Original Research Article

Influence of plant health clinic advisory services on potato production among smallholder farmers in Molo Sub-County, Kenya.

ABSTRACT

Potato is one of the most widely cultivated crop in Kenya and a crucial source of income and food. Despite the importance, potato production has been constrained by pests and diseases resulting in low yields and returns among the smallholder farmers precise those in Molo Sub-County. Plant health clinic advisory services are extension services that benefit farmers in terms of changes in knowledge, skills and management of crop pests and diseases leading to production improvement. Although are considered important mechanism in solving plant health problems, not much is known about their influence on potato production. This study sought to determine the influence of plant health clinic advisory services on potato production among smallholder farmers in Molo Sub County, Kenya. The study used a cross section survey design. The accessible population of the study was 6000 smallholder potato farmers and 10 key informants. Simple random sampling was used to select a sample of 152 respondents from four wards and purposive sampling for key informant. Data collected were analyzed using frequency tables, percentages and multiple regression analysis. Frequency of contact with advisor, use of advisory services, usefulness of plant health clinic services and type of advisory information access were found to have statistically significant influence on potato production p = 0.000, p = 0.000, p = 0.007 and p = 0.000 respectively with R^2 = 0.618. The study recommendation is that the Ministry of Agriculture in the study area should enhance the provision of plant health clinic advisory services to potato farmers in the area. This could help in the identification of possible areas of intervention in utilization and access so as to improve potato production.

Key words: *Potato production, Plant health clinic advisory services, Smallholder farmer, Plant doctor, Multiple Regression*

1. INTRODUCTION

Potato (*Solanum tuberosum L.*) is a crop of major economic significance worldwide ranked fourth globally after maize, rice, and wheat, it ranks first among the non-cereal crops in terms of production and human consumption (Farooq et al., 2020). The crop is critical in achieving food security, employment creation, income generation, poverty reduction and economic development (Food and Agriculture Organization

[FAO], 2019). Global output of potato is about 388 million metric tons on about 20 million hectares of land annually with Asian countries contributing approximately 27 percent of the world's output (FAOSTAT, 2020). However, on the other hand Africa potato production only accounts for 7 % of global output (Obi-Egbedi & Gulak, 2020).

In Kenya, potato is ranked second most important food crop after maize with average annual production estimates of between 2 to 3 million metric tonnes (Mbego, 2019). This accounts for 23.5% of the country's economy through income generation of almost USD 500 million annually (Kenya Investment Authority [KIA], 2020). The potato sector also play a significant role in employing about 3.3 million people along the potato value chain (Bolt et al., 2019). Similarly in Molo Sub-County potato production is a valuable enterprise contributing positively towards food and income levels (Kamau et al., 2019).

Despite the potato increasing importance in terms of consumption and income in the country, production has been constrained by traditional production systems, shortage of quality seeds, decline soil fertility, poor agronomic practices, a disorganized marketing system, high incidence of pests and diseases, poor technology transfer, climate change and low use of quality inputs [VIB], 2019). Past studies have shown that high incidence of pests and diseases are the most contributing factors resulting in estimated 80% reduction in production (Centre for Agriculture and Bioscience International [CABI], 2020). According to Majeed and Muhammad (2018) many diseases such as bacterial wilt, late blight, leaf roll virus, pests such as aphids, cutworms, nematodes, and trips attack potato causing significant losses to producers and therefore restricting the potential of achieving the optimum production.

Savary et al. (2019) pointed out that losses due to pests and diseases can be substantial and may be prevented or reduced, by crop protection measures. It is therefore, important to provide farmers with options that are context-specific to their agricultural conditions and socioeconomic circumstances to address pests and diseases outbreaks (Heeb et al., 2019). As documented by Fanadzo and Ncube (2018) an improvement in performance of crop production always brings about an improvement in the livelihood of the most farmers especially smallholder due to the positive relationship between farm production and economic development growth. Thus, use and access to effective, reliable, and practical agricultural extension services on a regular basis, more so those that enable smallholder farmers to address the threats of pests and diseases is required (Mburu et al., 2020). Agricultural extension services act as fundamental in supporting farmers to deal with existing and new challenges in agricultural production (Bourne et al., 2017).

Agricultural extension services are also important in offering farmers with advisory information that equip them with crop production skills and knowledge such as seed selection, technologies, marketing, pests management, diseases management, soil management among others (Mugambi et al., 2016).

Additionally, agricultural extension services are effective in forecasting agricultural problems outbreaks, therefore permitting time for development and application of proper mitigation measures (Kalimba & Culas, 2020). Improving crop production conditions of smallholder farmers through agricultural extension services has been an ongoing imperative action to address the huge deficit in those services promoting crop production (Zeweld et al., 2017). One intervention for doing so involves use of approaches such as demand-driven, which are farmer-centered and allow participatory therefore encouraging empowerment of farmers (Koutsouris, 2018).

The demand-driven method is significant in improving agricultural extension service provision to farmers as they response to the specific needs on time (Chimoita et al., 2017). The major objective of demand-driven agricultural extension services for instance plant health clinic advisory services as expressed by Hirschfeld et al. (2016) is to increase agricultural production, income and household food security of farmers by providing access to advisory services that have the content and quality farmers ask for. The literature reviewed from studies by Danielsen et al., 2020; Danielsen et al. 2013; Davis et al, 2018; Khaila et al., 2015, indicates that plant health clinic advisory services improve farmers' access to advice such weeds, pests and diseases control and management, proper chemical application, monitoring of pests and diseases emergence, field hygiene, value addition, high yielding crop seeds and improved crop production practices among others. Vennila et al. (2016) argued that providing farmers with plant health clinic advisory services is one of the best ways of increasing crop production.

Plant health clinic advisory services enable farmers to access reliable and concrete advices on various aspects of improved crop and seed production, seed storage and utilization of technologies on crop production that promote crop protection (Bett et al., 2018). According to a study carried out in Kenya by Kansiime et al. (2020) it has been pointed out that plant health clinic advisory services provide real-time, reliable, and relevant advisory services that promote crop health by reducing incidences of crop pests and diseases. They are gaining importance in their capacity of offering advisory services to farmers, that leverage best ,relevant, timely and reliable recommendations on handling crop health problems in the country (Kra et al., 2017). Plant health clinic advisory services have also been associated with the significant role in equipping farmers with advices which are timely on crop protection (Chege et al., 2020).

A study by Musebe et al., (2018) found that using plant health advisory services by farmers is one way of equipping farmers with skills and knowledge that help them reduce crop losses by keeping pests and diseases at bay in the process of farm production. Therefore, such services are vital in Kenya for crop production especially in potato production because of its vulnerability and susceptibility to diseases and pests (Kamau et al., 2019). Although reviewed research studies have shown the important role played by plant health clinic advisory services, their influence on potato production particular among smallholder farmers in Molo Sub County, Kenya has not received notable attention in research. This study thus sought to establish the influence of plant health clinic advisory services on potato production among smallholder potato farmers in Molo-Sub County, Kenya. The Sub-County was chosen for the study because it is the leading potato producer in Nakuru County and among the major producers of potato in Kenya (NPCK, 2018).

2. Methodology

2.1 Objective of the Study

Objective of the current study was to determine the influence of plant health clinic services on potato production among smallholder potato farmers in Molo Sub-County, Kenya.

2.2 Study Area

The study was conducted in Molo Sub-County, Kenya. The Sub-County is located in the Rift Valley along the Mau Forest, which runs on the Mau escarpment (Kenya National Bureau of Statistics [KNBS), 2019). It is situated at 0.25° South latitude, 35.73° East longitude and 2534 meters above sea level with annual average temperature of 14.1°C and an average annual rainfall of 1131mm. Generally, the main economic activities in this area include crop farming [main crops are maize, pyrethrum, potato, and barley], dairy, and sheep rearing (Kamau, et al., 2020b).

2.3 Research design, population and data collection materials

The study used a cross section survey design. It targeted accessible population of 6000 smallholder potato farmers. Nassiuma's formula was used to determined sample size which was then distributed proportionately among the four wards Elburgon, Molo, Turi and Mariashoni. Simple random sampling technique was employed to select respondents in each ward. Ten agricultural officers were interviewed as key informants. Data was collected using questionnaires and key informant interviews. Cronbach alpha method was used to test reliability of the instruments. Thirty respondents participated in a pilot study done in Nessuit ward of Njoro Sub-County. The questionnaire was considered reliable upon attaining a Cronbach's alpha coefficient of 0.726.

2.4 Data analysis

Analysis of data was done using *Statistical Package for Social Sciences (SPSS)* data management software version 22. Descriptive statistics and multiple regression were used to analyze data.

3. RESULTS AND DISCUSSION

3.1 Use of Advisory Services by the Smallholder Potato Farmers

The smallholder potato farmers were asked to indicate their convention of plant health clinic advisory services in the potato production. Their responses are illustrated in Figure 1.

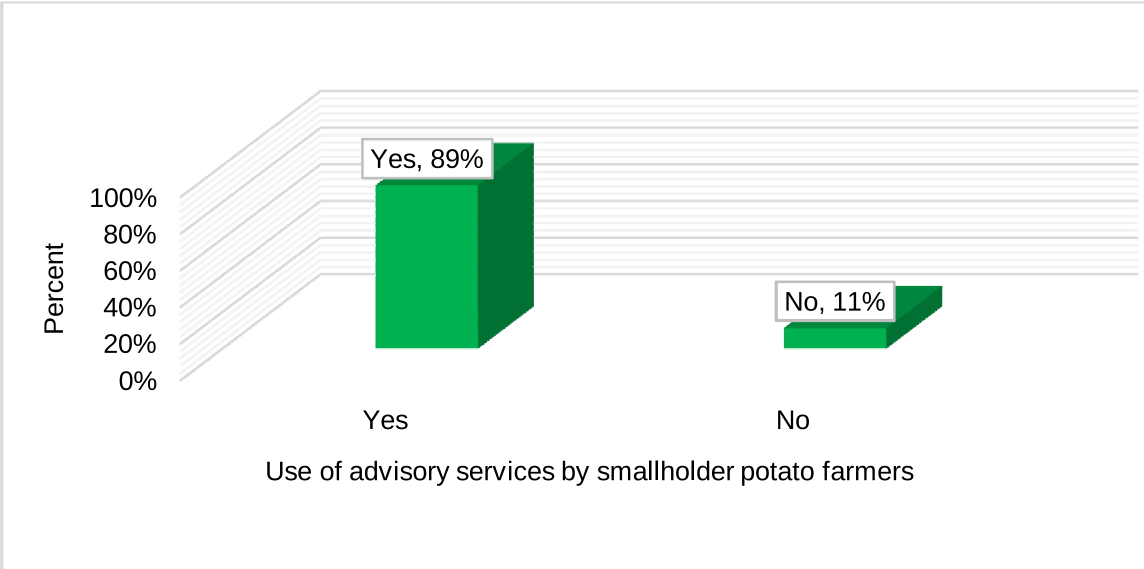

Figure 1: Use of advisory services by smallholder potato farmers

The results in Figure 1 reveals that that 89 % of smallholder potato farmers use advisory services from plant health clinic for potato production purposes whereas 11 % of the smallholder potato farmers did not use advisory services for potato production tenacities. Key informants agreed with the findings by stating that plant doctors disseminate the advisory information on potato production in the area. These associations may have succeeded because they offer free agricultural services and are equipped with specialized quality skills and knowledge to solve farmers problems (Bett, 2018). Having extension officers who have a specialization in particular crop management and production is important as they equip farmers with skills and knowledge as per their needs (Okeke et al., 2020). This is in conformity with (Musebe et al., 2018) who found out that plant health clinics advisory services are most likely to enable smallholder potato farmers have access to better knowledge and practices regarding proper use of pesticides, mix of substitute management options (including non-chemical options) for instance Integrated Pest Management approaches such as improved potato seed varieties and non-chemical pest management options, correct input application. From the results in Figure 1 it can points to plant health clinic advisory services playing an important role in providing useful information for managing potato health issues.

3.2 Frequency of Contact with advisor by Respondents

The study also sought to determine the number of times the respondents had contact with advisor from plant health clinic in the previous one year they planted potato. This was achieved through asking the respondents to indicate the frequency of contact with advisor. Figure 2 presents their responses.

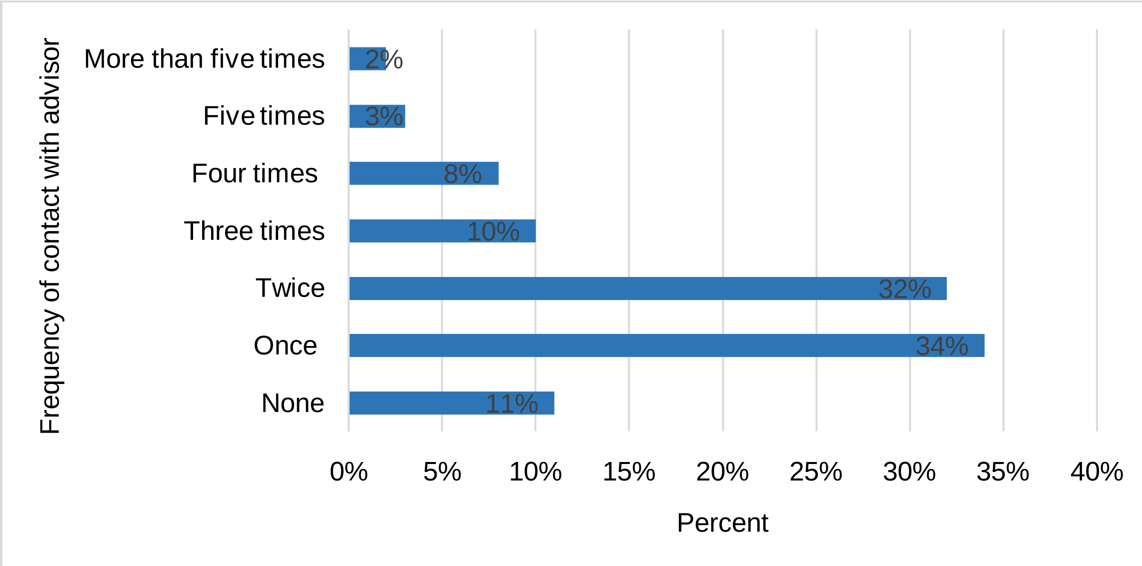

Figure 2: Frequency of contact with advisor by the respondents

The results in Figure 2 show 34% of the respondents contacted advisor once, 32% contacted twice, while 10 %, 8 %, 3 %, and 2% contacted it thrice, four, five and more than five times, respectively. Only 11% had no contact with the advisor. This imply that the frequency of contact with advisor was once and twice during the potato production period. This can be attributed to the fact that each area is served by few plant health clinic advisors (plant doctor) which limit the coverage due to high ratio of farmers to be handle compared to available plant doctors. The results are consistent with the findings by Gurmessa and Bundi (2021) who in their study in Ethiopia found out that majority of farmers contact with plant health clinic advisor once and twice during crop production per year.

3.3 Type of advisory information access on Potato Health

The study further sought to determine the type of advisory information smallholder potato farmers had access to from plant health clinic in the previous one year they planted potato. The results of access are given in Table 1.

Table 1: Proportion of farmers with access to advisory information on potato production in the area surveyed

Advisory information accessed	Percent

Proper chemical application	77
Selecting appropriate pests and diseases resistant potato varieties	80
Proper weeding and intervals	66
Removing and destroying infected potato plants	61
Early potato planting	65
Monitoring pests and diseases emergence	70
Planting certified seed potatoes	73
Practicing field hygiene	69
Growing potato tubers in rotation with other crops	76

As shown in Table 1, 76% of the respondents had access to advisory information on growing potato tubers in rotation with other crops, 77 % and 80 % of the respondents reported to have access advisory information on proper chemical application and selecting appropriate pests as well as diseases resistant potato varieties. 66% reported to have access advisory information on proper weeding and intervals, 61% had access to advisory information on removing and destroying infected potato plants, while 70% had access to advisory information on monitoring pests and diseases emergence, 65% had access to advisory information on early potato planting and 73% had access to advisory information on planting certified seed varieties. Further 69% of the respondents had access to advisory information on practicing field hygiene. The study established that various types of advisory information were access by the respondents with over 60 % representations from each type of advisory information. In the interviews key informants indicated that most farmers seek advisory information on how to carry out crop protection therefore acquire knowledge and skills on guidance about the cultural and agronomic aspects of farming seed treatment, required seed rate, technical advice on sowing time and seed bed preparation, management of pests and diseases. This result agrees with those of Bundi (2021) who found out that farmers had access to various type of advisory information from plant health clinic that help in promoting of crop production in Ethiopia.

3.4 Usefulness of advisory services on improving potato production by the respondents

The respondents were asked to how useful advisory services on improving potato production was to them, and their responses were as illustrated in Table 2.

Table 1: Usefulness of Plant Health Clinic Advisory Services

Usefulness	**Percent**
Not useful	11

Moderate	3
Useful	6
Very useful	80

The majority (80%) of the respondents indicated the plant health clinic advisory services as very useful in potato production, 6% as useful, 3% as moderate, while about 6 % indicated the plant health clinic advisory services as not useful in improving potato production as shown in Table 2. This imply that majority of the indicated that the advisory services are very useful in potato production in the study area. Interviews from key informant also agree on this as they stated plant health clinic advisory services are very useful to smallholder potato farmers as they are very significant in helping them improve production through providing them with advisory information that promote potato production that include selection of quality potato varieties and other valuable quality inputs that can help in improving potato health and vitality, crop protection services, marketing information and harvesting services as useful in helping them improve production. Conferring to this Kansiime et al. (2020) pointed out that there is a positive relationship between usefulness of plant health clinic advisory services and crop production. Smallholder potato farmers can access technical advisory services from the plant doctors on multiple avenues regarded necessary for the potential outcomes among various aspects include agronomic and plant protection related contents (Okeke *et al*., 2020).

3.5 Influence of plant health clinic advisory services on potato Production

The objective of the study was to determine the influence of plant health clinic advisory Services on potato production among smallholder farmers in Molo Sub-County, Kenya. The hypothesis stated that *there is no statistically significant influence of plant health clinic advisory services on potato production among smallholder farmers in Molo Sub-County, Kenya*. To test hypothesis multiple regression analysis was used, multiple regression was in the form of $Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4$ where Y = potato production, X_1 = use of advisory services, X_2 = frequency of contact with advisor, X_3 = type of advisory information access, X_4 = usefulness of advisory services whose results are presented in Table 3, 4 and 5. Table 3 presents results of Analysis of variance

Table 3: Analysis of Variance between plant health clinic advisory services and potato production

ANOVA[a]

Model	Sum of Squares	Df	Mean Square	F	Sig.

Regression	798.433	4	199.608	30.396	.000[b]
Residual	965.347	147	6.567		
Total	1763.78	151			

According to Table 3 F (4, 147) = 30.396, p = 0.000, therefore the overall regression model was significant at p = 0.000. This indicates that the model was fit for looking into the influence of plant health clinic advisory services on potato production.

Table 4: Coefficient of determination for the relationship between plant health clinic advisory services and potato production

Model Summary

				Std. Error	Change Statistics				
		R	Adjusted R	of the	R Square	F			Sig. F
Model	R	Square	Square	Estimate	Change	Change	df1	df2	Change
1	.789[a]	.622	.618	0.9238	.622	30.396	4	147	.000

From Table 4, factors; frequency of contact with advisor, use of advisory services, perception of usefulness of advisory services and type of advisory information access that were studied explained 61.8 % of the of variance in potato production as represented by R^2.

Multiple regression results were as presented in table 5

Table 5: Multiple regression between plant health clinic advisory services and potato production

Coefficients[a]

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
(Constant)	3.781	.867		6.426	.000
Frequency of contact with advisor	.881	.260	.284	3.721	.000
Usefulness of advisory services	.427	.132	.130	1.443	.007
Type of advisory information access	.751	.051	.754	8.952	.000
Use of advisory services	.573	.517	.131	1.240	.000

a. Dependent Variable: Potato production

b. Predictors: (Constant), Use of advisory services, Type of advisory information access, Frequency of contact with advisor, usefulness of advisory services

The results in Table 5 show that frequency of contact with advisor, use of advisory services, type of advisory information access were significant at 5 % level of significance. usefulness of advisory services was found to be statistically insignificant.

The following regression equation was used and it explains the interaction of factors:

$Y = b_0 + b_1X_1 + b_2X_2 + bX_3 + b_4X_4$

Where;
Y = potato production; X_1 = use of advisory services, X_2 = frequency of contact with advisor, X_3 = type of advisory information access, X_4 = Usefulness of advisory services
Hence
$Y = 3.781 + 0.573X_1 + 0.881X_2 + 0.751X_3 + 0.427X_4$

As shown in Table 5, more precisely intercept (b_0) = 3.781 is the estimated average potato produced when any predictor variable is not considered in the model. Frequency of contact with advisor coefficient b_2= 0.881, implies that when frequency of contact with advisor is increased by one unit, then potato production is increased by 0.881 tons per hectare if all other variables are fixed. In the same way type of advisory information access coefficient b_3 = 0.751 implies that when farmers access various types of advisory information then potato production is increased by 0.751 tons per hectare respectively keeping all other variables constant. Usefulness of advisory services b_4 = 0.427 mean that advisory services will lead to 0.427 tons per hectare increase in potato production and use of advisory services b_1 = 0.573 infer that when a farmer use advisory services potato production is increased by 0.573 tons per hectare. Use of advisory services, frequency of contact with advisor, usefulness of advisory services and type of advisory information access were at 5 % significance (p-values, p = 0.000, p =0.000, p = 0.007 and p = 0.000 respectively which are less than level of significance 0.05 ($p \leq 0.05$). Thus, the study null hypothesis that there was no statistically significant influence of plant health clinic advisory services on potato production among smallholder farmers was rejected. This implies that the plant health clinic advisory services had statistically significant influence on potato production in Molo Sub-County, Kenya.

These findings are consistent with those of Gurmessa and Bundi (2021) who found that frequency of contact with plant health clinic advisor was important and statistically significant in crop outputs produce by farmers in Ethopia. It also agree with those of Musebe et al. (2018) who found out that frequency of contact by farmers with plant health clinic advisor significantly influence the farmer’s crop production in Loactions of Kuti, Kibugu, and Matumbei of Kenya. This they argued that more frequent visits enable farmers to gain more knowledge and skill advice on areas such as efficient use of agricultural productivity enhancing inputs such as fertilizer, improved seed, pesticides and cultural methods of diseases and pests’ management and control. The findings are also are consistent with those of Negussie et al. (2017) who found out that access to various types of advisory information from plant health clinics favorably influence farmers access and utilization of advices therefore get equip on how to manage the pests and diseases problems in Ethiopia. According to Rebecca (2012) farmers access to advisory service strongly suggests that most of the respondents are likely working in conjunction with an extension agent therefore utilizing advisory services that improve crop production. These results are also sturdy with the findings of Bundi (2021) who found out that type of information access from plant health clinic advisory services favorably influence potato, maize and tomato production in Ethiopia. He stated that farmers who accessed this advisory information had more knowledge related to pests and diseases management and knew more about new technologies in crop production. Knowledge gained through advisory information exposes farmers to the advantages of learning different measures that improve production (Majuga et al., 2018).

Further the results in Table 5 shows that usefulness of advisory services positively contributed to potato production at 0.427, had a significant influence on potato production, since the p-value was ($p = 0.007$) greater than level of significance 5%. This finding is in line with those of Rajendran and Islam (2017) who found out that plant health clinic advisory services was statistically significantly in influencing crop yields among sampled farmers in Bangladesh. They explained that usefulness drives the ability of farmers to utilize the service and therefore gain knowledge and skills to identify then address crop health problems therefore improve production.

4. CONCLUSIONS

The majority of the smallholder potato farmers used plant health clinic advisory services. Plant health clinic advisor was contacted mostly once and twice. Smallholder potato farmers were able to receive various advisory services from plant health clinic services. Consistent with the expectation and findings from previous studies frequency of contact with advisor, use of advisory services, usefulness of advisory services and type of advisory information access were found to significantly and positively influence potato production. This study therefore concludes that the importance of plant health clinic advisory services cannot be underrated as it has an influence on quantity of potato to be produced.

5. RECOMMENDATIONS

The study recommends that more efforts and policies should be put in place to ensure smallholder potato farmers increase their utilization of plant health clinic advisory services to make them more technically efficient. They should also ensure that the extension agents offering plant health clinic advisory services educate and sensitize smallholder potato farmers importance of utilizing the plant health clinic advisory services on regularly basis during potato production seasons so that they obtain current, relevant, timely and best farm advisory practices on improving potato production.

CONSENT

Informed consent was sought from the respondents before collecting the data.

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