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Leadership, Innovation, and Stability in Bridging Agricultural Development Gaps: A Literature Review

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Abstract. This study addresses the gap in understanding how leadership, innovation, and socio-political stability influence agricultural development. By conducting a literature review, this research aims to provide insights into improving regional agricultural policies. The review focuses on leadership in agriculture, socio-political dynamics, economic factors, and the role of innovation. Findings suggest that while global initiatives and local efforts emphasize agribusiness for economic growth, regions like BARMM in the Philippines face challenges such as weak data systems and structural barriers. The study concludes that technological advancements and cooperative efforts are essential for sustainable agricultural development in these regions, highlighting the need for targeted policies to enhance productivity and food security.

Keywords: Leadership; Agricultural innovation; Peace and order; Agricultural development; Farm production.

1.0 Introduction

Agriculture remains a fundamental pillar of economic stability and growth worldwide, particularly in developing countries where a substantial portion of the population depends on farming for both sustenance and income. Despite its critical role, the agricultural sector in these regions often faces significant challenges, with farmers frequently being among the most vulnerable to poverty and food insecurity. This paradox, where those who produce food struggle to meet their own nutritional needs, underscores the pressing need to identify pathways for agricultural development that can both alleviate poverty and enhance the well-being of farming communities. This necessity is particularly urgent in regions characterized by high levels of socio-economic deprivation, where agricultural development has the potential to drive significant and hopeful socio-economic change.

The relationship between agricultural development and economic growth has been extensively explored in the literature, revealing a complex and multifaceted connection. Dane (2022) underscores the importance of agriculture as the backbone of national economies, emphasizing its role in providing essential food supplies, raw materials, and employment opportunities. This perspective is further supported by Vespia (2021), who argues that agricultural development is crucial for reducing poverty, especially in rural areas where most people depend on farming for their livelihood. These studies collectively highlight the critical role of agriculture in promoting economic progress. However, they also expose significant disparities in how the benefits of agricultural development are distributed, particularly within developing regions. These disparities point to a gap in the current understanding of how to create more equitable and inclusive agricultural development strategies.

Sustainable agricultural development, as discussed by Udemezue and Osegbue (2018), involves increasing agricultural productivity and ensuring the long-term sustainability of environmental resources. This approach necessitates the enhancement of agricultural practices, the introduction of innovative technologies, and the equitable distribution of resources. The authors emphasize that sustainable agricultural development is about more than just boosting output; it also entails improving the quality of life in rural areas, ensuring food security, and providing a stable income for farmers. However, the challenge remains in achieving these goals without compromising environmental sustainability, which requires a delicate balance between economic growth and ecological preservation.

Despite the progress made in understanding the links between agriculture, economic growth, and sustainability, there remain significant gaps in how these factors interact with leadership, innovation, and socio-political stability—factors crucial in shaping the effectiveness of agricultural development strategies. This study seeks to address this gap by examining the roles of leadership, agricultural innovation, and the maintenance of peace and order in fostering agricultural growth. Through a comprehensive literature review, the research aims to provide insights that could inform the development of more effective regional agricultural policies and interventions. The significance of this study lies in its potential to contribute to the socio-economic upliftment of some of the most impoverished areas. By advancing the understanding of how targeted agricultural development strategies can foster sustainable economic growth and improve the quality of life for farmers, this research hopes to offer valuable contributions to the discourse on sustainable development and poverty alleviation.

2.0 Methodology

The literature review used a structured approach to identify, evaluate, and synthesize relevant academic studies, reports, and policy documents. Academic databases such as JSTOR, Scopus, and Google Scholar were searched using keywords such as "agricultural development," "leadership in agriculture," "agricultural innovation," and "peace and agriculture." Inclusion criteria focused on studies published in the last ten years, ensuring the review incorporates the most recent advancements in the field. Studies are selected based on their relevance to the research questions, methodological rigor, and the contexts in which they were conducted. Particular attention is given to studies focused on developing regions, as these are most pertinent to the research objectives. Key information from the selected studies is extracted and organized into themes related to leadership, innovation, and peace in agricultural contexts. Synthesizing this data helps to identify the current state of knowledge, gaps in the literature, and potential for new research contributions.

3.0 Findings and Discussion

This literature review begins with a general perspective of agricultural development. Subsequently, it focuses on the context of the province of Lanao del Sur, analyzing leadership impacts, examining affected agricultural innovations, and resolving conflict issues affecting agricultural sector development.

Leadership

Previous research shows that several countries have developed leadership programs for agricultural entrepreneurs. For example, Australia, Canada, the United States, and New Zealand have developed strategies for leadership development in the agricultural sector (Brosnan, 2014). A study by (Ulvenblad et al., 2019) mentioned that a greater focus is needed on leadership development for agricultural entrepreneurs to manage larger units better and identify and implement innovative ways to create, deliver, and capture value in this rapidly changing agricultural environment. Their study also addresses the deficiency in leadership education for practicing agricultural entrepreneurs, focusing on self-leadership practices in a leadership development program designed specifically for agricultural entrepreneurs.

However, in the Philippines, policymakers in the BARMM region experience difficulty in crafting evidence-based plans and strategies to increase agriculture productivity and improve the nutritional status of the communities due to the lack of robust information systems and databases on agricultural statistics and nutritional status at the village or barangay level that LGUs and decision-makers at the local level can use for targeting, planning, and implementing programs. BARMM was confronted with several issues and challenges that affected the growth in its agricultural production and poverty incidence. These include a need for more focus on existing government programs for the improved productivity of small-scale fisher folk and farmers, coupled with unsustainable

practices. (BARMM, 2020). On the other hand, RD Maria Lourdes Lim of NEDA Regional Office XI pushed for the advancement of agribusiness towards a matatag, maginhawa at panatag na buhay for Mindanaoans when she spoke to 300 delegates at the Philippine Financial Summit 2018 in Davao City on February 24, 2018 "Agriculture is still the most important sector in rural areas of almost all developing countries," said Regional Director Lim on her topic 'Money Does Grow on Trees' which focused on the potential of agribusiness in reducing poverty. "Developing the rural economy is key to achieving inclusive growth," she added.

The study made by Kolaj et al. (2017) in Albania concluded that the growth and strengthening of the role of leadership in the farming communities would also be helpful for the promotion and development of agriculture. It would also bring positive effects, such as raising awareness of the degree of competence and quality of decision–making concerning the use of resources and rural development. The scale and intensity of the use of resources, such as land, forests, and rivers for economic development and growth, implicates costs and requires the quality of agricultural products.

Political

Agriculture has always been affected by the activities of governments around the globe. However, many of the evolving countries have had food deficits, with little in the way of exportable goods to pay for food imports. Several countries and international groups have been established to deal with the issues of developing countries, and direct assistance has also been provided by the governments of progressive countries (Britannica, 2022). Efforts are continually made by countries worldwide to cite one is the establishment of the SDG. In an excerpt from PSA regarding Sustainable Development Goals (SDG), In September 2015, the United Nations Member States adopted a new global plan of action entitled "Transforming Our World: The 2030 Agenda for Sustainable Development." The 2030 Agenda, its 17 Goals, and 169 targets are a universal set of goals and targets that aim to stimulate people-centered and planet-sensitive change. The Sustainable Development Goals (SDGs) and targets are integrated and indivisible, common in nature, and universally acceptable, and consider different national realities, capacities, and levels of growth and respect national policies and precedence. Furthermore, each administration is expected to take ownership, establish national frameworks, and set nationally owned marks guided by the global level of desire but considering country-level situations for attaining the 17 goals. Countries will also decide how these aspirational and global targets should be incorporated into national planning processes, policies, and strategies. In line with the Philippines' agreement to achieve the SDGs, the PSA Board issued PSA Resolution No. 04 Series of 2016, allowing government agencies to deliver data support to the sustainable development goals (SDGs). In this resolution, all concerned government agencies are invited to provide the necessary data support to monitor the country's performance vis-à-vis the SDGs based on the indicator framework determined by NEDA, PSA, and other government agencies. Further, the Resolution designated the PSA as the official repository of SDG indicators in the Philippines.

Accordingly, Agriculture Secretary William Dar urged entrepreneurs and business leaders to continue investing in Mindanao as agribusiness remains a priority, providing opportunities for exporting agricultural products and establishing state-of-the-art production technologies and value-adding facilities. "Mindanao is a veritable food basket in the Philippines, considering its substantial contribution to the country's agri-fishery sector. We can attract investments to nurture local agribusiness," said Secretary Dar during the 30th Mindanao Business Conference on September 23, 2021 (DA Communications Group, 2021). "The government is fully prepared to continue investing in Mindanao's future, but the government alone cannot finance Mindanao's long-term progress. The island region's private sector – its entrepreneurs and business leaders – must continue to make significant investments in developing the regional islands, especially in those places where investments are most needed," Sec. Dar further said.

Economic

Despite the country's recent general economic success, the agricultural sector remains challenging, falling behind other Southeast Asian countries' output and productivity development (OECD-FAO, 2017). The 2012 Family Income and Expenditure Survey (FIES) showed that 68% of Philippine families derive some earnings from agriculture. However, only 22% of all families derive more than half of their earnings from it, and 10% derive more than three-quarters (FIES, 2012). On the one hand, an act (R.A. 8435) prescribing urgent related e measures to modernize the agricultural and fisheries sectors of the country to enhance their profitability and prepare said

sectors for the challenges of globalization through an adequate, focused, and rationale delivery of necessary support services, appropriating funds therefore and other purposes, otherwise known as the "Agriculture and Fisheries Modernization of 1997" (AFMA) was created by the Third Congress on the Third Regular Session. Section 2 of the Organic Agriculture Act of 2010 (R.A. 10068) and its Implementing Rules and Regulations (IRR) stated the policy of the State to encourage, proliferate, develop further, and implement the practice of organic agriculture in the Philippines that will cumulatively condition and enrich the fertility of the soil, growth farm productivity; lessen pollution and devastation of the environment, prevent the depletion of natural resources, further protect the health of farmers, consumers, and the general public, and save program for the promotion of community-based organic agriculture systems which include, among others, the farmer produced purely organic fertilizers such as compost, pesticides, and other farm inputs, together with a nationwide informative and promotional campaign for their use and processing, as well as the implementation of the organic agricultural system as a feasible alternative shall be undertaken (Philippine Congress, 1997).

Collective action

A study by Rolaj et al. (2017) relates that an essential alternative for overcoming structural problems is cooperation among farmers based on principles of collective action. They further mentioned that because of the small farm size and land fragmentation, farmers encounter many difficulties while improving technology at the farm level, providing inputs, selling their farm products, and facing unfair competition from input suppliers and traders. Hence, there is no better alternative than cooperation among farmers (Skreli et al., 2011). In the study of Rolaj et al. (2017), they said that the asymmetry of information, limited sanctions, enforcement mechanisms, and lack of monitoring create conditions through which opportunistic behavior can dominate. Banaszak explained that the same forms of cooperation in collective action in a similar environment can bring different results (Banaszak, 2008). The question is why certain cooperation agreements on agricultural markets are successful while others are not. Some of the groups of producers are effective, while others are not. Banaszak states that variables such as the strength of leadership, previous knowledge in the field of business, the initial selection of members, and the number of members significantly impact the chances of success.

Furthermore, the study of Rolaj et al. (2017) concluded that the growth and strengthening of the role of leadership in the farming communities would also be helpful for the promotion and development of agriculture; it would bring positive effects, such as raising awareness for the degree of competence and quality of decision–making concerning the use of resources and rural development. The scale and intensity of the use of resources, such as land, forests, and rivers for economic development and growth, implicates costs and requires the quality of agricultural products.

Cooperative Agriculture

A study made by DeSalva (2012) stated that forming local and organic agricultural cooperatives is one way to eliminate the barriers currently preventing local and organic farmers from doing business with midlevel institutions and, therefore, to help realize the health, economic, and environmental benefits that come from local and organic farming. It also mentioned the following reasons, and I quote: First, by pooling the supply of produce, agricultural cooperatives can supply the amount of food demanded by mid-level institutions (USDA, 1990). Second, cooperatives give farmers more control over the price of their products and can, therefore, bargain for a price that satisfies both the farmer and the institution (Diamond & Barham, 2012). Third, cooperatives can allow members to invest in group insurance coverage to meet the insurance requirements of mid-level institutions. Fourth, cooperatives make it more feasible for farmers to pool resources and work together to purchase processing and distribution equipment (Hardesty, 2008; Markley, 2010).

Furthermore, in the Philippine setting of ARMM, a report from the Regional Agriculture and Fishery Information Division of DA-ARMM indicated that from January to February, 33 batches have already completed the short course. Nasrodin A. Saripada, a municipal agricultural officer of Piagapo, said the training sprang out of the success of the U.N. World Food and DA tie-up program on the Establishment of Participatory Vegetable Techno Demo Farms in Piagapo. The activity involved establishing a 1,000 sq. meter communal vegetable garden per site and the required 120 sq. meter individual home gardens (Government of the Philippines, 2016). This training covered six municipalities, and 1,671 farmers were trained. It was implemented under the agency's High-Value Crops Development Program and by the Lanao del Sur Provincial Agriculture Office. Most of the participants

were from the municipalities of Piagapo and Masiu, where at least 29 villages were covered. Piagapo and Masiu are pilot areas of the United Nations–World Food Program (UN-WFP) (Government of the Philippines, 2016).

Agricultural Innovations

Agriculture Secretary Dr. William Dollente Dar was the Agro-Industrial Development Program (AIDP) launching keynote speaker who represented President Rodrigo Roa Duterte last November 16, 2021, in Wao and Amai Manabilang. Dar discussed the current condition of Philippine agriculture before the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) Ministers, local officials, SPDA's private business partners, and local farmers, "The use of modern technology can spur or accelerate the development of agriculture in the country," Secretary Dar was quoted as saying during his speech.

The revised development concept for the 26,000-hectare-proclaimed property in the Municipalities of Wao and Amai Manabilang upon the reactivation of SPDA has been focused on establishing a special economic zone dubbed MinSEZ, or Mindanao Special Economic Zone. Another explanation on the subject was agricultural that evolution is the method whereby people or organizations bring new or existing products, operations, or ways of organization into use for the first time in a particular situation to boost its efficiency, competitiveness, flexibility to surprises or environmental sustainability and thereby provide to food security and nutrition, economic growth or sustainable natural resource management (FAO, 2018). Farmers have always looked to new technologies to reduce costs. In addition, higher incomes, more excellent knowledge, and improved communication channels are leading consumers to demand low-cost food of higher quality, increasingly produced through organic methods in many countries, with more variety, consistency, and year-round availability. At the same time, consumers are increasingly demanding that their food be produced using techniques that conserve natural resources, limit environmental pressures, and pay greater attention to rural viability and animal welfare (OECD, 2001).

Indeed, agricultural innovations frequently concern not so much the adoption of newly introduced technologies but the adaptation of existing ones. The term' agricultural revolution' is used when several improvements in separate areas of the farming system co-occur as a complex. Although these may be introduced gradually, once they reach a critical mass, their impact on society may be of a magnitude deserving of the term 'revolution.' Moreover, an article (Praxis, 2018) stated that agricultural revolutions spanning different agricultural scales, from urban farms and aquaponics to food hubs, have been established worldwide. Innovative agriculture is safeguarding the new models of farming and agricultural production. It is also emerging and bringing fresh methods to growing and distributing food.

It is no surprise that it was mentioned in the Bangsamoro Food Security and Nutrition Roadmap 2020 that research and development play a huge potential in contributing to the improvement of this aspect. For instance, pest prevention can be strengthened with the help of a Crop Protection Center wherein in-depth research on pests and diseases is conducted, and further identify control mechanisms. With the meager budget allotted by the central government for agricultural research, these institutions must be strengthened or well supported in providing necessary modern and quality facilities and improving the technical capacities of the scant workforces and researchers. Stated further that there is also insufficient human resources to conduct research, laboratory testing, and other technical jobs as data from the Philippine Statistics Authority shows that only 0.43 percent, or 114 personnel out of the total 26,495 of the country's research and development workforce, is present in the region (BARMM, 2020).

It further mentioned that the region needs a regional crop protection center, soil testing centers, and other agriculture-related laboratories. Hence, several farming requirements are still done in areas outside the region. Moreover, farmers and other regional stakeholders are heavily dependent on interventions extended by the government and other development partners, which sometimes limit innovative initiatives that may improve their farming status. Furthermore, public ventures in agricultural R&D are vital for sustainable agricultural productivity development. By assuring that farmers have access to innovations that meet their diverse and complex needs, public spending on agricultural R&D is more helpful in raising sustainable agricultural productivity than other public expenditures in agriculture, such as irrigation and fertilizer assistance. Recent results suggest that countries in Southeast Asia have the potential to improve R&D and innovation systems more greatly to enhance productivity growth and achieve better future production and food security (OECD, 2017).

Technical advances in agriculture demand further scientific advances to refine the underlying scientific principles and resolve emerging problems. In agriculture, the performance of most technologies is sensitive to local climate, soils, and economic factors, so the potential for local adaptation is excellent, and the impact of new technologies varies widely across locations on a given farm (Huffman, 1998).

Farming methods

Farming methods are undergoing significant technological changes. New government regulations and the demand for more advanced, labor-saving technological solutions drive the change (OECD, 2001). The choice of farming technologies will continue to increase in the future. One problem, however, is the price of new technology, which is often high. Adopting new technologies can thus require making significant investments, and farmers are only willing to invest money when it is profitable for them to do so. The following Innovations as part of their global campaign to reach zero hunger of Food and Agriculture Organization of the United Nations in its Sustainable Development Goals (FAO – SDG) presented the "Innovation and the 2030 Agenda" (2018).

Technologies and practices for small agricultural producers (TECA) – TECA is a global, web-based platform for knowledge exchange, documenting, and sharing practical information on agricultural technologies and practices to help smallholder farmers in the field. It combines this knowledge base with a forum of exchange groups for interactions, identification of needs, and joint learning between various actors of the agricultural innovation systems. Aimed at making demand-driven information available on the production and protection of plants and animals (including fish) and managing natural resources better while adapting to climate change and reducing risks of natural disasters, TECA is also designed to improve nutrition from agriculture and to allow smallholders and other users to access markets better. Apart from small agricultural producers, users include professionals from rural extension and advisory services, producer organizations, NGOs, research organizations, universities, and the private sector.

Mechanization Sustainable agricultural mechanization covers all levels of farming and processing technologies, from simple and essential hand tools to more sophisticated and motorized equipment. It takes 60 days to cultivate a hectare of land using a hand hoe, compared to about three days with draught animal power or less than a day if using a powered direct seeder. In many farming-based communities, women provide up to 80 percent of the total farm labor. Mechanization can ease and reduce hard labor and relieve labor shortages. In Zambia, for example, labor savings from adopting animal-powered equipment have been estimated to be 25 to 35 percent. FAO aims to increase knowledge exchange on agricultural equipment and sustainable practices by fostering partnerships with public and private sector organizations that promote innovation and construct existing technology. FAO helps governments improve strategies that facilitate mechanization and works with small-scale industries, cooperatives, and local groups to ensure smallholder farmers can access and use mechanized services.

Farming practices

In its Sustainable Development Goals, the Food and Agriculture Organization of the United Nations presented the "Invention and the 2030 Agenda" (2018), which stipulated that family farmers play a significant role in feeding a growing entire population. The U.N. General Assembly recently declared 2019–2028 the United Nations Decade of Family Farming, realizing the success of its International Year, which heightened the profile of the role of family farming, pastoralism, and smallholder farming in providing the science, technology, innovation, and entrepreneurship play a vital role in supporting smallholders, including pastoralists and household farmers, in particular women and youth in rural areas attainment of food security and improved nutrition. In its Resolution, the U.N. General Assembly gave special attention to innovation, recognizing "the important role of science, technology, innovation, and entrepreneurship in supporting smallholders, including pastoralists and family farmers, particularly women and youth in rural areas."

The agenda presented further includes the following innovations as part of their global campaign to reach zero hunger. Over 12,000 members from 170 nations and territories comprise the FAO-led global Community of Practice on e-Agriculture. Members can utilize it as a forum to exchange knowledge, concepts, and materials about information and communication technology (ICT). It aims to enhance decision-making regarding the critical function of ICTs in strengthening rural communities, enhancing rural livelihoods, and establishing sustainable

agriculture and food security. The platform is focused on knowledge exchange between U.N. agencies, governments, universities, research organizations, NGOs, farmers' organizations, and private companies.

FAO encourages a change from interventions that concentrate on single agricultural innovation components to a system approach aimed at strengthening institutions and stakeholders' networks that better meet the needs of smallholder farmers. Agriculture innovation across all scopes of the harvest cycle along the entire importance chain - from crop, livestock, forestry, or fishery supervision to input and resource management, organization, and demand access FAO2c's work on agricultural innovation. 11 Senegal A fishing community has increased market access thanks to a growing network of trucks hauling the catch. Recognizing that information exchange requires constructive dialogue, one of the most popular activities is the e-Agriculture Forum Discussions, where themes are driven by demand and guided by partner institutions specializing in various aspects of e-agriculture.

Over 60% of Africa's projected 1.2 billion inhabitants are under 25; however, with limited job development in rural areas where most of the public lives, there is increasing doubt about the landmasses' eagerness to tap into this resource. Digital design and using ICTs will be critical in unlocking Africa's agribusiness, bridging the rural divide, and assisting smallholders and family farmers, fishers, pastoralists, and forest dwellers. Innovative technologies and approaches can boost productivity and profitability, increase consumption of healthy foods, provide access to information, technology, and markets for youth and women, and ensure that agricultural practices are environmentally sustainable for future generations. FAO and partners collaborate to create, promote, and implement digital inclusion projects and scale up innovative digital services. Bringing solutions closer to the requirements of poor households in Africa and other places contributes directly to poverty reduction and food security. ICTs contribute to the effectiveness of existing rural advising services, 12 financial services, and social protection programs. ICTs improve access to markets, information, and business prospects. Through infrastructure and legislation, cost, digital literacy, and the availability of local content, digital inclusion programs overcome the barriers to mobile internet usage.

Tropic Agriculture Platform: Agricultural Innovation Systems To bring capability progress up to speed with the struggles confronting agriculture in the twenty-first century, the Tropical Agriculture Platform (TAP) partners have adopted a new approach, the so-called Agricultural Innovation Systems (AIS) standpoint, which acknowledges that agricultural innovation is a process involving many different players and factors and that it can only take off if it meets the demands of its primary users. The AIS is a network of persons, organizations, and businesses in the agricultural and joined sectors, as well as helping institutions and policies, which bring current or new commodities, processes, and organizational forms into social and economic usage. Policies and institutions (both formal and informal) impact how these actors interact, generate, share, and use knowledge. It comprises four main components: research and education, business and enterprises, bridging institutions, and the enabling environment.

Blue Growth plans to promote ways to balance economic growth, social development, food security, and the long-term usage of marine and freshwater ecosystems. Sharing experiences and lessons learned is a crucial first step toward encouraging innovation and the advancement of strong "blue" economies. FAO's Blue Development Initiative aims to promote a more significant coalition and dialogue on successful agricultural innovation 13 practices that have sparked sustainable development and examine innovative industries and markets that can offer a competitive advantage. Using fish skin to make gorgeous fashion designs is one unique and inventive example. Traditional fisheries and fish farming generate massive volumes of fish skin, often regarded as a waste product. Seaweed cultivation is also increasing in the North Atlantic. The inventive and expanded use of aquatic resources in the fashion industry has the potential to boost the sustainability of both the fashion and fishing industries.

AgLab in China To stimulate innovation in all areas of work, FAO China has established AgLab Cx, an innovation lab integrating a diverse range of partners and expertise, including the Ministry of Agriculture of China, social innovators, academia, and consumer groups. The lab is dedicated to experimenting, prototyping, and developing new ideas in sustainable agricultural development and food security. It provides a platform for engaging the government, young people, technologists, the commercial sector, and civil society in issue resolution. AgLab Cx, which takes a people-centered approach, brings together actors in food and agricultural systems who must

address an issue with those with the technical and financial means for interdisciplinary collaboration and co-creation.

Neglected and underutilized crop species have been pushed aside in favor of those in higher demand. Only 30 of the 30,000 edible plant species available are employed to feed the world. However, these crop species can assist in diversifying food production by introducing new species into our diets, resulting in healthier eating and a higher supply of certain nutrients such as vital amino acids, fiber, and proteins. These neglected and underutilized crops bring economic and environmental benefits in addition to diversifying nutritional intake. Farmers can cultivate them independently, as part of crop rotation systems, or interplanted with other crops to protect and enhance agro-biodiversity. In a crop rotation system, having a more extensive range of species allows farmers to have a more sustainable production system.

Furthermore, shifting species in a crop rotation system disturbs the life cycle of several pests and diseases, lowering the likelihood of infestations. One-third of food produced for human consumption is lost or wasted globally, equivalent to around 1.3 billion tons each year. To put FAO's work on agricultural innovation into action, it is critical to fulfill the fruitful potential of family farmers, especially small and medium-sized family farms, which maintain a substantial percentage of parcels and provide much of the food in low and middle-income countries. The FAO-led Save Food program collaborates with international organizations, the commercial sector, and civil society to find new solutions to reduce food loss and waste along the food supply chain in developing and developed worlds. Because of the enormity and complexity of the problem, all parties - governments, research institutions, manufacturers, distributors, retailers, and consumers - must work together to find solutions, act, and effect positive change. Global Forum on Agricultural Research and Innovation, hosted by FAO, is a multi-stakeholder forum on agricultural study and innovation that allows stakeholders from researchers and organizations to farmers to engage in collaborative discussion and action on the current and future State of agriculture. GFAR promotes collaboration, partnerships, and the sharing of goals along the complicated routes from research to development outcomes.

Machineries & Equipment

A new technology introduced in the province is the system; the pilot area for halal rice cultivation is the first to be covered by the solar-powered irrigation systems in Taraka, which will fully function before the end of August with the commissioning of four more solar-powered systems. The solar-powered irrigation systems are the first in BARMM and were funded by a loan from the state-owned Development Bank of the Philippines (BIMP-EAGA, 2021). These would enable farmers to plant at least twice a year and provide residents with safe drinking water. Service fees would be charged to users to help the municipal government pay for the cost of these facilities. The following Innovations as part of their global campaign to reach zero hunger on Food and Agriculture Organization of the United Nations in its Sustainable Development Goals (FAO – SDG) presented the "Innovation and the 2030 Agenda" (2018).

System for earth observations, data access, processing, and analysis for land monitoring (SEPAL) SEPAL provides comprehensive image-processing capabilities. It enables the detection of small-scale changes in forests, such as those associated with illegal or unsustainable timber harvesting. Users can query and process satellite data quickly and efficiently, tailor their products for local needs, and produce sophisticated and relevant geospatial analyses. Harnessing cloud-based supercomputers and modern geospatial data infrastructures (such as Google Earth Engine), SEPAL allows users to access and process critical historical satellite data and newer data from Landsat and Europe's Copernicus programmed. SEPAL helps countries pave the way for improved climate change mitigation plans and better-informed land-use policies. Kenya Farmers use a combined planting and fertilizing machine near Nyahururu.

Potential of drones for locust early warning and preventive control Vast areas of desert stretching from West Africa to India and including some of the world's poorest countries are regularly monitored for Desert Locust by national ground teams in vehicles. These areas have no mobile or internet coverage and may be several days' drive from the national locust center. Research and development are underway to provide a fixed-wing drone solution to speed things up. The drone could fly some 100 km while collecting data on the location of green vegetation and processing this imagery on board as a map. In turn, the map would guide ground survey teams to specific areas.

A control drone could safely and effectively spray significant infestations before the locusts form swarms. All the drones must be lightweight, portable, solar-powered, durable, and easy to use and maintain locally. The "dLocust family" would be integrated with eLocust3, the hand-held tablet used by survey and control teams for recording observations and transmitting them in real-time by satellite. National locust centers would be responsible for managing and using dLocust.

Farm-to-market roads (FMRs)

When only limited resources are available to build and maintain road networks, one should use the available resources most optimally. Regarding pavement design and construction, pavements should be designed and constructed to sustain large numbers of heavy traffic loads for a long time without showing significant damage. Overloading, for example, is a severe problem in almost all developing countries (Molenaar, 2013). It is necessary to disseminate the culture transforming how the roads are designed, constructed, maintained, and managed, including raising awareness of all those involved in the construction of roads and their impact on the quality of life of citizens to achieve road sustainability. (Corriere, et.al., 2012). Decent transportation infrastructure enables producers to obtain inputs, move their products over large distances, and increase the global market (Agricultural Infrastructures, n.d.). Numerous studies have illustrated the importance of paved highways on agricultural labor productivity. For example, Llanto has expressed that a one percentage point increase in the distance of paved roads as a ratio to the total length of roads is associated with an increase in agricultural labor productivity of PHP 285 000 per laborer. This differentiates from results for irrigation expansion, which has exhibited a positive but insignificant relationship with agricultural labor productivity (Llanto, 2013).

A study by Faiz A. et al. (2012) on Sustainable rural roads for livelihoods and livability concluded that the review of sustainability and livability suggests that a rural road must fulfill two conditions to be sustainable: first, it must contribute to and enhance rural livelihoods and livability, and secondly, its planning and design (as well as construction and maintenance) must be context sensitive to ensure a balance among economic, social and environmental objectives, that is reflective of community values, aspirations, and needs. The required increase in food production will require massive improvements in the agricultural supply and marketing systems, with the rural road providing the first value-enhancing link as agricultural produce moves up the value chain from the farm to the market and on to the consumer.

Rodriguez (2014) reported in an article that FMRs can increase local trade and productivity, reduce transportation costs of farm input and output, and minimize post-harvest losses. They connect farms and coastal areas to main roads, hence promoting agro-tourism. "Rural transport not only concerns the movement of farm produce, but also helps in household tasks such as procuring food, water, and fuel wood," the Food and Agriculture Organization (FAO) said. Ensuring physical access – transportation and infrastructure – to food is one of the dimensions of food security. When deliveries are delayed, the quality of crops drops, as well as their prices and sales – impacting farmers' income and their families' food security. Some farmers would just let their products rot rather than spend for transportation.

Insufficient and poor-quality farm-to-market roads remain an important issue. While the length of FMR roads has been improving, most are still gravel or red dirt roads, vulnerable to damage from flooding and extreme weather events, and often impenetrable during the wet season (ADB, 2012). In coalition with the Department of Public Works and Highways and LGUs, the DA seeks to address this issue through rising expenditure on FMRs and concrete rather than "all-weather" gravel roads (DA, 2015).

Agricultural Infrastructures

Like other public investments, rural infrastructure boosts agricultural production, which promotes growth in rural regions and results in higher agricultural incomes and more opportunities for non-farm workers. Urban and rural populations, net food consumers, gain from increased agricultural output that lowers food prices (Llanto, 2012). Consequently, agricultural production has considerable implications for reducing poverty and its benefits for growth. Roads and electricity are essential determinants of agricultural productivity. This is credible considering a related result regarding the growth restrictions imposed by insufficient infrastructure. Rural roads provide significant connectivity with growing markets adjacent to rural areas; they also lessen input costs and transaction costs of rural producers and consumers. Access to electricity generates various income-earning opportunities for

rural households (Llanto, 2012). Moreover, "the government is investing heavily in infrastructure to achieve high economic growth. This includes the improvement of farm-to-market roads in the rural areas to support agriculture", said DPWH Secretary Mark A. Villar (DPWH, 2020).

Peace and Order

A relatively small body of recent literature on conflict in Muslim Mindanao exists. This primarily consists of grey literature, although several academic journal articles have also been published. A recent initiative led by International Alert and the World Bank provides quantitative data on all the main drivers of conflict in the ARMM, disaggregated by province. This is called the Bangsamoro Conflict Monitoring System (Strachan, 2015). Indeed, peace order is the only significant factor that could either hamper or trigger farm productivity, as shown by the experiences of many farmers in Mindanao, Muslims and Christians alike (Pablico, 2007).

A brief overview of the Conflict situation in Lanao del Sur is multi-faceted, ranging from insurgency, election-related violence, land-related conflict, Rido, and conflict involving the shadow economy (emanating from pyramid scams or other illicit activities) (Province of Lanao del Sur, 2021). The absence of state services in the ARMM also contributes to fragility and instability in the region. Regional government spending on services is low, and the provision of healthcare and education in the region needs to be improved. International involvement in resolving conflict in the ARMM has been limited. Conflict resolution efforts have been led by, but not limited to, Muslim actors, such as Malaysia and the Organization of Islamic Conference. Beyond Malaysia's facilitation of the peace process, regional actors have shown little interest in the conflict in Mindanao in recent years (Strachan, 2015).

FAO (2015) has reported that most combatants from the Moro Islamic Liberation Front (MILF) belong to farming and fishing households and are predominantly farmers and fisher folks. Those wanting to return to a life of peace cannot do so due to a lack of land access and the capital assets to regain their livelihoods. Additionally, despite its rich natural resources, Mindanao could be faring better in harnessing its agricultural potential. While more than 60 percent of the ARMM's economic outputs comprise agriculture, fisheries, and forestry products, these are low value. There are virtually limited market opportunities for farmers, and agricultural labor productivity is significantly lower than in the other provinces in the country. When roads are blocked, and some areas become off-limits because of armed conflict, it becomes increasingly difficult and sometimes impossible to bring the produce to the markets to allow farmers to earn sufficient income and afford the purchase of inputs to sustain farming (FAO, 2015).

Despite some threats to peace and security in Lanao del Sur, the province sees agriculture to achieve peace and stability. The province supports the Ministry of Agriculture, Fisheries, and Agrarian Reform's "From Arms to Farms" program, which aims to "Foster peace through Agriculture and fishery Development in Conflict Areas of the Philippines" (Province of Lanao del Sur, 2020). Efforts are exerted to attain peace and stability in Mindanao, wherein one of the flagship programs of BDP (Bangsamoro Development Plan) is the Bangsamoro Sustainable Agriculture Program. In the report of FAO (2015), this program aims to increase farm productivity, income, and food security, focusing more on vulnerable groups. For the transition period, FAO intends to support smallholder farmers and fishers by enhancing their capacities to jumpstart the restoration and rehabilitation of their livelihoods, engage in microenterprises, especially for women, have access to markets, and sustain their gains by integrating climate-resilient agriculture principles in their production and processing.

Rido or Clan feuding

It is one of the primary drivers of conflict in the region. Moreover, it is interlinked with many other drivers of conflict discussed in this report, as conflict actors in the ARMM often belong to multiple groups and frequently shift alliances (Strachan, 2015). Rido is a constant source of vulnerability for the citizens of the province. The triggers of a Rido can be just anything from slander, misdemeanor, debt fault, damage to property, and theft to the more severe cases such as murder, land disputes, political rivalry, election-related conflicts, sex crimes, and accidents (Province of Lanao del Sur, 2020).

Most ridos start from simple disputes that can quickly be settled locally, employing traditional conflict-finding mechanisms and religious approaches. However, an overdue justice system coupled with inadequate governance

at the local level usually escalates a simple conflict into a complex one, resulting in heightened armed conflicts between and permanent displacement of the families involved (BARMM, 2020).

Lawlessness

Lawlessness in Mindanao is responsible for thriving shadow economies, such as the trade in illegal drugs and weapons. While the shadow economies in the ARMM are linked to violence and conflict, some of them, such as cross-border trade in the Sulu Sea, also have the potential to contribute to peace. This is because they provide livelihoods for fragile island communities (Strachan, 2015). Concepcion et al. (2003) report in the International Alert Organization stated that large areas of southwest Mindanao have been abandoned to lawlessness, so local communities and businesses are insecure. There is a proliferation of armed groups, in some cases' lost commandos' who once fought for one or other of the warring parties but now operate outside any external control. Added to this are the civilian 'volunteers' armed by the military over the years to fight perceived supporters of the Moro armed groups and the NPA. Civilian volunteers can use their weapons in pursuit of gain or localized resource conflicts. They further mentioned in the report, and I quote: In Muslim areas, the failure of the government to provide for or protect Muslims in the past means that many people question its legitimacy, so there is little or no confidence in law enforcement agencies. In Muslim areas, the failure of the government to provide for or protect Muslims in the past means that many people question its legitimacy, so there is little or no confidence in law enforcement agencies. Rumors and reports – some quite well-founded – of the police, the military, and government officials colluding with criminal gangs, local politicians (many of whom have an extensive armed following), and illegal loggers erode this confidence even further.

Disagreements

The disagreement between the government and Moros showed that the root cause of armed fighting in Mindanao can be found in the history of Mindanao people's ongoing struggle for their right to self-determination. A fight includes claiming their identity and requesting meaningful governance in the face of the national government's negligence to realize genuine social growth, peace, and development in the southern Philippines (Batac et al., 2019). The fight is also a response to "historical injustices" and grave human rights violations committed against the people of Mindanao. With the urge to correct these historic discriminations and to recognize their inherent right to chart their own political and cultural direction, the Bangsamoro people – together with their non-Moro allies – have struggled to get their calls heard and worked upon by the central government (Batac et al., 2019).

The dispute between the Government of the Philippines and the armed groups in Mindanao, Especially the Moro Islamic Liberation Front (MILF), is not the only dispute affecting the whole region. The multi-faceted dispute in Mindanao affects numerous armed groups, clans, criminal gangs, and political elites. The leading players in this decades-old conflict are the Moro Islamic Liberation Front, Moro National Liberation Front, and other organizations such as the Bangsamoro Islamic Freedom Fighters, Abu Sayyaf, as well as other armed non-state actors who are always 'in conflict' with the central government. when a Muslim armed group (Moro National Liberation Front or MNLF) started to advocate for a "Moro homeland."

The Philippine government responded through military means, resulting in numerous deaths and displacement of the civilian population (Muslims and Christians). In the 1970s, the Philippine government initiated peace talks and obtained a peace agreement with the then-leading Muslim armed opposition group (MNLF) to stop the conflict and address the problems. However, armed confrontations broke out now and then between the Philippine military and the MNLF and also with another Muslim armed opposition group (Moro Islamic Liberation Front or MILF). For every breakout of armed hostilities, thousands of non-combatants are caught in the crossfire and suffer displacement and other human rights violations (Mindanao Conflict: in Search for Peace and Human Rights, 2008).

Consequently, the security forces and the LGU in Lanao del Sur monitor three insurgent groups: the Maute Group, the BIFF, and the NPA. The ISIS-affiliated Dawlah Islamiya also called the Maute Group, was seen as the most direct security threat in the province after they staged the bloody attacks in a few towns in Lanao del Sur, including Marawi City, in 2017. Their followers still operate in the municipalities to the south of Lake Lanao, such as Butig, Pagayawan, and Sultan Dumalundong, and areas to the north of the lake, like Balindong, Marantao, and Piagapo (Lanao del Sur, 2021).

The BIFF is a breakaway faction of the MILF led by Ameril Umbra Kato; the faction operates in Maguindanao Province with few fellows from Lanao del Sur. Some BIFF members fought during the Marawi City in 2017 (Lanao del Sur, 2021). The NPA is confined to the borders of Bukidnon, Lanao del Norte, Misamis Oriental, and Lanao del Sur, particularly in the mountainous or forested areas of Kapai, Tagoloan II, Bubong, Maguing and Lumba Bayabao. Because the communist group does not have a foothold in the province, the military does not perceive the NPA as an imminent security threat to the province. However, the insurgent group is on the watch list of the 103rd brigade (Province of LDS, 2022).

4.0 Conclusion

This literature review explores the multifaceted aspects of agricultural development, focusing on leadership, political, economic, and cooperative dynamics, agricultural innovations, farming methods, and peace and order. Leadership development in agriculture is critical, as seen in successful programs in countries like Australia and Canada. However, in the Philippines, particularly in BARMM, challenges such as inadequate data systems hinder effective policymaking. Politically, global initiatives like the SDGs influence agricultural policies, and Mindanao efforts emphasize agribusiness's role in economic growth. Economically, despite the broader success of the Philippine economy, agriculture lags, with policies like the Agriculture and Fisheries Modernization Act attempting to address these gaps. The review also highlights the importance of collective action among farmers to overcome structural challenges and the potential of cooperatives to improve agricultural productivity and market access. Innovations in agriculture, including modern technology and sustainable practices, are essential for improving productivity and ensuring food security. The review underscores the need for enhanced research and development in BARMM to address regional agricultural challenges, emphasizing the critical role of technological advancements and cooperative efforts in driving sustainable agricultural development.

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