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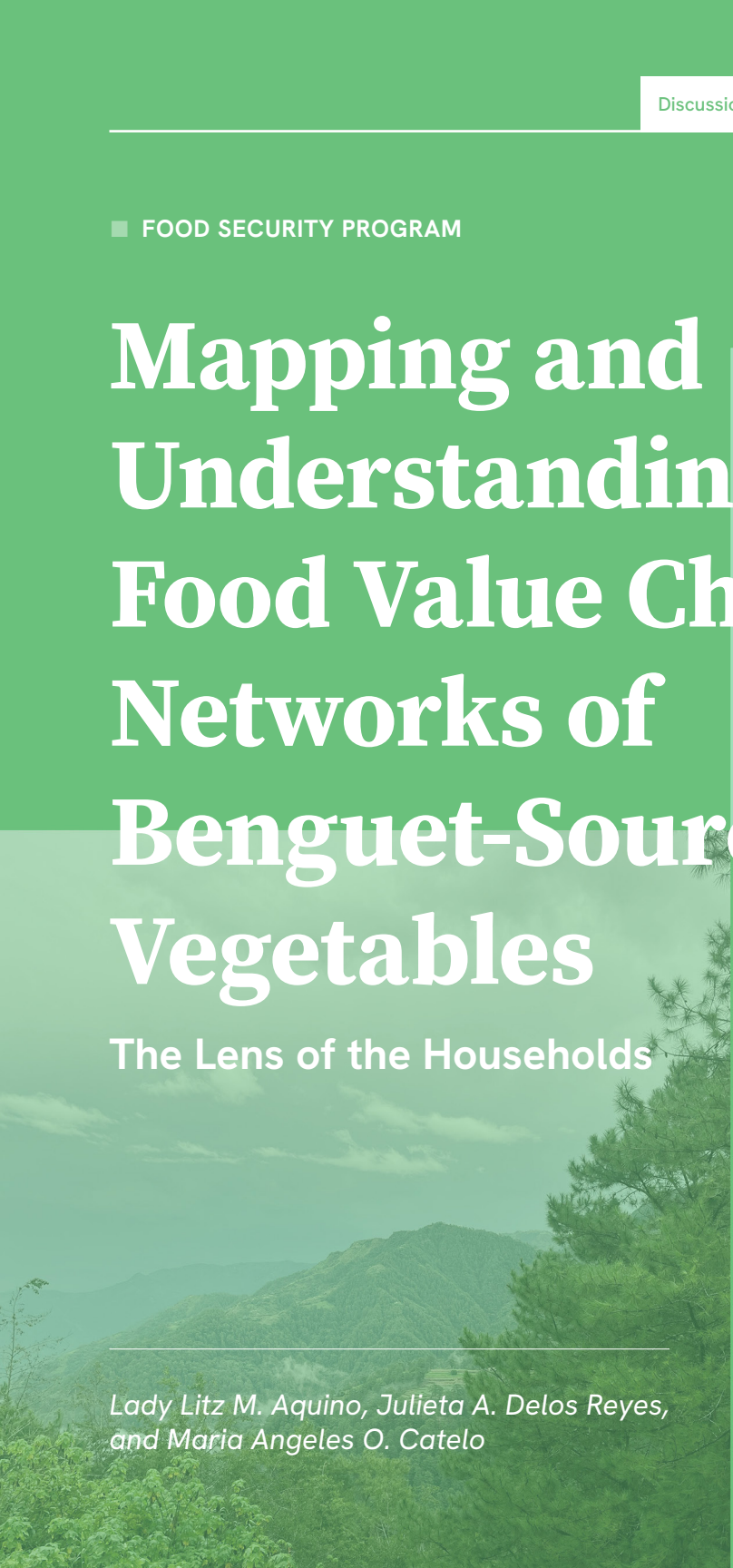
FOOD SECURITY PROGRAM

Mapping and Understanding Food Value Chain Networks of Benguet-Sourced Vegetables

The Lens of the Households



Lady Litz M. Aquino, Julieta A. Delos Reyes, and Maria Angeles O. Catelo

■ PROGRAM ON FOOD SECURITY

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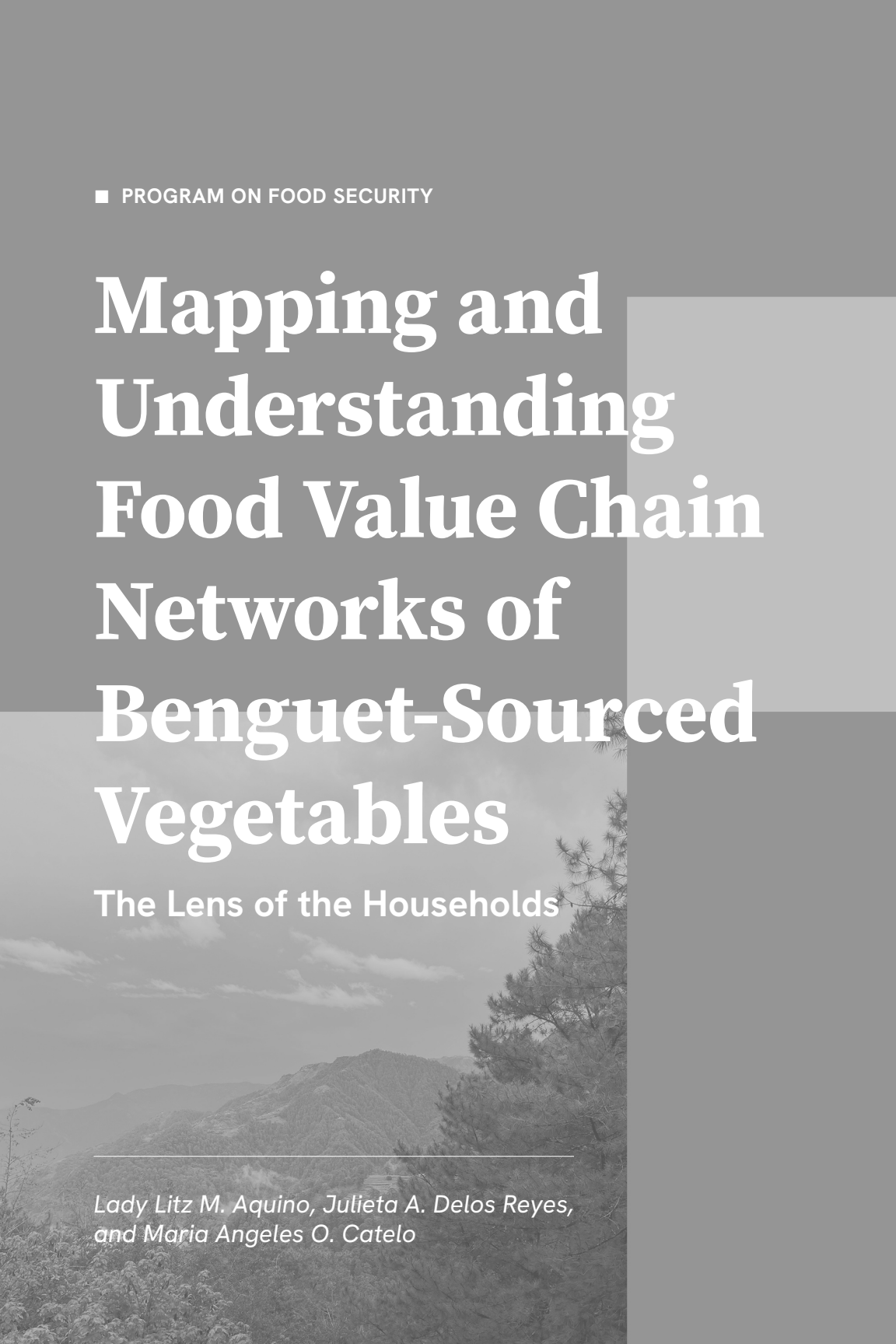

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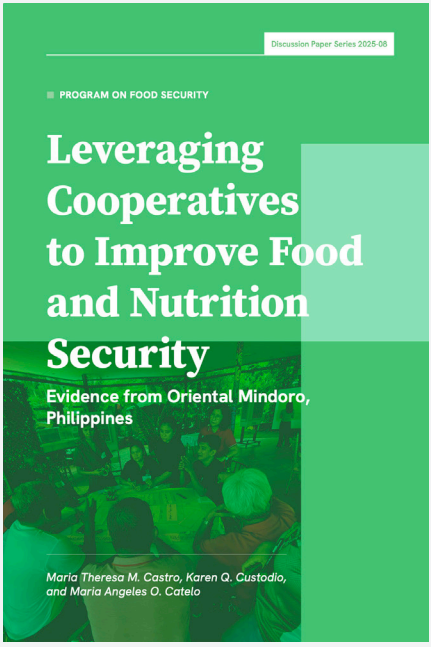

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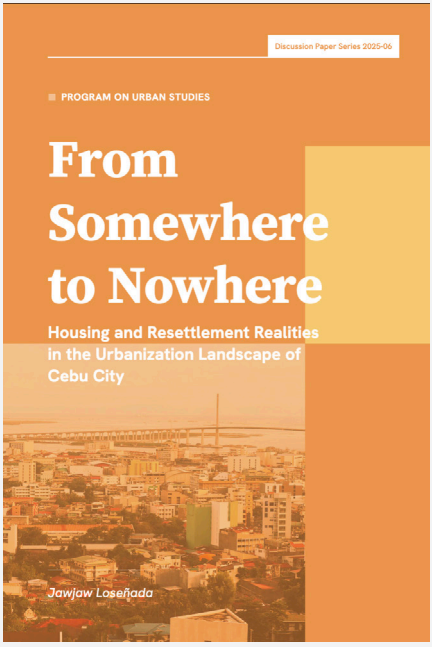

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MAPPING AND UNDERSTANDING FOOD VALUE CHAIN NETWORKS OF BENGUET-SOURCED VEGETABLES

The Lens of the Households[1]

Lady Litz M. Aquino[2], Julieta A. Delos Reyes[3], and Maria Angeles O. Catelo[4]

1 This discussion paper is part of the research, "Analyzing Value Chains for Food and Nutrition Security Within the Context of Pinggang Pinoy: Communities from the Northern Philippines" which is a component project of the Program on Food and Nutrition Security, supported by the University of the Philippines Center for Integrative and Development Studies (UP CIDS).

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ABSTRACT

The Province of Benguet supplies 89.05 percent of the country's potato production, 82.30 percent of carrots, 81.43 percent of pechay Baguio, 66.61 percent of cabbage, and 55.97 percent of chayote. This makes Benguet a vital contributor to national food security. However, inefficiencies in the vegetable value chain such as transportation issues, post-harvest losses, price fluctuations, and limited market access threaten both farmer profitability and consumer affordability. This paper used the value chain framework, GIS mapping, and survey data from 180 households to map the destinations of Benguet vegetables across three ecological settings (urban, coastal, and upland). The combined product and geographic flows traced from the households proved the substantial role of Benguet in providing the vegetable needs of the three communities and being nearer the source guarantees improved consumption. Based on production shares, Benguet plays a significant role in supplying the upland vegetable requirements of the country. The vegetable value chains in the three types of communities are supported by their local government units (LGUs) and the Department of Agriculture (DA) as enablers that ensure access to raw materials and other inputs. While farmers serve as the main vegetable suppliers, households also engage in vegetable production. Logistical challenges in Benguet continue to prevail due to the inadequacy of road networks that delay the distribution and limit the market outlets of the farmers.

Strict enforcement of road budget allocations, prioritizing substantially productive agricultural areas like Benguet as mandated by Republic Act (RA) 917 was recommended. The opportunity provided by RA 7900 through the High Value Crops Development Program (HVCDP) should be immediately grabbed since the program was allotted ₱1.80 billion in 2023.

Keywords: GIS, highland vegetables, logistical challenges, HVCDP

INTRODUCTION

In 1995, the High Value Crops Development Program (HVCDP) was created through Republic Act 7900 (High Value Crops Development Act) with the goal

of promoting the production, processing, marketing, and distribution of high-value crops. It is one of the banner programs of the Department of Agriculture (DA). Among its priority commodities are vegetables, which include lowland, upland, spices, and indigenous (MAFAR-BARMM, n.d.). In support of this, under the 2023 General Appropriations Act (GAA), the Department of Budget and Management (DBM) reported that the Marcos Jr. administration allotted ₱42,844,114,000 to the agriculture sector's banner food security programs to propel it to become one of the main drivers for growth and employment in the country. The National High-Value Crops Development Program was allotted ₱1.80 billion to help promote the production, processing, marketing, and distribution of high-value crops (DBM, n.d.). Given this limited amount, there is a need to rationalize its use to programs and projects that would have high impacts to the country's economy—the vegetable sector.

The vegetable industry is among the industries of the agriculture sector that need careful attention because vegetables are crucial in promoting food and nutrition security among Filipinos. The biological nature of vegetable production resulted in fragmented production areas. Thus, in the Philippines, there are highland and lowland vegetables, both of which are highly perishable with short shelf life making logistical functions for distribution and marketing more challenging.

Meanwhile, food and nutrition security is a critical global concern, particularly in geographically diverse regions like the northern Philippines. Benguet, in the Cordillera Administrative Region (CAR), plays an important role in the country's food security as the primary producer of highland vegetables, including cabbage, carrots, and potatoes (PSA 2024). Benguet is the backbone of the region's vegetable production, supplying nearly half of the country's highland vegetables. However, there are challenges in the vegetable value chain from production to consumption, threatening the stability of the other three food security dimensions: availability, accessibility, and utilization.

Transportation issues in the vegetable supply chain affect not only local farmers, especially those in upland regions, but also consumers who rely heavily on their produce. Problems such as postharvest losses, highly fluctuating prices, and limited market access affect both local farmers and consumers, especially in the faraway demand centers. These issues, compounded by the geographical location of Benguet and the area's

inadequate infrastructures, make it more difficult to transport fresh produce to other markets, aggravating postharvest losses, reducing farmers' income, and making the product expensive for the consumer. Ironically, farmers continue to receive low prices for their vegetables while more and more consumers can hardly afford them.

Recognizing the role of Benguet as a major producer of vegetables in the country, this paper draws attention to the necessity of understanding the value chain of vegetables produced in the area to address these issues. More specifically, it examined the role of Benguet in the vegetable value chain as gleaned from the lens of the household consumers. The paper determined the product and geographic flows within the vegetable value chain of Benguet-sourced vegetables, particularly those produced in Barangay Topdac, Atok. Additionally, for better understanding, this study provided maps of vegetable production sites in the barangay, along with road networks and possible markets.

REVIEW OF RELATED LITERATURE

The Value Chain Framework of the Food and Agriculture Organization (FAO) aims to optimize the entire food production, processing, and distribution process to enhance food security, promote sustainable agricultural practices, and improve the well-being of communities. FAO (2020) acknowledges that food systems are intricate and involve various stakeholders, including farmers, processors, retailers, and consumers. The framework focuses on adding value at every stage of the chain, from inputs like seeds, fertilizers, and equipment to final products that reach consumers.

FAO's value chain approach highlights the need to build resilient and sustainable food systems that prioritize not only economic profitability but also environmental sustainability and social inclusion. This is especially crucial given global challenges like climate change, population growth, and the increasing demand for nutrition and food security. By strengthening different nodes of the agricultural value chain—from enhancing farming practices and food processing technologies to improving market access and lowering trade barriers—FAO seeks to increase the efficiency, inclusivity, and sustainability of the global food system. For instance, through its value chain initiatives, FAO

helps farmers access market information, advanced production technologies, and financial support, thereby improving their productivity and income (FAO 2020).

Agricultural Value Chains in the Philippines and Their Challenges

The agricultural sector remains critical to the Philippines' food security, rural development, and poverty alleviation. Yet, inefficiencies in food value chains, particularly in vegetable production, continue to hinder productivity and profitability. Key constraints include inadequate farm-to-market infrastructure, high input costs, limited market access, and low adoption of productivity-enhancing technologies. For highland farmers, especially in Benguet and the Cordillera region, these challenges are exacerbated by restricted access to trading centers, reliance on intermediaries, and the absence of stable market connections (JICA and PwC Philippines 2019).

Similarly, the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA 2022) stated that the Philippines urgently requires efficient agricultural value chains to enhance food and nutrition security. These value chains encompass the journey of agricultural products from inputs to production, post-harvest processing, and distribution, creating economic opportunities for farmers and other stakeholders. However, smallholder farmers face persistent challenges such as poor infrastructure, limited market access, and significant postharvest losses, which undermine their profitability and restrict participation in high-value chains.

Perishability and postharvest infrastructure constraints impact fruit and vegetable value chains. Mango, onion, and tomato postharvest losses are substantial due to poor cold storage, packaging, and transportation. In some production routes, onion postharvest losses can reach 63.9 percent, costing farmers and stakeholders a lot of money (SEARCA, 2022). Limited access to technologies and quality inputs exacerbates productivity losses. In the study by Japan International Cooperation Agency (JICA) and PwC Philippines (2019), farmers in the highlands face challenges due to intermediaries and limited access to market information, resulting in their being price-takers. This situation benefits merchants and wholesalers, who gain the largest profit shares as high as 30.6 percent to 34.4 percent for carrots and 21.1 percent

to 25.5 percent for potatoes. In contrast, lowland vegetable value chain growers enjoy the highest profit margins reaching 33.1 percent for eggplant, 35.9 percent for tomato, and 50 percent for red onion. This is so because they benefit from access to multiple marketplaces, which provide them with greater price-setting power due to reduced reliance on intermediaries.

Additionally, breakeven price and volume analyses show that farmers, whether in highland or lowland areas, have the potential to earn income given their average production costs and volumes. Sensitivity analysis indicates that farmers' gross income remains positive even across varying price scenarios. However, vegetable pricing is subject to market supply and demand fluctuations, as well as seasonality, causing instability in production and prices. Addressing these issues requires interventions such as improving the quality and quantity of harvests and establishing direct market connections to stabilize pricing and supply (JICA and PwC Philippines 2019).

Value chain disruptions in Benguet's vegetable industry are also significantly influenced by climate variability and extreme weather conditions, particularly in highland farming areas like La Trinidad and Atok. The study by Reyes et al. (2017) highlights that the province's mountainous terrain and dependence on seasonal rainfall make it highly susceptible to hydrometeorological hazards such as excessive rainfall, landslides, and frost, which directly impact agricultural production and market access. During typhoons, traders and truckers delay deliveries, causing disruptions in the vegetable supply chain and limiting market availability, which in turn affects both producers and consumers. The reliance on indigenous knowledge for frost forecasting and the demand for localized weather forecasts from the Philippine Atmospheric, Geophysical, and Astronomical Services Association (PAGASA) underscore the necessity of accurate and timely climate information to mitigate risks and optimize production cycles.

The value chain of Benguet is disrupted further by limited access to post-harvest handling, transportation bottlenecks, and farmers' dependency on intermediaries, among others, leading to poor farmer's profit and loss in inefficiency in the market. Seasonal climatic shocks, especially El Niño and La Niña events, force farmers to reschedule farming, diversify food, and, in some cases, move cultivation plots to minimize damage. Yet these adaptive technologies are usually insufficient because of restricted access to climate-

resilient technologies, lack of infrastructure, and financial constraints (Reyes et al. 2017). Farmers struggle in storing and transporting perishable goods, which leads to the decay and added marketing cost. The involvement of intermediaries in the value chain further reduces the farmers' ability to negotiate on price thus, farmers become price takers whereas they need to become price setters.

The Role of Market Intermediaries in the Supply Chain

Middlemen in the Philippines establish market connections between farmers and markets by managing transportation and warehousing and distributing agricultural products. Their existence has caused economic discussions about their influence on both farming communities and household stability. Several farmers argue that middlemen enable small-scale agricultural producers to access markets, yet such intermediaries face criticism due to their seemingly unfair prices, their unclear operations, and the power imbalance that exists between farmers and traders. Hayami, Kikuchi, and Marciano (1999) demonstrate that Philippine paddy traders and rice millers achieve substantial profits by holding big volumes of paddy rice yet charge small unit prices to customers which demonstrates how large-scale operations benefit traditional market middlemen but hurt smallholder farmers. Traditional middlemen create problems because they make supply chain profits unevenly distributed. The middlemen system causes farmers to suffer by buying produce at rock-bottom prices and then reselling it for much more to customers.

However, recent developments in the Philippine agribusiness sector show the emergence of social enterprise middlemen, trying to create fair treatment for farmers through transparent processes. When middlemen take a social direction, they focus on buying fairly-produced goods from farmers while providing them with equal outlet opportunities. The new middlemen provide farmers with education, infrastructure development, and straight connections to markets allowing them to make better deals and earn higher profits (Dewinta 2024). Agribusiness supply chains are evolving to put sustainability and fair farming systems ahead of traditional ways of doing business in agriculture.

Despite these promising changes, the transition away from traditional intermediaries remains challenging. Smallholder farmers depend on

current supply chains because they need market access alongside funds and market knowledge to seek other sales options. Distributors keep control of agriculture because farmers face supply chain problems such as poor storage units and expensive transportation services. Solving this problem needs both government policies helping farmers plus money spent on countryside transportation and programs to shield cooperatives so farmers can trade fairly (Hayami et al. 2024).

Urban and Rural Differences in Food Security

The geographic environment plays a crucial role in influencing food and nutrition security, impacting the availability, accessibility, and sustainability of food systems. Environmental elements such as climate, soil conditions, and water availability are key factors that determine agricultural productivity. For example, areas with dry climates or recurring droughts often face challenges in producing sufficient crops, which can lead to food shortages and limited access to nutritious food. Research indicates that climate change, particularly in regions prone to extreme weather events like droughts, floods, and heatwaves, worsens food insecurity by disrupting agricultural production cycles (FAO 2018). Additionally, factors like soil quality and water resources are essential in determining the types of crops that can be grown, thereby influencing the quantity and diversity of food. In areas with poor soil or scarce water, food production is often severely constrained, threatening food security.

Moreover, the geographic location of communities has a significant impact on food distribution. Isolated or remote areas often experience higher transportation costs and logistical challenges in accessing food markets, which can increase food prices and reduce availability. For instance, communities in mountainous or island regions may find it difficult to access a variety of food sources, exacerbating malnutrition and food insecurity (Pollard et al., in press). In coastal areas, marine resources are vital for nutrition, but overfishing and environmental degradation pose significant risks to the sustainability of these resources. Therefore, the geographic environment plays a key role in shaping both food production and distribution, making it a critical factor in determining food and nutrition security in different regions.

In addition, rural households in Occidental Mindoro have been shown to have greater levels of food insecurity and a lack of nutritional diversification compared to their urban counterparts, according to a study conducted in the province. Dela Luna and Bullecer (2020) ascribe this gap to agroecological constraints, which include restricted infrastructure and access to markets. These constraints have an impact on the availability, accessibility, and consumption of food.

A key factor influencing food security is a community's position along the rural–urban continuum, as there are significant socioeconomic and environmental differences between urban and rural areas that affect food access. The COVID-19 pandemic triggered social and economic shocks that impacted financial and food security, with varying effects depending on whether a community was rural or urban. The prevalence of food-secure households varied between large rural towns, cities, small rural towns, and isolated rural areas, highlighting differences in food access in nonmetropolitan regions. Specifically, small rural towns before the pandemic appeared to be areas of concentrated socioeconomic deprivation, as they had a lower pre-pandemic food security rate compared to other rural classifications in unadjusted estimates for all households. These findings also suggest that households in small rural towns may have benefited more from pandemic-related support compared to those in other areas (Brady et al. 2025).

Rural areas, especially in developing countries, depend heavily on agriculture for their livelihoods. Climate change, land degradation, and limited access to modern farming practices can exacerbate food insecurity in these regions. In addition, the lower population density and underdeveloped infrastructure in rural areas result in fewer grocery stores and markets, making it harder for people in remote areas to access a wide variety of fresh food. Indigenous communities are particularly affected, as they face disproportionately high levels of food insecurity due to historical injustices, scarce resources, and isolation. Cities have their own unique challenges in ensuring access to enough nutritious food. However, urban farming can help improve food affordability by cutting down on transportation costs and shortening the supply chain. When communities grow their own food or support local urban farms, they can obtain fresh produce at lower prices, making it more accessible for individuals and families with limited financial means. Urban farms can take many forms, including community gardens, rooftop farms, as

well as hydroponic, aeroponic, and aquaponic systems, whether intended for personal consumption, commercial sale, education, or therapy (zipgrow n.d.).

Reyes and Delos Reyes (2024) examined the food and nutrition security of selected urban and rural households in Pili, Camarines Sur, Philippines during the COVID-19 pandemic. Their study assessed the prevalence of food insecurity, identified the determinants of food insecurity, determined the prevalence of malnutrition, and explored the relationship between food security and nutrition security in these households. The study utilized primary data from a survey of 185 households and secondary data from the Electronic Operation Timbang Plus (e-OPT) Tool to measure food insecurity using the Food Insecurity Experience Scale (FIES) by the Food and Agriculture Organization (FAO) and assess nutrition insecurity in both urban and rural households. Findings revealed that during the pandemic, 89.1 percent of households were food-insecure, with the majority being from urban areas (88.3 percent). The ordered logistic regression analysis showed that factors contributing to food insecurity in urban households included the age of the household head, monthly income, household size, and access to credit. In rural households, food insecurity was influenced by education, monthly income, daily food expenditure, and land ownership. Stunting and wasting were more prevalent in urban households among children under five, while rural households had higher rates of stunting and wasting in children aged 6 to 12. The Fisher's Exact Test indicated that there was no significant relationship between the food security status and nutrition security of children aged 0 to 5 and school-age children. Based on the results, targeted actions are recommended to address nutrition issues specific to each area.

Agricultural Supply Chains and its Impact to Food Security in the Philippines

According to Galang (2022) in his discussion paper, supply chain problems along with poor infrastructure and market problems make food harder to get to and buy affordably. These operational problems in supply chains produce supply blockages that result in higher prices for food products and greater waste during handling. It also affects the functioning of food delivery systems and directly harms how households maintain their food supply. The country generates large agricultural outputs, but it struggles to transfer this food supply to rural customers through weak logistics systems

and inadequate farm market connections. Price fluctuations during seasonal shortages heavily burden income-weaker households who spend most of their money on buying food (Galang 2022). High transportation costs together with market fragmentation and marketplace participation lead to expensive food prices and small farmers receive lesser earnings compared to actual harvest value. The research shows that problems within agricultural supply networks increase food waste from fresh produce items, especially vegetables and fruits. The lack of cold storage facilities, modern processing techniques, and efficient distribution systems means that a significant portion of the country's food supply is lost before reaching consumers. Vulnerable families find obtaining safe nutrition harder because there is less food at lower prices throughout the system (Galang 2022).

The paper also details how government actions can enhance agricultural supply chains. It was also found out that despite the efforts of the Agriculture and Fisheries Modernization Act (AFMA, RA No. 8435) to enhance farm yields since 1997, its success was hindered due to poor execution, insufficient rural infrastructure, and absent supply chain cooperation. To make food more secure at the household level, enhancing farm-to-market infrastructure, promoting direct market access for farmers, and strengthening storage and processing capacities are essential steps (Galang 2022).

Governance and Institutional Support

In food value chains, governance encompasses not only production and distribution but include policies and institutional support as well. The implementation of efficient governance structures is necessary in order to solve systemic problems such as the fragmentation of policies and the lack of suitable financial assistance for smallholders. It is possible to improve food security by strengthening institutional frameworks to prioritize the development of infrastructure, market access, and financial inclusion (JICA and PwC Philippines 2019). This is especially true in rural and semi-urban areas.

Government initiatives, such as the Department of Agriculture's High Value Crops Development Program (HVCDP), play a crucial role in promoting vegetable production and export. By addressing limitations and improving value chain efficiency, HVCDP, alongside the Philippine Rural Development

Project (PRDP), tackles governance challenges within agricultural value chains. These programs prioritize essential components such as agriculture infrastructure, capacity-building, and value addition. Furthermore, public-private partnerships (PPPs) and institutional cooperation are emphasized as vital to strengthening value chains and ensuring smallholder farmer inclusion (SEARCA 2022). Programs like the Barangay Integrated Development Approach for Nutrition Improvement (BIDANI) show the need for multi-stakeholder engagement in community food and nutrition security (Balatibat 2004).

Despite these efforts, fragmented policies and inadequate financial support often constrain the impact of many programs. To address these challenges, experts recommend that policy frameworks focus on improving infrastructure, market access, and financial inclusion for smallholder farmers (JICA and PwC Philippines 2019). Effective governance mechanisms are equally important in enhancing food value chains, as they depend on strong relationships among key actors, farmers, processors, and distributors. Public–private partnerships, such as contract farming arrangements, exemplify the potential of collaborative governance. These arrangements provide farmers with stable markets while ensuring that buyers meet quality standards, fostering a more integrated and sustainable value chain.

The literature emphasizes the importance of governance and institutional support in addressing agricultural value chain challenges. The HVCDP and PRDP boost agricultural infrastructure, capacity, and value. These efforts are vital since smallholder farmers in upland regions like Benguet and the Cordillera face disproportionate challenges like market access, infrastructure, and postharvest losses.

Fragmented policies and low financial inclusion hinder these efforts, underlining the need for better governance and public-private relations. Agroecological factors affect food and nutrition security and rural-urban inequality, the review notes. Governance and value chain dynamics are often explored, but governance's nutrition security influence is not. Nutrition-sensitive governance strategies would improve value chains and provide equitable and sustainable food and nutrition security in northern provinces. This coordinated approach is needed to solve the region's problems and achieve long-term growth.

METHODOLOGY

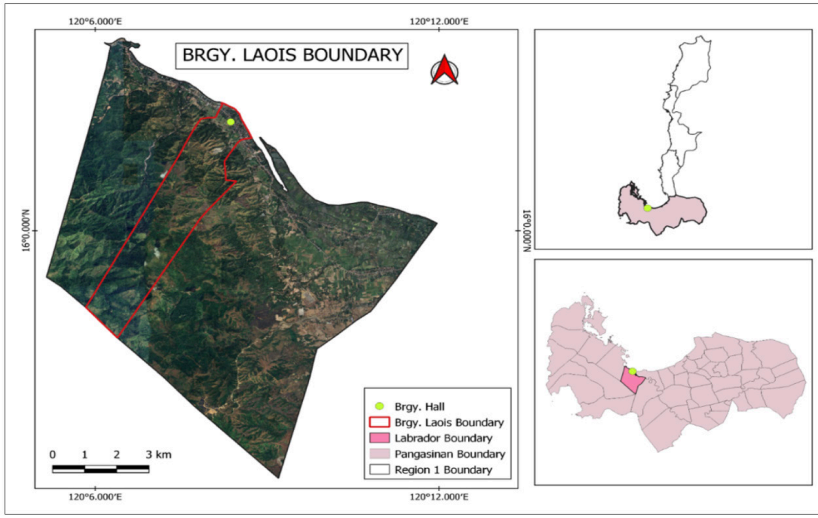
Addressing the above-mentioned problems and inefficiencies requires mapping the entire food value chain to identify critical points for intervention. To capture the diversity of food systems, this paper covered three distinct ecological settings in Northern Luzon: Barangay Laois, Labrador in Pangasinan; Barangay Balsigan, Baguio City; and Barangay Topdac, Atok in Benguet. Each area represents unique challenges and opportunities in securing food.

Laois is a coastal community in Labrador, Pangasinan with reported population of 2,832 which accounts for 10.56 percent of the total population of Labrador in 2020. Laois's population grew by 2.66 percent from only 2,500 in 2015 (PhilAtlas, n.d.). Many production sites located near residential areas and close to Lingayen Gulf benefit from access to agricultural and aquaculture products. Specifically, the natural advantages of Lingayen Gulf contribute to the availability of fresh seafood in Laois.

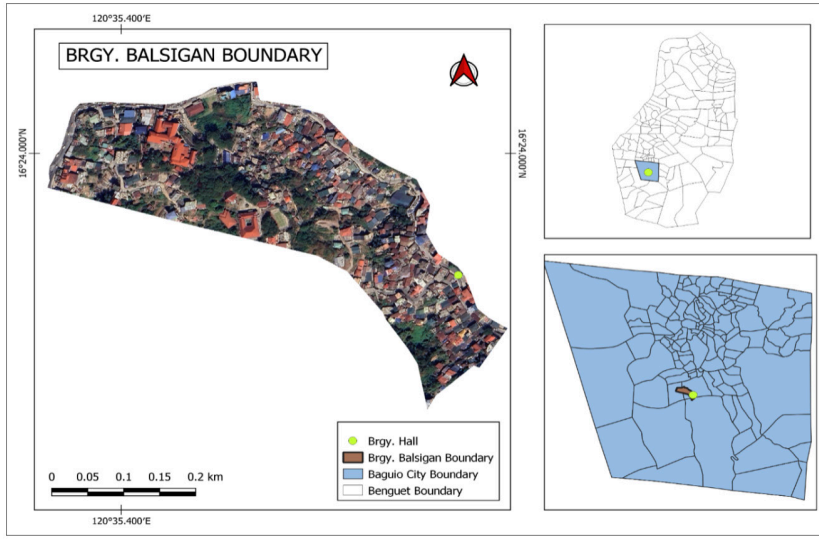
Meanwhile, Barangay Balsigan is an urban community in Baguio City. It is a cluster of residences, road networks, and a variety of food outlets and services, including sari-sari stores, meat shops, food establishments, water refilling stations, and public markets. The area is equipped with a well-established road network that facilitates access to external markets and services like Foodpanda and GrabFood.

In contrast, many households in Barangay Topdac, Atok, an upland community, tend to cluster near food production sites primarily due to logistical difficulties, especially concerning transportation and the transfer of food from production areas to consumption points. As a result, they often establish production sites close to their homes. Topdac is home to Indigenous Peoples, whose land ownership is communal, making it easier for them to set up production sites near their residences.

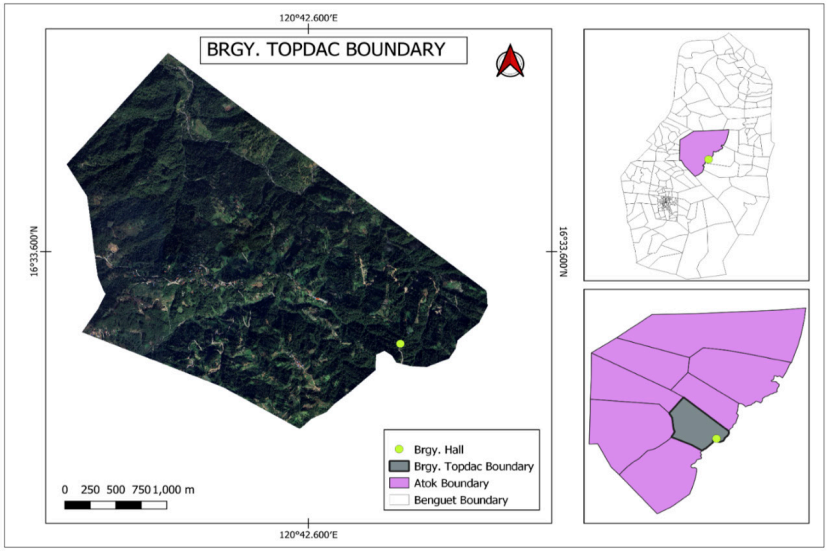
The diversity of these ecological settings offers a comprehensive perspective on the interplay between production, distribution, and consumption in the Benguet vegetable chain. Figures 1 to 3 show the location of the study sites.



■ **Figure 1.** Location map of Brgy. Laois, Labrador, Pangasinan.
Source: project-generated map using GIS



■ **Figure 2.** Location map of Brgy. Balsigan, Baguio City, Benguet.
Source: project-generated map using GIS



■ **Figure 3.** Location map of Brgy. Topdac, Atok, Benguet
Source: project-generated map using GIS

Secondary data covering the period 2010–23 were collected from the Philippine Statistics Authority (PSA) to present an overview of how important Benguet is in terms of supplying highland vegetables to the country. The following vegetables were considered: cabbage, carrots, chayote fruit, *pechay*, and potato were considered for this analysis as they were the ones highly demanded among highland vegetables and are abundantly produced in the area. For visual clarity, graphical presentations were done.

Interviews of 180 households were conducted (60 respondents/area) to trace their sources of vegetables. Households were selected from a list obtained from the barangays within the study areas. Information about their demographics and opinions on vegetable availability and prices were likewise gathered. Spatial data for GIS analysis were also collected through stakeholder interviews to ensure an accurate representation of transportation and distribution dynamics. Armed with these data, GIS mapping was employed.

In addition, the study used the value chain framework as the backbone of analysis as this enables the pinpointing of the root causes of the existing problems and challenges to determine what will be the strategic actions for improvement. According to Kaplinsky and Morris (2001), value chain analysis

addresses several key limitations of traditional sectoral analysis, which is often static and constrained by its own defined parameters. Traditional sectoral analysis struggles to capture the dynamic connections between productive activities that extend beyond a specific sector, including inter-sectoral linkages or interactions between formal and informal sector activities. In contrast, value chain analysis moves beyond the firm-specific focus found in much of the innovation literature. By emphasizing interconnections, value chain analysis facilitates the identification of the dynamic flow of economic, organizational, and coercive activities among producers across different sectors, even on a global scale.

The combined product and geographic flows were also presented for better visualization of the route of vegetables that originate from Benguet including volume traded/handled. Product and geographic flows analysis not only shows the market channel participants and the location where the vegetables passed through but also depicts the relative shares of each participant. It should be noted, however, that the tracing conducted was from the view of the households and not of the farmers.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Respondents

The survey has a higher participation from female respondents (74 percent) since they are the ones more frequently in charge of buying and cooking food for the household. On average, they are 49 years old and when it comes to educational attainment, the urban community stands out with the highest proportion of those with college-level education (32 percent) and graduates (17 percent), which may be due to better access to educational facilities and opportunities. In terms of household size, the average is 5. However, across all communities, most households (55 percent) have 4 to 6 members with the upland area having the highest proportion (5 percent) of households with more than 9 members. On the other hand, income sources are diverse, with urban areas favoring business-related activities (28 percent), upland areas focused on agriculture (47 percent), and coastal areas on fishing (15 percent) and business (30 percent). The respondents' average monthly household income was ₱13,948, with urban households reporting the highest average (₱16,478) followed by upland (₱13,725) and coastal households (₱11,516). The

upland community was only a little above the poverty threshold in Benguet (₱13,002/month) while the coastal area was way below Pangasinan's poverty threshold of ₱16,870 per month (PSA 2024).

TABLE 1. SOCIOECONOMIC CHARACTERISTICS OF 180 HOUSEHOLD-RESPONDENTS, BY TYPES OF ENVIRONMENT, SELECTED NORTHERN PROVINCES, PHILIPPINES, 2024

SOCIOECONOMIC CHARACTERISTICS	TYPE OF ENVIRONMENT			
	COASTAL N = 60	UPLAND N = 60	URBAN N = 60	TOTAL (N = 180)
	PERCENTAGE			
Sex				
Male	18	28	32	26
Female	82	72	68	74
Age (years)				
≤ 30	10	30	18	19
31–40	25	17	15	18
41–50	22	32	28	27
51–60	28	15	18	21
61–70	13	7	15	12
≥ 71	2	0	5	2
Average	**59**	**41**	**47**	**100**
Educational Attainment				
Elementary Level	7	0	2	3
Elementary Graduate	15	17	5	12
Junior HS Level	12	3	8	8
Junior HS Graduate	10	8	23	14
Senior HS Level	10	3	0	4
Senior HS Graduate	27	20	10	19
College Level	7	18	32	19
College Graduate	7	18	17	14
Vocational	7	12	3	7

SOCIOECONOMIC CHARACTERISTICS	TYPE OF ENVIRONMENT			
	COASTAL N = 60	UPLAND N = 60	URBAN N = 60	TOTAL (N = 180)
	PERCENTAGE			
Household Size				
1–3	27	30	23	27
4–6	57	45	63	55
7–9	15	20	10	15
≥9	2	5	2	3
Average	**5**	**5**	**5**	**5**
Primary Sources of Income				
Business	30	20	28	26
Farming	6	47	0	18
Fishing	15	0	0	5
Wages/Salaries (Private)	17	25	30	24
Wages/Salaries (Public)	3	7	22	11
Pension	7	1	7	5
Government Allowances/Benefits	18	0	7	8
Family Support	3	0	7	3
Household Income (₱)				
<10,000	50	48	33	44
10,001–20,000	40	38	40	39
20,001–30,000	8	7	17	11
31,001–40,000	0	7	7	4
41,001–50,000	2	0	3	2
Average	**11,516**	**13,725**	**16,478**	**13,948**

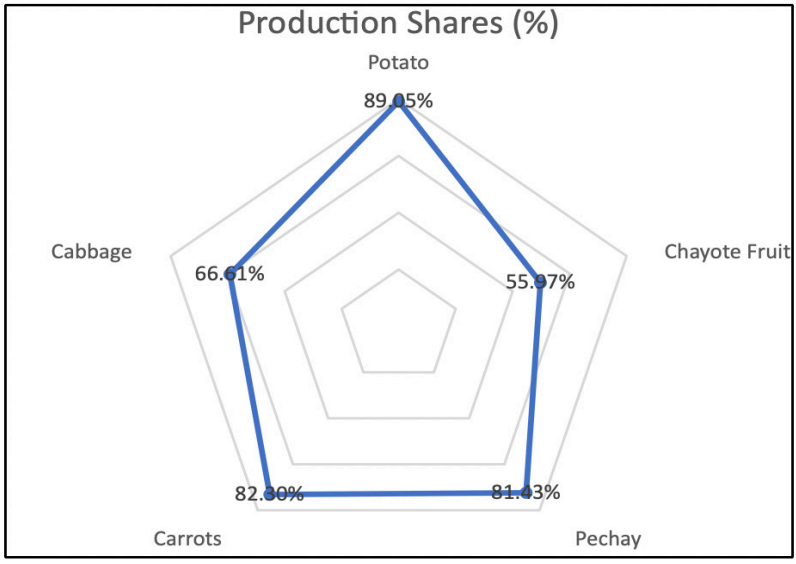
■ Source: Authors' survey

Benguet as the "Salad Bowl of the Philippines"

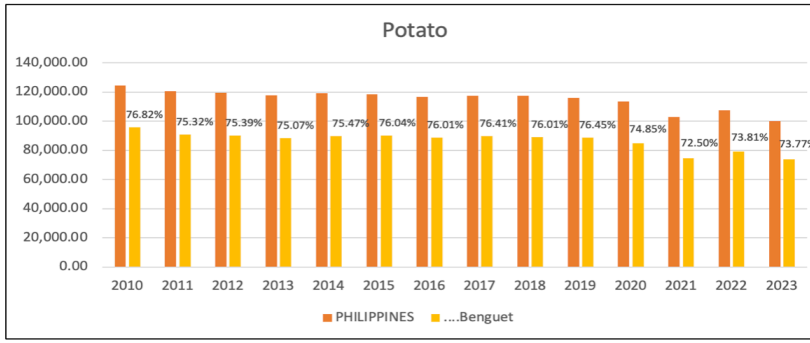
For this study, cabbage, carrots, *pechay*, chayote fruit, and potato were considered in the analysis as they are the top vegetable produce of Benguet. Figure 4 shows that depending on the type, on average, Benguet has been contributing about 55.97 (chayote fruit) to 89.05 percent (potato) to the

country's production of these vegetables for the last 10 years. For potato, peak production share was recorded in 2010 at 76.82 percent while the lowest was in 2021 at 72.50 percent (see figure 5). Looking at chayote, the lowest contribution by Benguet was in 2017 at 51.02 percent and the highest was in 2022 at 66.13 percent (see figure 6).

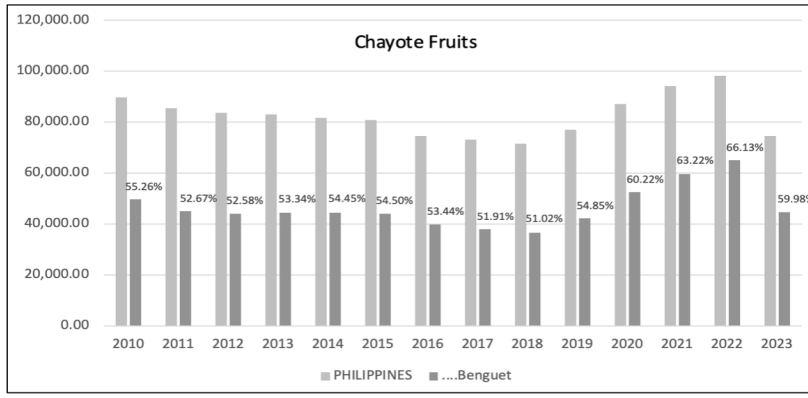
The second highest share of Benguet was in the production of carrots averaging 82.30 percent (see figure 4), the greatest of which was 84.19 percent in 2020 and the least was 80.03 percent in 2010. An overall decreasing trend was however noted for carrots (see figure 7). In contrast, on average, *pechay* production share of Benguet was 81.43 percent (see figure 4) and its trend has been increasing although the highest share of the province was recorded way back in 2010 at 82.79 percent. The lowest production was noted in 2018 at only 80.07 percent (see figure 8). Meanwhile, cabbages had an average share of 66.61 percent for the period 2010–2023, the lowest of which was in 2022 at 64.26 percent while the highest was again in 2010 at 68.85 percent (see figure 9).



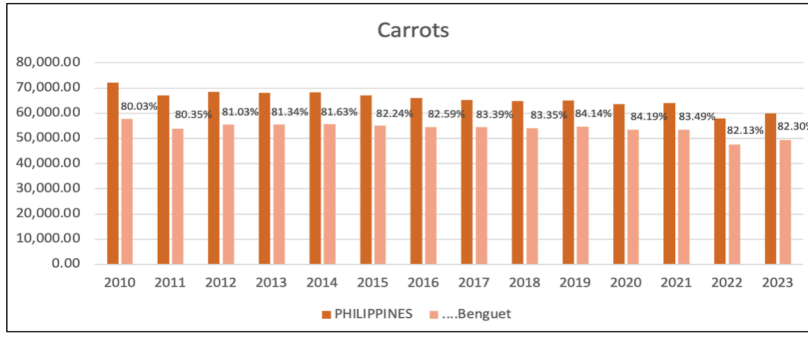
■ **Figure 4.** Share in production by vegetable type, Benguet, Philippines, 2010–23
Source of basic data: PSA



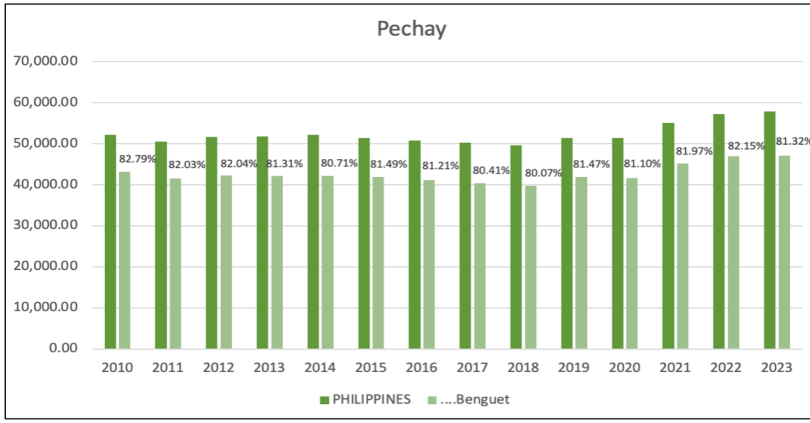
■ **Figure 5.** Trend in production and share in potato production, Philippines and Benguet, 2010–23
Source of basic data: PSA



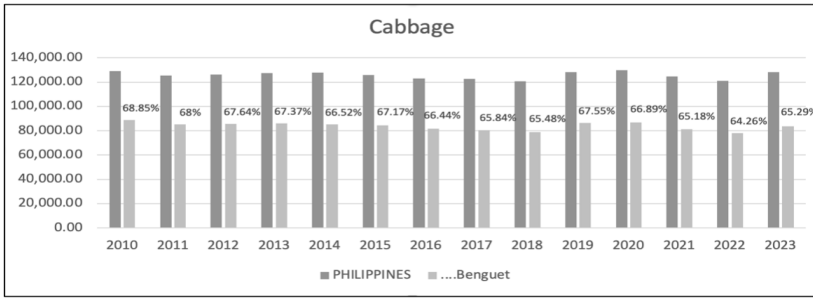
■ **Figure 6.** Trend in production and share in chayote production, Philippines and Benguet, 2010–23
Source of basic data: PSA



■ **Figure 7.** Trend in production and share in carrot production, Philippines and Benguet, 2010–23
Source of basic data: PSA



■ **Figure 8.** Trend in production and share in *pechay* production, Philippines and Benguet, 2010–23
Source of basic data: PSA



■ **Figure 9.** Trend in production and share in cabbage production, Philippines and Benguet, 2010–23
Source of basic data: PSA

The Value Chain of Benguet Vegetables

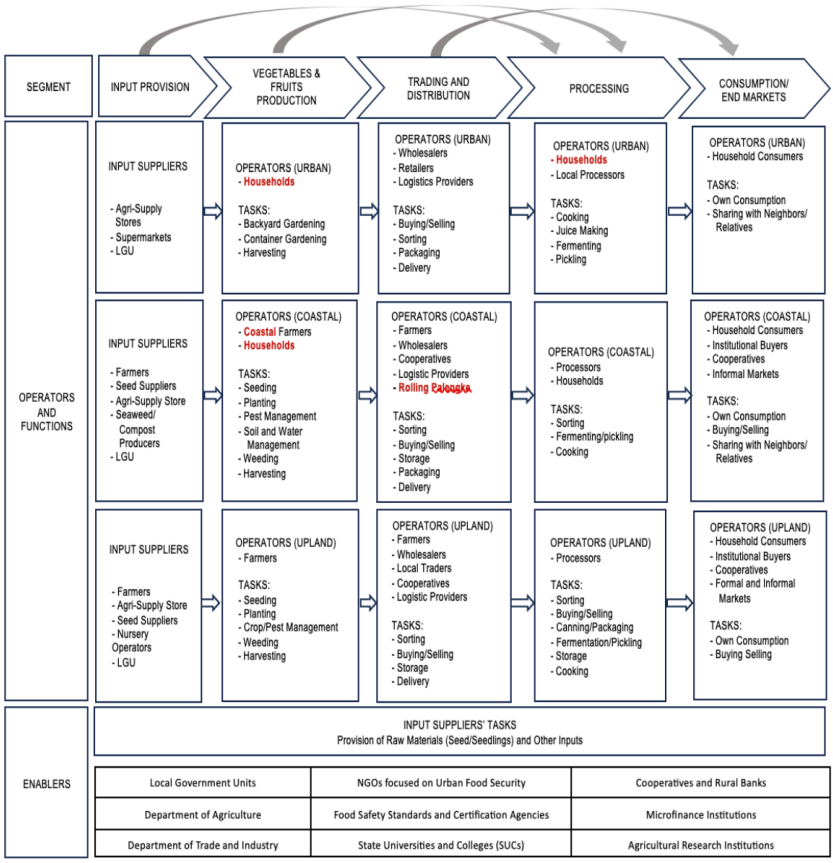
The findings of the study emphasized the interconnected network of activities, actors, and processes that contribute to the production, distribution, and consumption of vegetables (see figure 10). The key actors identified within the chain are the farmers, traders, wholesalers, retailers, and consumers. Laois, a coastal barangay in Labrador, Pangasinan, mainly depends on fish and other seafood sources from Lingayen Gulf. The vegetable value chain system in this area begins with the input provision where farmers, households, seed suppliers, and local government units supply the raw materials like

seeds, fertilizers, and other agricultural inputs necessary for farming. This is supported by enablers such as local government units (LGUs) and the Department of Agriculture (DA), which ensure access to raw materials and other inputs. While farmers are vegetable growers and serve as primary producers, households also engage in vegetable farming activities. In trading and distribution, the traders act as intermediaries, facilitating the distribution of the produced vegetables to wholesalers and retailers. These wholesalers and retailers then supply these vegetables to various end-users or consumers such as households and institutional buyers. In Laois, vegetable availability is not only from the local markets but also from mobile vendors (rolling *palengke*), improving vegetable accessibility. However logistical challenges often restrict timely distribution. Nevertheless, these mobile markets provide residents with additional options for purchasing vegetables sourced from Benguet, ensuring a more diverse food supply despite the area's reliance on seafood.

The vegetable value chains of Barangay Laois in Labrador and Barangay Balsigan in Baguio City share many of the same key actors, but the difference lies in the absence of farmers and rolling *palengke* in the urban community. In urban areas like Barangay Balsigan, vegetable production is minimal, and the role of farmers is replaced by households engaging in small-scale gardening or sourcing vegetables directly from public markets. The proximity of Brgy. Balsigan, Baguio City to markets ensures consistent vegetable availability. The residents enjoy the advantage and accessibility of food from various outlets such as wet markets, supermarkets, and convenience stores. Food delivery services also improve their accessibility to food, eliminating the need for rolling *palengkes* which are important in the vegetable distribution in Laois, Labrador (Figure 10). While households in the area generally have higher income levels, which increases their purchasing power, they complain that they are still constrained by the high prices of the commodities.

On the other hand, the vegetable value chain system in Barangay Topdac, Atok, an upland area, reveals a strong emphasis on vegetable production which is different from the systems observed in urban and coastal communities (see figure 10). The farmers play a crucial role in agricultural activities such as seeding, pest management, planting, and harvesting of vegetables. The production segment dominates the value chain in upland areas due to the area's suitability for cultivating highland vegetables such as cabbage, carrots, and potatoes. Farming is the primary livelihood for most

households however despite its production dominance, farmers in Topdac struggle with transportation networks causing high postharvest losses and limiting their profitability due to limited access to markets. This information provides critical insights into marketing systems, particularly the limitations of the supply chains in the timely movement of the harvested produce to the demand centers.



■ **Figure 10.** Vegetable value chain by type of community, selected northern provinces, Philippines
Source: Authors' survey

Combined Product and Geographic Flows of Benguet Vegetables

Figure 11 depicts the combined product and geographic flows of vegetables produced in Benguet and traced towards Balsigan, Baguio City; Laois, Labrador, Pangasinan; and within Benguet, particularly in Topdac, Atok. It is to be noted that the quantities and percentages depicted in the chart do not in any way represent the total volume produced and sold in the given market outlets. Those were the only ones that were traced during the one-time survey done by the project team. The broken box and broken arrows imply that some of the vegetables produced by the Topdac farmers were brought/sold in the vegetable trading centers, from which the public markets bought, but due to resource constraints were no longer traced. Also, multiple responses were noted hence corresponding percentages do not add up to 100 percent. Lastly, these values are composites only for the indicated vegetables.

It can be seen in figure 11 that 91.67 percent of the households in Balsigan sourced their vegetables from the public market. This is understandable because the area is only about 4.6 kilometers away from the nearest public market. Additionally, 11.67 percent of the households were found to have bought their vegetables from either grocery stores or supermarkets.

In Laois, 3.33 percent of the household-respondents sourced their vegetables from mobile markets and 98.33 percent of them purchased from the public markets that obtained their vegetables from Benguet farmers. In contrast, 68.33 percent of the households in Topdac, Atok were able to buy directly from the farmers within the municipality and 6.67 percent of them occasionally bought from sari-sari stores. The rest of them claimed to have been planting vegetables for their own consumption (see figure 11).

Overall, it is observed that among the three communities, Topdac, Atok had the highest reported consumption of vegetables (24.4 kg) while Laois, Labrador had the lowest (9.84 kg). It is highly possible that Laois' farther location from Benguet could have been one of the reasons for their low vegetable consumption. Also, aside from the lower quantities of vegetables available, the lack of an effective and efficient transportation network could have increased also the price of these commodities in Laois. This was supported by the complaints of high prices by the respondents.

Figure 12 showcases the location of the municipality of Atok relative to La Trinidad and Baguio City where the vegetable trading centers and wholesale markets can be found. A notable issue here is the fact that a single main road traverses only one side of the municipality, suggesting problems in mobility and therefore issues also in the marketing of the harvested vegetables.

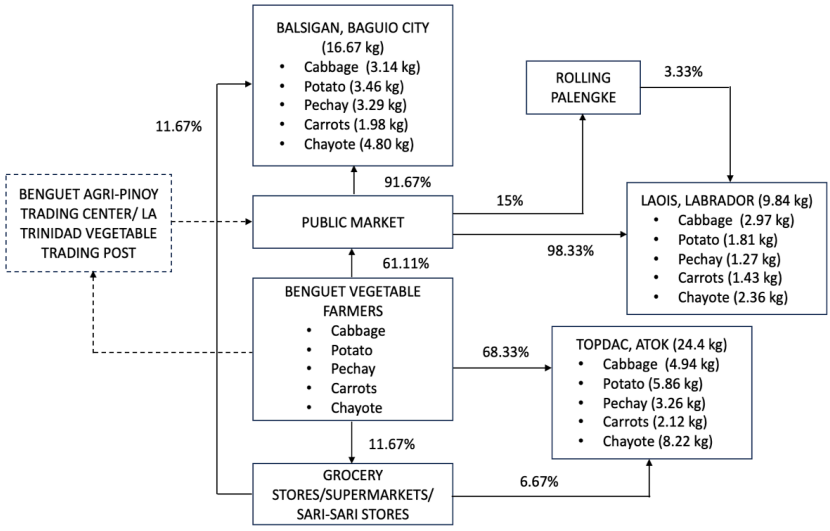
Figure 12 also provides a representation of Benguet, a province in the Cordillera Administrative Region (CAR), Philippines. It shows the municipal boundaries, marking the provincial capital, highly urbanized areas, main roads, and key facilities. The provincial capital of Benguet is La Trinidad, which is highlighted in yellow. Baguio City, on the other hand, is the only highly urbanized city in the province shaded in pink. The road network is depicted with purple lines, indicating the main roads connecting different towns and cities. These road networks ensure accessibility between La Trinidad, Baguio City, and the surrounding municipalities, facilitating trade and transportation.

One of the key facilities and landmarks included in the map are the Multi-Purpose Cooperative Halls, marked with small orange house icons, these cooperative halls serve as community centers. Trading Posts, which are indicated by yellow dots, represent commercial hubs where local goods are traded while Public Markets with a blue basket icon, spread across different towns, supporting economic activity, and lastly, the Benguet Agri-Pinoy Trading Center (BAPTC) Office. This office is responsible for overseeing organic producers, Good Agricultural Practices (GAP)–certified farmers, and conventional farmers' cooperatives in Benguet.

In addition, some organizations manage local trading posts like the Benguet Farmers Multi-Purpose Cooperative of La Trinidad, which helps streamline vegetable distribution. BAPTC, together with BSU and the Department of Agriculture, gives additional support to these groups through the supply of financial resources, technical training services, and construction of supporting infrastructure. However, to enhance their impact, recommendations include expanding cooperative membership, improving logistics and infrastructure, promoting GAP certification, and increasing financial and technological support for farmers. Strengthening these accredited groups will improve farmers' economic conditions and contribute to a more resilient and competitive agricultural sector in the region.

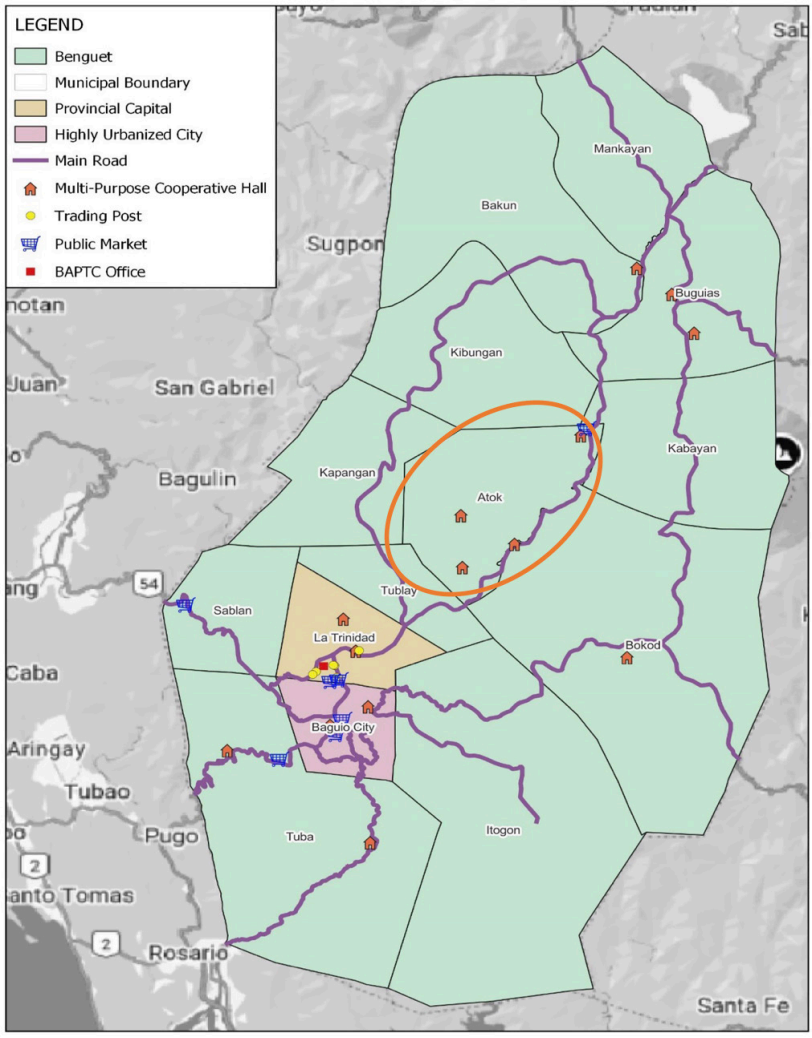
A Bird's Eye View of Vegetable Production Sites in Topdac, Atok, Benguet

Within Atok, vegetable production sites in Topdac are scattered with only a few of them having direct access to a road network, further emphasizing mobility issues within the barangay. The biggest site in the middle seems to be the most accessible as evidenced by the large number of households concentrated along the road. Under this condition, it is but natural that marketing of harvested produce would become problematic. Indeed, JICA and PwC Philippines (2019) reported that among the key constraints faced by vegetable farmers are inadequate farm-to-market infrastructure, high input costs, limited market access, and low adoption of productivity-enhancing technologies. For highland farmers, especially in Benguet and the Cordillera regions, these challenges are exacerbated by restricted access to trading centers, reliance on intermediaries, and the absence of stable market connections. This is verified by the GIS-generated map of Topdac, Atok (Figure 13) where access roads are scant and no nearby markets are present, except for *sari-sari* stores and one multi-purpose cooperative.



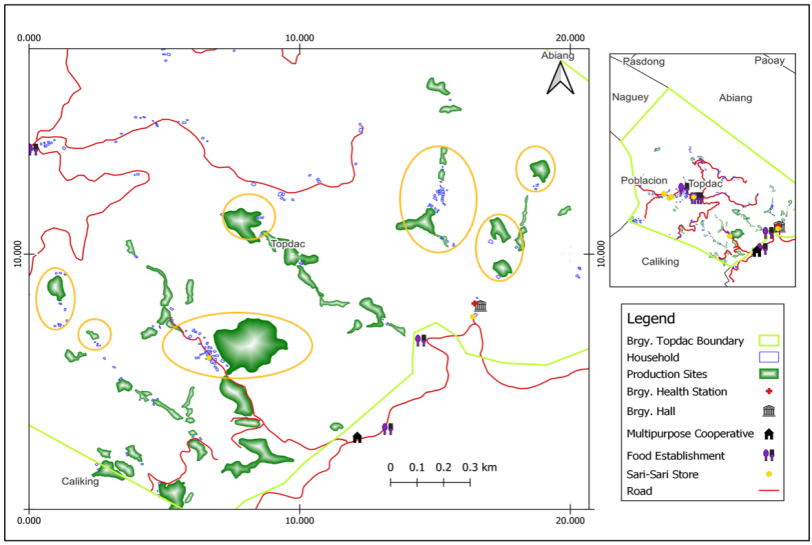
■ **Figure 11.** Combined product and geographic flows of vegetables produced in Benguet as traced from household consumers

Source: authors' survey



■ **Figure 12.** Map of Benguet highlighting Atok as one of the suppliers of vegetables along with the trading posts and public markets

Source: project-generated map using GIS



■ **Figure 13.** Vegetable production sites, Topdac, Atok, Benguet
Source: project-generated map using GIS

CONCLUSIONS

Gleaning from the results of this study, it can be concluded that based on production shares, there is no doubt that Benguet plays a very significant role in supplying the vegetable (upland) requirements of the country. The vegetable value chains depicted in the three types of communities covered by the study are supported by enablers such as LGUs and the DA, which ensure access to raw materials and other inputs. While farmers are vegetable growers and serve as primary suppliers, households also engage in vegetable farming activities. However, logistical challenges in Benguet continue to prevail, particularly due to the inadequacy of road networks that tend to delay the distribution of these highly perishable products and limit the market outlets of the farmers for their harvested produce. In addition, the combined product and geographic flows traced from the households proved the substantial role of Benguet in providing the vegetable needs of the three communities, and being nearer the source guarantees an advantage in terms of volume consumed.

RECOMMENDATIONS

This study recommends the provision of more roads and bridges to connect the vegetable production sites of Benguet to major thoroughfares. Republic Act No. 917 (An Act to Provide for an Effective Highway Administration, Modify Apportionment of Highway Funds and Give Aid to the Provinces, Chartered Cities, and Municipalities in the Construction of Roads and Streets, and for Other Purposes) which was passed way back in 1953 has very relevant provisions on this. It provided that there should be a sum set aside for improvement, reconstruction, paving, and wherever applicable, for the construction of roads, streets, and bridges. It also provided that such appropriation should consider the following (among others):

> Sixty per centum to provinces and chartered cities in proportion to the potential area (uncultivated and undeveloped) available for agricultural and industrial purposes including commercial timber lands as shown by the latest census or data available in the Department of Agriculture and Natural Resources, and populated but isolated areas that are served only by existing trails, bullcart-roads and that are unclassified roads, to be distributed to provinces and cities. (RA No. 917 [1953], sec. 10, ¶1, emphasis added).

Under the above context, the highly recommended approach is to ensure the strict enforcement of road budget allocations, prioritizing substantially productive agricultural areas like Benguet. Furthermore, the opportunity provided by RA No. 7900 (High Value Crops Development Act) through the HVCDP should be immediately grabbed given that the Program was allotted ₱1.80 billion in 2023 to help promote the production, processing, marketing, and distribution of high-value crops. Strategically constructed roads and/or bridges will improve access, fostering economic sustainability in vegetable-growing areas. More access road networks can facilitate efficient movement of the harvested vegetables reducing losses that can translate to more income for the farmers and lower the prices paid by the consumers for the nutrition-dense vegetables.

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