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Operational and production determinants contributing towards commercialization among female Agripreneurs in Vhembe district

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Abstract

This study investigates operational and production determinants that significantly influence small-scale transitioning to commercial farming among female agripreneurs, the implications for food security and gender equality with various elements impacting the commercialization of agricultural production in emerging economies. A quantitative research design was used in this research. This study was conducted in the emerging economic zone, the Vhembe district of Limpopo province where agricultural activities dominate. A purposive sampling was used to select 149 female agripreneurs. Structured questionnaires were handed to the participants during the in-person interview sessions. The study results reveal that the sample was dominated by elderly agripreneurs who primarily relied on permission to occupy arrangements for land security. The study findings exhibit that operation determinants such as type of farming and record keeping were positive contributors towards commercialization among female agripreneurs. Meanwhile, production elements such as commodity types regressed the commercialization effort among female agripreneurs. The study findings imply that policy tools should advocate for land security among female agripreneurs as they enhance the implementation of their long-term agricultural plans. The study findings suggest that emerging female agripreneurs should be made aware of various farming types that propel commercialization within a shorter period due to their lifecycle.

Keywords: Agripreneurs, Commercialization, Determinants, Female, Farming, Transition.

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Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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1. Introduction

Agricultural commercialization is no longer a luxury but an essential mechanism to cope with the burden of food demand throughout the globe due to a daily population increase [1]. Agribusiness is vital to support the well-being of society as it satisfies people's requirements for nutrients [2]. In agriculture, commercialization refers to the progressive shift from household production for home consumption to production for sale in the market to generate income [3]. Agricultural commercialization is effective for governments to achieve the development goal of eliminating hunger and poverty and ensuring food security within society [4]. A similar study also alluded that achieving agricultural commercialization could serve as a growth engine for the country's overall economic development particularly for emerging economies [5]. Agricultural commercialization is desirable as it enhances the livelihood of smallholder farmers through economic welfare in food systems. Furthermore, it has been noted that agricultural commercialization is a complementary stimulator for the rural economic growth process [6]. Practicing commercially viable agriculture enhances farmers' resilience towards climate change [7]. The level of commercialization would depend on the farmer's total expenses in the enterprise including the operational costs [4]. In developing countries, women remain a crucial driver of agricultural growth due to their large population and contribution to the farm labor force [8]. However, literature has boosted the idea that women's commercialization capacity in the production scale is much lower than men [9].

Furthermore, it has been a trend that the commercialization of agriculture has seen women increasingly disadvantaged because of persistent gender disparities in access to productive resources [10]. Contributing to food security in society requires women as well as men to participate in commercial agriculture [11]. The empirical evidence supports realising economic growth through commercializing agricultural production [4]. The lack of comprehensive literature on gender-dimensioned agricultural commercialization motivated this research to examine the operational and production factors that influence female agripreneurs' commercialization. Many studies investigating agricultural production commercialization primarily focused on the influence of institutional factors and postharvest activities like marketing performance on commercialization enhancement amongst farmers. Hence, the current study investigates the operation and production determinants as they are critical to agricultural commercialization's postharvest performance and sustainability. As a result, the current study addresses the following two research questions: What are the operational and production determinants contributing to the commercialization of agricultural production? What are the production and operational determinants contributing to the regress commercialization of agricultural production? This study aimed to investigate operational and production determinants that contributed to the commercialization of agricultural production among farmers. The study was structured into the following six sections: the first is about an overview of the importance of agricultural commercialization. Section two reviewed the existing literature on commercialization among small-scale farmers. Section three outlined the methods executed in the study and section four presented and discussed the study findings. Sections five and six presented the research implications and the proposed future research, respectively.

2. Literature Review

Several factors have been associated with the commercialization of farming as demonstrated by the various studies that have examined this phenomenon worldwide. However, studies have focused on external farm factors such as institutional support and policies that govern agricultural development that could impact commercialization among smallholder farmers. This can be noted in a similar study conducted in South Sudan which alluded to the affiliation of farmers to various farmers' groups being crucial towards commercialization among horticultural crop farmers [12]. This was supported by a review of the significant determinants of smallholder agricultural commercialization which discovered that support provision from various agencies has significantly led to technology adoptions, market integration and improved policy aspects that enable farmers to commercialize [13]. Meanwhile, in Kenya, land access and ownership have been identified as predictors of commercialization among vegetable producers [14]. A similar study that determined factors influencing commercialization among farmers indicated that landholding size plays a prominent role in transitioning from small-scale to commercial farming [15]. In this process, there has been the omission of investigating determinants contributing to commercialization among female farmers particularly in remote areas. Furthermore, it has been noted that the transformation of agricultural production from subsistence to a commercial farming system is technically influenced by improved income generation which reduces destitution levels among smallholder farmers [16].

Moreover, the availability of draft power, livestock ownership, access to irrigation, agricultural training and household income significantly and positively influence commercialization among smallholder farmers [17]. Furthermore, it has been revealed that household size, livestock ownership and distance to the market are the significant factors influencing crop commercialization [18]. A study that examined the operational variables that affected commercialization found that the operational land, level of crop diversity and market distance had a significant detrimental effect on the efforts of producing farmers [19]. A related study pointed out that secondary education and communal tenure significantly and negatively influence commercialization efforts among smallholder farmers [17]. The amount of inorganic fertilizer used, the area under tractor-ploughing and the area under pump-set irrigation were found to positively impact the commercialization of cash-crop farmers [15]. The current study attempted to address this gap by examining the operational and production factors that support the commercialization of female agripreneurs who play a crucial role in ensuring food security in the context of developing countries.

3. Materials and Method

3.1. Research Design

This study used a quantitative method. Quantitative research deals with quantifying and analyzing variables to get results [20]. This type of design was suitable to understand the in-depth determinants contributing towards commercialization among female agripreneurs.

3.2. Participants

The study was conducted in the Vhembe district of the Limpopo Province. Vhembe district is one of the five districts constituting the Limpopo Province of South Africa. The Vhembe district covers 25,597 km² with an estimated population of 1,294,722. The Global Positioning System (GPS) coordinates are 22° 56' 0" S, 30° 28' 0" E [21]. Vhembe district is one of the most emerging economic zones within the Limpopo province with agricultural activities being the most reliant economic venture people consider for survival such as street food and fruit vending [22]. The study participants were emerging female agripreneurs who had intentions to commercialize their current agribusiness ventures.

3.3. Sampling Techniques

The current study used purposive sampling to select 149 female agripreneurs within the Vhembe district. Purposive sampling was preferred due to its ability to locate and select units that would efficiently use the scarce resources available [23].

3.4. Data Collection Tool

Structured questionnaires were handed to the participants during the in-person interview sessions.

3.5. Data Analysis

Statistical Package of Social Sciences (SPSS) version 28.0.1.1 software was used to analyse the data. The binary logistic model was used to investigate the considerable influence of farmers' transition towards commercialization. The model aimed to determine the significant contributors towards commercialization among agripreneurs from the pooled operational and production variables. The binary regression model was preferred for its ability to estimate the relationship between one or more explanatory variables [24]. The model was expressed as follows:

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_n X_{in} + \mu_i \quad (1)$$

From the mathematical expression, Y_i was dichotomous denoting the study's dependent variable measured by the agripreneurs' readiness to commercialize (Yes = 0 and No=1). The explanatory variables used in the analysis were denoted by X_s as shown in Table 1.

Table 1.
Description of explanatory variables.

Variable description	Type of measure	Expected sign
Type of commodity	0= Durable, 1 = High perishable, 2= Bulky	-/+
Type of livestock	0= Beef, 1= Poultry, 2= Pork ,3= Goat, 4=Sheep	-/+
Type of farming	0= Specialized, 1= Diversification, 2= Mixed	-/+
Size of land	0= Less than 10 ha, 1= 11-20 ha, 2= 21-30 ha, 3= 31-40 ha, more than 40 ha.	-/+
Land ownership	0= Owned, 1= Lease, 2=PTO.	-/+
Farming experience	0= Less than 5 years, 1=5-10 years, 2=11-15 years, 3=16-20 years, 4= Above 20 years	-/+
Type of labour	Permanent =0, contract =1, seasonal =2,	-/+
Access to water	Dummy,0=No,1=Yes	-/+
Managerial style	0= top and down approach, 1= collaborative, 2= supervisory, 3= servant	-/+
Working hours	0= Flexible,1=8 Hours, 2= half day	-/+
Duty allocation	0= Individual,1= Teamwork, 2= Combination	-/+
Record keeping	Not keeping =0, weakly=1, monthly=2, seasonal=3	-/+
monitoring	Not implemented =0, weakly=1, biweekly=2, monthly=3, seasonal=4	-/+
Equipment maintenance	Scheduled =0, random=1, seasonal=2, frequently=3	-/+
In service training	Not implemented =0, biweekly=1, seasonal=2	-/+
Institutional support	Seasonal=0, occasional=1	+
Communication channel	Word of mouth =0, telephonically=1, Email =2, others=3	-/+

4. Results and Discussion

This section presents and discusses the study findings accordingly.

4.1. Discussion on the Socioeconomic Distribution among Female Agripreneurs

This study investigated the socio-economic characteristics to gain insight into the participants' economic status that could influence their commercialisation. From the study results, most farmers were aged fifty-five and above, accounting for 33.6% suggesting female agripreneurship was dominated by the elderly within the study sample. The second dominant group was female agripreneurs between the ages of forty-six and fifty-five. The most minor group was aged below the age of twenty-five accounting for 6%. In an educational context, most participants within the study sample had attained secondary education status followed by those with primary education. Those with tertiary education accounted for 17.4% which could be interpreted from the minority groups of young female agripreneurs within the study sample.

Regarding marital status, most study participants were married at 67.8% followed by those who were single, accounting for 28.9%. Most participants had farming experience of less than five years (38.8%) followed by those with farming experience of between five and ten years despite the elderly group being dominant within the study sample. Those with more than twenty years accounted for 10.7% only. The study findings about the larger group of participants being in the farming space for less than five years are desirable in this study for the stimulation of their willingness to commercialise compared to their counterparts who are not eager to commercialise. Regarding land ownership, the study findings revealed that most participants within the study sample owned the land under permission to occupy followed by those under the lease agreement.

The study profiled the socioeconomic status of the study participants as depicted in Table 2. Table 2 provides an insight into the distribution of socioeconomic characteristics among farmers.

Table 2.
Socio-economic characteristics of the participants.

Variables	Frequency	Percentage (%)
Age group		
below 25 years	9	6
25-35 years	32	21.5
36-45 years	13	8.7
46-55 years	45	30.2
55 years and above	50	33.6
Educational status		
No formal education	10	6.7
Primary education	41	27.5
Secondary education	72	48.3
Tertiary education	26	17.4
Marital status		
Single	43	28.9
Married	101	67.8
Widowed	4	2.7
Divorced	1	0.7
Farming experience		
less than 5 years	58	38.9
5-10 years	40	26.8
11 -15 years	26	17.4
16-20 years	9	6
20 years and above	16	10.7
Land ownership		
Own	46	30.9
Lease	48	32.2
PTO	55	36.9
Total	149	100

Table 3 shows the results of the estimated model. The model classified rates as 61.3% for agripreneurs ready to commercialise and 56.7% for those not ready to commercialise while the overall classification rate was 68.1%. These results indicate the degree of accuracy of the model. Therefore, the reliability of the resulting estimated coefficients with their accompanying statistics. From the analysis, the dependent variable would explain 61.9% (Cox & Snell) and 64.4% (Nagelkerke) of the variation in results. The non-significance of the goodness of fit indicates that the model fits the data well [25].

Table 3.
Binary logistic results for agricultural commercialising among agripreneurs.

Variables	B	Standard error	Wald	df	Sig.
Type of commodity	-0.790	0.669	1.394	1	0.038**
Type of livestock	-0.200	0.246	0.661	1	0.416
Type of farming	0.371	0.469	0.625	1	0.061*
Size of land	0.316	0.275	1.320	1	0.006***
Land ownership	-0.315	0.123	6.572	1	0.010**
Farming experience	0.014	0.023	0.348	1	0.020**
Type of labour	-2.346	0.962	5.942	1	0.015**
Access to water	0.284	0.577	0.243	1	0.622
Working hours	-1.381	1.305	1.121	1	0.290
Management style	3.392	1.280	7.017	1	0.108
Employee duties	0.113	1.223	0.019	1	0.314
Record keeping	3.635	1.473	6.090	1	0.014**
Operations monitoring	0.057	0.153	0.139	1	0.070*
Maintenance cost	0.000	0.000	0.883	1	0.347
In-service training	0.718	0.514	1.950	1	0.163
Institutional support system	-0.117	1.727	0.005	1	0.846
Communication model	2.234	0.980	5.193	1	0.023
Constant	-9.599	2.817	11.613	1	0.001
Diagnostics:	Classification:	Goodness of fit:			
-2 Log likelihood = 64.871	Yes = 61.3%	$\chi^2 = 2.339$			
Cox & Snell = 0.619	No = 56.7%	df = 1			
Nagelkerke = 0.644	Overall = 68.1%	Sig. = 0.711			

Note: Significant levels: *** (1%), ** (5%) and * (10%).

Source: Field data, (2024).

4.2. Discussion of Determinants Contributing to Commercialization

4.2.1. Type of Farming

The type of farming was one of the determinants that contributed positively to smallholder farmers' transition towards commercialization. Most participants within the study sample were primarily interested in diversification and mixed farming with the least being interested in specialized farming. The study findings are corroborated with the discovery that subsistence farmers who exhibited high crop production diversity were more likely to achieve commercial status [26]. The same trend was noted in promoting crop commercialization by incentivizing farmers through their diversification production system [27]. The findings of the study indicate that practicing a certain kind of farming might provide a farmer with an advantage in commercialization and also supplement the discovery of a type of commodity being influential towards commercialization among female entrepreneurs. The findings about the type of farming influencing commercialization could primarily be based on the advantages of farming methods. A farmer who uses diversity as a means to balance revenue when one business is profitable and the other is not might benefit from the aforementioned advantages.

Regarding mixed farming, farmers may prefer the supplementary and complementary associations of enterprises towards the resources at their disposal. The study findings could imply the importance of effective methods and resource allocation that could contribute to farmers' efforts towards commercialization. It is essential to use mixed agricultural strategies since they significantly facilitate resource rotation and subsequent allocation. Furthermore, the study findings could be influenced by the rate of investment returns that each type of farming could achieve under various periods.

4.2.2. Size of Land

From the findings, it has been noted that the size of the land positively contributes to farmers' commercialization. Logically, more extensive farming land has the potential to accommodate a more significant production which enhances productivity and ultimately ensures production on a commercial scale. Therefore, the study findings suggest that access to more extensive land positively positions farmers to expand their production significantly. This specific finding of the study supplements the current study's finding relating to land ownership which indicates that land allotted to agricultural production is a significant driver of the commercialization of agriculture [28]. The current study findings are congruent with the findings of Endalew et al. [29] who noted that land size positively influences commercialization through increased productivity eventually enhancing market participation.

Furthermore, the study findings could be significantly influenced by a particular segment of study participants mainly in livestock and mixed farming. It demands a more extensive land size. The positive influence of the larger size of land towards commercialization among farmers could also depend on the production methods that require free-ranging for those rearing livestock. Furthermore, the findings were also supported by the study of Negesse [30] who indicated that land size is a crucial variable in determining smallholder farmers' participation in commercial farming. The study findings could also pinpoint the importance of land access among smallholder farmers as a mitigating factor to enhance their transition into commercialization. The study findings highlight the importance of female agripreneurs owning land as they practice farming through leased land.

4.2.3. Record Keeping

Keeping the records was another determinant that contributes to commercialization significantly and positively. Keeping the records relating to the farm operations and financial transactions was found to be statistically significant at a 5% significance level towards commercialization. The study results imply that keeping records enhances one's chance of transitioning from being a small-scale farmer to being a commercial farmer. The study findings are consistent with the study of [Wongnaa et al. \[31\]](#) who indicated that the record-keeping among commercialized farmers was higher than that of non-commercialized farmers. The same was noted in the study of [Omotesho et al. \[32\]](#) who also reported that there is poor record-keeping among non-commercialized farmers. The study findings could be logically influenced by records keeping being essential to track the business trails and utilising such records for informed decision-making. The findings were supported by [Manteaw et al. \[33\]](#) who noted that record-keeping is common and effective among commercialized farmers compared to their counterparts.

Furthermore, keeping record of activities makes it easier to find gaps and offers customized solutions. The study findings could further imply that keeping records is essential for growth as one may identify areas of excellence and those for improvement. Record-keeping plays a vital role in identifying activities that are gearing up for such a transition and those that hamper the development with the transition from small-scale to commercial farming being a lengthy process. The current study's findings align with the view that monitoring an enterprise through records significantly influences commercialization as it helps to compare with the actual plans. This is vital for the progress of the business as one may quickly identify areas of improvement while the business keeps improving on its strengths.

4.2.4. Operations Monitoring

The results revealed that monitoring operations significantly contribute to commercialization among female agripreneurs. With the monitoring exercise critical to ensure that the business conducts its activities as planned, the results confirm that agripreneurs who frequently monitor operations are likely to transition from small-scale farming into commercialization. The study findings imply that monitored operations will yield the desired results and achieve the objectives. With the farming landscape being dominated by environmental impacts beyond human control, frequent monitoring is essential in ensuring that variations within the business are addressed at the earliest convenience to mitigate any harmful consequences. The study findings are complemented by the study which revealed that monitoring farm data using various innovative technologies enhances productivity and sustainability particularly among livestock farmers [\[34\]](#). The study findings could also imply that regular monitoring of a farm business is an essential exercise that serves as a risk-hedging mechanism to protect farmers from potential loss.

Furthermore, the study findings resonate with the importance of scouting for possible environmental challenges that significantly impact farm business operations. Monitoring exercise is vital for the survival and sustainability of the business with challenges associated with agricultural production because monitoring exercise is handy in all production phases within the food value chain. For example, farmers ought to monitor their crops or livestock to ensure that they control or treat disease outbreaks. Meanwhile, monitoring during production could also ensure that the desired quality and quantity are obtained. Monitoring might be useful in making sure that market standards are met as we move down the food value chain. The study findings are also aligned with the findings of a similar study which alluded to the ideal use of precision farming due to its use and development of high-tech factories increasingly characterized by large-scale production [\[35\]](#).

4.2.5. Farming Experience

The study findings indicate that farming experience positively contributes to transitioning farmers from small-scale farming to commercialization within the study sample. Most participants possessing extensive farming experience could influence the study findings, positively positioning them for commercialization. Farming experience within the farming sector is essential in noting patterns of business operations and effective mitigating strategies to maneuver various farming setbacks. The study findings imply that accumulation of farming experience plays a positive role in commercializing which is critical for most sustainable commercial farmers worldwide. The study findings are corroborated by the study that discovered that farming experience is influential in commercializing commodities such as Bambara [\[1\]](#). The study findings could imply that farming experience is an ingredient for commercialization among farmers as it is a predictor for informed decision-making processes.

Furthermore, farming experience serves as an engine for sustaining the farming business in that it guides farmers to decide through gained experiences that include observation and applications. The study findings are affirmed by the study of [Abate et al. \[36\]](#) which indicated that farming and marketing experience go a long way towards the farmers' market participation and performance which positively contributes to their growth. The positive association between farming experience accumulation and commercialization could be influenced by the former being essential in discovering working combinations that could enhance the development and expansion of the farming unit. Furthermore, the study findings are also aligned with a similar study which noted that the extent of potato commercialization varied based on farmers' knowledge of production and marketing [\[37\]](#).

4.3. Discussion of Determinants Contributing Towards the Regress of Commercialization

4.3.1. Land Ownership

The study findings show that land ownership significantly contributed to the regress of commercialization among female agripreneurs within the study sample. Land ownership provides some sense of security among farmers which enhances the execution of long-term plans for their agribusiness. The study's findings revealed that most female

agripreneurs could influence a regress towards commercialization within the study sample with those who had secured the permission to occupy (PTO) followed by those who had the land leased to them. Land ownership is critical within the farming landscape as land is the most economic resource within farming. In contrast, its ownership provides the opportunity to implement any farming practices without unforeseen circumstances that would impair the sustainability of farming ventures. The study findings could imply that farmers are unlikely to transform from small-scale to commercial farming when they do not fully own the land. Although farmers usually enter into a lease agreement, most elderly and those in remote areas are not fully vested in regulations that could protect them during such agreements. This is noted in a study that pointed out that leased land significantly contributes to market participation among smallholder farmers to a certain extent [38].

Furthermore, the study findings resonate with the importance of land security and ownership being critical in investing in a long-term farming venture and enhancing farmers' intentions towards commercialization and female agripreneurs. The study findings also suggest that other various land ownership arrangements could influence commitments among female farmers as male farmers generally own more farms than their counterparts. The study findings are validated by the study which indicates that vegetable commercialization could be boosted through policies that seek to facilitate secure land tenure as they enhances farmers' willingness to invest in long-term land development [39].

4.3.2. Type of Commodity

The study findings also revealed that the commodity type has a regressive contribution towards commercialization among female agripreneurs. The study results imply that certain commodities significantly contribute to farmers not transitioning from small-scale farming into commercial operations due to their production and marketing dynamics. The findings are similar to those of Dureti et al. [40] who noted that farming commercialization is positively associated with clustered crop types. As the research's participants were cash crop farmers, various farmers in the study sample lack marketing contracts which might have an impact on the study's findings. Lack of marketing contracts among farmers meant they lost a substantial portion of their harvest through spoilage due to their high perishability.

Furthermore, most farmers within the study area did not have storage facilities which could also be interpreted to increase the possibility of selling at a lowered price to gain market share or risk losing out to perishability. The study findings could also suggest that commodities that have a short lifespan negatively contribute to small-scale farmers transforming into commercial farmers particularly for those without farming contracts. Furthermore, the study findings suggest that certain commodities with high production costs could also hinder farmers' transformation particularly those with longer turnaround times for returns. Moreover, the findings further suggest that commodities with a slow investment return rate could significantly contribute towards farmers' failure to expand their operation from a small scale to a commercial one.

4.3.3. Type of Labour

The study findings reveal that the type of employment has a negative yet significant contribution towards commercialization among female agripreneurs. The labour force is crucial within the farming business as it may make or break it. From the study sample, female agripreneurs employed farm workers under three types: permanent, contractors, and seasonal. The current study findings point out that the type of labour influencing the regression towards commercialization could be primarily influenced by the massive reliance on seasonal farm workers within the study sample. Farm owners broadly use seasonal farm workers to reduce wages from full-time to the specific seasons when they need extra hands, yet this norm impacts skills retention. Most smallholder farmers rely on seasonal workers feasible in conducting their farming activities and impacts the operation of the farm business due to other technical aspects such as the potential lack of the desired skills among the hired workers. Training is costly providing continuous training for each group of farm workers employed every season may be challenging. A similar study is congruent with the results that indicate that land-based investments usually minimize other technical expenditures particularly among low-skilled and seasonal workers [41]. Furthermore, although a non-permanent type of employment goes a long way for the sustainability of the farm business, it poses some threats to its growth and conversion from small-scale to commercial operations. The findings of this research can also suggest that a company's long-term development and viability are negatively impacted by a lack of staff retention. No two humans have the same production capacity particularly within the agricultural space where the variation of technical and non-technical skill combinations is enormous. The findings are supplemented by a similar study which noted that profitable and commercial agricultural production is achieved by providing qualified technical support to farm workers to enhance their performance standards [42].

5. Research Implications

The current study investigated the operational and production determinants that significantly impact the transitioning of small-scale farmers into commercialization. The study findings imply that female agripreneurs be assisted with land security as it enhances the implementation of their agricultural long-term plans. The findings further imply the importance of exploring agribusiness enterprises with a high return on investment within the shortest period as it could speed up agripreneurs' transition into commercialization compared to enterprises with a longer production cycle. The findings imply the development and enhancement of a record-keeping practicing culture among small-scale agripreneurs as it may effectively assist them in tracking their progress with the literature pointing out poor record- keeping among small-scale

agripreneurs. Consequently, the study findings imply balancing permanent and seasonal labour to retain the desired skills within the staffing component.

6. Research Limitations and Future Research

This study has some limitations. The study's primary limitation was its participants being only female agripreneurs. The study was also limited to small-scale agripreneurs with the intention to commercialize. This study also investigated the operational and production determinants without integrating other farm aspects such as the institutional support towards commercialization. The study recommends future research to investigate gender dimensions as agricultural commercialization drivers. Furthermore, future research should also investigate the relationship between the internal and external determinants towards commercialization of agribusiness ventures using commodity approaches.

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