Original Research Article

Problem Analysis of Garlic Cultivation in Major Production Areas in Luzon, Philippines

ABSTRACT

Using the problem analysis framework, this research analyzed the current situations in the garlic-producing areas in Luzon, Philippines, and identified the possible reasons for the decrease in the volume and total area of production. A total of 111 garlic farmers from 25 municipalities and cities in the Ilocos Region, Cagayan Valley, Central Luzon, CALABARZON, and MIMAROPA were included in the study. Results showed that extreme weather conditions such as heat, drought, and excessive rains, insect pest and disease occurrences, and inaccessibility to market with high pricing for locally produced garlic are the most encountered problems by garlic farmers across the regions. Continuous heavy rainfall during the planting season caused extreme damage to the crop, in which 41% of the respondents mentioned this as a major concern. The presence of different field and storage insect pests and diseases of garlic resulting in lower yield was also cited by 32% of the respondents. Furthermore, the market for native garlic is less competitive due to the cheaper cost of imported garlic varieties, which leads to a significantly reduced market for the produce. The conditions led to the production of other crops such as squash and sweet potato, or in some cases, the selling of chives as they require fewer inputs, thus making it more profitable in a shorter period than producing bulbs.

Keywords: garlic; problem analysis; survey; interview; focus group; insect pests; diseases; market; imports; extreme weather

1. INTRODUCTION

Garlic is an annual crop cultivated around the world. It is a major spice and is used for its different medicinal properties. In the Philippines, it is planted once a year in specific areas with pronounced wet and dry seasons (Suarez 2015) on well-drained or sandy loam soil. The crop requires a cold climate (November to February) and short days are favorable during its early growth stage for optimum bulb development (Tindall 1983). During the bulb maturity stage, a comparative dry soil, dry atmosphere, and moderately high temperature, mostly from March to April, are important for bulb drying (BPI, 2010). The Ilocos Region is the main producer of garlic with the top producing provinces, namely, Ilocos Norte and Ilocos Sur. Other garlic-producing regions in Luzon are Regions IV-A [Cavite, Laguna, Batangas, Rizal and Quezon (CALABARZON)] and IV-B [Mindoro, Marinduque, Romblon, and Palawan (MIMAROPA)], Region II [Batanes and Nueva Vizcaya (Cagayan Valley)], and Region III [Nueva Ecija (Central Luzon)]. Different cultivars and varieties are being cultivated in the country such as Batanes Red, Batanes White, Ilocos Pink, Ilocos White, Mexican, Miracle, Bang-ar, MMSU Gem, and Ilocos Tan Bolters (NSIC, 2020).

The seasonality of the crop limits local production and makes the country a net importer of the commodity. In 2022, the Philippines imported approximately 94% of the total garlic

requirement, while the remaining percentage was supplied by domestic production. In the 2021-2022 cropping seasons, only 4,817 metric tons (MT) were locally produced, while 78,132 MT was imported (DA-BPI Allium Monitoring Team Report 2022) from countries such as China, India and Hong Kong (Miraflor 2020). From 1996 to 2022, local production has been continuously declining due to several factors, from 1,547.800 MT to 4.817 MT (PSA, 2022). These figures are alarming; thus, countermeasures must be installed to reduce spending on imported garlic and support and empower local production.

On a global scale, according to Zhai (2023), the price of garlic is rising every day, and the price changes almost every day. Price fluctuations are mainly caused by the following reasons. First, the yield is expected to decrease. Topics such as the heavy snow climate causing garlic seedlings to be covered by heavy snow and the prediction of the new season's yield reduction have once again become catalysts for the market, which has further stimulated the industry's expectation of yield reduction, and the market is bullish. The second reason is the expected reduction of the garlic area. Influenced by factors such as the poor gains from planting garlic, the high cost of labor and agricultural materials, the enthusiasm of garlic farmers in the main producing areas was suppressed, and the garlic area harvested in summer in 2023 decreased. In addition, the booming market demand is also one of the reasons for price fluctuations. The domestic catering industry was booming, and the demand for garlic increased significantly, which indirectly led to an increase in garlic prices.

In 2020, the Department of Agriculture released Administrative Order 02 series of 2020 on strengthened guidelines for monitoring and evaluation of local production and importation of onions (Allium cepa) and garlic (Allium sativum). However, this general guideline needs intensified implementation and should be directed to specific areas where problems are encountered.

This paper aims to identify research gaps based on the problems encountered by Filipino farmers. Those issues that can be managed on the farm level where research and development interventions could play a significant role. Furthermore, this paper also aims to provide better guidance in formulating future policies regarding the garlic industry, specifically in the production aspects.

2. METHODOLOGY

2.1 Study area

A Luzon-wide survey was conducted from July 2021 to May 2022 on garlic-producing areas in the provinces of Ilocos Norte, Ilocos Sur, Batanes, Nueva Vizcaya, Nueva Ecija, Cavite, Laguna, Batangas, Quezon, Occidental Mindoro, and Marinduque using structured questionnaires (Figure 1).

2.2 Survey Proper

Data were obtained through face-to-face interviews with garlic farmers. Respondents of the survey were identified by the Local Government Unit (LGU) and/or Department of Agriculture Regional Field Offices (DA-RFO). The survey covered the respondents' personal, demographic, farm, socio-economic and crop profiles; problems encountered; and coping mechanisms employed. After the individual interviews, focus group discussions with the agricultural technicians, a few traders, and farmer leaders were conducted to verify the validity of the survey results.

Figure 1. Garlic production areas in Luzon covered by the survey

2.2 Data analysis

A research synthesis approach (Onwuegbuzie et al. 2012) was utilized to produce this paper which is purely a qualitative research design. The primary data from the farmers and focused group discussion information were validated and combined to produce the results. The data were then tabulated, summarized, analyzed, and interpreted. After thorough analysis, the problems were ranked, and the impacts were identified. Based on the results, both research and policy recommendations were formulated.

3. RESULTS AND DISCUSSION

A total of 111 garlic farmers from different garlic-producing areas in Luzon, namely; Burgos, Pasuquin, and Sta. Catalina in Ilocos Norte; Sinait, Ilocos Sur; Basco, and Itbayat, Batanes; Aritao and Dupax del Sur in Nueva Vizcaya; Lupao, and Muñoz in Nueva Ecija; Carmona City, General Trias City, Tanza and Dasmariñas City in Cavite; Cabuyao City and Calamba City in Laguna; Calaca, Lemery and Tanauan City, Batangas; San Francisco and San Narciso in Quezon; Lubang Island, Magsaysay, and San Jose City in Occidental Mindoro; and Boac, Marinduque were interviewed.

Farmer respondents consist of 67% male and 33% female farmers with an average age range of 41-50 years old. The age demographic characteristics of farmers also come into play with the current situation. As seen in Figure 2, most of our farmer-respondents fall into the 51-60 age group (33%) followed by 24% in the 41-50 age group. This is critical as it indicates that less of the younger Filipino generation go into farming or agriculture in general. Based on the 2020 data from the Philippine Statistics Authority (PSA), there is a steady decline of an average of 2.04 to 7.23 percent in the country's agricultural employment rate from 2014 to 2020. If this is left unaddressed, this will cause a huge gap in terms of human

resources for the country's agricultural sector in the coming years. Furthermore, this will affect the food security and self-sufficiency of the country.

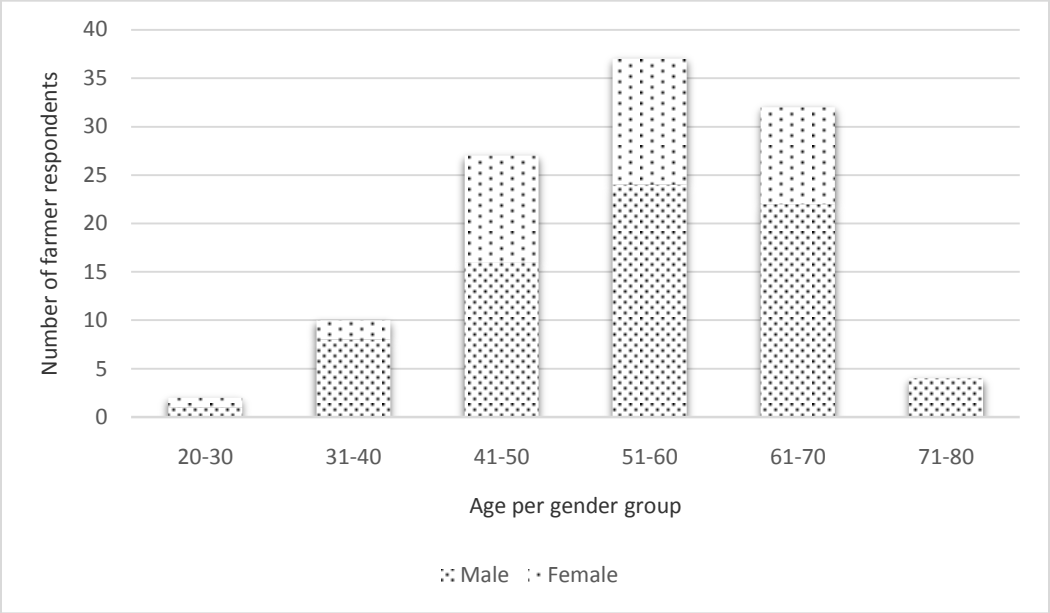

Figure 2. Age-sex demography of garlic farmers in Luzon based on survey

Generally, garlic production constraints can be divided into internal or yield-reducing factors and external or income-reducing factors. These factors can further be classified as biotic and abiotic factors which can directly or indirectly affect crop growth and development. Biotic stressors in garlic production include insect pests, diseases, and weeds (Rathor and Sharma, 2019; Madamba, 2019; Etana, 2018; Hasan and Khalequzzman, 2015, USDA, 1996). On the other hand, abiotic constraints in garlic-producing countries are environmental conditions like excessive rain, heat, and drought, flooding, or cold (Muska and Saksone, 2019; Hasan and Khalequzzman, 2015; USDA 1996). Other factors such as fertilizer unavailability (Rathor and Sharma, 2019), low usage (Etana, 2018) due to high cost of chemical fertilizers (Awad, 2019; Rathor and Sharma, 2019) and pesticides (Awad, 2019) also posed problems in garlic production. In addition, the source and cost of quality planting materials (Awad, 2019; Muska and Saksone, 2019; Rathor and Sharma, 2019), lack of improved varieties (Hasan and Khalequzzman, 2015), and planting of Chinese varieties (Bayrakli and Gul, 2018) are also concerns. These constraints singly or in combination could potentially cause high production losses (Bayrakli and Gul, 2018; Calica 2001), thus many farmers shift to the production of cash crops (Madamba, 2019) over high-value ones.

The absence of mulching materials adversely affects production (Etana, 2018; Hasan and Khalequzzman, 2015) since there will be more competition with weeds and less holding capacity of the soil for moisture. On the other hand, soil degradation (Muska and Saksone, 2019; BAS, 2015) resulting in low soil fertility (Etana, 2018), is another major factor affecting garlic productivity in some areas. In other aspects of the garlic industry, investment (Calica et al, 2001) or the absence of credit facilities (Etana, 2018) also affect the initiation and sustainability of production.

Basic utilities and logistics such as lack of irrigation (Etana, 2018; Patidar et al., 2018), transport, storage (Rathor and Sharma 2019, Awad 2019), electricity (Patidar et al. 2018), and high cost of automation are considered as negative factors in garlic production. Farmers are also complaining about the lack of labor (Patidar et al. 2018), and costly labor

(Awad, 2019) considering that intensive labor is needed in garlic production (Muska and Saksone, 2019).

Aside from farm factors, market forces are also affecting the behavior of the farmers, which influences their decision in producing garlic. The fluctuating price (Awad, 2019; Bayrakli and Gul 2018), oversupply (Rathor and Sharma, 2019), low or variable returns (Etana, 2018), huge price difference in farm gate and retail, no market price information, monopoly, and agricultural associations not helping in marketing (Awad, 2019) are marketing problems of crops in general.

However, not all constraints are due to physical absence, there are also instances that the farmers lack appropriate knowledge (Rathor and Sharma, 2019; Bayrakli and Gul, 2018) in garlic production as aggravated by poor extension services.

Based on the interview conducted, garlic farmers have a variety of concerns and difficulties in garlic farming which collectively leads to low garlic production. The problem tree (Figure 3) shows the interconnection among the various factors identified during the survey, while Figure 4 shows the ranking of each identified problem based on farmers' responses to the interview. This tree also shows that there are issues that are related to or have a cause-and-effect relationship with one another.

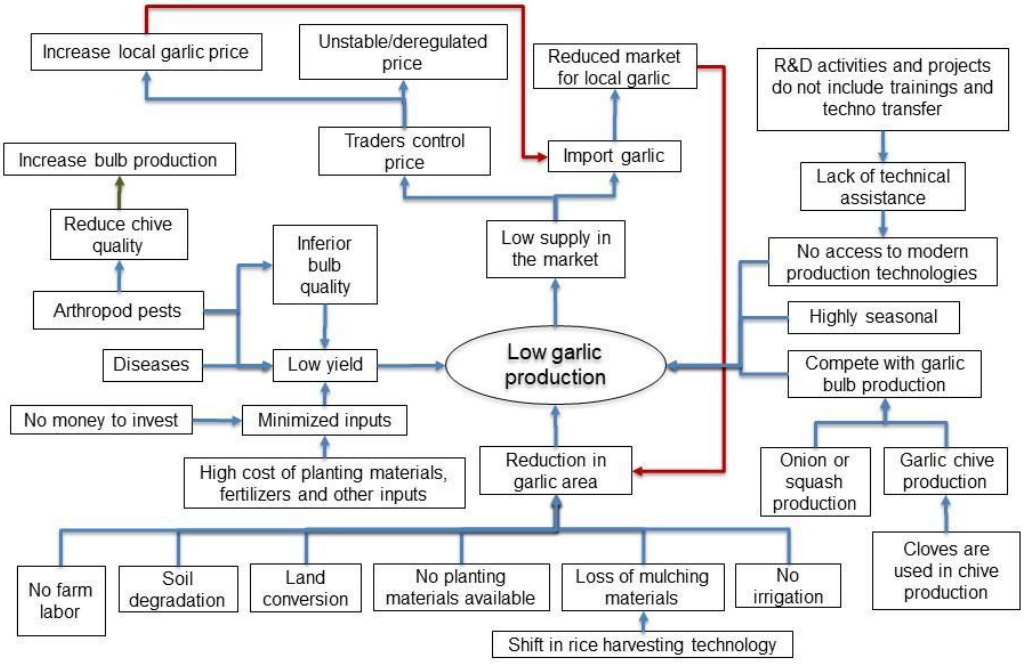

Figure 3. Problem tree of the garlic production in Luzon based on FGD

Accordingly, excessive rainfall and extreme weather conditions, which were identified by 41.07% of the respondents, occurring during the planting season has the most detrimental effect on their harvest as cited. This is also experienced in the Ilocos region areas, the garlic capital in the Philippines, even having the best climatic conditions for garlic production, such weather disturbances greatly affect their harvest quality and quantity. A similar situation is experienced in Central California where untimely rain at planting is the primary production peril in garlic production (USDA-ERS 1996). In some cases, extended wet periods can make the soil too wet to work on, thus delaying planting past recommended planting dates. Locally, this is crucial since delayed planting would lead to small bulb development. Missing the appropriate and recommended planting date window or garlic would result in missing the

required cool temperature and short daylight requirement for optimal bulb formation. High humidity and saturated soil due to rainfall also provide a favorable environment for the growth of plant pathogens resulting in higher incidences of infection. This includes the presence of different fungal pathogens such as *Colletotrichum* sp. causing anthracnose, *Fusarium* sp. causing basal rot, and *Cercospora* sp. causing leaf spots. These pathogens thrive in a moist environment brought about by continuous rainfall. Aside from fungal diseases, virus diseases also persist in most of the garlic areas in Luzon and cause serious damage to the crop. Virus-infected garlic planting materials led to lower yields generation by generation. Arthropod pests like mites, thrips, and armyworms also affect garlic yield. Both insect pests and diseases were identified by 32.14% of the respondents. In relation to this, farmers have limited knowledge of the appropriate control measures. In most cases, farmers use the readily available inputs in the market such as insecticides or fungicides that may not be effective for specific pests. For instance, on mite control, farmers usually apply insecticides that are not registered to control mites, hence, not effective. This specific scenario implies that there is a need for farmers' protection from natural calamities and pest outbreaks by employing affordable crop insurance (USDA-ERS, 1996). In the Philippines, the government has a state-owned agricultural insurer committed to developing and implementing insurance programs highly responsive to the needs of small farmers and fisherfolk, and other agricultural stakeholders. The Philippine Crop Insurance Corporation (PCIC) was created to provide insurance protection to farmers against losses arising from natural calamities, plant diseases, and pest infestations of their palay and corn crops as well as other crops. However, farmers do not avail of such insurance due to small land holdings, low awareness of the insurance lines of the PICC and their terms of conditions, and the issue of the assessment of the damages when claiming indemnity which resulted in low penetration rates for specific crop insurance (Reyes, 2015).

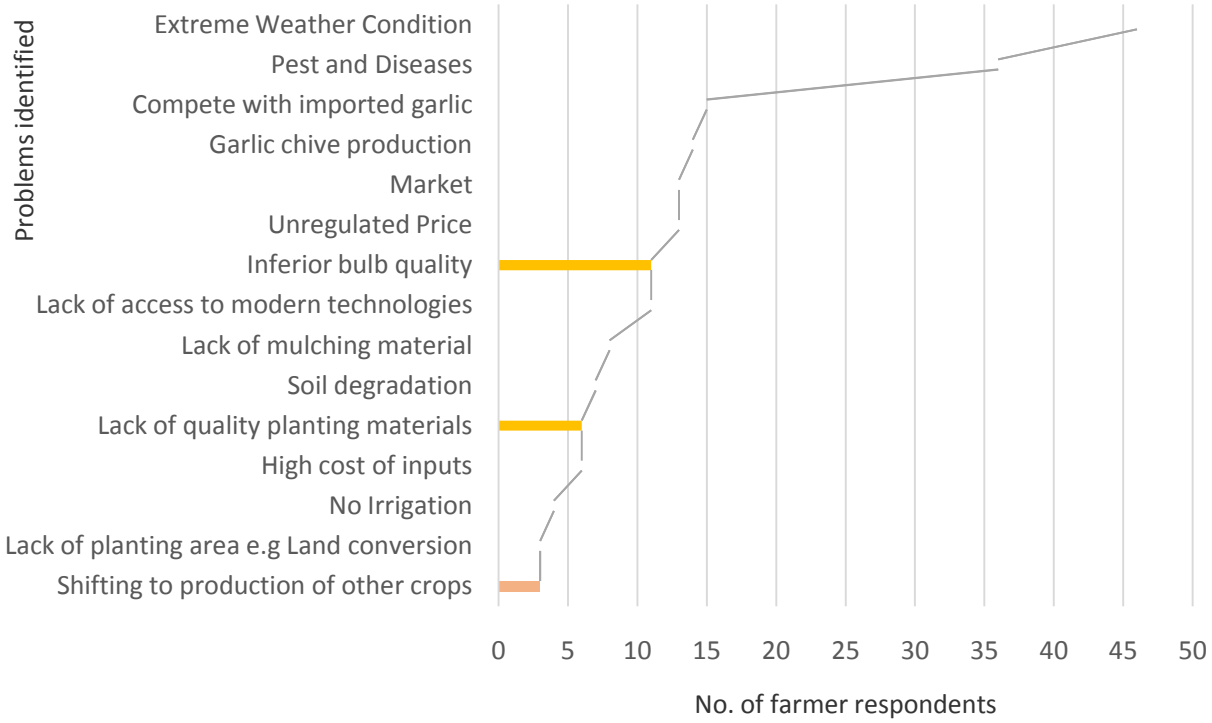

Figure 4. Ranking of identified problems encountered by garlic farmers of Luzon

With the increased importation of cheaper garlic (13.39% of the respondents), the market (identified as a problem by 11.61% of the respondents) for local garlic suffers due to unstable price (identified as a problem by 11.61% of the respondents) of the local produce as dictated by traders, middlemen and 'biyaheros'. Based on PSA garlic harvest data from 2004 to 2018, throughout this period, production decreased from 15,000 MT of garlic in 2004 to almost half of the volume produced in 2018 (7,600 MT). Garlic import volume during this 15-year period shows a 4-fold increase from 23,140 MT in 2004 to 81,970 MT in 2018. This resulted in the flooding of imported garlic in local markets further leading to competition with the local produce. Imported garlic is usually seen by consumers in stalls/stores, wet markets, supermarkets, and groceries. A limited number of locally produced garlic are transported and sold in the market throughout the country. In addition, retail prices of imported garlic are cheaper in comparison to the local ones as the cost of production in other countries is much lower compared to the local production cost. The direct impact of low local garlic production is low garlic supply which led to manipulation of price by traders and importation which eventually resulted in a reduced market for local garlic, higher price, and unregulated pricing. Thus, it is important to ensure that local produce will be sold directly to the market and not to the traders who usually hoard and only sell them when the market price is high. One general statement made by DA Secretary William D. Dar in 2017, is that garlic is among those that are neglected when it comes to funds invested for research, development and extension, and marketing support. Thus, RDE programs, marketing linkages, and price control must be in place to help farmers improve their production, increase their income and compete with imported garlic in terms of quality and price.

Another factor that comes into the picture is the decrease in the planting area of garlic throughout Luzon. Through time, the planting area devoted to garlic has reduced due to several factors such as land conversion (identified as a problem by 2.68% of the respondents), soil degradation (identified as a problem by 6.25% of the respondents), while some are converted to production of other crops (identified as a problem by 2.68% of the respondents). In certain places, planting of other crops specifically, in Cabuyao City in Laguna, squash has replaced most of the areas planted with garlic. On the other hand, in Nueva Ecija, Nueva Vizcaya, and Occidental Mindoro, farmers are venturing into onion production. Other cases are also observed in Tanauan City and Lemery in Batangas, where native garlic is harvested as chives (identified as a problem by 12.50% of the respondents) at around 70 days after planting instead of growing these into fully matured bulbs. Selling chives ensures higher income for the farmers in a shorter period compared to having bulbs. Unfortunately, this practice leads to a decrease in the source of garlic planting materials for bulb production. Other areas in Luzon also experienced the unavailability of quality planting materials (identified as a problem by 5.36% of the respondents) to sustain their production. The practice of farmers selling all their garlic produce in the local market resulted in the procurement of garlic planting materials for the next planting season. They usually procure these materials either from Ilocos Norte, Ilocos Sur, or Occidental Mindoro based on surveys. They usually do not store garlic since they do not have any long-term storage facilities and storing them in 'bodegas' in their houses would result in degradation due to storage insect pests and diseases. They usually store their garlic bulbs temporarily until such time that the prices would go up, but those who do not have space, just sell their dried garlic bulbs to the middlemen that usually bargain lower prices.

As for the lack of technical assistance, most farmers are not aware of the appropriate management and control measures (identified as a problem by 9.82% of the respondents), which are reasons for the decline of production. Furthermore, most of the first-time garlic farmer recipients of planting materials from the government did not have any training or the technical know-how on garlic production resulting in inappropriate practices and minimal harvest. Some were not even aware of the appropriate planting season, they usually plant the garlic planting materials after receiving it. As mentioned by Calica et al. in 2001, and Bayrakli and Gul in 2020, the lack of knowledge on garlic cultivation are factors that

contributed to low production locally and abroad but became a perennial problem due to poor transfer of technologies. The lack of enough capital for planting has also been cited by some farmers. Agricultural inputs such as planting materials, fertilizers, and pesticides have also increased in price over the years (5.36% of the respondents). According to Villa and Bautista in 1997, garlic production requires Php 556,050.00 (~USD 17,063.50) per hectare from land preparation to harvesting to post-harvest handling as an initial investment for new garlic farmers in Tanza, Cavite, due to high labor and capital. With the intervening problems with garlic production and marketing, garlic farmers tend to lose interest in garlic production and decide to switch to other commodities, which will give them a higher income and support from the government.

One minor constraint considered by the farmers that determine their decision to plant garlic is the unavailability of appropriate mulching materials (identified as a problem by 7.14% of the respondents). The common mulching material for garlic is rice straw which is very abundant after rice harvesting. However, due to the mechanization of harvesting, the rice straw was shredded by the harvesting machine. Whenever used as mulching materials, the materials easily decompose and weed growth is inevitable. With shredded straw, there is a need for more materials, which incurs more labor, therefore, higher labor costs. This issue could be addressed by using alternative mulching materials, but still, these materials also have their innate disadvantages such as availability, compostability, heat absorption and emission, cost, and compatibility.

In Central Luzon and some remote areas, irrigation (3.57% of the respondents) is also a constraint in planting garlic. Garlic has a relatively shallow root system and is sensitive to dry soil conditions. Water is needed after sowing to initiate germination and produce uniform growth of garlic. The most critical stage for irrigation is during bulb formation. Lack of water at this stage will result in early maturity and the development of smaller bulbs (Etana, 2018).

In other countries, different constraints were identified as contributors to the decline of garlic production. Fortunately, with our knowledge of the problem tree (Figure 3), the central goal to increase garlic production in Luzon, Philippines could be addressed. To achieve this central goal, an objective tree (Figure 5) was developed by using all the elements that constituted the problem tree. The causes presented in the problem tree were translated into means while the effects were turned into the ends of the objective tree.

The major constraints faced in garlic production can be found in the problem tree. The possible effects were identified based on the causes of the constraints which are depicted in the problem tree. The 'means' to address the underlying 'causes' of the problem tree and thereby, to reach the expected 'ends' were illustrated in an objective tree.

The overall findings led to identifying the followings as means to overcome the constraints in garlic production: provision of loan facilities and funding to start-up farmers; technical assistance and/or training on garlic production, soil fertility, and pest management; non-conversion of agricultural lands; provision of quality planting materials and inputs; provisions of the reliable irrigation system; development and promotion of modern production technologies; price control; eliminating/minimizing the role of traders in the marketing chain; marketing support from the farmers' group/government; and import regulation to give way to local produce. Sustainable garlic farming and the establishment of an efficient marketing organization are necessary (Hasan and Khalequzzman, 2015) to eliminate traders in the marketing chain of garlic, more so, preventing illegal hoarding.

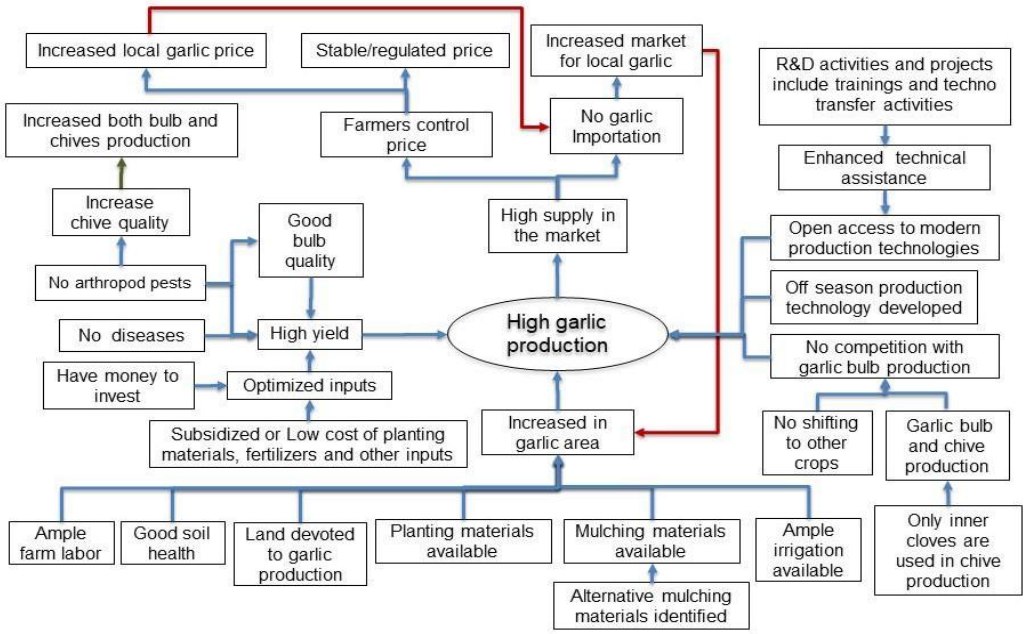

Figure 5. Means to overcome the constraints in garlic production in Luzon

All the abovementioned problems may or may not be valid at the present time, there might be more pressing issues in the country that are affecting the garlic industry. Some of the influencing factors include the change in the agricultural landscape, climate change, emergence of new insect pests and diseases, import-export situation, application of modern technologies, and more, which directly or indirectly affect the present industry. Influencing factors should be considered in determining the evolution of each constraint to formulate practical solutions and sound recommendations. As such, it is imperative that the root causes of low garlic production be identified and updated analysis be done so that the government can come up with appropriate measures. Analysis of the declining garlic production in Luzon through identification and ranking of the inter-related issues and determining the impacts of these problems on the overall supply and demand of garlic in the country are the main considerations to be able to craft such recommendations. In terms of research and development, different institutions should focus on ways to increase garlic production through varietal development, adaptability trials in potential expansion areas, fertilizer trials, effective pest management, mulching alternatives, off-season production, micropropagation, planting and harvesting technology application, storage, value-adding, and market support systems.

The fulfillment of these measures invites conjugated efforts from policymakers, better nodal training institutes, researchers, and other support stakeholders. Formulation of policies to regulate the prices of garlic in such a way that the local produce can compete with the imported garlic would significantly help the farmers with the recurring market issues. In terms of research and development, there should be a focus on the development of improved varieties, enhanced cultural management, alternative pest management practices, weed management options, storage techniques, off-season production, planting area expansion and marketing. These proposed means are well supported by contemporary research and surveys done locally (Villa and Bautista 1997, Suarez 2015, Dar 2017, Madamba 2019, Miraflor 2020) and abroad (USDA-ERS 1996, Hasan and Khalequzzman 2015, Shiferaw 2016, Bayrakli and Gul 2018, Patidar et al. 2018, Etana 2018, Awad 2019, Muska and Saksone 2019, Rathor and Sharma 2019). Therefore, these serious constraints like social

constraints, financial constraints, marketing constraints, and technical constraints need to be overcome to increase garlic production in Luzon Philippines.

4. CONCLUSION

The garlic industry is a declining industry in the Philippines considering the annual reduction in local production and area planted to garlic. This needs to be addressed immediately for the country to lessen importation and save money in procuring this important commodity outside the country. As per analysis, the problems are interconnected such that addressing one or two concerns will not save the garlic industry. The approach should be multisectoral, which would address the social constraints, financial constraints, marketing constraints, and technical constraints, thus a systems approach should be applied. Here we must consider that each farmer has his own perceived problems regarding garlic production as determined by their status, knowledge, finances, access to technology, agroclimatic environments, infrastructure, and marketing forces. Thus, many solutions to the constraints encountered by the farmers should be addressed locally, these include problems on inputs, labor, irrigation, technical assistance, soil degradation, mulch availability, and storage facilities. On the other hand, more pressing problems such as marketing linkages, price regulation, land conversion, and agricultural loan policies should be addressed on the national level. The objective analysis has presented the various means to somehow improve garlic production in the country and the realization of which can significantly improve the local garlic industry. Local and national policies advantageous to garlic farming should be acted upon and implemented strictly. Research and development initiatives also play an important role in saving the Philippine garlic industry. Using NSIC-approved garlic varieties in the expansion areas for garlic, there would be increase in production that would supply garlic in areas remote from the major production areas. This would ensure continuous garlic supply in the area and would also minimize reliance on Ilocos and Mindoro-produced garlic. Aside from using improved native varieties, it is also important to address insect pests and disease problems through R&D undertakings. All these issues should be addressed simultaneously through effective R&D and policy formulation and implementation. If these suggested measures are taken up suitably, the success rate of saving the garlic industry in the country will increase quite significantly.

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