

## Agricultural expansion and trade-off decision making using analytic hierarchy process in Ghana



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### ABSTRACT

#### Article History

Received: 29 May 2023

Revised: 7 July 2023

Accepted: 31 July 2023

Published: 18 August 2023

#### Keywords

Agriculture

Co-operatives

Domains

Farm expansion

Land managers

Trade-offs.

The current study sought to investigate the factors influencing the conversion of forest lands to agricultural areas, which is primarily a result of agricultural expansion. This phenomenon is recognized as a significant driver of land use and land cover change in Ghana. Data was collected from land managers (commercial and subsistence farmers) who are major decision-makers on accelerated farm land expansion in districts known for large-scale food and tree crop production. The method used for data collection was the Analytical Hierarchy Process (AHP). AHP was used to assess factors that influence farmers' decisions to expand their farms. These are economic, environmental, social, and policy factors that were weighted to determine the most important factors of agricultural expansion. Study results showed that economic factors were weighted above other factors in terms of importance when it came to making decisions on farm expansion. Environmental and social factors were second and third, respectively, while policy factors were weighted as the least important factors. The study provides valuable insight into key factors that influence land managers farm expansion decisions and how land-use change can be addressed. The study concludes that the Analytic Hierarchy Process is a useful method for analyzing multiple factors considered by farmers when expanding their farms, despite its limitations.

**Contribution/ Originality:** The application of the Analytic Hierarchy Process (AHP) as a method for investigating factors of agricultural expansion among farmer cooperatives in Ghana is quite new, as shown in this study. Application of the method has been useful for determining the most important factors considered by farmers when taking farm expenditure decisions for profit.

### 1. INTRODUCTION

The conversion of forested areas to agricultural lands has emerged as a significant contributor to deforestation in Africa. This phenomenon can be attributed to various factors, including population growth and government policies, which serve as underlying forces driving changes in land cover. In the meantime, mechanization and increased crop production help to expand agriculture, which is the main factor driving this land conversion process. Consequently, these activities have detrimental impacts on forests and biodiversity (Jellason et al., 2021). Agricultural

expansion occurs when non-agricultural lands are converted to food crop and tree crop production (Qi, 2014). Key agents of tropical deforestation in Africa are traditional smallholder shifting cultivators who shift from one cleared agricultural plot to the other in search of fertile agricultural fields (Acheampong, Macgregor, Sloan, & Sayer, 2019; Janssen et al., 1990). Studies in the Ashanti region of Ghana showed, for example, that a substantial decrease in the forest cover was due to the clearing of the forest for crop cultivation and a change from shifting cultivation to permanent cultivation (Acheampong, Sayer, Macgregor, & Sloan, 2021). Population pressure has been a driving force of agricultural expansion for many years at regional and global scales, where short-term rotational fallow periods led to the loss of riparian forests due to limited farming spaces to contain the rising population (Eaton & Lawrence, 2009). Intensive farming on agricultural lands cut down on the length of farming fallow periods. As a result, many Sahelian countries' woody plants could not grow back, which led to negative effects like the loss of woody plant cover and soil erosion (Elmqvist & Khatir, 2007). To the farmers, the loss of forest and woodlands is a gain, because space is created for crop production to enable them to increase their incomes at the expense of nature conservation and the biophysical resources of the environment (Gusenbauer & Franks, 2019).

Some authors refer to the tradeoffs in agriculture, where gains come with inescapable losses (Gusenbauer & Franks, 2019). It is also argued that there are positive synergies between ecosystem services that directly increase the supply or benefits of forest land use to farmers, depending on the pathways of engagement (Gusenbauer & Franks, 2019). Dealing with tradeoffs therefore requires that multiple factors such as social, economic, institutional, political, and biophysical factors are weighted to determine which factors among the many are the most important drivers of agricultural expansion (Turkelboom et al., 2016).

Studies in Ghana revealed that about 622.22 km<sup>2</sup> of forest was lost in the Ashanti region, 560.49 km<sup>2</sup> in the Eastern region, and 545.32 km<sup>2</sup> in the Brong Ahafo region from 1986 to 2002 due to annual tree crop cultivation (Opoku, Macgregor, Sloan, & Sayer, 2019). The accelerated loss of protected forest cover at annual rates of 0.7%, 0.5%, 0.4%, and 0.6% for the periods 1990-2000, 2005-2010, and 2010-2015, respectively, has contributed to massive loss of biodiversity due to multiple induced human actions (Opoku et al., 2019).

Different agricultural business models, such as farming for export and food crop production, account for the loss of forest cover and biodiversity (Bennett-Lartey & Adu-Dapaah, 2015). Expanding the range of agricultural commodities for export has increased the demand for lands bought by wealthy farmers and business people to increase their export earnings, to the disadvantage of poor farmers (Wolter 2008). Agricultural business models that contribute to forest loss include small-scale farm lands controlled by chiefs and families that discourage farm expansion by commercial farmers, but when many small-scale farms are put together, their impact on forest and biodiversity loss is enormous given the land tenure system in Ghana (Yaro, Teye, & Torvikey, 2018). Smallholder farm models comprise farm sizes less than 5 hectares, while medium-size farms are usually 55 to 100 hectares (Kwapong, Ankrah, Anaglo, & Vukey, 2021). In the forest transition zone of Wenchi, known for maize, cassava, yam, cowpea, and groundnut cultivation, average farm sizes are 0.75 hectares per farmer (Filli, Onu, Adebayo, & Tizhe, 2015).

In view of the complex nature of issues at stake where land use decisions are influenced by multiple factors such as the processes followed in land use decision making and the opportunities for farm expansion, the Analytic Hierarchy Process has been applied to this study to understand the priorities of farmers in deciding where to expand farms.

## 2. MATERIALS AND METHODS

### 2.1. Selection of Farmers

Farmers were purposively selected for the study using the analytic hierarchy process. Three (3) commercial farmers (land managers), 5 smallholder farmers, and 5 smallholder farmer cooperatives were interviewed. Each of the five farmer cooperative groups comprised 30 individual farmers, making a total of 150 farmers in the cooperative. In

total, 158 farmers were interviewed. These farmers are located in Wenchi Municipal, Kintampo North, Sunyani West, and Brekum West, districts that are considered major agricultural areas in Ghana (Adjei-Nsiah & Sakyi-Dawson, 2012; Ministry of Economy and Industry Israel, 2020). The participants were chosen from the districts mentioned because they are known to be actively engaged in farm land expansion. The list of farmers was obtained from the Ministry of Food and Agriculture, which works with the farmers (land managers) in terms of providing them with extension services and other agricultural programmes.

## 2.2. Questionnaire Data

A structured questionnaire was used to collect demographic data on the types of land managers, years of farming experience, drivers of expansion, tradeoffs considered when expanding farms, and domains considered when expanding farms using the KoBoCollect tool.

## 2.3. Analytic Hierarchy Process

The Analytic Hierarchy Process was used because of its ability to break decision-making into sub-levels, intermediate levels, and low levels. In this study, the questionnaire listed economic, environmental, social, and policy factors as the domain factors farmers consider when expanding their farms. Higher numbers were regarded as key criteria when determining where and how to grow farms, and lower values were considered low-rated variables by farmers when it came to their decision-making. These domains' sub-level factors were weighed on a scale of 1, 3, 5, 7, and 9, with higher numbers being considered important. After weighting the sub-level factors, the domains were compared using a pairwise matrix with weights assigned as 1, 3, 5, 7, and 9. For the pairwise comparison, a weight of 1 does not mean the least important factor, but a value of 1 means the pair of domains being considered are of equal importance (Renwick et al., 2017).

## 2.4. Definition of Domains

The domains for this study were identified and refined through a process of literature review and scientific verification of opinions from those involved in land management decision-making, particularly stakeholders from agriculture, forestry, environmental, and local government sectors. Economic, environmental, social, and policy factors emerged as the key domains influencing the expansion of farmlands during the opinion verification processes.

*Social:* The social domain comprises ethnic groups, clans, natives, settlers, and social networks where rules of land ownership are dictated by family heads, chiefs, and other recognized custodians of land. Government influence or control over such lands is absent. The social domain also includes traditional belief systems, customs, and available labor for farming.

*Environment:* These are natural environmental factors that influence the decision of farmers on farm expansion by considering environmental factors such as soils in the area, vegetation types, climate, topography, and irrigation facilities.

*Economic:* The economic domains considered include revenue to farmers and technological and other agricultural inputs into farming that make farming rewarding and provide motivation to expand.

*Policy:* The policy domains are social assistance received from non-Governmental organizations, such as food for work and planting seeds. In terms of government policy, a guaranteed price for some cash crops for export and industrial use was motivation for farm expansion in some cases.

## 3. RESULTS

The study results showed that smallholder farmers have average farm sizes of 2 acres and farmer cooperatives have average farm sizes of 7 acres. The smallholder farmers and cooperatives engaged in the cultivation of cereals and root crops for food production. These farmers consume what they produce and also sell part of their food and

cash crops for income. Farm expansions by smallholder and cooperative farmers occur on forest lands where the soil is fertile for good yields. In the case of commercial farmers, they consider farming a business and believe the extent of investment in any farming activity determines the quantum of revenue earned. With this business mindset, commercial farmers invest in machinery and irrigation schemes to facilitate continuous farming all year, which accelerates farm expansion.

Analysis of a weighted pairwise comparison of four domains mentioned by the farmers—economic, social, environment, and policy showed that economic reasons were the most important considerations for farm expansion by the farmers (Figure 1).

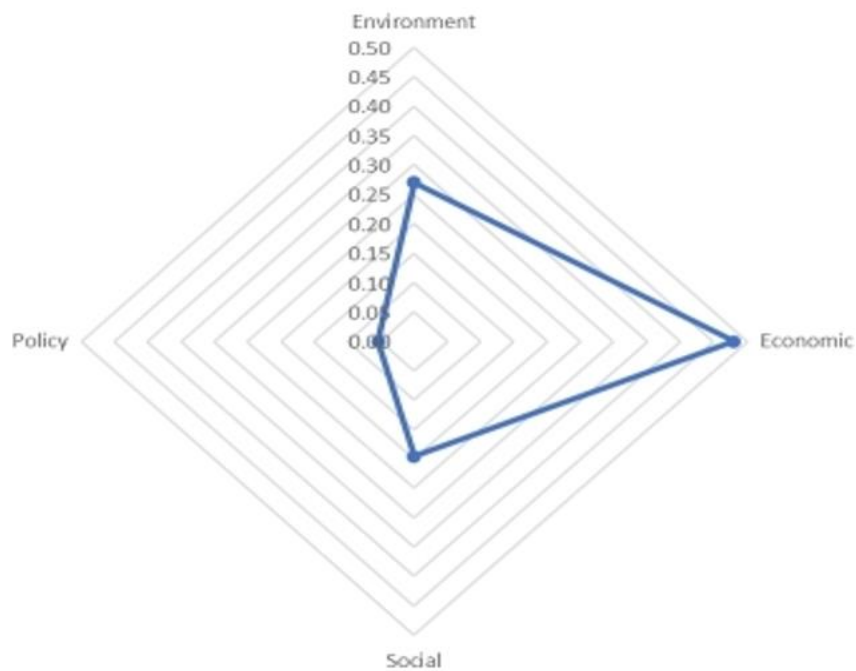


Figure 1. Average domain weights for all participants.

The second most important factor considered by the farmers are environmental factors; the third most important factor is social; and the least important is policy. The explanation given for considering economic factors as motivation for expanding farms is income from the sale of crops. The environment has been ranked second because of considerations given to suitable soils, sufficient rainfall, and irrigation facilities available on farmlands. As far as social factors are concerned, commercial and smallholder farmers get access to farmlands with long-term leases, and in some instances, farmers own the lands they cultivate. In terms of policy, commercial farmers claimed they have not benefited from any government policy or subsidy and, as such, do not think about policy when expanding their farms. In the case of smallholder farmers, very few of them benefited from the policy initiatives of non-governmental organizations in the form of free seeds.

In an attempt to understand differences and similarities among commercial and smallholder farmers, weights were assigned to domains considered to be the causes of farm expansion. Figure 2 showed that economic motives were the key issues considered by commercial and smallholder farmers alike. The underlying driver for the economic domain is the annual increase in the price of commodities they produce for export, such as cashew. In terms of cereals, vegetables, and root crops, price fluctuations push farmers to expand their farms when prices are high. At other times, however, farmers do not expand their farms when prices are low. In the case of commercial farmers, cashew, mango, tiger nuts, plantains, and vegetables were crops they expanded their farms to cultivate.

Smallholder farmers weighted the environment second because they rely on soil fertility, good environmental conditions such as topography for their farming. Commercial farmers, on the other hand, weighed social factors as

the second most important consideration for farm land expansion, given that they have easy access to land and labor to work on farms at affordable costs. Investment in machines and irrigation facilities enabled farmers to produce during the dry season, which is the most profitable season in farming as most farmers cannot farm due to a lack of rainfall. As far as policy is concerned, both commercial and smallholder farmers do not pay much attention to policy when expanding farms.

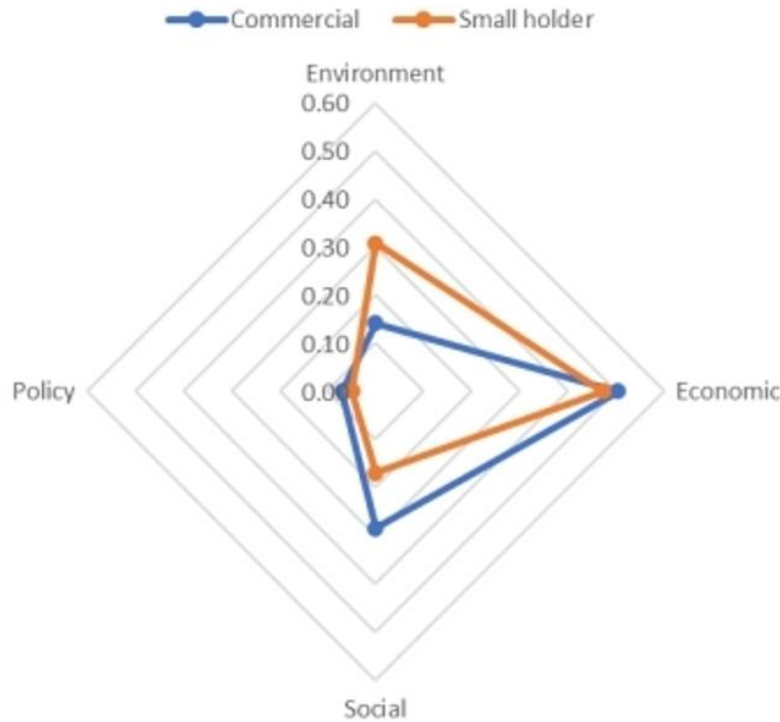


Figure 2. Average weights for commercial and smallholder farmer domains.

The consistency of responses was checked using a consistency ratio of 0.10 or less (Saaty, 1987), and the result shown in Figure 3 shows that the consistency of all farmers was within an acceptable margin except respondent P7, who had a consistency ratio of 0.27. Given the average overall consistency ratio of 0.09, it can be said that the results are acceptable.

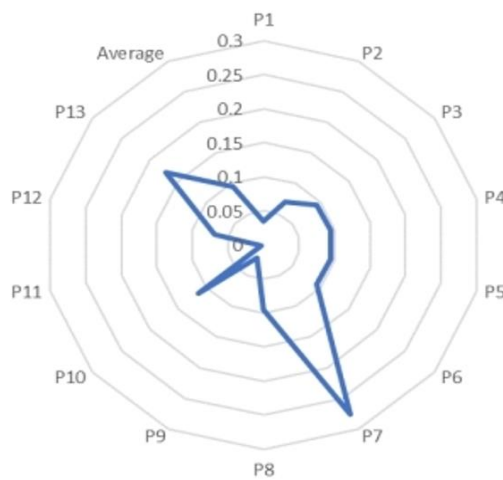


Figure 3. Consistency ratio of each participant and the overall average.

Only 3 participants had a consistency ratio above 0.10, and the figures were 0.27, 0.11, and 0.17 for participants P7, P10, and P13, respectively. Except for P7, all the smallholder farmers had acceptable consistency ratios.

The decisions of individual land managers (Figure 4) showed that all of them assigned high weight to economic opportunities as the most important domain when expanding farm lands. Environment was the next most important factor considered, given that respondents P1, P2, P3, P5, P7, P10, P11, P12, and P13 gave it high weight. The exceptions are respondents P6, P8, and P13, who rated social factors as their second most important factor for expansion instead of the environment.

According to P1, P2, P3, P4, P6, P7, P8, P10, P11, and P12, policy was the least weighted factor. The exceptions are P5 and P9, who rated policy as their third most important factor and environment the least because they have benefited from some policy initiatives by Non-Governmental Organizations such as the Adventist Development and Relief Agency (ADRA), which provided food for work as aid to farmers to encourage them to grow cashew.

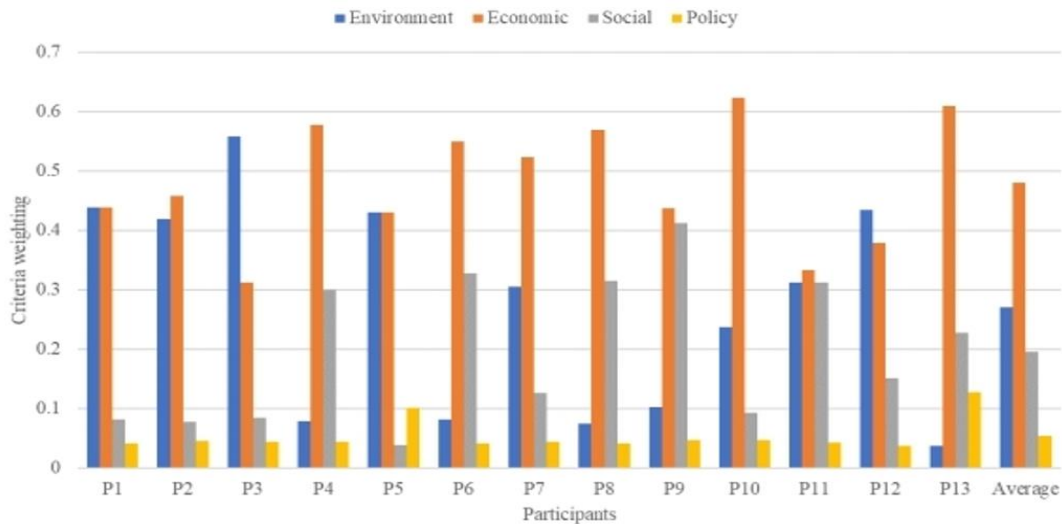


Figure 4. Weights of individual responses.

A more detailed analysis of the responses (Figure 5) shows that the subdomains listed and ranked as priorities for expansion by the participants are both similar and different, even though they all farm in the same agro-ecological zone and are driven to grow in the same way by the same environmental factors. The similarity here is that the economic domain remained the most important factor of expansion, the environment second, social third for most respondents, and policy the least. This analysis shows how land managers expressed themselves about what motivated them to expand their farms and also what sometimes discouraged them from expanding.

For example, Land Manager (farmer) P1 stated that “the price of cashew always appreciates, and this encourages expansion”; P3 said "commodity prices fluctuate and may discourage expansion when prices are not favorable. Land manager P4 mentioned that when prices get very low, no farmer becomes interested in planting additional crops due to the drop in prices. Similar comments were made by P7, P8, P9, P10, and P12. These respondents stated that they get discouraged from expanding when the price of farm inputs such as agrochemicals is high, to the extent that when they sell their products, the money earned goes to pay for the cost of agrochemicals and sometimes fertilizer used; hence, the land managers were keenly concerned about the increase in agrochemical prices.

The environmental concerns were mainly associated with climatic changes (P1, P3, P4, P5, P6, P7, P8, P9, P11, P12, and P13). These land managers are concerned about the variability of rainfall and temperature, which increases the risk of flower abortion in fruit trees, leading to poor yields and a low harvest. It was also mentioned that climate variability is responsible for an increase in pest infestations, which the land managers believed they had little or no control over. In terms of the fertility of the soils land managers cultivate, they are happy the soils are fertile, as they do not need fertilizers for farming except in a few places. Where irrigation services are available, farmers do dry-season farming, which is very profitable for them (P2).



The degree to which social factors contribute to farm expansion is contingent upon the observation that a majority of native farmers cultivate their own or family lands, thereby obviating the need for additional financial expenditures when pursuing farm expansion. Settler farmers who acquire agricultural land also possess the autonomy to engage in expansionary activities as a result of the availability of land resources. Those who engage in share cropping also have land available to them to expand. There were however instances where farmers got discouraged from expanding due to social pressures of the destruction of farms by free-range grazing livestock, particularly cattle that destroyed their crops, as mentioned in P1, P2, P3, P4, P5, P6, P7, P9, P11, and P12. The farmers dealt with crop destruction by livestock by policing farms against intrusion by cattle herds. Another challenge to farm expansion is bush fires that occur as a result of the cultural practice of burning the bush to hunt for animals during the dry season. This practice unfortunately destroys tree crops. An interview with the Wenchi Fire Service indicated that bush burning is an annual issue that destroys many tree crops in the district when fire bands are not created around farms. The road network was not a major hindrance to farm expansion as commercial farmers constructed the access roads to their farms, while smallholder farmers usually rely on tricycles to transport their products to the market.

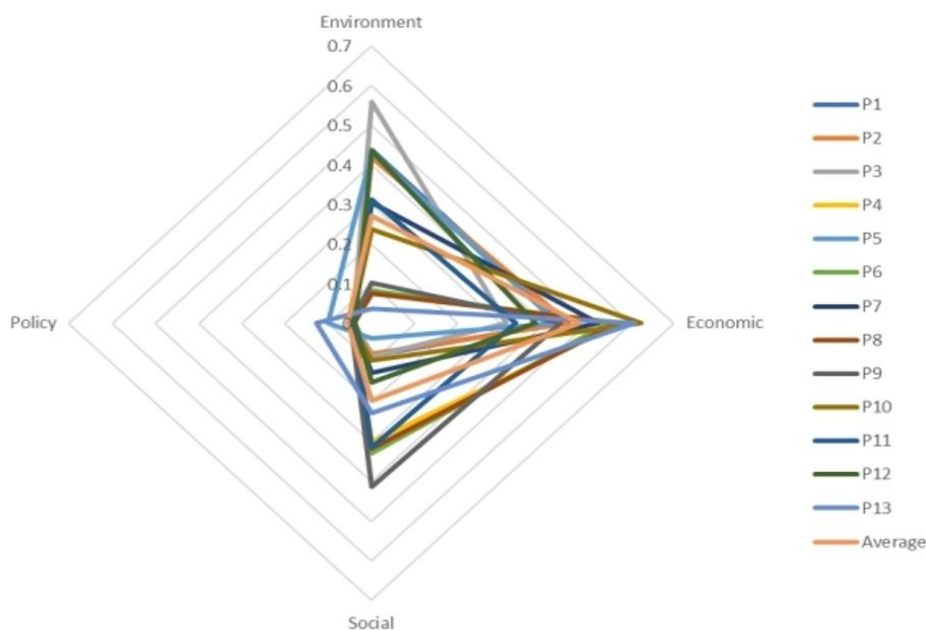


Figure 5. Individual responses and challenges.

Policy was the least considered factor regarding the expansion of farms, as farmers claimed they have not benefited from government policies of fertilizer subsidies, free seedlings, planting for food and jobs, and planting for feed industries. The only policies land managers have benefited from are those of non-governmental organizations. Instances cited by land managers were ADRA food for work support meant to encourage cashew cultivation, World Vision, and Hayfa support to smallholder farmers in terms of seeds and animals to rear, respectively. Commercial farmers claimed they have benefited from some technical support from organizations such as the German Agency for International Cooperation (GIZ) in terms of machinery and training services. Commercial and smallholder farmers alike mentioned that the government of Ghana in 2022 dictated a minimum price for cashew, which farmers believe will benefit them when implemented.

#### 4. DISCUSSIONS

Smallholder, cooperative, and commercial farmers expand their farms to forests and woodlands where the soil is considered fertile for their yields, as they expect high profits from their farming work. This study corroborates (Acheampong et al., 2021) findings that farmers depend on fertile land banks for agricultural production. Usually tree

crops form a close canopy, making cultivating food crops impossible; hence, farming activities are promoted on the remaining fallow lands (Opoku et al., 2019). With cashew and mango being the primary tree crops planted by farmers in the study area, among other food crops, the chances of closed canopy formation are inevitable, thus affecting food crop production. This situation has compounded the gradual expansion of farms into fallow lands. Earlier studies in Wenchi acknowledged that maize, cassava, yam, cowpea, and groundnuts cultivated by farmers increased over the years as farm sizes expanded (Filli et al., 2015).

Analysis of results for individual respondents showed that all land managers paid much attention to economic factors when expanding farms. Access to credit facilities to grow specific cash crops such as cashew encouraged farmers to expand their farms (Saaty, 2008). Access to credit from village elites and out-grower schemes to enable farmers to buy seeds and fertilizers has also contributed to farm expansion to forest lands (Boafo, 2019). Increasing market access as a reason for farm expansion is consistent with (Khatun, Maguire-Rajpaul, Asante, & McDermott, 2020). A major means for dealing with price fluctuations is the storage of farm products during moments of low prices and selling them off when prices are higher. This finding is consistent with Khatun et al. (2020) finding that farmers normally store and market their crops on a piecemeal basis when market prices are high. The cost of agrochemical inputs such as fertilizers, weedicides, and herbicides incurred by farmers together increases the total crop expenditures incurred as most input prices have risen beyond the purchasing power of farmers. Khatun et al. (2020) made a similar observation, stating that the cost of fertilizers increases the cost of crop production.

The second factor considered was environmental issues as a second-level priority when taking decision to expand farms, as climate variability has made agriculture vulnerable to the adverse effects of erratic annual rainfall and the occurrence of dry days. Small-scale and medium-scale farmers expand their farms to places with suitable environmental conditions, such as areas of suitable precipitation, ideal temperature, and suitable soils (Houssou, Johnson, Kolavalli, & Asante-Addo, 2016). Smallholder farmers are the most vulnerable, as their farming is predominantly rain-fed and thus climate-sensitive (Houssou et al., 2016). Meteorological data has become indispensable to smallholder farmers, who rely on it to synchronize farming activities. Participants in the Wenchi district rely on the Royal Frequency Modulation (FM) station, a local radio station, for meteorological information, which is broadcast at 5:30 a.m. daily.

The third factor considered was social factors, and the least was policy, as mentioned earlier. Improved roads foster better market integration as smallholders are able to transport their harvested produce to the market (Acheampong et al., 2021). According to Khatun et al. (2020), improvements in road infrastructure take the burden of transportation off the farmer, as traders are encouraged to travel to the farm gate to buy their produce. Currently, farmers use tricycle motorbikes to attenuate the problem of road infrastructure, as the motorbikes are able to travel on these roads, reducing the burden of transportation of farm products. Farmer-based associations are seen as a means of championing farmers' interests. In Ghana, farmer-based associations have been important networks through which farmers access credits, markets, farm inputs, and communal labor, as well as vessels for making their views known in agricultural development and transforming policies (Acheampong et al., 2021; Chemura, Schauburger, & Gornott, 2020; Francesconi & Wouterse, 2015; Lu & Horlu, 2019; Sinyolo & Mudhara, 2018). The lack of influential farmer-based associations was apparent in this study, as there were no proper structures for these associations. Only one association helped secure reasonable prices for agricultural products marketed by members. The farmer-based associations need to be strengthened to be involved in projecting the views of their members. Land tenure security is also considered key to farm land expansion (Salifu, Funk, Keefe, & Kolavalli, 2012), but this was not the case in this study as most farmers did not have a challenge with the acquisition of land. Contrary to Khatun et al. (2020) assertion that agricultural intensification is induced by policy, this study found it to have virtually no influence on the expansion of farmlands. Most land managers, such as smallholder farmers, cooperatives, and commercial farmers, do not consider policy a key influence on their decisions to expand farm lands, as they have not benefited from policies. Some farmers, however, mentioned that in 2022, the government of Ghana came out with a minimum price for cashew,



which, in their view, will enable them to earn much more money when implemented. Policy factors such as the price ratios of inputs such as fertilizers, herbicides, and pesticides were nonexistent, as was access to stable markets and prices. Agricultural inputs play a vital role in farming in Ghana, and the lack of reliable supply from the central government is a constraining factor for land managers (Acheampong et al., 2021). There is limited development and implementation of government policy, for pro-active state interventions to improve value chains or the interests of farmers. A comparison between commercial farmers and smallholder farmers showed that both farmers are motivated to expand their farms on the basis of economic considerations. In Southern Ghana, access to market opportunities encouraged farmers to expand their farms. In other instances, farmers are expected to take advantage of increased domestic prices of agricultural commodities (Agyei-Holmes et al., 2020). In the case of commercial farmers, their second important motivation for expansion was social factors such as the availability of land for farming and favorable lease terms. Literature information indicates that farmers expand their farms when free land spaces are available to coincide with opportunities to expand their farms (Mellon-Bedi, Descheemaeker, Hundie-Kotu, Frimpong, & Groot, 2020). In the case of smallholder farmers, they are more concerned with environmental factors as their second most important domain when expanding their farms. When it comes to policy, commercial farmers and smallholder farmers do not consider it as important when they take decisions to expand their farms. Other studies, however, revealed that an increase in government expenditure from 2018 to 2019 due to government policy to increase the acreage of farms motivated farmers to expand their farms (Kumeh, Kyereh, Birkenberg, & Birner, 2021).

## 5. CONCLUSIONS

This study investigated the potential application of the Analytic Hierarchy Process (AHP) in comprehending the decision-making process of farmers when confronted with various opportunities for farm expansion. The study's findings showed that both smallholder and commercial farmers had a strong desire to expand their farms, primarily for economic reasons. This factor emerged as the most significant among the four domains assessed in the questionnaire survey, namely environment, economics, social, and policy. The environment was identified as the second most prominent domain according to the assessments of land managers, while the social domain was ranked third in terms of significance. After conducting interviews with all land managers, it was determined that the domain with the lowest weight was policy. The utilization of pairwise comparison facilitated the identification of priority domains among farmers through the implementation of the Analytic Hierarchy Process. Based on the findings acquired, it is feasible to employ the Analytic Hierarchy Process as a decision-making tool for farm expansion, notwithstanding its inherent limitations.

## 6. LIMITATION OF STUDY

A major limitation of the study is the limited sample size used, which does not permit generalizing the study results.

**Funding:** The funding for this research was provided by the research question 5b component of the Social and Environmental Trade-offs in African Agriculture project, which is supported by a grant from the Global Challenge Research Fund with the grant number ES/P011306/1, awarded by the United Kingdom.

**Institutional Review Board Statement:** The Ethical Committee of the Ho Technical University, Ghana has granted approval for this study on 10 January 2022 (Ref. No. HTU/DRI/EC2022-011).

**Transparency:** The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.

**Competing Interests:** The authors declare that they have no competing interests.

**Authors' Contributions:** The literature review and data collection, A.S.K.; the data collection and data analysis, B.M.K.; funding for the study, X.H.J.; supervised the data analysis, R.A. All authors have read and agreed to the published version of the manuscript.

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## APPENDIX

The appendix provides information on farmer co-operatives and land managers interviewed.

Table 1 presents the list of farmer co-operatives and land managers interviewed.

Table 1. Overview of interview participants.

Participant ID	Location	Land management descriptor	Number of years in farming	Current farm size (Acres)	Farm size 5 years ago (Acres)	Drivers of farm expansion	Where farms are expanded to	Major crops grown
1	Wenchi Municipal	Small holder	14	10	0	Labour reduced on tree crop	Fallow land/ Savanna woodland	Cashew** Maize Garden eggs Okro
2	Wenchi Municipal	Small holder	4	4	0.5	Intensity of farming in the main farming season because involved in farming along the river. Market demand	Fallow land/ Savanna woodland	Cabbage Lettuce Cucumber Okro Spring onion Carrot Snail
3	Wenchi Municipal	Small holder	20	67	40	Price of commodities  Farming now business for me	Fallow land/ Savanna woodland	Cashew** Maize Cassava
4	Wenchi Municipal	Small holder	11*	25*	20*	Commodities prices Revenue generation Livelihood support	Fallow land/ Savanna woodland	Cashew** Cassava Maize Plantain
5	Wenchi Municipal	Company	27	1000	850	See farming as a business Sell at any given price if you have a big farm You can break even with larger farms	Fallow land/ Savanna woodland	Cashew** Mango** Citrus** Yam Maize Cassava
6	Wenchi Municipal	Small holder/ Cooperative	20*	60*	50*	Revenue  Price of commodities  Canopy formation by cashew tree requires new land for food crop production  Business	Fallow land/ Savanna woodland	Cashew** Mango** Maize Cassava Carrots Tomatoes
7	Kintampo North	Small holder	22*	20*	15*	Price of commodities	Fallow land/ Savanna woodland	Cashew** Maize Groundnut Cassava Mango

								Vegetables Beans Watermelons
8	Kintampo South	Small holder	45	22.5	19	Revenue  Price of commodities	Fallow land/ Savanna woodland	Cashew** Maize Yam Cassava
9	Kintampo South	Small holder	38	26	24	Price of commodities	Fallow land/ Savanna woodland	Cashew** Yam Maize Cassava Millet
10	Kintampo South	Small holder	31	15	18	Trend analysis of prices  Price of commodities	Fallow land/ Savanna woodland	Cashew** Maize Yam Mango
11	Sunyani West	Corporative	12	1800	1800	Land availability  Water availability	Forest	Tiger nuts Ginger Chile pepper Maize
12	Brekum West	Small holder	30	10.5	11.5	Business  Reward for rice	Fallow land	Rice Maize Yam Cassava
13	Kintampo North and South	Company	16	1300	600		Forest	Cashew Mangoes Maize Cassava

**Note:** \*Average for the group.

\*\* Main purpose for the expansion (the other crops are planted prior to the established of the main crop).

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