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Prospects and Barriers of Commercial Tomato Farming in Hilly Areas of Eastern Nepal

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Abstract

Commercialization of agriculture has become indispensible for the supply of food and nutrients to people and income generation. Thus, this study deals with the feasibility of commercial tomato farming including the analytical study of problems related to this agricultural system in the study area. This study applied household questionnaire survey, key informant survey, focus group discussions and field observation to collect relevant primary information. Secondary data were collected from previous research journals, dissertations and official records. This study covers the entire area of Ward No. 9 of Dhankuta Municipality. The study based on around, 30 percent (280hhs) farm households of the study area.

This study reveals that the commercial tomato farming in the hilly areas of eastern Nepal seems to be full of both challenges and opportunities. The commercial success of this agricultural system seems to have made this system widespread in the eastern hills of Nepal. Apart from this, it also helps to develop the habit of choosing appropriate agricultural technology among the local farmers. Thus, this farming system seems to be a more popular business at present context in this area. Moreover, this study also confirms that the commercial tomato farming is not only a profitable business but also a risky and challenging. The farmers are facing various socio-economic challenges while doing this cultivation. Therefore, this study proves that any human activity is not free from barriers or challenges, so such challenges must be faced in an intelligent way. This conclusion also conveys the message that the success achieved by facing such barriers is sustainable and fruitful.

Keywords: *adoption, chemical fertilizers, expansion, haat-bazar, kulo, pesticides*

Introduction

Nepal is a country having three geographical variations Tarai, mid hills and high hills respectively. Tomato is best suited in Tarai, in low and mid hills; and it is becoming increasingly attractive for cash generation in the high hills too (Thapa Magar, 2015). Now, Agriculture Development Strategy, 2015-35 is prioritized horticultural crops for import substitution and trade surplus. The role of cash and horticulture crops seems significant to increase the share of agriculture in gross domestic product of the country. Commercialization of high value and low volume crops farming in the country is getting momentum at present. Majority of the farmers are

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shifting from the farming of agronomic crops to the cash crops recently. In this context, fruit farming is gaining popularity among the farmers of Tarai, mid-hills and High hills of Nepal. Though farmers are trying to be commercial, there is lack of sufficient research and experiment in their farming system because these crops are perennial in nature (Bhandari, et al, 2016). Tomato (Solanum lycopersicum L.) is one of the important crops used as a fresh vegetable as well as in a variety of processed products such as ketchup, sauce, juice, puree, pasta sauce, salsa, tomato based powders, sun-dried tomatoes, curries and ready-to-eat products (Subramanian, 2016; as cited in Ghimire et al, 2017). Tomato is also known as the poor man's apple in Nepal. The import from India is increasing as compared to previous years. The reason behind this might be increase in consumption of tomato in recent years in the country. The average national consumption of tomato is found 11.97 Kg/person/year in Nepal (Ghimire et al, 2017). The fresh seasonal and off-seasonal vegetables have been considered as high value crops and commercial production of fresh vegetables is also promoted. Tomato is one of the most commonly produced vegetables in Nepal. The tomato farming in offseason has been gaining popularity as it fetches reasonable price than seasonal production. But the domestic production of tomato is not enough to meet the demand during the lean period. Many efforts have been made to increase the off-season tomato production but still it is facing various barriers which have disturbed the rapid expansion of tomato cultivation on sustainable way (Pokharel, 2021).

The farmers who adopt new farm technologies have certainly changed their products to get good prices from the market. It requires too much time to watch-and-see from their neighbors which helps them to make new ideas towards such technologies (Berner et al Harrison, 1984). In addition, the use of new agricultural technologies is also depends farmers' perceptions, infrastructures and market price of agricultural production (Wagle, 2019). Tomato is the most important vegetable crop grown in Nepal. It is cultivated commercially in some areas (Mulghat, Belahara Besi, Guthitar etc) of eastern hills. Due to the high incidence of the diseases, it is difficult to cultivate during the summer season. Farmers have to work little harder to grow this crop as an intercrop with maize cultivation due to various barriers (Chapagai et al, 2012). In this regard, increasing road access and the establishment of various organizations seems to have played an important role in bringing positive change. It has also proved through the studies of different scholars like Virgo and Subba (1994), Koirala (2006) and Khatiwada (2014). They point out that the establishment of the then Pakharibas Agriculture Research Centre (PAC), increasing access to roads (Koshi highway including other agricultural roads network), farmers' self-efforts and market integration seem as major drivers to this change (Wagle, 2019). Thus, the commercial tomato cultivation which has started recently in this area as a new technology has not yet been adequately studied. Taking this fact in to consideration, the study is carried out through the research questions such as why this farming is becoming widespread in this area, what are the major barriers while cultivating it and what is its future/possibility etc.

Method and Materials

This study has strictly followed the procedures mentioned below as much as possible:

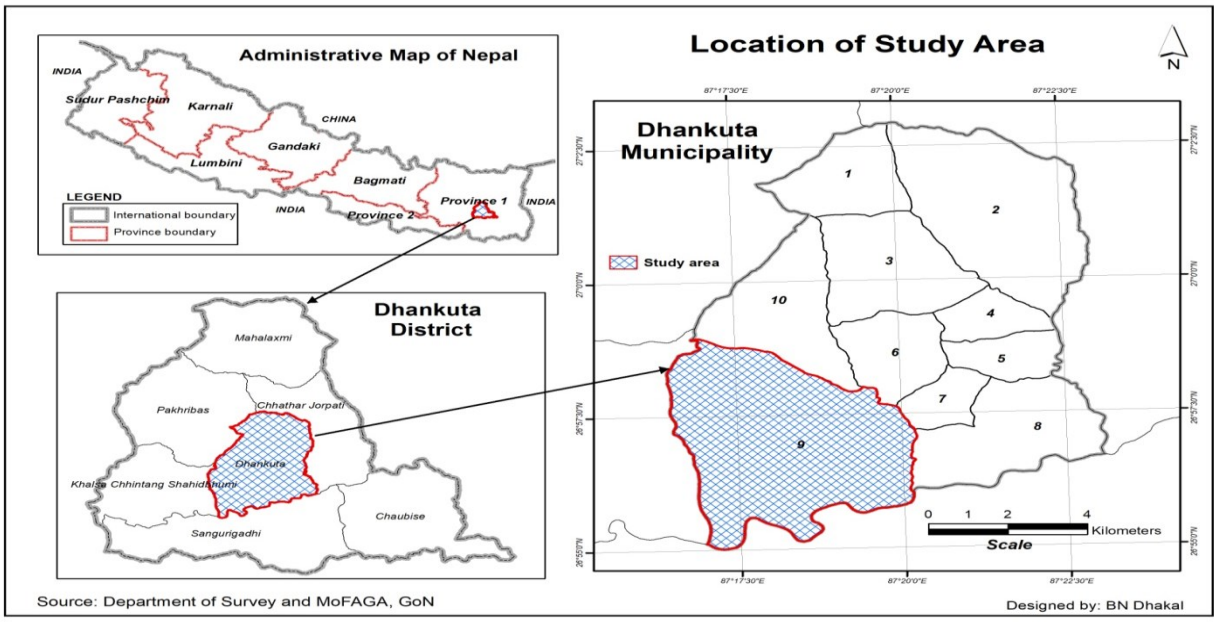
Study Area

The study area is known as mid-hilly area which is located in the south western part of Dhankuta Municipality. Most of the farmers in this area are engaged in off-season vegetable farming through the using new agricultural outputs. This area extends from 300 meters to 1500 meters above sea level (DADO, Dhankuta, 2013).

Based on physical characteristics, this area can be divided into two major belts namely, lower altitude and middle altitude belts (Wagle, 2019). Mulghat, Belahara, Guthitar, Rudrabari,

Belahara Basin, Sawabari and Mahang are known as the main settlements of area. There are 943 households with a population of 4246. Among them 2149 are male and 2097 are female (Dhankuta Municipality, 2018).

Figure 1: *Location Map of the Study Area*



Method of Data Collection and Tools

The entire study is based on both primary and secondary data. Mainly, the primary data are collected from interview, field observation, key informant survey and interaction with focus groups. Similarly, the official documents, books, journals, Google Scholar and dissertations are the main sources of secondary data. The collected statistical information are processed, analyzed and presented in tables with detail interpretation. In addition, the study has adopted both quantitative and qualitative techniques in order to prepare detailed paper.

Moreover, seven major settlements (study units) are determined through the use of systematic random sampling method. Approximately, 30 percent (280hhs) farm households are selected from those settlements using Yamane's sample determination formula (1967 as cited in Adhikari and Pandey, 2018)):

$$n = \frac{N}{1 + Ne^2}$$

Where,

N = Sample size

N = Total population size,

e = Acceptable sampling error

[At the 95 percent confidence level P (e) value is assumed to be 0.0 5]

If, N = 943

Then

$$n = \frac{943}{1+943\ (0.005)^2}$$

$$= \frac{943}{1+943\times0.0025}$$

$$= \frac{943}{1+2.36}$$

$= 280$ Households

In addition, there has been a maximum effort to follow the ethics of research throughout the research period.

Results and Discussion

The analysis of the both qualitative and quantitative data acquired from the field survey and determined conclusions based on the analysis are arranged in order as follows:

Historical Background of Development and Expansion of Tomato Farming

This study makes clear that tomato farming in this area has been practiced since ancient times. Generally, the local farmers produced tomato by using traditional methods of cultivation, especially for domestic consumption and only small portion surplus product sold at local markets which are known as *haat-bazars*. In addition, they had also occasionally sold their production outside the local markets especially in Dharan and Itahari bazars before the construction of Koshi highway. Local pioneer farmer Mr. Kul Bahadur Karki has informed that local varieties of tomatoes are known as commonly *'Ramveda'*. Moreover, a local retired agriculture expert Mr. Rajkumar Shaha also indicates that the indigenous varieties of tomatoes are relatively small in size and little sour in taste than other species of hybrid tomatoes and such varieties are used especially as pickles and vegetable species

Regarding the development and expansion of tomato cultivation in this area Mr. Wagle (2022) remarks that while studying the beginnings of commercial tomato farming in eastern hills of Nepal, the improved tomato cultivation system seems to have started from 1996/97. Many studies show that the development and expansion of this technology in the eastern hills of Nepal is a result of the joint effort of various governmental, nongovernmental organizations and local farmers (Wagle, 2022).

Similarly, a local agronomist Mr. Surya Sapkota says that the first credit for initiating improved tomato cultivation in this area goes to Mr. Rabindra Yogi, Mr. Dilliman Rai and Mr. Chakra Bahadur Rai. According to him, Mr. R. Yogi had practiced this technology in Guthitar area of Dhankuta Municipality (Dhankuta, 9) at first time. Then it was immediately followed by other two pioneer neighboring farmers. First of all, they cultivated improved of tomato called *'Pusharuby'* through the technical support of the then District Agriculture Development Office (DADO), Dhankuta and Pakharibas Agriculture Center (PAC), Dhankuta. This statement makes clear that Guthitar is the origin point of commercial tomato farming in this area.

In addition, the pioneer agriculture experts Mr. Surya Sapkota and Mr. Rajkumar Shaha both mention that this farm technology seems to have gained popularity only after the beginning of the 21_{st} century through the joint efforts of various governmental and nongovernmental agencies like Krishi Uddham Kendra, Dharan (Agriculture Enterprise Center, Dharan, AECD), District Agriculture Development Office (DADO, Dhankuta) and the farmers themselves. As

they mentioned, the AECD provided the latest technology of tomato farming to the farmers in the beginning of 21st century in collaboration with the then DADO Dhankuta. At the same time, this program was extended to other wards the municipality like Khalde, Pangsing and Patle Khola areas of Ward no. 6; Syaule, Lankure Patle and Nigale of Ward no. 3 and Thoka area of Ward no. 4 (DADO Dhankuta, 2018). Similarly, Mr. Sapkota, who was himself involved in this program added that DADO, Dhankuta had launched a new program in this area by providing new variety of seed *'Avanas 2'* to the local farmers with 50 percent subsidy at the same time. Since then, through the joint efforts of these various agencies and the local farmers, it seems to be gradually spreading to the other areas of the district with new varieties of improved seeds like arounder, srijana, sarita, winsory, manisha and gaurav etc. He further added that in addition to these institutions, the role of other various media such as neighbors and friends/relative etc was also significant to diffuse this agricultural technique in this area.

This study reveals that most of the improved farming techniques are concentrated around the Koshi highway and other subsidiary agricultural roads in this area. The field study data indicates that nearly 40 percent (52hhs) farmers using such agricultural outputs living within the distance of 500 meters from the Koshi highway. In the same way, nearly 45 percent (58hhs) adopter farmers remain around the distances of 500 to 1000 meters and more than 15 percent (20hhs) such framers are living beyond the 1000 meters distance from the highway. In addition, it is also seen that most of the farm households in this area are connected to the main road by subsidiary and agricultural roads. Considering this situation, it seems that the road network has an important role in the development and expansion of commercial tomato farming technology in the study area.

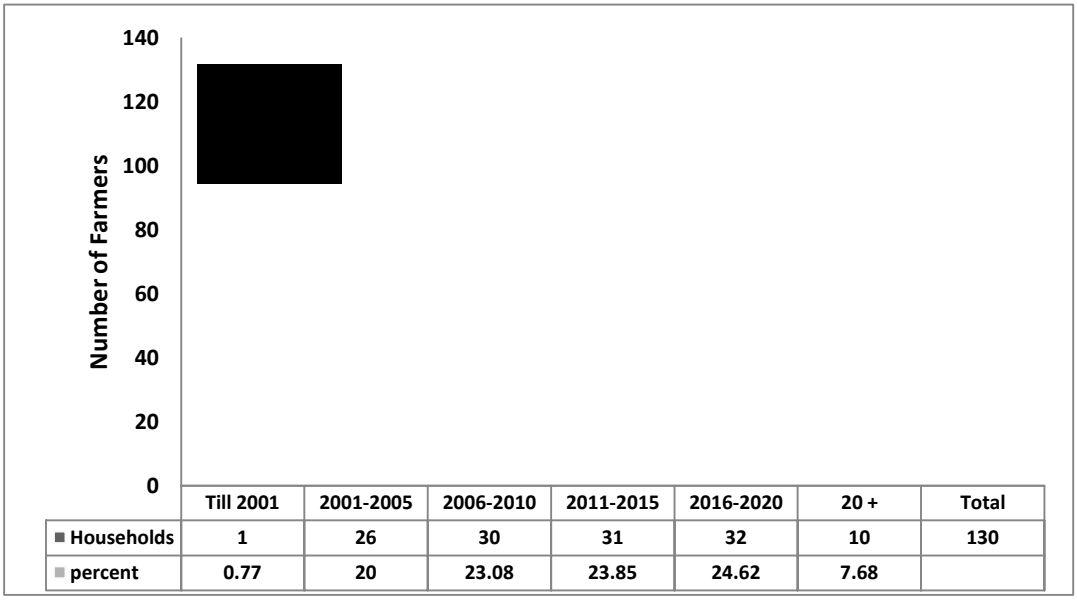
Trend of Development and Expansion

The new farming techniques have been developed and expanded in different intensities and ways at different times in the eastern hills (Wagle, 2019). Allan (1986) identified that the construction of roads, tracks, and bridges, has brought miraculous changes in the land use pattern of the Alpine region in Europe. Such changes are mainly concerned with the degree of accessibility between mountains and lowland areas. That reflects successful human manipulation of the great range in environmental conditions found in mountain habitats (as cited in Khatiwada, 2019). Virgo & Subba (1994) finds some major factors influencing in land use changes in eastern hills such as the use of new agricultural inputs, farmers' response to market integration, and improved accessibility due to construction of Dharan-Dhankuta-Basantapur road in Dhankuta district from 1978 to 1990. Regarding the eastern hills of Nepal, the use of new technologies has brought some major changes in land use pattern and its continuity seems to be continuous. However, the expansion rate does not seem to be the same (Wagle, 2019). This study also confirms that the use of new agricultural inputs has an important role in the development and expansion of commercial tomato farming in the hilly areas of eastern Nepal. The conclusions of various focus group discussions conducted during the study period have pointed out that the use of improved seeds, chemical fertilizers, pesticides and tunnel technologies has made possible to grow year-round and increase its productivity. Along with this, the development and expansion of new road networks has also helped to increase farmers' access to the market which has inspired them to adopt new inputs in their agricultural works (Figure 2).

The data of figure 2 shows that the study area has achieved significant progress in commercial tomato framing in a short period of time. Over a period of about 22 years more than 46 percent (130hhs) farmers have been adopting this farm technology as their main source of income. At first, it was started by the one farmer with the joint efforts of local governmental and non government agencies and now it is being continued by 130 farmers. Its usage rate seems to

be increasing continuously although the rate of increase is gradually decreasing. The data of the same figure also indicates that 20 percent (26hhs) farmers have started to use such agricultural inputs during the period from 2001 to 2005. Similarly, more than 23 percent (30hhs) farmers began to practice this technique from 2006 to 2010 and almost the same numbers (31hhs) of new users added in the period of 2011 to 2015. The number of users seems to be at a peak point during the period of 2016 to 2020. The field survey data shows that around 25 percent (32hhs) farmers added as adopters at that time. Moreover, only about 8 percent (10hhs) farmers started to use such farm technology in the last two years. In this way, almost 46.45 present (130hhs) farmers are involving in this farming system at present day. Thus, based on this analysis, the development and expansion of the use of this technology in this area seems to be satisfactory. Both studies of Wagle (Wagle, 2019 and Wagle, 2022) in the case of eastern hills of Nepal and the study of Pathak (2010) in Dhading district under the similar title are consistent with this result. Moreover, in the course of analytical study of the commercial tomato farming in eastern hills of Nepal from the past to the present, some major continuities and changes in farming techniques are also identified which are presented in the following table (Table, 1).

Figure 2: *Trend of Development and Expansion of Commercial Tomato Farming*



	Till 2001	2001-2005	2006-2010	2011-2015	2016-2020	20 +	Total
Households	1	26	30	31	32	10	130
percent	0.77	20	23.08	23.85	24.62	7.68	

Source: Field Survey, September, 2022.

Prospects of Development and Expansion of Commercial Tomato Farming

The role of geospatial, socio-economic and cultural factors seem to be decisive and crucial to disseminate new agricultural techniques among the various factors. Mainly, it depends on ability of motivators. If the motivator is capable and respectable he/she is followed by the majority farmers which make diffusion process more effective (Wagle, 2019).

The study has confirmed that geographical factors also play an important role in the development and expansion of commercial tomato faming in the study area. In this regard, agricultural experts of Agriculture Research Station Pakharibas (ARSP) clarify that the role of geospatial factors such as favorable temperate climate, enough rainfall and fertile soil texture for tomato farming seems remarkable to diffuse this framing technique in this area. Making this reality more clear local agronomist Surya Sapkota also says that the success and failure of commercial agriculture depends on geographical suitability and adversity.

Moreover, this study also reveals that socio-economic factors play an important role to disseminate this technology in the study area. Three group discussions were conducted during the field survey period to identify the role of such factors. The major conclusions obtained from the discussions are:

Table 1: *Continuity and Change in Tomato Farming Techniques*

Continuity	Major Changes
1. The traditional tomato farming system still in existence and some farmers are continuing it in the forms of kitchen garden farming till now.	1. Most of the farmers are using new outputs like mini-tiller, sprayer, chemical fertilizers, pesticides, insecticides and tunnel technology etc. in tomato farming for commercial purposes. It shows a massive change in the mentality of the farmers.
2. The use of organic fertilizers seems to have continued even in commercial tomato farming.	2. The amount of use of organic fertilizers is increasing in the current farming system as compared to the past.
3. Traditional irrigation techniques of irrigation like *Kulo, Hajari and Pipe* are still in practice.	3. Along with traditional irrigation techniques, the use of new techniques, like spring *call, water tank (plastic and concrete) and bubble irrigation technique* is also increasing at present. .
4. The use of traditional methods for crop protection is still being used by framers.	4. At present, farmers have maximized the use of newly developed techniques as compared to the traditional.

Source: Field Survey, September, 2022.

- The link of study area through the construction of Koshi highway with other major cities of the country like Dharan, Itahari, Biratnagar, Damak and Birtamod etc. makes easy to introduce new outputs in the agricultural activities. Moreover, it also helps to promote the market of local agricultural production.
- Farmers are able to achieve good returns in a short time with reasonable price as compared to other crops. Besides, its cultivation is possible throughout the year and demand is high in the market
- The farmers do not have to face any major problems yet in its sale due to the development of organized agricultural market centres and its global identity.

Similarly, the role played by various social factors to diffuse commercial tomato farming in this area cannot be forgotten. The role of neighbors and governmental and nongovernmental organizations seems to be prominent among these factors. After this, the role of friends and

electronic media seems to be important respectively. The similar studies of Pathak (2010), Wagle (2019) and Wagle, (2022) also support this result. Pathak has carried out study in the case of Dhading district while Wagle has studied from the perspective of eastern hills in Nepal (Table, 2).

Table 2: *Major Social Factors of Commercial Tomato Farming*

Sources	Number	Percent
Neighbors	49	37.69
GOs /NGOs	33	25.39
Friends	24	18.46
Electronic Media	20	15.39
Others	4	3.08
Total	**130**	**100**

Source: Field Survey, September 2022.

Table 2 shows four major social motivational factors of using new agricultural outputs in the study area. As seen in the data, around 38 percent (49hhs) farmers have stated that they were inspired towards that farming through the influence their neighbors. It is followed by various governmental and nongovernmental agencies with almost 25 percent (33hhs). The data indicates that the government policy is also positive to promote commercial vegetable farming in this area. According to the information from the Dhankuta Municipality and Agriculture Knowledge Center, Dhankuta and Terrhathum (Krishi Gyan Kendra, Dhankuta and Terrhathum), Nepal Government has been providing 50 percent to 75 percent subsidy for the farmers to purchase various agricultural outputs. Apart from this, various local nongovernmental agencies have also been providing various such inputs with full or partial subsidy for the promotion of this farming system. Similarly, more than 18 percent (24hhs) farmers mention that they have adopted such techniques through the inspiration of their friends. Besides, around 17 percent (19hhs) farmers express their opinion that they are attracted towards it through the encouragement of television and radio programs.

Thus, it can be concluded that due to favorable geographical conditions, positive government policies, maximum attraction of farmers towards this farming system, development of road networks and expansion of markets, high returns and reasonable price of production, there is a bright future of commercial tomato farming in this area.

Major Barriers of this Farming System

The previous study of Wagle (March, 2022) concludes that the existing commercial tomato farming system in the eastern hills of Nepal is a confluence of possibilities and challenges. The conclusions of this study also seem to be consistent with this notion. This study also depicts that farmers are getting enough benefits from the use of new agricultural outputs

with facing various challenges. Some of the major challenges identified from the group discussions with the farmers of this area are mentioned in the following points: In addition to the high prices of the agricultural outputs, farmers are not able to obtain such outputs at the appropriate time of plant cultivation sufficiently.

- The excessive problem of diseases and pests in crops and failure to identify and diagnose it in time.
- Lack of periodic soil testing facilities and gradual decrease in soil fertility.
- Lack of adequate and reliable access to irrigation facilities and storage facilities.
- The problems of strikes and lockdowns caused by political instability and pandemic diseases.

In spite of such problems, the farmers have been getting good returns by continuing this farming system. But due to the lack of technical knowledge among the farmers, inability to identify and diagnose the problem of insects and diseases in time, lack of proper arrangement of soil testing facilities and continuous decrease in soil fertility, some question marks have definitely been raised in the sustainability of this farming system.

Conclusion

The commercial tomato farming in the hilly areas of eastern Nepal seems to be full of both challenges and opportunities. The success of this agricultural system has made farmers realize that agricultural occupation can be made profitable by using advanced agricultural inputs. As a result of this, it seems that the habit of identifying and using appropriate techniques is gradually developing among them which can be considered as an important achievement. Besides, it has playing an important role in the development and expansion of commercial relations between the hilly and Tarai regions of eastern Nepal with distinct identity of the hilly region. Thus, this farming system seems to be profitable and popular at present. Finally, this study conveys the message that success cannot be achieved by only a new work, but in order to achieve success, one must act in a new and appropriate technique.

Moreover, this study confirms that the commercial tomato farming is not only a profitable business but also a risky and challenging. The farmers are facing various socio-economic challenges while doing this cultivation. Thus, another important conclusion of this study is that any human activity is not free from barriers or challenges, so such challenges must be faced in an intelligent way. Therefore, the next message of this study is that the success achieved by facing such barriers is sustainable and achievable also.

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