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KEY DETERMINANTS OF YOUNG SMART FARMER SUCCESS IN NORTHEASTERN THAILAND FOR AGRICULTURAL DEVELOPMENT AND FARMER EMPOWERMENT

Supaporn Poungchompu[1*] and Porntip Phuttachat[2]
[1] Department of Agricultural Economics, Faculty of Agriculture, KhonKaen University, KhonKaen, 40002, Thailand/ https://orcid.org/0000-0002-6374-1709
[2] KhonKaen Provincial Office of Agriculture, Department of Agricultural Extension, KhonKaen, 40000, Thailand/ https://orcid.org/0009-0008-1000-5987
*Corresponding author: psuppap@kku.ac.th

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ABSTRACT

This paper examines the socioeconomic factors influencing the success of the young smart farmers in the northeastern part of Thailand. This research provides empirical evidence on key socioeconomic and technological factors influencing young farmers' success, contributing to policies that promote youth participation in modern farming. Data were obtained from 375 farming households across eight provinces of northeastern Thailand from May 2022 to May 2023 using multistage sampling. The Logit model was used to identify the main factors of the farm success, achieving an 89.5% prediction accuracy. Statistically significant positive predictors included education level, technology adoption, farm area, farm record keeping, and participation in the Young Smart Farmer program. Technology adoption was the most influential positive predictor of success (48.82%), while credit accessibility and farming experience showed positive effects ($P<0.01$). Education increased the likelihood of success by 6.33%, credit access by 0.44%, farming experience by 1.05% and record keeping by 0.16%. The results imply that even less-educated young farmers can achieve productivity and sustainability by using improved technology, targeted education, and organized programmes. Consequently, sustaining the Young Smart Farmer initiative through continuous training, affordable credit, and land allocation is essential to strengthen Thailand's agricultural competitiveness and ensure long-term rural livelihoods.

Key words: aging farmer, farm income, technology adoption

INTRODUCTION

The transformation of Thailand's agricultural sector has increasingly involved the participation of youth from diverse backgrounds, like agriculture graduates, farm successors, and career shifters from non-agricultural fields. These young entrants are drawn to agriculture by greater access to knowledge, information technology, modern production systems, and expanding markets. Despite having higher education levels, many youths choose smallholder farming as a sustainable livelihood. This trend mirrors global patterns where youth are viewed as the next generation of agro-entrepreneurs visionary, efficient, and competitive (Balezentis et al. 2020). Young farmers actively participate in production, processing, and marketing, and tend to invest more in farm development than older counterparts,

contributing to rural economic progress (Milone and Ventura 2019). Their adaptability to social and technological changes allows them to introduce innovations that promote regional development. Many pursue strategies such as expanding land holdings, obtaining GAP or organic certifications, and adopting modern technologies that enhance sustainability and climate resilience (Läpple et al. 2011; Lastra-Bravo et al. 2015). Thailand's 12th National Economic and Social Development Plan (2017–2021) and the 20-Year National Strategy (2018–2037) emphasize strengthening agriculture by empowering young farmers to lead agribusiness transformation. Programs like the Young Smart Farmer (YSF) that was launched in 2014 by the Department of Agricultural Extension, Ministry of Agriculture and Cooperatives of Thailand initiative have enhanced the skills and technological capacity of young farmers aged 18-45 years. The program offers comprehensive training on modern means of production, digital agriculture, farm management and marketing. This orientation toward the digital is consistent with evidence that YSF members in Central Thailand have a strong need for increased knowledge of digital agricultural technologies (Klayson and Jirakajohnkool 2023). In addition, as the program provides continued mentoring and networking support. Media and communication have also been significant means of disseminating the YSF activities, with young farmers requesting more extension media program (Purintrapibal and Kruekum 2023). Each year, participants are recruited through provincial agricultural offices, and the program operates on an ongoing basis with regular monitoring, evaluation, and follow-up activities to ensure sustainable skill development. Recent study also indicates a significant increase in farm income among the YSF and increased yield and productivity as a result of greater access to training and networks (Poungchompu and Phuttachat 2023). Between 2014 and 2022, YSF participants demonstrated notable improvements in technology adoption and farm management. Despite such efforts, many young farmers still face obstacles in accessing land, credit, and modern technologies (Adekunle et al. 2009). The same conclusion was reached by Jansuwan and Zander (2021), who evaluated Thailand's YSF scheme, which further emphasized the ongoing issue with access to resources, and the long-term viability of programmes. Limited financial access constrains their ability to invest in productivity-enhancing tools, while high collateral requirements, lending risks, and bureaucratic hurdles further restrict capital access. In addition, gaps in business management skills such as planning, budgeting, and marketing limit their ability to respond to volatile market demands. Beyond economic and technical capabilities, social networks and peer collaboration play a vital role. These networks promote knowledge sharing and innovation, as well as improve access to markets and collective action opportunities (Koutsou et al. 2014; Lastra-Bravo et al. 2015). Such dynamics are essential for resilience and long-term sustainability. However, while existing literature addresses youth involvement in agriculture, there remains a gap in region-specific research that identifies the nuanced drivers of young farmers' success in Northeastern Thailand. Tikum and Ahmad (2024) also explored the social and institutional constraints of YSF participants, where they state that policy support for YSF is ineffective without addressing the local context. Although many previous studies have examined access to agricultural resources and government support, few have explored how these factors influence young farmers' success within the socioeconomic and institutional context.

To address this gap, the study aims to analyze key socioeconomic factors influencing the success of young smart farmers in Northeastern Thailand based on measurable indicators such as farm income, productivity, and credit accessibility, which collectively represent the socioeconomic performance of young farmer. Unlike traditional research that emphasizes capital or marketing alone, this study applies a comprehensive framework incorporating variables such as farm size, type, labor availability, off-farm income, digital technology usage, education, and access to extension services (Beck and Demirguc-Kunt 2006; Gabre-Madhin and Haggblade 2004). Previous research also tends to rely on self-assessed financial performance, yet recent findings suggest that many farmers prioritize income stability and work-life balance over profit maximization (Hayden et al. 2022). This study focuses particularly on access to finance as a key factor differentiating successful and struggling farm enterprises (Bakshy et al. 2012). It explored both the socioeconomic and technological dimensions of success by comparing successful and less successful young farmer cases. Findings from this research will offer practical insights for policymakers to design targeted development strategies that support young farmers,

promote inclusive agribusiness, and align with Thailand's long-term goals of strengthening the agricultural sector and preparing future-ready farmers.

RESEARCH METHODOLOGY

Study area and sampling procedure. This research was performed in Northeastern Thailand which is centrally located in the Mekong Sub-region (latitude 14°7′–18°27′ N, longitude 100°54′–105°37′ E), and covers 8.38 million hectares, representing 16.3% of the country's total land area. Land use is dominated by rice fields (64.6%) followed by field crops (21.0%) and para rubber (8.7%); average landholding size is about 3.008 ha. (National Statistical Office 2018). The YSF Programme which is in pursuit of livelihood since 2014, in this region, is undertaken by the Department of Agricultural Extension. The study participants were young farmers aged 18–45 years and actively involved in farming. The multistage random sampling method was used. Km), which purposively selected eight provinces (Khon Kaen, Chaiyaphum, Kalasin, Maha Sarakham, Roi Et, Loei, Nong Khai, and Nakhon Ratchasima) according to their agricultural productivity and income results. A district was drawn from each province in collaboration with the Office of Agricultural Extension and Development No 4, totaling eight districts. The overall number of young farmers was believed to be 5,900. A sample size of 375 farm households was calculated using Yamane's formula (95% confidence level). An equal number of participants (46–47) were selected at random from each district using a simple random sampling procedure.

The list of registered Young Smart Farmers was obtained from the Provincial Agricultural Extension offices, and random numbers were generated to select the respondents. In districts where the list was incomplete, enumerators worked with local agricultural officers to verify eligible participants and applied systematic random selection within the village. The household ratio was not adjusted. Data collection was done from May 2022 to May 2023 using structured questionnaires administered through guided interviews. The guided interview technique was applied to ensure that respondents clearly understood each question and to maintain consistency in data collection across all districts. Data included socio-economic characteristics and agricultural practices for the 2022–2023 cropping season. All data were processed with SPSS (Version 17). A portion of the sampling framework was derived from Poungchompu and Phuttachat (2023), who studied Young Smart Farmer Programme (YSF) program participants and non-participants in 5 provinces in Northeastern Thailand. For the present study, the dataset was expanded and updated between May 2022 and May 2023 by collecting new observations from the same provinces (Khon Kaen, Chaiyaphum, Kalasin, Maha Sarakham, and Nakhon Ratchasima province) and by adding three provinces was Loei, Nong Khai, and Roi Et province. The entire sample included 375 YSF participants who were newly recruited from all eight provinces. Each original provinces collected an additional 4–5 samples, and the new provinces each produced 47 respondents, all of whom were active YSF members. Contrasting the previous research which has investigated the income effect of YSF participation, this study stresses the socioeconomic and technological antecedents behind success among YSF participants to provide a broader understanding of regional empowerment and agricultural production results.

Economic model. Success in this research is described as making a profit on the farm, which is aligned with the Department of Agricultural Extension (DOAE)'s standard and characterized as young farmers as those earning annual net farm income exceeding 5,168.70 USD (1 USD = 28.72 THB). Although net farm income more accurately reflects profitability, net farm income was adopted in this study to maintain consistency with the DOAE's official evaluation criteria and to ensure comparability with national statistics on young farmer performance. A number of socio-economic variables were hypothesized to influence farm success, including gender, education, area under cultivation, experience in farming, membership in an organization, access to credit, access to market, record keeping, support from government, training, and participation in the YSF programme. The relationships between these variables and farm success were tested using a Binary Logistic Regression Model, which estimated the

likelihood of success (1=successful, 0=otherwise) as a function of these explanatory factors. Previous studies have highlighted the significance of high adoption of technology and income (Ruiz et al. 2019), access to credit, education (Balana and Oyeyemi 2022; Consentino et al. 2023), market (Bakshy 2012; Changsheng et al. 2020), training (Adeyanju et al. 2021; Lekhanya and Mason 2014), and record keeping (Hayden et al. 2022). Logistic regression analysis was performed where the binary response (success=1, non-success=0) as the dependent variables. Based on Walker and Duncan (1967), the log odds of success is estimated by the model considering that this is a linear function in 12 independent variables, including categorical and continuous predictors. The model used is summarized below:

$$\ln\left(\frac{P_i}{1-P_i}\right) = Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \varepsilon \quad (1)$$

Where P_i is the probability of young farmers' success, $P_i = 0$ indicates no success, and = 1 indicates success

Y_i	=	The probability of success for a Young Smart Farmer; (0 if an unsuccessful young farmer 1 if a successful young farmer)
β_0	=	The Intercept
β_1- β_{12}	=	The regression coefficients of the dependent variables
X_1	=	Gender of Farmer (1 if Male 0 if Female)
X_2	=	Farmer's Education (years)
X_3	=	Membership of Group Farmer (1 if being a member of a farming group, 0 if otherwise)
X_4	=	Farming Experience (years)
X_5	=	Cultivated area (ha)
X_6	=	Technology Adoption (1 if adoption 0, if non-adoption)
X_7	=	Government Support (1 if yes, 0 if no)
X_8	=	Credit Access (1 if yes, 0 if no)
X_9	=	Recordkeeping (1 if yes, 0 if no)
X_{10}	=	Market Access (1 if yes, 0 if no)
X_{11}	=	Training (1 if yes, 0 if no)
X_{12}	=	Being a Young Smart Farmer (1 if yes, 0 if otherwise)
ε	=	the disturbance term

RESULTS AND DISCUSSIONS

Characteristics of farmers. Of the 375 surveyed youth-operated farm households, 50.7% were labelled as successful while 49.3% were unsuccessful as presented in Table 1. In this study, a successful farmer refers to a respondent whose net farm income exceeded the sample mean, indicating better management efficiency and profitability after accounting for production expenses. The successful farmers were equally divided with respect to their gender, with 50% being male and 50% female. This distribution occurred by chance through random sampling, as no gender quota or stratification was imposed during the selection process. Education was another significant discriminator: 90.5% of successful farmers had at least a bachelor's level compared to 53.5% of less successful farmers. Both successful and unsuccessful farmers had almost similar participation rates in farmer organizations (52.1 and 49.9%, respectively), suggesting efforts on collaborative learning and entrepreneurship networks.

Technology use was also strikingly different between the two groups. Modern technologies were used in cultivation by 93.2% of successful and only 27% of unsuccessful farmers. Such a result highlights the importance of developing new technology, especially technology that is both productive and sustainable. The successful and non-successful young farmers had an average farming experience of 8.8 years and 11.7 years, respectively, indicating that younger entrants with training and access to technology achieved a higher success rate, highlighting the positive effect of targeted support programs

such as YSF, rather than implying differences in government support across age group. Farm size was not statistically different among groups, averaging 3 hectares (Table 2). But, the YSF program beneficiaries were associated with a higher probability of success. More proportion of the successful farmers are involved in YSF activities and supported by the government (55.8%) than the unsuccessful farmers (49.7%). These findings are consistent with those in Chokpigunthong and Chantaranamchoo (2023), who explore the success factors of smart farmers in Nakhon Pathom, showing similar institutional patterns.

Loan was also found to be a significant determinant: 77.4% successful had access to a loan, whereas only 31.9% unsuccessful had access to loan. This shows how financial inclusion allows investment in inputs, infrastructure, and innovation. It was observed that records were more frequently kept among successful (87.9%) than unsuccessful (70.3%), indicating that the successful group demonstrated stronger business management practices. Market access was also higher among successful farmers (74.2%) than the unsuccessful group (53.5%).

Gender, membership, cultivated land, and general government support were found to be insignificant while education, technology adoption, credit access, market access and training and YSF participation were found to have a significant relation with the success ($P<0.05$). Although the t-statistics for these variables are negative, this does not imply an inverse relationship. The negative sign arises from the group-coding order used in SPSS, where the unsuccessful group was coded first. In fact, the proportions presented in Tables 1 and 2 indicate that successful farmers had higher levels of education, technology adoption, record-keeping, credit access, market access, and participation in YSF program, findings that are consistent with the positive effects reported in the logistic regression results.

Moreover, farming systems also varied such that the majority of the young farmers were practicing integrated farming, including field crops (such as rice, sugarcane) with horticultural crops (e.g., vegetables) with or without livestock. This method provides year-round revenue and is sustainable. However, there also some young farmers who concentrate on either single-crop rice cultivation or vegetable farming. Jasmine 105, Glutinous RD6, and Riceberry were the most frequently planted rice varieties, and the types of vegetables grown depended on market demand (lettuce, morning glory, eggplant, tomatoes, onions, and garlic). These choices range from integrated, resilient agricultural practices to market-driven, specialized farming.

Table 1. Socioeconomic characteristics of success and non-success.

Variable	Successful (N= 190)	Less Successful (N= 185)	t-Statistics
	%	%	
Gender of farmer			
0= Female	50.0	50.3	-0.052^{NS}
1= Male	50.0	49.7	
Farmer's education			
0 = under bachelor's degree	9.5	46.5	-8.767***
1= bachelor's degree or above	90.5	53.5	
Membership			
0= No	47.9	54.1	1.192^{NS}
1= Yes	52.1	49.9	
Technology adoption			
0= No	6.8	73.0	-17.738***
1= Yes	93.2	27.0	

Variable	Successful (N= 190)	Less Successful (N= 185)	t-Statistics
	%	%	
Government support			
0= No	44.2	50.3	-1.174 NS
1= Yes	55.8	49.7	
Credit access			
0= No	22.6	31.9	-2.020***
1= Yes	77.4	68.1	
Farming record			
0= No	12.1	29.7	
1= Yes	87.9	70.3	-4.295***
Market access			
0= No	25.8	46.5	-4.264***
1= Yes	74.2	53.5	
Training			
0= No	26.3	37.8	-2.403***
1= Yes	73.7	62.2	
Being a young smart farmer			
0= No	26.3	62.2	-7.799***
1= Yes	73.4	37.8	

Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. ns means not significant.

Table 2. Mean comparison of selected variables

Variable	Successful (N=190) (Mean ± SD)	Less successful (N=185) (Mean ± SD)	t-Statistics
Farming experience (years)	8.6 ± 6.9	11.7 ± 9.7	-3.381***
Cultivated area (ha)	3.2 ± 3.1	3.1 ± 2.8	-0.123 NS

Factors affecting the success of Young Smart Farmers. The Logit regression analysis yielded a stable, well-fitted model, which achieved the overall classification accuracy of 89.5%, including 86.4% of successful and 82.7% of unsuccessful farming classified. A -2 Log Likelihood of 252.497 showed that the model fitted well and 68.0% of the variance in farm success was explained by the independent variables as indicated by the generalized R^2, which was 0.680. This R^2 level is high, especially for logistic regression models on a cross-sectional sample where acceptable values of R^2 tend to be between 0.2 and 0.5. Furthermore, the p-value of the Hosmer-Lemeshow test was 0.604, which is more than 0.05, indicating that the model had a good fit and was valid. Nine of the twelve variables were found to be significant statistically ($p < 0.05$ or $p < 0.01$), that is, formal education, hectares of land cultivated, technology adoption, keeping of farm records, participation in YSF programme, gender, farming experience, government support, and access to credit as presented in Table 3. Education ($p < 0.05$) had a strong association with the chances of being successful on the farm with each additional level increased the chances of farm success by 6.331 times. This further underscores the vital role of formal education in building the innovative capacity of young farmers to analyze, assimilate, and strategize

their decision-making under dynamic agro-environmental conditions, in line with the earlier evidence that associated education with productivity and innovation (Mottaleb et al. 2017).

The effect of the main factor, cultivated area ($p < 0.05$) was also noteworthy with each one unit increase increasing the odds of a success by 1.136%. This finding is in line with the hypothesis that larger landholdings can have the potential for greater economies of scale, as well as access to other infrastructures, such as irrigation, machinery and different crop diversification practices such as rotation as emphasized in Foster and Rosenzweig 2010; Pereira et al. (2012). Technology ($p < 0.05$) utilization presented as the most prominent predictor, implies that a unit rise in this variable contributed around 48.821 times increase in odds of being successful. This result is consistent with those of Khobkhet et al. (2024) who found that YSF participants taking up solar and digital technologies showed higher levels of innovative behavior and farm efficiency. The use of digital technology, such as sensors, precision farming tools and mobile applications, contributes to resource efficiency, environmental sustainability and resource management (Jones-Garcia and Krishna, 2021). Likewise, a 0.161 times gain in probability of success was generated by better record-keeping and establishment of better basis in financial tracking, loan eligibility, and decision-making in line with Morgan et al. (2010) and Hayden et al. (2022).

The YSF programme ($p < 0.05$) also demonstrated significant effects, accounting for 38.1% increase in success and observing positive learning outcomes in the form of skills, digital literacy and market readiness. These results confirm those of the previous studies by Sinyolo and Mudhara (2018), which emphasized the opportunities for domiciled training support and institutional support targeting youth. The male gender ($p < 0.01$) was significant, increasing the chances of success by 0.5%, possibly as a result of more access to training, credit and leadership positions. This is consistent with the previous findings of Lastra-Bravo et. al. (2015) and Läpple et al. (2011). Notably, farm training contributed a relatively limited 1.0% increase as evidenced by the fact that young farmers, while holding the experience constant can be more productive than their experienced counterparts when they receive training and are open to innovations, confirming assertions of Sinyolo and Mudhara (2018). Government support also incurred a 1.77% change, which confirms the supportive role of policy measures, subsidies, and extension services on farm performance. Similarly, having access to credit increased the success probability by 0.447 times. While credit can increase access to inputs that raise productivity, it can also lead to exposure risks if not adequately managed as pointed out in Balana and Oyeyemi (2022); Beck and Demirguc-Kunt (2006), and Stiglitz and Weiss (1981).

The other three variables, namely, market access, training and membership to organizations, did not reach conventional statistical levels of significance, though they provided useful qualitative information. For instance, market access was linked to improved price realization and increased linkages to supply chains. Initiatives such as Thailand's "Market-led Production" show that when production is moved towards consumer demand it makes farms more competitive and reduces post-harvest losses. Participation in its training programmes proved positive and it is a complement to the effect of the YSF programme through the consolidation of the acquisition of knowledge and the change in behaviour. The membership in associations can allow access to networks of peers, knowledge exchange, and bargaining power for collaboration which would increase the ability of resilience and market integration. Also, young farmers' farming system preferences also affect their performance. Over 60% of the sample performed integrated farming of field crops and horticulture as part of the agricultural practices, securing long-term income and building resilience. Diversified agriculture (integrated farming) was more robust in anomalous years than monoculture, for which prices and the anomaly-prone climate can be very volatile. These practices are also linked to sustainable farming objectives, such as enhancing soil health through the use of livestock manure and managing risk.

The success of young farmers in Northeast Thailand is clearly a manifestation of a mix of both socio-economic and technology factors. Some similar findings were found in Meechoovet (2022),

where smart agriculture projects of Thailand provided a positive impact on farmers' adaptation and income. The results of the logistic regression analysis are summarized in Table 3. Education, land size, technology adoption and institutional support, with special reference to programs like YSF, were identified as the most significant determinants. These findings underscore the necessity of prioritizing youth capacity development, land access system overhauling and appreciation of digital agriculture infrastructure. For decision makers who want to scale successful interventions, while addressing structural issues behind credit and training, and supporting the shift to climate-smart and competitive farming systems. The role of smart farming in improving social and economic well-being has also been illustrated in Thailand's Pa-Laew Pak Dee Dee project (Suntornmeth et al. 2025). Not only will these approaches help to turn young farmers into empowered producers, they will also work to build success in rural development, food security, and environmental sustainability at large.

Table 3. Factors affecting the success of young farmers.

Variables	**B**	**S.E.**	**Wald**	**Exp(B)**
Gender	-0.664*	0.368	3.269	0.515
Education level	1.845***	0.480	14.766	6.331
Membership	0.489ns	0.361	1.839	1.631
Farming experience	0.049*	0.028	3.201	1.051
Cultivated area	0.128***	0.058	4.832	1.136
Technology adoption	3.888***	0.400	94.422	48.821
Government subsidy	0.573*	0.342	2.807	1.774
Credit access	0.805*	0.420	3.664	0.447
Record keeping	1.825***	0.688	7.030	0.161
Market Information access	0.169 ns	0.409	0.170	1.184
Training	0.201 ns	0.369	0.298	1.223
Becoming YSF	3.800***	0.898	17.892	44.709
Constant	-6.169***	0.927	44.293	0.002

-2Log likelihood = 252.497
LR chi2 = 267.297
Prob > $\chi 2$ = 0.0000
Nagelkerke R Square = 0.680

Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. ns means not significant.

CONCLUSIONS

Five determinants significantly affected the success of young farmers, namely education, farm size, technology utilization, record-keeping, and the young smart farmer (YSF) participant. One of these being the adoption of technology, and in the case of smart farming, the technology can be used to optimize productivity, efficiency, and environmental sustainability. The YSF initiative is key in educating young farmers on how to use such technologies, informing decisions that make them more efficient in how they farm and therefore reduce costs and boost yields. In addition, educated farmers are better equipped to learn, judge, and accept new innovations and the related practices, thereby improving their managerial capacity to oversee contemporary farming. With agriculture moving

towards technology-enabled and precision farming, bridging the divide between the next-generation farmers will be critical, in terms of upskilling, providing access to capital, and targeted interventions. Providing young farmers with essential resources, education, and accessibility will secure their success and further national objectives for innovation, competitiveness, and sustainability in agricultural production. Thus, the authorities need to scale up support for YSF projects and promote the greater use of modern agricultural technologies to promote sustainable rural development and long-term food security.

Farmer empowerment and agricultural development is important for the success of young farmers. Such programs offer important resources to young farmers and ranchers such as access to new technologies, government programs, and education and market opportunities. Since farmer empowerment is closely related to agricultural development and scores are effectively higher in the process of the production chain, well-coordinated movement between these two fronts eventually transforms into a great force for change in the agricultural sector.

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Authorship Contributions:

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