers to cultivate even in waterless environment (Sharma, Acharya, Kumar, et al., 2018; AlShrouf, 2017). Aquaponics is a hybrid of aquaculture and hydroponics, in which the effluents of the fish serve as nutrients and are bound to a floating raft system; the research findings proves that the aquaponics improves the agricultural yield (Surnar, Sharma and Saini, 2015; Kloas, et al., 2015). Vermiponics is a technique in which the earthworms are used as a substrate to improve the microbial activity along with the decomposition

process, the process not only improves the agricultural productivity but results in reducing the chemical footprints (Dominguez & Edwards,1997; Katheem, Mahamad, Shlrene, et al.,2015; Ansari and Ismail,2012). Finally, the Bioponics is a systematic method of Hydroponic growing in which the vegetables and the plants are grown through the organic manner which utilizes the organic fertilizer, microbes, bacteria and fungus instead of any chemical composition. Similar to that of vermiponics, the bioponics results in reducing the chemical footprints and improve the ecological balance (Shubha, Mukherjee, Dubey, et al.,2019; Azariz, Elblidi, Yahyaoui, et al.,2017).

C. Agricultural Innovation and Poverty

Agriculture is a rapidly expanding industry around the world. Poverty in agriculture is critical because poor farmers are drawn to poor lands, as demonstrated by the existence of a greater number of poor lands in the United States (Schultz,1950). According to a study conducted in the Philippines, poverty is more prevalent among agricultural households, which account for 57% of poverty contributions, far exceeding the contribution of non-agricultural households, which is only 17% (Reyes, Tabuga, Asis, et al.,2012). Agriculture and poverty are intertwined, with farming households suffering significant losses in agriculture due to a lack of knowledge and resilience in adapting to changes in the industry. This condition affects farmers both psychologically and physically, acting as a driver towards poverty (Winslow, Shapiro, Thomas, et al.,2004). Hertel and Rosch (2010), argue that the poverty, as a distinct problem within a nation, is linked directly to climatic changes within that country; the findings suggest that poverty and climatic change, as well as climatic change and agriculture, have a proportionate relationship. Study based on Indonesia concludes that the growing poverty in agriculture are mainly due to the deficiencies in quality human resources, assets in agriculture, social facilities, information, and communication. Also, various other literatures concludes that the unavailability of irrigation facilities due to the low economic activity are a crucial reason for individual fall into

the poverty line (Amarasinghe, Samad, & Anputhas,2005). Failing to meet the breakeven within the agricultural sector results in the drastic downfall of the consumption expenses per individual which results in the formation of the poverty among the communities (Shaw,2004). Finally, when it comes to the spatial clustering of rural poverty and food insecurity in Sri Lanka, the higher poverty is observed in rural areas where agriculture is the dominant practice, so it isoverly assumed that agricultural poverty is a significant

determinant for the country's economy.

The presence of new technology leads to an increase in farming income due to a decrease in the marginal cost of producing an output (Berdegue & Escobar, 2002). According to a study conducted in central Cameroon on fish farming, the integration technology focused on agricultural byproducts as a fishpond input acts as a factor in strengthening the fish farming; whereas the study findings clearly shows that the aquaculture as a technique helped in alleviating the poverty (Brummett, Gockowski, Pouomogne, et al.,2011). The study findings from 32 Sub Saharan African countries for a period of 1990 to 2011 concludes that the productivity in agriculture is a factor of innovation concerning technology, raw materials, process, and policies (Dhrifi, 2013; Dhrifi, 2014). Furthermore, few other literatures suggest that the application of Sen Index which focuses on the dimensions of public policies that increase farmers' technical knowledge directly and indirectly, increases production within the regions facing poverty (Devkotaa & Upadhyay,2013). According to other scholarly findings, agricultural innovation in the form of biotechnology entails a wide range of biological disciplines that result in a rapid increase in crop yield by providing a buffer against drought or pests, resulting in an increase in productivity (Sere & Rege,2006; Mendola,2007). The study based in Soviet areas of China interprets that agriculture along with internet can alleviate the poverty, that is the presence of a strong rural internet and the infrastructure improves the information flow in the Agri business, establishes a strong ecommerce which builds a strong supporting system for agriculture and the allied Agri business, along with which few other studies based in china suggested that the optimization of supply chain within agriculture can act as the driver to alleviate poverty (Yang & Huang,2018; Yuhui,2017; Pu,2018).

The study findings of Africa concludes that the establishment of agricultural SMEs will result in an increase in agricultural demand, as well as increased production and innovation within the sector, resulting in the alleviation of poverty (Okpachu,2018). The study based on animal husbandry and cultivation clearly concludes that the existence of financial facilities in the formof insurance and credit facilities improves the livelihood of poor farmers by ensuring adequate funds availability, which indirectly supports the farmers' risk resistance potential; the accessibility of the financial feasibility privilege the poor farmers in stepping onto the zone of innovation in agriculture (Yin,2020; Ejembi, Attah, & Damulak,2015). Few other research findings conducted based on Asian countries states that the organic approach mainly in the form of integrated duck farming

and vermi compost in the agriculture are a vital and most innovative approach to improve the agricultural productivity; furthermore the approach reduces the poverty through leveraging the productivity and also by opening up new business opportunities to the farmers furthermore this increases the cash inflow within the households (Hossain,2013; Hossain, Sugimoto, Ahmed, et al., 2005).

Conclusion

The importance of agricultural innovation on poverty in both developing and developed countries has been extensively discussed in this paper. Furthermore, the study findings provide an adequate understanding on the existing issues in developing nations and the deterioration of economic stability in rural areas compared to urban areas. The review on range of literatures have illustrated the innovations in various platforms such as policies, procedures, financial aids, learning & development, institutional restructuring and the technological or technical schemes. When viewed at a macro level, the impact of agricultural innovation on developing countries is marginal when compared to developed countries, which are further influenced by various forms of chaos within the region, such as war, natural disasters, etc. The results of the literature reviews revealed that the implementation of these Innovative approaches in agriculture is minimal in the context of developing nations, so this paper serves as evidence for future research in the aforementioned context. Many countries have tried to alleviate poverty by implementing various forms of agricultural innovation. When comparing study results from key publications, technological innovation for agriculture is effective in some developed countries but is still in the experimental stage in many developing countries. Many studies have found that the existence of technological innovation within agriculture streamlines the financial terms associated with farmers and strengthens the roles of departments associated with agriculture such as sales and marketing, as well as improves the input/output ratio that prevails in the process. Overall, the presence of Agricultural Innovation drove on technological platform results in the uplift in the country's economic stability.

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