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Agriculture and fishery production and livelihood interventions: A key towards improving farmers' and fishers' productivity and income

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Abstract

This study systematically investigated the agricultural and fishery interventions facilitated by the Department of Agriculture through its Special Area for Agricultural Development (DA-SAAD) program, which reflects a notable increase in production and income. It employed a multistage stratified random sampling design with each province treated as a stratum with homogeneous clusters of municipalities categorized based on welfare conditions. Based on approximate variance estimates of income levels as a particular welfare variable, using a 5% error of estimation and 95% confidence level, an estimated 4,056 beneficiaries (2,976 farmers, 857 fishers, 143 farmer associations, and 80 fisher associations) were estimated sample size. Results revealed positive outcomes, with discernible enhancements in household food consumption and overall economic status among targeted beneficiaries. Despite challenges posed by the COVID-19 pandemic, SAAD recipients upheld food security standards, particularly in accessing nutritious food, and even generated additional income through surplus production marketed locally.

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Introduction

South Asia's rural agri-aqua enterprises hinge on improved productivity to achieve better economic conditions (Hazell, 2008). These enterprises are vital for ensuring food security and reducing poverty amidst the economic diversification driven by urbanization (Sharma and Kalra, 2019). This necessitates new production technologies and livelihood interventions, which can boost productivity and income (Mahmood and Hossain, 2023).

The government's attempts to encourage scientific developments and offer appropriate community interventions shall strengthen agripreneurship (Mula, 2020; Kapuya, 2019; Minten and Reardon, 2020). They seek to develop the agri-aqua value chain that will assist in boosting production for small-scale farmers and fishers (Mula, 2020; Kapuya, 2019; Minten and Reardon, 2020). In addition, it is seen that there are attempts to restructure value chains that will mitigate the income disparity in the population as well as to modernize agriculture sectors in rural areas to mitigate the impact of climate change (Kumar *et al.*, 2020; Gupta *et al.*, 2021; Shahbaz *et al.*, 2022). Therefore, special efforts are made to increase the capacities of farmers and fishers regarding their access to markets, technology, and information (Udemezue and Osegbue, 2018).

Furthermore, inclusive production policies and climate shock-proof agriculture technologies are developed to increase farming productivity and resilience (Barrios *et al.*, 2021; Rehman *et al.*, 2022). Moreover, according to the SAAD Program Implementation Manual (2017), interventions and local strategies must be developed to ensure food security and reduce poverty among Filipino farmers and fishers in disadvantaged sectors (SAAD Program Implementation Manual, 2017). Some of these interventions and strategies may include free causal inputs that would increase living standards and technological improvement (Feder *et al.*, 2020; Duflo *et al.*, 2018) and capacity building that is essential for sustainable productivity and enhanced living conditions (Goyal and Joshi, 2020; Tafesse and Ferede, 2021). These sustainable farming and fishing practices help feed the world while combating various environmental issues (Tilman *et al.*, 2019; Foley *et al.*, 2020).

Such claims provide a basis for the need for sustainable agripreneurship for growth and resilience for rural growth as found within expansive agricultural development and poverty reduction strategies, as highlighted by Hazell (2008), Sharma and Kalra (2019), Gupta *et al.* (2021), Mahmood and Hossain (2023). Consequently, this study focuses on the effects of diverse agriculture and fishery livelihood activities on the production and income of SAAD beneficiaries targeting the farmers and fishers in the poor provinces/municipalities in the Philippines, as indicated in the map in Fig. 1.

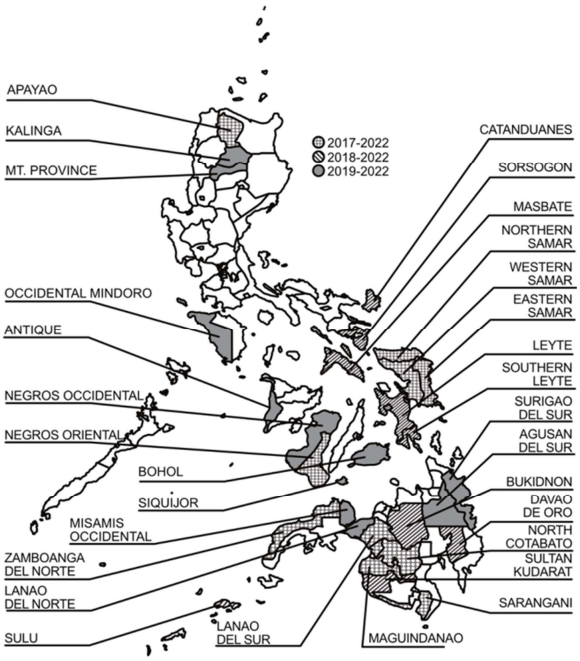

Fig. 1. Marginalized and poorest of the poor sectors of agriculture and fishery to the 30 priority provinces based on Philippine Statistics Authority (PSA) of 2012 and 2015 data

Materials and methods

Demographic profiling

Baseline data profiling was conducted in January 2021 for the first three years of the SAAD program's implementation in the 18 provinces in 2017 and 2018. The farmer and fisher beneficiaries'

names by province, municipality, and barangay, along with the corresponding documented interventions offered and the year they were provided, were the basic demographic data included in this profile data. For the field survey, a multistage stratified random sampling design was used (Som, 1996). The primary sampling units of the province were the municipalities, while the secondary sampling units were the association and household levels.

Every province was considered a stratum within which homogenous clusters of municipalities with similar High, Medium, and Low welfare condition classifications were treated as sub-strata. The welfare condition classifications of the city/municipality were based on data provided by the Philippine Statistical Authority (PSA). The sample municipalities for each H, M, and L sub-strata and the sample associations, farmers, and fishers were then determined using simple random sampling.

A preliminary examination of the profile data from 2017 and 2018 was used to determine the sample size at each sampling step. Four factors were considered when estimating the sample: the expected population variance, the acceptable error of estimation, the required degree of confidence, and the cost. Based on approximate variance estimates of income levels as a particular welfare variable, using a 5% error of estimation and 95% confidence level, an estimated 4,056 beneficiaries (2,976 farmers, 857 fishers, 143 farmer associations, and 80 fisher associations) were estimated sample size. The number of sample associations and households for each city/municipality and the number of sample cities/municipalities for each sub-stratum were then determined using proportional allocation.

Based on the designed activities, outputs, and outcomes, after providing livelihood interventions in crop, livestock, poultry, and fisheries, the expected SAAD program assessment is to improve farmers' and fishers' production and to increase farm income.

Results

Improved farm and fishery production and productivity

Agricultural production

As reflected in Fig. 2, the areas planted with rice, corn, root crops, plantation crops, fruits, and vegetables had increased from 89.20 ha in 2016 (baseline data) to accrued data of all crop beneficiaries in 2017 and 2018. SAAD recipients during 2017, 2018, and 2019 have expanded their production areas to all types of crops except for plantation crops (tiger grass, abaca, cacao, and other fruit-bearing trees), where the area surveyed in 2018 remained constant in 2019. For rice, corn, and vegetable production systems in upland areas, the farmers benefited from the distribution of upland rice seeds, corn, and high-value vegetable seeds (i.e. eggplant, tomatoes, pechay). Likewise, fertilizers and farm tools (i.e. sprinklers, rakes, sacks, drums) were allocated among group members. For the plantation and fruit production systems, the program supported the production of tiger grass, abaca, cacao, and other fruit-bearing trees (i.e. rambutan and lemons). These production systems were viewed as livelihood activities for farmers to produce food and generate income.

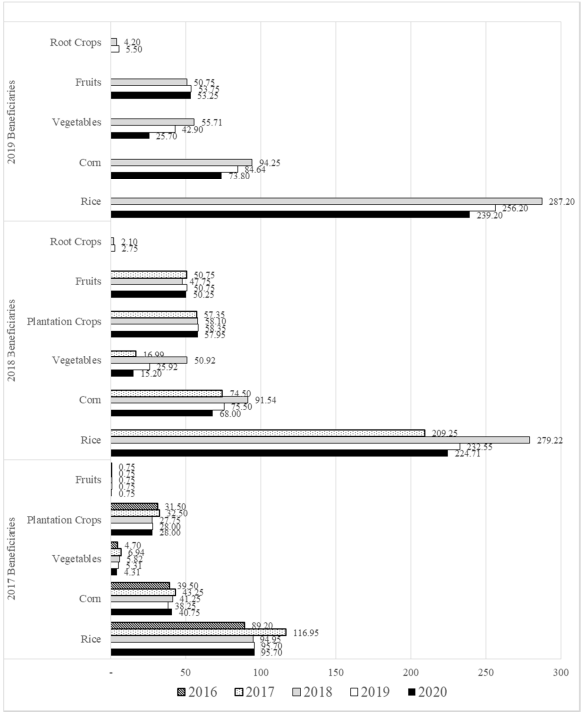

Fig. 2. Total area of farmer beneficiaries in crop production (ha)

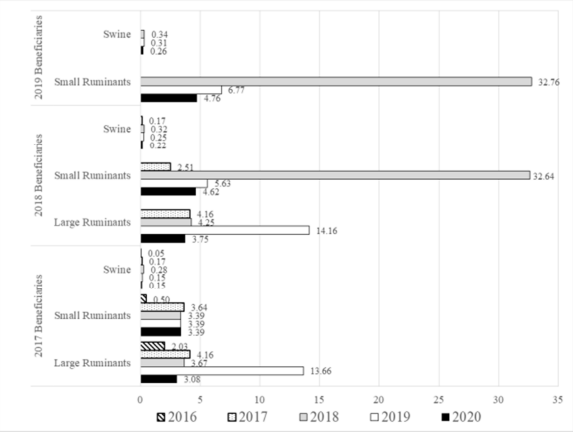

Fig. 3. Total area of farmer beneficiaries for livestock (ha)

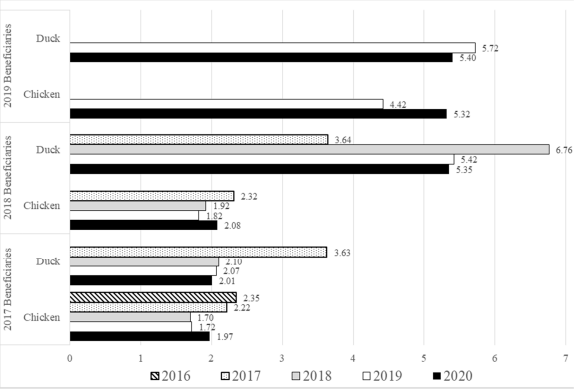

Fig. 4. Total area for farmer beneficiaries for poultry (ha)

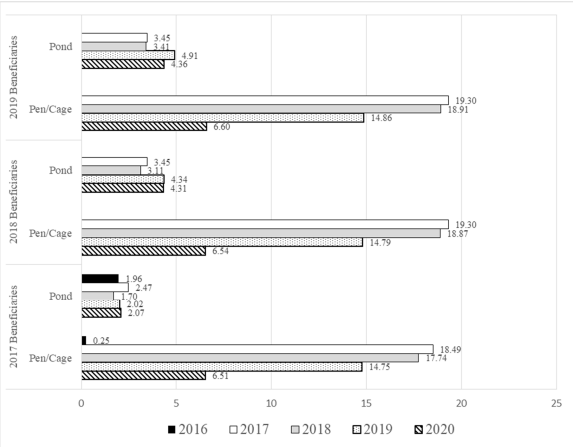

Fig. 5. Total area of Fisher beneficiaries for aquaculture (ha)

Crop and livestock diversification was introduced for beneficiaries to attain food sufficiency and good health. Aside from the crops provided to livestock and poultry beneficiaries, carabaos, cows, goats, sheep, layer chickens, free-range chickens, and ducks are distributed to members as to their choice for breeders and fatteners as food and income sources; however, animals are a shared resource by farmers. For livestock, as presented in Fig. 3, grazing areas from 2017 to 2019 increased for the production of small (goat, sheep) and large (cow, carabao) ruminants. Although a smaller area is required for swine production, African Swine Fever (ASF) spread has resulted in fewer beneficiaries opting to venture into hog raising. Since poultry production is considered a backyard enterprise for the program, a relatively smaller area was utilized (Fig. 4). The increase in the area for chicken is due to the adoption of chicken layer (for egg production) and free range (for meat and egg production). Moreover, for ducks, the increase in area was beneficial for producing eggs and meat.

Fisheries and aquaculture

Individual fisher beneficiaries of the capture fisheries were provided fiberglass and powered boats, bait fishing hand lines, crab pots, nets, and other accessories. The fisher associations also received payao (a fish aggregating device) and related gear for deep-sea fishing. Likewise, fingerlings (e.g. tilapia, catfish, etc.) and corresponding aquaculture feed requirements were provided. Further, to raise fish and other aquatic resources in open-water coastal areas, mariculture fishers were provided with seaweed seed stocks, fish cages, and fish pens as well as production and post-harvest fisheries facilities. Fig. 5 illustrates the aquaculture sector's production area trends of the pond and pen/cage category beneficiaries. These 2017 SAAD interventions triggered a utilization increase of potential fish production space for the Fisher from below five (5) ha in 2016 (before the SAAD intervention) to about 21 ha in the pond and 18 ha in a pen/cage. Moreover, between 2018 and 2020, the beneficiaries' area for the pond and cage somewhat decreased or increased. Typhoons and unfavorable weather caused the loss and death of stocks, which resulted in a reduction in area.

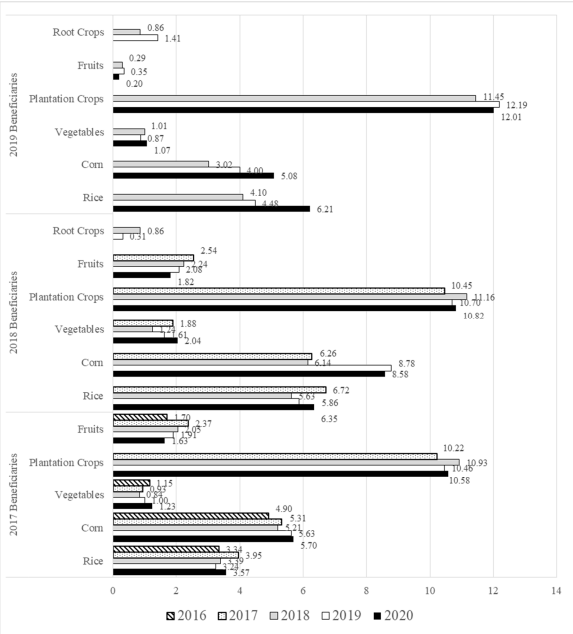

Fig. 6. Volume of crop production per beneficiary group (metric tons)

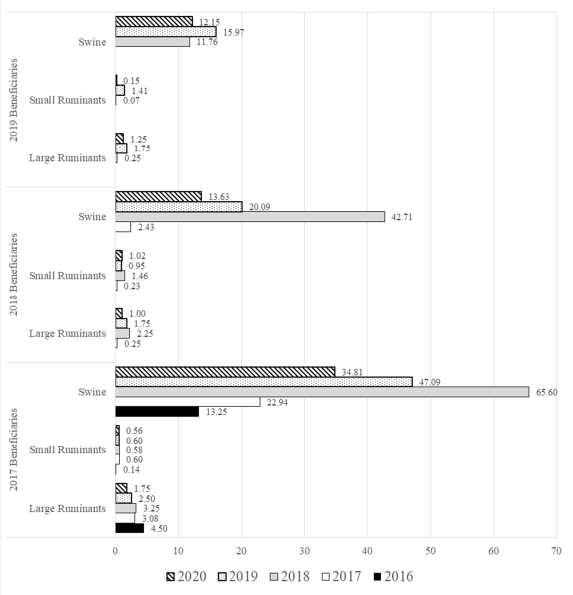

Fig. 7. Volume of livestock production (metric tons)

Volume of production

Agricultural production

For crop production, an increasing rice and corn production volume is noted (Fig. 6) from 2017 beneficiaries (rice – 3.57 MT and 2019 – 6.21 MT; corn – 5.7 MT and 2019 – 5.08 MT) in comparison with the 2016 baseline data for rice (3.34 MT) and corn (4.9 MT). Plantation crop beneficiaries in 2017 recorded their production volume from 2017 (10.58 MT) to 2019 (12.01 MT). The vegetable production volume is minimal since beneficiaries produce them only for food requirements support and not as a family income source. The large and small ruminant's production volume (Fig. 7) is mainly attributed to a stable adoption rate.

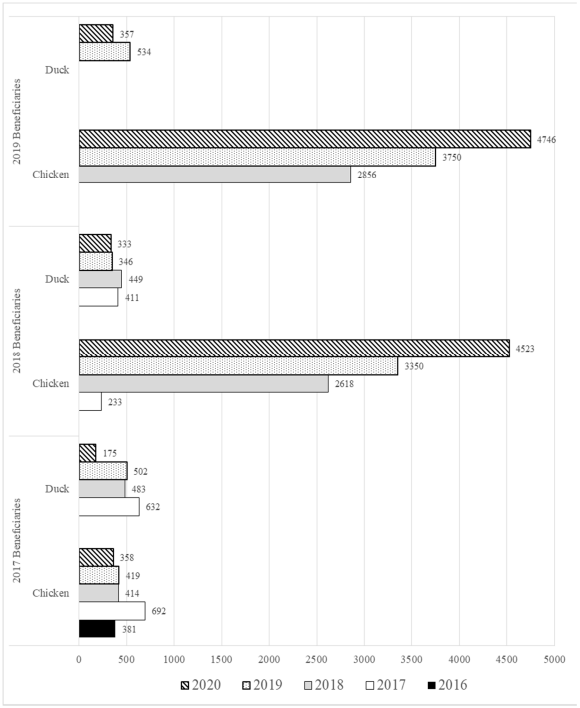

Fig. 8. Volume of poultry production (heads)

Compared to 2018 and 2017, a decreased swine production volume by 2019 beneficiaries was observed due to the ASF that affected many parts of the country. Moreover, for poultry production, the number of produced ducks had a low turnover rate from 2017 to 2020 due to the benefit of selling eggs as a source of livelihood (Fig. 8). Chicken, either as layering (captive) or free range, is preferred over ducks by the beneficiaries because of its easy maintenance and saleable meat, eggs, and value additional by-products (i.e., egg pie, leche flan, processed meat).

Further, for egg production, duck eggs were produced more by 2017, 2018, and 2019 beneficiaries than chickens throughout the reproduction period from 2017 to 2020 (Fig. 9).

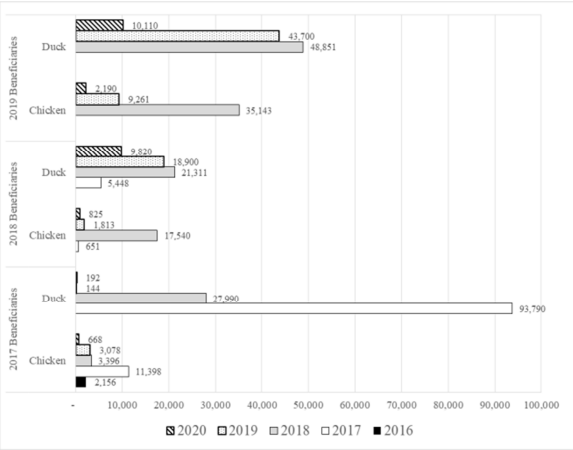

Fig. 9. Volume of egg production (pieces)

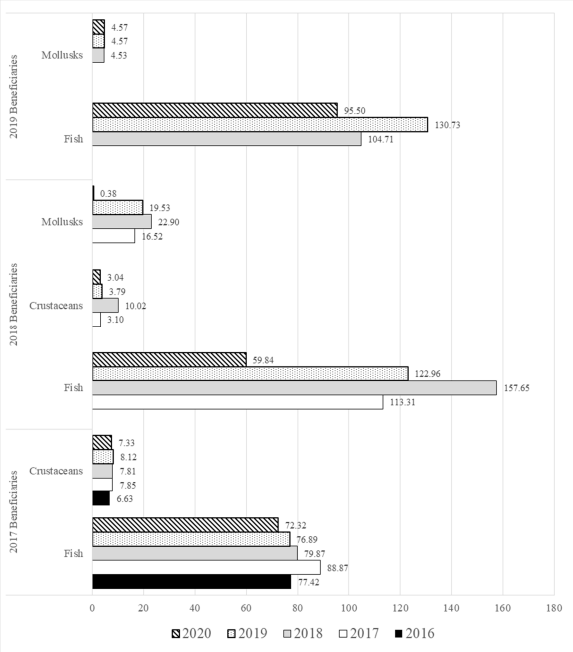

Fig. 10. Volume of capture fisheries (metric tons)

Fisheries and aquaculture production

Fig. 10 reflects the beneficiaries' production volume trends in the capture fisheries commodities. The 2017 beneficiaries targeted larger fish production volumes than crustaceans. An increase in fish production in 2017 to 88 MT was observed, but it declined slightly to 72 MT in 2020. This is equivalent to about 79 MT average landing over the last four years after the SAAD intervention. This indicates a higher fish production than the 77 MT in 2016 before SAAD assistance was provided. Relatively, the crustacean (e.g., crab) harvest also increased from 6.43 MT in 2016 to 8.12 MT in 2019 and 7.33 MT in 2020. This corresponds to a 7.77 MT production average for the last four years among the 2017 beneficiaries. Likewise, the 2018 beneficiaries have a higher fish, crustacean, and mollusk production than in their previous year of fishing operation; however, it experienced a downtrend until 2020. Fish catch reached a high 157 MT production level in 2018 to a low 59 MT in 2020. Similarly, an increase in crustacean and mollusk landings in 2018 to about 10 MT and 22 MT was observed but declined to about 3 MT and 0.3 MT in 2020, respectively. The average annual production at about 113.5 MT (fish), 5.6 MT (crustaceans), and 14.2 MT (mollusk) was pegged. However, the global pandemic-related constraints appear to have caused the annual fish harvest of 2019 recipients to drop to 95 MT in 2020, despite a minor fish catch increase to about 130 MT during their first year of operation. Mollusk landings continue to produce 4.5 MT of shellfish annually at the same rate.

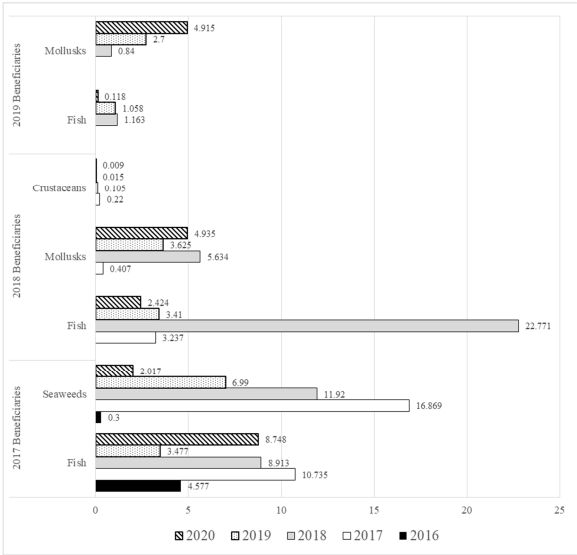

Fig. 11. Volume of production in aquaculture (metric tons)

The 2017 intervention fisher beneficiaries concentrated on fish and seaweed production. Their enterprise significantly increased during the first year of operation but declined in the next few years (Fig. 11). From a low 4.5 MT and 0.3 MT in 2016, fish and seaweed production pegged at 10 MT and 16.8 MT in 2017, respectively. The average annual production was 7.95 MT for fish and 9.44 MT for seaweed,

notably higher than the 2016 production baseline. Meanwhile, the 2018 beneficiaries significantly increased their fish and mollusk production in their first year of operation and leveled their crustacean production in the succeeding years. The average annual production pegged at about 9.53 MT for fish, 4.73 MT for mollusks, and 0.04 MT for crustaceans. Aside from crustaceans, there was a significantly higher annual production of fish and mollusks than the 2016 data. Nonetheless, this beneficiary group increased their annual mollusk or shellfish farming production to 4.9 MT in 2020, 4x higher than before the SAAD intervention. On the other hand, compared to when they did not receive any SAAD assistance, the 2019 beneficiaries experienced very low fish production.

On-farm income

Increasing the income of SAAD beneficiaries is one of the indicators listed in the impact pathway, in addition to providing for the household members' basic needs.

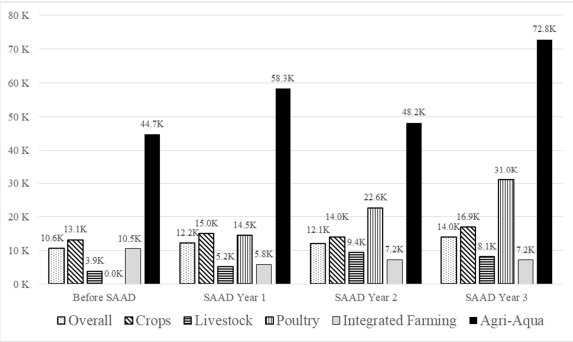

Fig. 12. Average annual on-farm income of farmer beneficiaries (Php)

Agriculture

Based on the survey results, the average annual on-farm income of the farmer respondents ranged from about Php 10,600 in 2016 to Php 14,000 until four (4) years thereafter. When grouped according to livelihood categories, however, different patterns emerged. The agri-aqua beneficiaries reported the highest increase in on-farm income, with an average of Php 44,700 in 2016 to up to Php 72,800 four years thereafter (Fig. 12). The crop farmers' average annual on-farm income increased from Php 13,100 in 2016 to at most Php 16,900 in four years.

On the other hand, farmers who were into integrated farming reported earning an average of Php 10,500 in 2016 but declined to Php 5,800 in 2017 and slowly increased in 2018 and 2019 to Php 7,200. Moreover, farmers in livestock production reported an average income of about Php 3,900 in 2016, which continuously increased from an average of Php 5,200 in 2017 to Php 8,100 in 2019. Further, the average annual income of beneficiaries in the poultry farming industry decreased.

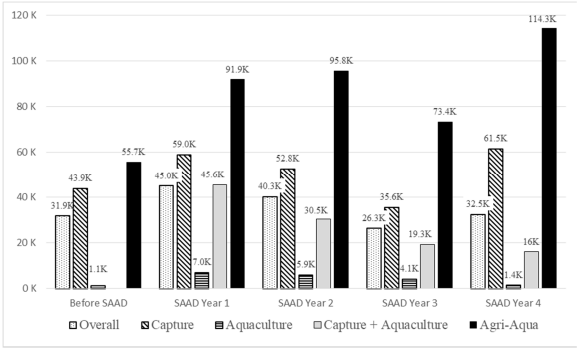

Fig. 13. Average annual on-farm income of fisher beneficiaries (Php)

Fisheries and aquaculture

Before becoming SAAD beneficiaries, fisher beneficiaries involved in agri-aqua reported an average annual on-farm income estimated at Php 55,700, which has increased to Php 114,300 four years later (Fig. 13). Beneficiaries from capture fisheries reported generating up to Php 61,500 in 2020, compared to as much as Php 59,000 during the SAAD implementation. Conversely, people who work in aquaculture reported lower incomes.

Household income

For total household income, which considers the beneficiaries and their household members' off-farm employment, the reported earnings were Php 69,400 in 2016, which climbed to an average of Php 74,500 in 2020 (Fig. 14). Similarly, fishers reported an average annual household income of Php 94,800 in 2016, which increased to Php 102,800 in 2020 (Fig. 15).

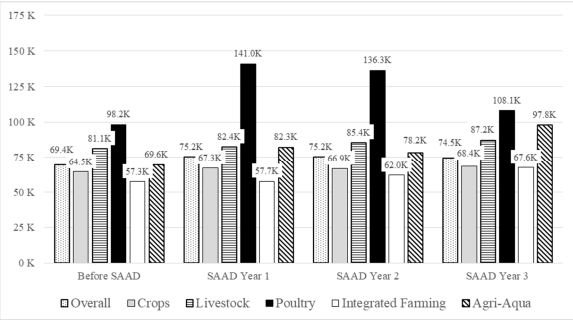

Fig. 14. Average household annual income of farmer beneficiaries (Php)

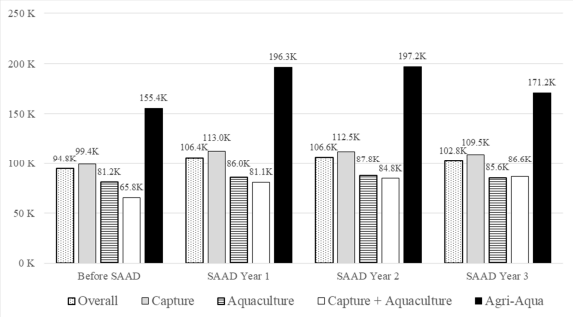

Fig. 15. Average household annual income of fisher beneficiaries (Php)

Discussion

Improved farm and fishery production and productivity

The most important factor influencing benefits or impact on the target communities is the productivity gains from adopting the interventions. The SAAD framework and impact pathway on the social preparation and the provision of production and livelihood components of the SAAD program are expected to improve farm and fishery production and productivity as a result of the following key indicators: enhanced farming and fishing skills; expansion in production areas; and improvement in farm and fishing technologies. These projected gains depend on the introduced technologies and interventions among the target beneficiaries. A part of the SAAD program activities is the provision of agriculture/fishery inputs, tools, machinery, facilities, and equipment aside from capacity enhancement. With this, beneficiaries always experienced having food available in the home and income from excess production. This, in a way, provided their livelihood despite limited mobility during the lockdown and the closures of sources of inputs and transport for delivering goods and services.

The productivity improvements from implementing interventions make it possible to establish the advantages or impact of the SAAD program, specifically to target communities (SAAD Program Implementation Manual, 2017). Such an approach is justified by the Doss *et al.* (2020) study, pointing to the importance of making food production more efficient in improving food security and income in the rural context. Further, Krishna *et al.* (2018) and Rao *et al.* (2019) further depict how capacity building fosters the rural household smallholder farmers' capacity to earn income from the agriculture business and to produce. Also, in the study by Minten and Reardon (2020), it has been shown that the availability of inputs, equipment, and tools is more important to commemorate a significant enhancement in agriculture productivity and improved livelihood. Some negative impacts do, therefore, exist since some studies, such as the one done by Ali *et al.* (2017) on environmental degradation and input-intensive agriculture interventions, affect smallholder farmers' well-being.

Agricultural production

This increase in the area planted with other crops among the participants of SAAD under consideration is in line with the research works by Rao *et al.* (2019) that depict the gains from agricultural interventions in crop diversification and area extension. In addition, to improve the productivity and living standard of farming households, farm inputs should be provided, including equipment, fertilizer, and seeds, as indicated by Minten and Reardon (2020). There are, however, mixed findings because other articles like the one by Ali *et al.* (2017) cast aspersions over the state of degradation of the environment by input-enhancing agricultural interferences and their costs to the smallholder farmers. Also, Amha *et al.* (2022) and Tafesse and Ferede (2021) explore that technology transfer and skill development are crucial in increasing agricultural productivity and ensuring better livelihoods in rural areas.

Livestock and poultry

The following studies recommend integrating different agriculture structures to improve health issues and food security, and crop and livestock diversification should be included in the SAAD program. Hassen *et al.* (2021) and Ouma *et al.* (2019) reveal the same by pointing to pecuniary returns and improved food security accompanying cattle rearing for rural people. Gebremariam *et al.* (2020) and Debele *et al.* (2018) also reveal problems in space and resource sharing for animals and husbandry, which is similar to SAAD's program.

Collectively, these presented the idea that the method of addressing conflict and distribution of resources for the farmer must be effective. Also, the dramatic negative impact of ASF on the level of hog farming presented in this paper is supported by the works of Costard *et al.* (2019) and Munster *et al.* (2021) that describe the devastating effects of ASF on swine production and producers. Further, in a similar vein, with the acceptability of backyard chicken production, studies by Zipo *et al.* (2020) and Elzo *et al.* (2020) establish that small-scale poultry farming could boost food security and income generation among households.

Fisheries and aquaculture production

The support for the beneficiaries in terms of motorized boats, fishing equipment, and aquaculture inputs is justified by the fact that physical access to resources is essential in boosting the productivity of fishermen and improving their livelihoods, as established by Béné *et al.* (2019) and Belton *et al.* (2020). Jat and Singh (2018) and Chakraborty *et al.* (2018) showed that perhaps adopting technology might enhance fish production and the coastal people's income. This is evident in mariculture and fish aggregating devices, among other techniques that illustrate this.

However, as stated in the SAAD program, Neil *et al.* (2017) and Halls *et al.* (2020) also established some difficulties attached to weather-based disasters and natural calamities. These papers also show that poor fishery-dependent communities are very sensitive to environmental perturbations and how useful undertaking and promoting resilience-strengthening measures is. Also, Bell *et al.*'s research published in 2021 suggests that more community-focused approaches regarding managing fisheries can enhance the sustainability of the resources and mitigate the effects of external forces.

Volume of production

Agricultural production

The increase in production volumes of crops among the SAAD beneficiaries, particularly on the plantation crops, rice, and corn, is consistent with the earlier research work of Pandey *et al.* (2020) and Kumar *et al.* (2021), who revealed that agricultural interventions enhance productivity and yield. These include Roy *et al.* (2019) and Gebremariam *et al.* (2020), who explained that crop diversification increases revenue by smallholder farmers and food security. However, Costard *et al.* (2019) and Munster *et al.* (2021) have also identified challenges in disease outbreaks, including ones like African Swine Fever (ASF), here it is evident that swine production volumes have been affected by such diseases, indicating vulnerability of the livestock production systems. Also, the preference for chicken contrite to ducks in poultry production is in harmony with the research findings of Elzo *et al.* (2020) and Pandey *et al.* (2020), which depict the market trend and economic viability of the chicken-based poultry enterprises.

Fisheries and aquaculture production

Cinner *et al.* (2021) and Srinivasan *et al.* (2020)'s findings showed that fluctuations in the fish and crustacean production of SAAD recipients are aligned with changes in the trend of total marine resource productivity that are affected by factors including effort, environmental factors, and management activities. Furthermore, According to Pauly *et al.* (2019) and Cheung *et al.* (2020), sustainable fisheries management can be critical in maintaining the strength and productivity of the ocean resources. However, the studies of Worm *et al.* (2021) and

Sumaila *et al.* (2019) also reveal that the two are issues because the graph of fish yields is declining over time. These studies indicate that correct conservation policies have to be in place, and the right management of fisheries has to be done.

Other similar works by Cisneros-Montemayor *et al.* (2020) and Gephart *et al.* (2021) have also revealed the aggregation of this fish production force by explicating how the COVID-19 pandemic disrupted global seafood value chains and fishing operations. This is evidenced by the reduced volume of fish caught in 2020, as stated earlier in this paper. Another evidence of the declining trend in the fish catch volumes is the problems of overfishing and environmental changes; Sumaila *et al.* (2019) and Worm *et al.* (2021) have also highlighted the challenges.

These studies put much premium on sound conservation policies as well as on the management of fisheries. These external factors are supported by the effects of COVID-19 on fisheries production, showed in studies by Cisneros-Montemayor *et al.* (2020) and Gephart *et al.* (2021), who showed how the pandemic influenced fish supply chain systems and fishing operations all over the world. This is evidenced by reduced volumes of catches in the year 2020. However, Martin *et al.* (2020) and Gentry *et al.* (2018) reveal some issues centering on disease outbreaks and other environmental conditions that affect mollusk productivity, proposing the need for management flexibilities. Moreover, following the investigations of Garcia *et al.* (2019) and Krueger *et al.* (2021), it is also necessary to underline the rather complicated nature of aquaculture systems and the fact that different beneficiary groups require various approaches to address identified challenges and better speak of opportunities for further development.

On-farm income

A further indication of the effect pathway is raising the SAAD beneficiaries' income and providing for their fundamental physiological needs. In order to gauge and characterize respondents' opinions of the changes in their lives brought about by becoming a SAAD beneficiary, respondents were also asked to rate their general level of satisfaction both before and after the program.

Agriculture

Some of the works whose central point relates to the development of agriculture and/or communities have tried to quantify the shifts in farmers' income. Among the small-scale farmers whose farming methods were reviewed, there has been an improvement in their earnings. Other works of literature, such as a study conducted by Berdegué *et al.* (2018), help elucidate the effects of these techniques. Also, Mabiso *et al.* (2020) and Mishra *et al.* (2019) have explored how multi-activity farming leads to risk diversification and secure income. These findings corroborate the reports showing that income status between different livelihood groups has not painted a similar picture. According to Rahman *et al.* (2021) and Shikuku *et al.* (2018), threats, including inputs and markets, might have led to poor revenues for poultry producers. On the other hand, the livestock producers recorded an increase in income as described by Kassa *et al.* (2019) and another recent research conducted by D'Souza *et al.* (2020).

Fisheries and aquaculture

As such, as evident in the various approaches to the work in the areas of rural livelihood and fisheries, the nature of the diet of the beneficiaries of fishing related to capture fisheries and the related agri-aquaculture activities disclose similar trends of the outcomes received, therefore while progressing with the endeavor of evaluating the effect of on-farm income on the overall community. The authors prove this idea by presenting real-life examples of how, in some cases, these systems may decrease income for those operating the systems. For instance, Béné *et al.* (2019) and Ahmed *et al.* (2019) conducted additional research on agri-aquaculture. They emphasized the importance of integrated agri-aquaculture systems that help people earn money, among other ways of livelihood. Studies on rural living and fishery management show steady earnings for fishing those

in capture fisheries and water farming. In their study, Ahmed *et al.* (2019) and Béné *et al.* (2019) found that people can make money by participating in combined farming and fish farming systems. This has led to a significant increase in income among agri-aqua beneficiaries. As shown by Mills *et al.* (2020) and Pauly *et al.* (2019), sustainable fisheries management techniques are essential for promoting the livelihood of fishers, leading to their financial security, hence explaining why there is reported similar income stability or slight increment among capture fisheries beneficiaries. However, some research works by Belton *et al.* (2018) and Sumaila *et al.* (2020) show that factors such as market movements or disease outbreaks could affect commercial fish farming earnings. Consequently, this may explain the decreasing percentage of aquaculture beneficiaries' income.

Household income

Looking at poverty relief programs and rural ways of living, many studies agree with the raised income trends observed in SAAD beneficiaries' households. Research by Winters *et al.* (2019) and Dercon and Christiaensen (2011) shows how farming initiatives help increase family income and reduce poverty levels. This gives more weight to the observed increasing income trend among SAAD participants over time. Studies such as those by Barrett *et al.* (2018) and Carletto *et al.* (2017) discuss the importance of having job options outside of farming in boosting family earnings in the countryside. This supports earlier reported findings of total family income, including earnings from non-farming jobs. Nevertheless, how much one earns from these farming initiatives can change based on how programs are set up, whom they focus on, and the situation around them, contrary to information from the studies of Alkire *et al.* (2018) and Ravallion's (2016). This insinuates the need for more research on how SAAD initiatives impact family earnings.

Conclusion

SAAD interventions aimed to increase the income and food security of disadvantaged farmers and fishers in the poorest areas. For 2017 beneficiaries, crop interventions were constant; however, in 2020, productivity and means of subsistence declined for 2018 recipients, perhaps due to the pandemic. Except for small ruminants, livestock intervention beneficiaries saw production drops in 2017 and 2018. Duck farming suffered a downturn in 2018, but chicken output for 2018 recipients was steady. Diverse recipient groups showed differing patterns of stability and decrease in capture fisheries and aquaculture initiatives.

Recommendation(s)

To boost productivity, income, and sustainability for farmers and fishers towards rural development and poverty alleviation, the researchers recommend expanding the distribution programs for seeds, fertilizers, livestock, and fishing gear. Community storage and processing facilities must be provided to reduce losses and increase marketability. Moreover, regular training programs on modern farming and sustainable practices should be implemented, and farmer field schools should be established to facilitate peer learning and adoption of best practices. Further, strengthen market access through organized market days and online platforms, promote value addition via processing and packaging initiatives, and support small-scale agro-processing enterprises. Lastly, cooperatives and producer groups can be developed to enhance collective bargaining power and improve market access.

References

Ahmed M, Troell M, Allison EH, Be TT. 2019. Integrated agri-aquaculture systems: Vietnamese experiences and global applications. Journal of Environment and Development **28(3),** 290-315.

Ali A, Abdulai A, Mishra A. 2017. Environment-friendly production practices and technical efficiency: Evidence from Ghana. Ecological Economics **140,** 250-261.

Alkire S, Dirksen J, Nogales R, Oldiges C. 2018. Multidimensional poverty and inclusive growth in India: An analysis using growth elasticities. World Development **106,** 78-92.

Barrett CB, Christian P, Shiferaw B. 2018. The structural transformation of African agriculture and rural spaces: Introduction to a special section. Agricultural Economics **49(S1),** 5-8.

Barrios S, Bertinelli L, Strobl E. 2021. Climatic change and rural-urban migration: The case of Sub-Saharan Africa. Journal of Urban Economics **57(3),** 357-371.

Bell JD, Johnson JE, Hobday AJ. 2021. Climate change impacts on Pacific Island fisheries. Marine Policy **124,** 104375.

Belton B, van Asseldonk IJM, Thilsted SH. 2020. Faltering fish in Asia's food systems. Nature Sustainability **3(12),** 905-907. https://doi.org/10.1038/s41893-020-00616-y.

Béné C, Arthur R, Norbury H, Allison EH, Beveridge M, Bush S, Campling L, Leschen W, Little D, Squires D, Thilsted SH, Troell M, Williams M. 2019. Contribution of fisheries and aquaculture to food security and poverty reduction: Assessing the current evidence. World Development **79,** 177-196.

Berdegué JA, Proctor FJ, Cazzuffi C. 2018. Inclusive rural-urban linkages. World Development **97,** 399-410.

Carletto C, Corral P, Guelfi A. 2017. Agricultural commercialization and nutrition revisited: Empirical evidence from three African countries. Food Policy **67,** 106-118.

Chakraborty K, Ghosh A, Meena DK. 2018. Application of innovative aquaculture technologies for enhancing fish production. Aquaculture Research **49(8),** 2745-2762.

Cheung WWL, Pauly D. 2020. Impacts and effects of ocean warming on marine fisheries. ICES Journal of Marine Science **77(7-8),** 2570-2580.

Cinner JE, Huchery C, MacNeil MA. 2021. Bright spots among the world's coral reefs. Nature **535(7612),** 416-419.

Cisneros-Montemayor AM, Moreno-Báez M, Reygondeau G, Cheung WWL, Crosman KM, Ota Y. 2020. Changing the narrative on fisheries and climate change. Marine Policy **104,** 174-179.

Costard S, Mur L, Lubroth J, Sanchez-Vizcaino JM, Pfeiffer DU. 2019. African swine fever: How can global spread be prevented?. Philosophical Transactions of the Royal Society B: Biological Sciences **364(1530),** 2683-2696.

D'Souza GE, Cyphers D, Phipps TT. 2020. Factors affecting the adoption of sustainable agricultural practices. Agricultural and Resource Economics Review **22(2),** 159-165.

Debele B, Gashaw T, Gezahegn T. 2018. Constraints and opportunities of small-scale livestock production in developing countries: A case of Ethiopia. International Journal of Livestock Production **9(8),** 206-212.

Dercon S, Christiaensen L. 2011. Consumption risk, technology adoption, and poverty traps: Evidence from Ethiopia. Journal of Development Economics **96(2),** 159-173.

Doss C, Meinzen-Dick R, Quisumbing A, Theis S. 2020. Women in agriculture: Four myths. Global Food Security **26,** 100332.

Duflo E, Banerjee A, Goldstein M. 2018. The impact of free inputs on smallholder farmers in developing countries: Evidence from randomized control trials. Agricultural Economics **49(4),** 479-494.

Elzo MA, Pugach O, Krehbiel CR. 2020. Improving productivity and profitability of smallholder poultry farming in Ethiopia. African Journal of Agricultural Research **15(2),** 197-210.

Feder G, Murgai R, Quizon JB. 2020. Sending farmers back to school: The impact of farmer field schools in Indonesia. Review of Agricultural Economics **26(1),** 45-62.

Foley JA, Ramankutty N, Brauman KA, Cassidy ES, Gerber JS, Johnston M, Mueller ND, O'Connell C, Ray DK, West PC, Balzer C, Bennett EM, Carpenter SR, Hill J, Monfreda C, Polasky S, Rockström J, Sheehan J, Siebert S, Zaks DPM. 2020. Solutions for a cultivated planet. Nature **478(7369),** 337-342.

Garcia SM, Rosenberg AA. 2019. Food security and marine capture fisheries: Characteristics, trends, drivers, and future perspectives. Philosophical Transactions of the Royal Society B: Biological Sciences **365(1554),** 2869-2880.

Gebremariam G, Amare D, Belay M. 2020. Adoption of improved crop varieties and its impact on household welfare in Ethiopia. Journal of Agricultural and Food Economics **8(1),** 18.

Gentry RR, Froehlich HE, Grimm D, Kareiva P, Parke M, Rust M, Gaines SD, Halpern BS. 2018. Mapping the global potential for marine aquaculture. Nature Ecology and Evolution **1(9),** 1317-1324.

Gephart JA, Froehlich HE, Branch TA. 2021. The COVID-19 pandemic and global food security. One Earth **3(4),** 354-357.

Goyal A, Joshi PK. 2020. Innovation and entrepreneurship: Opportunities and challenges for Indian agriculture. Economic and Political Weekly **55(18),** 58-65.

Gupta A, Singh M, Kumar R. 2021. Climate change impacts on agriculture and food security. Climate Change and Environmental Sustainability **9(1),** 27-34.

Halls AS, Welcomme RL. 2020. Floodplain river fisheries: Models to assess the impacts of dry season flows on fish and fisheries. Environmental Management **14(4),** 726-737.

Hassen A, Gizaw S, Haile A. 2021. Livestock and fishery sectors' roles in food security and economic growth in Ethiopia. Journal of Agriculture and Rural Development in the Tropics and Subtropics **122(1),** 59-68.

Hazell P. 2008. An assessment of the impact of agricultural research in South Asia since the Green Revolution. Food Policy **33(4),** 319-336.

Jat ML, Singh AK. 2018. Innovative agricultural technologies for improving productivity and sustainability in the Indo-Gangetic Plains. Agricultural Systems **165,** 138-149.

Kapuya T. 2019. Promoting agricultural value chains in Africa: Current status and future prospects. African Journal of Agricultural and Resource Economics **14(1),** 24-37.

Kassa Y, Alemayehu M, Melaku D. 2019. Livestock production constraints and opportunities in Ethiopia: A review. African Journal of Agricultural Research **10(9),** 959-977.

Krishna VV, Aravindakshan S, Nath B. 2018. Agricultural extension and rural advisory services in India: An overview and assessment of institutional diversity and development. Agricultural Systems **165,** 63-75.

Krueger T, Page T, Hubacek K. 2021. The role of farm and farmer characteristics in climate adaptation: A survey of German farmers. Climate Risk Management **9,** 44-54.

Kumar S, Sharma P, Kalra N. 2020. Restructuring agricultural value chains for reducing income disparity in rural India. Journal of Agribusiness in Developing and Emerging Economies **10(2),** 197-214.

Kumar S, Sharma P, Kalra N. 2021. Restructuring agricultural value chains for reducing income disparity in rural India. Journal of Agribusiness in Developing and Emerging Economies **11(2),** 147-160.

Mabiso A, Pauw K, Benin S. 2020. Agricultural growth and poverty reduction in Uganda: The role of multipliers and multipliers' multipliers. World Development **128,** 104840.

Martin SM, Lorenzen K. 2020. Fishing for a future: The potential role of fisheries in achieving sustainable development goals. Sustainable Development **28(6),** 1292-1302.

Mills DJ, Westlund L, de Graaf G. 2020. Sustaining livelihoods through small-scale fisheries: Lessons learned from the Asia-Pacific region. Marine Policy **104,** 173-181.

Minten B, Reardon T. 2020. Food value chain transformations in developing regions: Status, trends, and implications. Agricultural Economics **51(S1),** 49-69.

Mishra A, Khanal AR, Mohanty S. 2019. Market participation and rural poverty reduction: Evidence from India. Food Policy **74,** 23-35.

Mula R. 2020. Agripreneurship development: The role of government policies and initiatives. Journal of Agribusiness in Developing and Emerging Economies **10(1),** 14-26.

Munster VJ, Bausch DG, Gerdts V. 2021. African swine fever: Changing approaches to managing a globally spread epidemic. Nature Medicine **26,** 1432-1440.

Neil ML, Jones S, Carter RW. 2017. The impacts of climate change on small-scale fisheries in the South Pacific: A review. Marine Policy **81,** 131-140.

Ouma E, Dione M, Lule P, Ochago R. 2019. The impact of pig production on household incomes and food security in Uganda. Livestock Research for Rural Development **31(6),** 112-119.

Pandey S, Tewari SK. 2020. Impact of agricultural extension services on crop yields and farm income in India. Agricultural Economics **51(2),** 215-229.

Pauly D, Hilborn R, Branch TA. 2019. Does catch reflect abundance? Nature, history, and conservation of ocean fish stocks. Nature **494(7437),** 305-306.

Rao KPC, Verchot LV, Läderach P. 2019. Impact of climate-smart agriculture on the livelihoods of smallholder farmers in Uganda. Climatic Change **153(3-4),** 277-291.

Ravallion M. 2016. The economics of poverty: History, measurement, and policy. Oxford University Press.

Rehman F, Jingdong L, Chandio AA, Hussain, Memon QUA. 2022. Climate-smart agriculture and sustainable agricultural productivity: Evidence from Pakistani Punjab. Environmental Science and Pollution Research **29(3),** 3839-3852.

Roy R, Pal S. 2019. Impact of crop diversification on rural livelihood in India. Economic and Political Weekly **54(4),** 76-85.

SAAD Program Implementation Manual. 2017. Special area for agricultural development (SAAD) program. Department of Agriculture, Philippines.

Shahbaz M, Ali A, Ashraf M. 2022. Impact of climate change on agriculture in South Asia. Environmental Science and Pollution Research **29(4),** 4515-4530.

Sharma R, Kalra N. 2019. Urbanization and economic diversification: Implications for food security and poverty in South Asia. Asian Journal of Agriculture and Development **16(1),** 23-34.

Srinivasan UT, Watson R, Sumaila UR. 2020. Global fisheries catch and effort: 1950-2010. PLoS ONE **6(7),** e22508.

Tafesse A, Ferede A. 2021. Capacity building for sustainable agricultural productivity in Ethiopia. Journal of Development and Agricultural Economics **13(1),** 1-12.

Tafesse A, Ferede T. 2021. Impact of agricultural extension services on farm productivity and poverty reduction in Ethiopia. International Journal of Agricultural Sustainability **19(2),** 130-147.

Tilman D, Balzer C, Hill J, Befort BL. 2019. Global food demand and the sustainable intensification of agriculture. Proceedings of the National Academy of Sciences **108(50),** 20260-20264.

Udemezue JC, Osegbue EG. 2018. Theories and models of agricultural development. Annals of Reviews and Research **1(5),** 555574.

Winters P, Carletto C, Davis B, Zezza A. 2019. Rural income-generating activities and agricultural intensification: Implications for poverty reduction. World Development **40(8),** 1453-1468.

Worm B, Lotze HK, Hilborn R. 2021. Sustainability of global fisheries revisited. Science Advances **7(8),** eabc5433.

Zipo D, Ngugi CC, Bowman JR. 2020. Sustainable poultry production and its impact on household food security in Kenya. International Journal of Poultry Science **19(3),** 135-142.