



International Journal of Engineering Researches and Management Studies

SUPPLY CHAIN ANALYSIS OF DRAGON FRUIT IN ILOCOS NORTE, PHILIPPINES

Angelina A. Tagay*

*College of Business, Economics and Accountancy, Mariano Marcos State University, City of Batac, 2906 Ilocos Norte, Philippines

ABSTRACT

The study analyzed the supply chain of dragon fruit in Ilocos Norte, Philippines. Specifically, it aimed to map the dragon fruit production, identify and assess the key players in the supply chain, project the demand requirements of dragon fruit and propose recommendations to improve and sustain the dragon fruit industry.

This is a descriptive study which made use of the interview schedule in gathering data from 73 dragon fruit growers and eight processors in Ilocos Norte. Percentage, mean and trend analysis were used in the data interpretation and analysis.

It was determined that 2,405,104 kg of dragon fruit were harvested in the past five years, with an average yearly increase of about 500,000 kg. A total land area of 70 ha (.02% of the total land area of the province) had been planted with dragon fruit benefitting 1,008 farmers. A modest forecast of 1,414,714 kg of dragon fruit was determined for 2016.

The key players in the supply chain include: input suppliers, dragon fruit growers/ processors; assemblers/transporters (KASA Coop and SAGRAP); wholesalers/ retailers and final consumers. The Kailokuan Saniata (KASA) Cooperative and Saniata Growers Association of the Philippines (SAGRAP) provide them a strong link in the market, community and government.

Directly linked, indirectly linked and fully integrated supply chains were identified. The first is seen in most of the small dragon fruit growers who directly transact with consumers. In the second, fresh dragon fruits pass through marketing intermediaries - KASA Coop, assemblers, wholesalers/retailers before reaching the consumers. These channels assemble, transport distribute and sell the products to their respective markets. The third is a unique case as all key activities related to the supply chain, from production to consumption of fruits to processing, have been integrated. In this chain, a player has control over the production and quality management of dragon fruits while supervising the production processes. This is practiced by growers who have established wide plantations and who process their harvest.

The supply chain is simple (only few players). Full vertical integration is adapted wherein the dragon fruit growers are also the processors. The supply chain starts from the growing of the plant to harvesting of the fruits and ends with the consumption. The stakeholders participate in the plantation establishment, maintenance, fruit harvesting, processing, packaging, transporting, distribution and retailing of fresh and processed products, and consumption. The growers sell most of the dragon fruits as fresh. Value adding or processed products from the dragon fruit stems, flowers and fruits, (food or non-food) are now available.

As the volume of production for fresh and processed products will increase and more players will be involved in the chain, there is a need for more coordinated efforts among the players in the supply chain. The dragon fruit producers should strengthen further their cooperative and association to have a stronger bargaining power in the supply chain.

Government interventions such as more training on product development should be conducted involving young and aspiring entrepreneurs. The formation of associations in the national level is perceived to hasten the development of the industry and its related chains.

Keywords: Supply chain analysis, dragon fruit industry, Farmer Cooperative/Association



International Journal of Engineering Researches and Management Studies

I. INTRODUCTION

Rationale

Dragon fruit is excellently grown in Ilocos Norte, Philippines because of its adaptability to the climatic (Type 1) and soil conditions in the province. It has become one of the identified alternative crops with sustainable farming practices that can cope with the uncertainties of the adverse impacts of climate change (Leonardo Pascual et.al.). Through the “Project SANIATA” or **SA**gut **Ni Imee Agnanayon Talged nga Agdur-as** (Imee’s gift for sustained progress), research, development and extension on dragon fruit proliferated. Its success has brought dragon fruit in the provincial, national and international scene.

It is considered as a super fruit as it is believed to be a powerhouse of nutrients and antioxidants. Due to its health benefits and economic value, the commodity gained immediate popularity in the country and prominence in the world market. A lot of farmers have established and are continually expanding their dragon fruit farms. The fruit as well as the value adding products were additions to the product lines in the market which are now preferred by buyers. Dragon fruit farming is now an emerging champion in the fruit industry by giving a lucrative income to farmers (DA-OPAG, 2014).

It is in this context that there is a need to strengthen and sustain the phenomenal success of the industry. Analysis of the supply chain is important in order to optimize operations so as to maximize both speed and efficiency in delivering the dragon fruit, considering its perishable nature. The purpose of the analysis is to determine which stages of the process can be shortened, refined, made better, to shorten the time it takes to deliver the product to customers without sacrificing the quality of the product or the customer service level of the business. Other benefit that the supply chain analysis provides include having enough supply to meet the demand requirements.

As the Dragon Fruit Industry in Ilocos Norte flourishes, it needs more efforts to fully develop the industry in order to cope up with the increasing demands in the local, national and international markets. To fully harness the increasing demand potentials, establishment of efficient mechanisms throughout the supply chain is necessary. Hence, this study.

II. OBJECTIVES

Generally, the study aims to map, characterize and analyze the supply chain of dragon fruit in Ilocos Norte as basis in proposing strengthening strategies to sustain the emerging dragon fruit industry in the Province.

Specifically, the study sought to:

1. Map the dragon fruit production in terms of:
 - Production volume in the past five years;
 - Geographical location and number of the dragon fruit growers; and
 - Based on the production, project the supply of dragon fruit in the province in the next 3 years;
2. Identify and assess the key players in the dragon fruit supply chain as implied by the practices and problems of the key players:
 - Input suppliers (suppliers of planting materials, technology, fertilizers and pesticides, materials needed);
 - Growers/processors;
 - Marketing intermediaries (cooperative, assembler/transporters, wholesalers, retailers);
3. Project the demand requirements of dragon fruit in the next three years; and
4. Propose recommendations to improve and sustain the dragon fruit industry in Ilocos Norte.



International Journal of Engineering Researches and Management Studies

III. REVIEW OF LITERATURE

The Dragon Fruit Industry in Ilocos Norte.

Dragon fruit (*Hylocereus spp.*), locally known as *Saniata* is considered a super fruit since it is a powerhouse of nutrients and antioxidants known to help in the prevention of diseases like cancer, digestive problems, heart diseases and diabetes, to name a few. It is a large oblong fruit with a red peel and large green scales. Its flesh ranges from white to various hues of red. The fruit can be harvested from 32-35 days after flowering and its eating quality approaches a maximum of 33-37 days after flowering. Dragon fruits are perishable as the peel and flesh easily deteriorate and the taste becomes inferior, thus, they should be transported in the shortest possible time.

The dragon fruit plant (cactus) is a native of Central America and cultivated in Asian countries. It was introduced in the Philippines a decade ago and is gaining its own niche in the Philippines as its economic value and health benefits are being realized. As it commands a very high price in the local market, this fruit is gaining immediate popularity among the interested growers, processors, marketers, governmental units and private entities. Among them are farmers in the Ilocos Region who have established their own dragon fruit farms and later produced value adding dragon fruit products and entrepreneurs who added the fresh dragon fruit and the processed ones in their product lines. As the dragon fruit industry enhances livelihood and ecotourism, the Provincial Governor spearheaded the efforts to develop this industry by designating expansion areas for dragon fruit plantation to make the province the main producer of dragon fruit, thus, making Ilocos Norte as the dragon fruit capital of the North.

Initial efforts to make the industry sustainable have been done like the development of production technologies which successfully increased the production of dragon fruit. The number of dragon fruit farmers tremendously increased as well as the area planted with it.

Little works have been done yet on the processing of dragon fruit (Islam et al. 2012). If quality products from dragon fruit are developed, this will address the low storability in its fresh form. To date, however, some researchers have developed food products such as jam, jelly, juice, puree, ice cream, cupcakes, bread, cookies, sweets, lumpiang shanghai, empanadita, siomai, wine and vinegar. Non-food products are: dragon cactus lightening soap, hand soap and deodorizer. These products were made from the fruit, flower, rind and stem of the dragon fruit. More efforts are to be undertaken in order to assure enough supply with guaranteed quality of fresh dragon fruit and its value adding products.

Supply Chain Management

Supply chain is a system of organizations, people, activities, information, and resources involved in moving a product or service from suppliers to customers. The activities transform natural resources, raw materials, and components into a finished product that is delivered to end customers. The basic idea behind SCM is that companies and corporations involve themselves in a supply chain by exchanging information about market fluctuations and production capabilities. If all relevant information is accessible to any relevant company, every company in the supply chain has the ability to help optimize the entire supply chain. This will lead to better-planned overall production and distribution, which can cut costs and give more attractive final product, leading to better sales and better overall results for the companies.

The primary objective of SCM is to fulfill customer demands through the most efficient use of resources: distribution capacity, inventory and labor. In theory, a supply chain seeks to match demand with supply and do so with the minimal inventory. Various aspects of optimizing the supply chain include liaising with suppliers to eliminate bottlenecks, sourcing strategically to strike a balance between lowest material cost and transportation; implementing just in time techniques to optimize manufacturing flow; maintaining the right mix and location of factories and warehouses to serve customer markets; and using location allocation, vehicle routing analysis, dynamic programming, and traditional logistics optimization to maximize the efficiency of distribution.

There are a variety of supply chain models, which address the upstream and downstream sides. The Supply-Chain-Operations Reference (SCOR) model developed by the management consulting firm PRTM, now part of



International Journal of Engineering Researches and Management Studies

PricewaterhouseCoopers has been endorsed by the Supply Chain Council (SCC) and has become the cross-industry de facto standard diagnostic tool for supply chain management. SCOR measures total supply chain performance. It is a process reference model for supply-chain management, spanning from the supplier's supplier to the customer's customer. It includes delivery and order fulfillment performance, production flexibility, warranty and returns processing costs, inventory and asset turns, and other factors in evaluating the overall effective performance of a supply chain.

The Global Supply Chain Forum has introduced another supply chain model. This framework is built on eight key business processes that are both cross-functional and cross-firm in nature. Each process is managed by a cross-functional team including representatives from logistics, production, purchasing, finance, marketing, and research and development. While each process interfaces with key customers and suppliers, the processes of customer relationship management and supplier management form the critical linkages in the supply chain.

According to the American Productivity and Quality Center (APQC) Process Classification Framework (PCF) SM is a high-level industry-neutral process model that allows organizations to see their business processes from a cross-industry viewpoint. The PCF was developed by APQC and its members as an open standard to facilitate improvement through process management and benchmarking, regardless of industry, size or geography.

SCM is the management of the flow of goods. It includes the movement and storage of raw materials, work-in-process inventory, and finished goods from point of origin to point of consumption. Interconnected or interlinked networks, channels and node businesses are involved in the provision of products and services required by end customers in a supply chain.

Supply Chain Mapping

This identifies members of the supply chain, flow of products, information and payments, activities and services conducted by the members, critical logistics issues, key decision-makers and external influences. It answers six key questions: a) who are the key customers and what are their product requirements; b) how do product, information, and money flow through the supply chain; c) what are the activities and services provided at each step in the supply chain; d) who are the key players and what are their respective roles; e) what are the critical logistics issues; and f) what are the external influences?

Identification of Areas for Improvement

After the supply chain has been validated and the impact of various practices along the chain is established, the next step is to identify areas for improvement. This will be done through a participatory approach involving the supply chain members. Supply chain champions will also be identified among members. These are expected to ensure that the identified improvement will be carried out.

Supply Chain Management in the Agribusiness Sector

In agribusiness, SCM involves managing the relationships between businesses responsible for the efficient production and supply of products from the farm to the consumers. This is to reliably meet consumer's requirements in terms of quantity, quality and price.

Agri-food chains (PCARRD, 2008) entered a new era in which customer orientation and social responsibility are the main driving forces. Consumers are more sensitive to quality, safety, health and nutritional aspects of food products, including means of production. Food traceability has become integral to food safety and food quality. Agribusiness enterprises no longer compete as solely autonomous entities, but rather as supply chains.

In response to these developments, an adoption of a new approach to agribusiness management is inevitable, that is SCM. Its framework and methodology can help improve the production, distribution and marketing processes to meet consumer's requirements in terms of quantity, quality and price of the products. It focuses on four management activities: determining market requirements; establishing and managing supply chain relationships; managing and sharing information; and managing material production and distribution.



International Journal of Engineering Researches and Management Studies

An agrifood chain differs from other supply chains due to: the nature of production, which is partly based on biological processes, thus, increasing variability and risk; the nature of the product, which has specific characteristics like perishability and bulkiness that require a certain type of supply chain; and the societal and consumer attitudes toward issues like food safety, animal welfare, and environmental pressure.

Status of Supply Chains in Philippine Agribusinesses

In developing countries such as the Philippines, (Faylon, 2008) supply chains are typically long and fragmented, involving multiple small-time producers delivering their produce to collectors. These produce then move to several layers of traders, wholesalers and retailers. These chains are characterized by multiple product handling steps, poor information flows and a predominance of spot transactions over longer-term-buyer-seller relationships.

Interest in better management of supply chains has expanded in line with increased consumer demand for quality, convenience, novelty and other non-food attributes in the food products they buy, together with an increased concern over food-production integrity and safety. Satisfying these consumer demands can be achieved only by coordinated management of the supply chain from farm to retail shelf.

IV. METHODOLOGY

Locale of the study

The study was conducted in Ilocos Norte. The province is primarily agricultural with major crops as rice and corn, while onion, garlic, tomato, mungo, beans, root crops and vegetables are the secondary crops. Most rural areas have been experiencing wide climate variability which has adverse effects on the cropping patterns, hence, dragon fruit farming is gaining prominence not only as an alternative crop but also becoming a tourist attraction.

Research Design

It is a descriptive research that employed a combination of survey, interview and observation methods of gathering data. This design is used to map the dragon fruit production, identify and assess the key players in the supply chain, determine the problems encountered by the members of the chain, and present suggestions and recommendations to improve and sustain the dragon fruit industry in Ilocos Norte.

Population and Sampling

The population of the study are the dragon fruit growers in Ilocos Norte who are enlisted by DA-OPAG in 2012 with at least 100 posts of dragon cactus (73 dragon fruit growers and eight of these growers are processors of dragon fruit).

Survey Instrument

The survey instrument used was patterned from PCARRD in the analysis of the supply chain of Banana Production in the country. Part I consisted of questions used in mapping the dragon fruit production. Secondary data were taken from DA-OPAG. Part II assessed the status, practices and problems of the key players of the supply chain while Part 3 delved on the recommendations posted by the stakeholders and members of the supply chain.

V. RESULTS AND DISCUSSION

Mapping the Dragon Fruit Production in Ilocos Norte

Production Volume of Fresh Dragon Fruit

DA-OPAG 2014 Report showed a total harvest of 2,405,104 kg of dragon fruit in the past five years (Figure 1). A significant increase in production volume yearly was noted at an average of 481,021 kg..

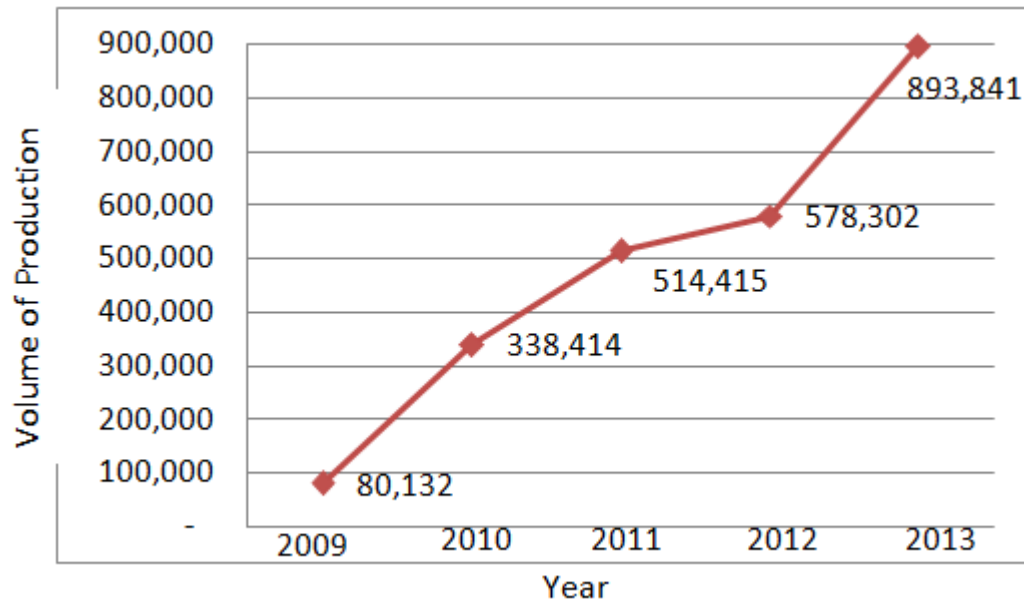


Figure 1. Volume of dragon fruit production in the last five years

Geographical Location and Number of Dragon Fruit Growers

Among the 21 component municipalities and 2 cities in Ilocos Norte, all except Dumalneg, grow dragon fruit. As of 2013, Burgos is the leading producer in terms of production and area planted. Laoag City is second and San Nicolas is third. Adams has the least production while Banna registered the least land area planted with dragon fruit.

In terms of the number of dragon fruit growers, DA-OPAG (2014) reported a total of 1,008 in the whole Province. Laoag City registered the most (210 growers), followed by Pasuquin (156 growers) and Burgos (131 growers). The least are Adams and Banna registering one grower each.



International Journal of Engineering Researches and Management Studies

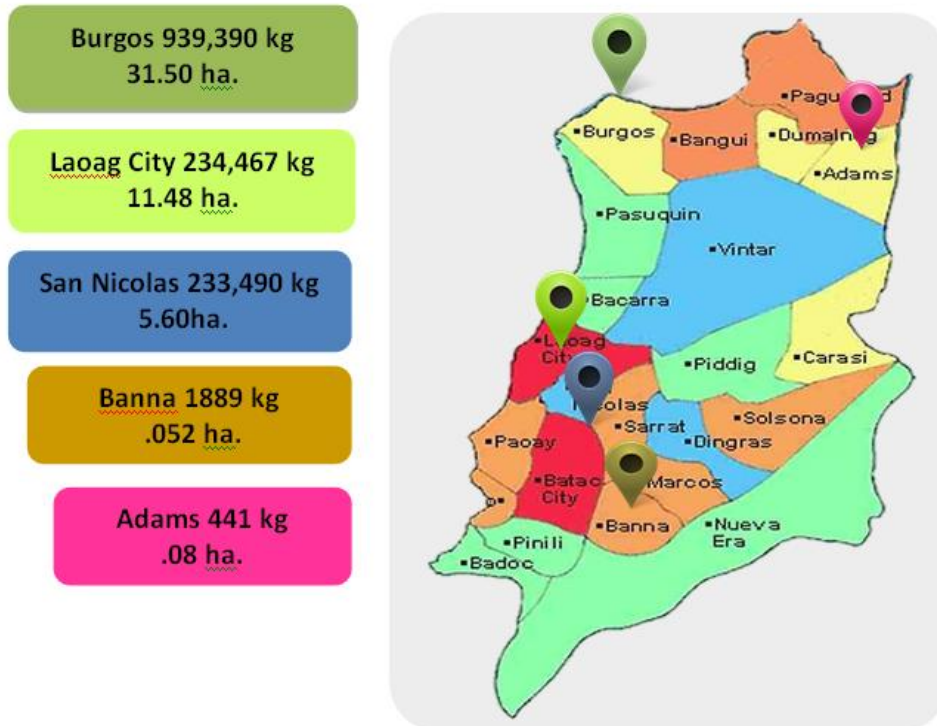


Fig 2. Production Map of Dragon Fruit in Ilocos Norte, Philippines

Projected Supply of Fresh Dragon Fruits in the Next Three Years

The forecasted supply of dragon fruit in the next three years (Fig 2) computed using trend analysis, is based from the dragon fruit production shown in Figure 1.

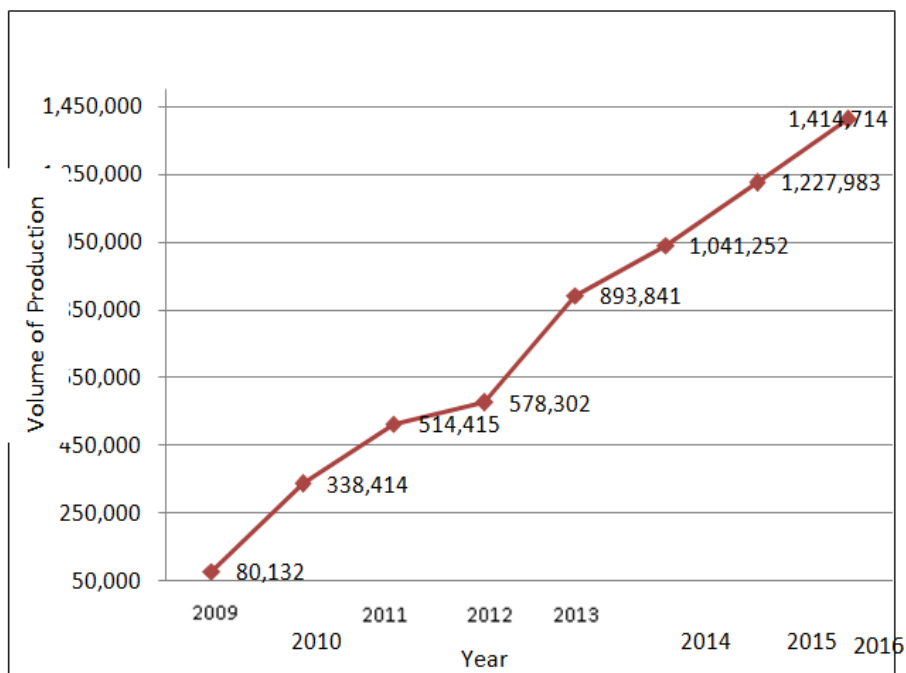


Fig. 3. Projected Supply of Dragon Fruits in the next three years (2014-2016)



International Journal of Engineering Researches and Management Studies

The increase in projected supply requires a corresponding increase in land area to be planted and the number of dragon fruit growers. Based on the average production of 18, 000 kg per hectare in the first three years, the projected production of 1,041,252 kg, 1,227,983 kg and 1,414,714 kg in the next three years, are forecasted to require a total land area of 56 ha., 68 ha. and 79 ha. to be planted, respectively. This is very conservative when compared to the recommendation of Pascua et al. where he estimated 1,000 ha to maximize the potential of the export market.

Identified Dragon Fruit Species Grown by the Farmers

In the Province, there are 6 dragon fruit varieties planted (ILARRDEC, 2013). These are: Saniata 1 (Imee), Saniata 2 (Imelda), Saniata 3 (Miriam), Saniata 4 (Edith), Saniata 5 (Mimi) and Saniata 6 (Elena). The respondents planted more of the ‘Imee and Imelda’ or the red varieties because these are more preferred by customers. The ‘Miriam’ variety is white while ‘Elena’ is yellow.

Market Distribution of Dragon Fruit

Almost all (99%) of the dragon fruit growers sell their fresh dragon fruit harvest in the province. Among those who sell outside the province, their produce are sold in Metro Manila (35%); La Union (18%); Pangasinan (14%); Isabela (11%); Baguio City (7%); Ilocos Sur (7%) 10 kg; Cagayan (4%) and Abra (4%). One respondent mentioned that all of the harvest are transported immediately to Metro Manila to fill in orders from friends and relatives where they can command higher prices. No one among them mentioned any export of the product, although they anticipate supplying in the export market.

Key Players and Their Roles in the Dragon Fruit Industry Supply Chain

It emerged in the study that the key players in the supply chain are the: input suppliers, growers and processors, KASA Coop, assemblers/transporters, wholesalers/retailers and final consumers.

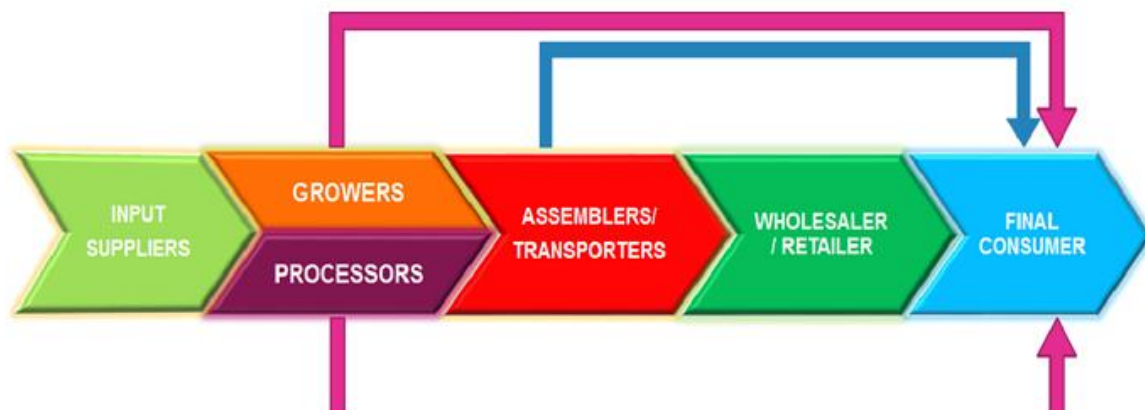


Fig 4. The Dragon Fruit Supply Chain

The different stakeholders participate in the chain: right from the plantation establishment, maintenance, fruit harvesting, packaging and processing, and transportation of the fruits and processed products, retailing and distribution, and consumption. The supply chain analysis (SCA) of the DFI identified all relevant chain links as shown in Figure 4.

A. Input Suppliers

Input suppliers provide the technology, planting materials, posts, fertilizers/pesticides and other supplies needed. They play a very vital role in the dragon fruit chain. They provide appropriate technology in planting, growing, maintenance and in harvesting.

Supplier of production technology

Table 1 reveals that the sources of technology and planting materials are (in rank): Mrs. Dacuycuy, the largest producer of dragon fruit in the province acclaimed as the Dragon Fruit Queen, the Department of Agriculture –



International Journal of Engineering Researches and Management Studies

Office of the Provincial Agriculturist(DA-OPAG), Mariano Marcos State University (MMSU), Provincial Government of Ilocos Norte (PGIN), Department of Trade and Industry (DTI) and other farmers in the province.

Supplier of planting materials

In the same table, the sources of planting materials were: Mrs. Dacucyuy, friends and relatives, DA and MMSU (in order of importance). Mrs. Dacucyuy is known for her quality produce. Hence, aside from the fruit, she propagates dragon cactus cuttings for sale.

Suppliers of posts, fertilizers/pesticides and other supplies needed

In planting, at least four cuttings are planted around a 5"x5"x7' concrete posts or *kakawate* wooden posts. However, concrete posts are preferred because they are more durable. These are ordered from local fabricators.

Table 1. Sources of technology and planting materials of dragon fruit in Ilocos Norte.

PARTICULARS	FREQUENCY* = 73	PERCENTAGE
Technology		
Mrs. Edita Dacucyuy	30	41
MMSU	19	26
OPAG/DA	19	26
PGIN	8	11
DTI	5	7
Others	25	34
Planting Materials		
Mrs. Edita Dacucyuy	32	44
Friends	13	18
DA	12	16
Relatives	9	12
MMSU	2	3
Others	9	12

*Multiple responses

Organic farming is highly advocated for dragon fruit. Organic fertilizers are produced by the dragon fruit growers themselves and are made available for sale to other dragon fruit growers whom they are assisting. Those who were trained by MMSU on *vermi* culture are now engaged in the production and sell to the dragon fruit farmers.

Inorganic fertilizers are optional. However, it was revealed by the growers that they use inorganic fertilizers to enhance the growth of the cactus and the fruiting. Some apply pesticides in order to protect the dragon fruit from the attack of the flies and ants. Other supplies needed include: cloth materials for tying, crates for the harvest, and farm tools which are available in the local market.

B. Dragon Fruit Growers/Processors

The dragon fruit growers are mostly male household heads who are in their productive years with a mean age of 53 years old. Majority are college graduates with varied sources of income aside from dragon fruit farming. Most of them (60%) are members of the KASA and SAGRAP which are the associations of dragon fruit growers in Ilocos Norte. They are responsible in the establishment of the dragon fruit farms, maintenance (weeding, pruning, watering), harvesting and selling. A few (11%) of these growers process their fruits. For those who do, they process fruits that are about to become overripe and those that are of smaller sizes, and attacked by insects and ants. The dragon fruit growers are characterized by their production profile as to:

Land Area Planted with Dragon Fruit

Initially, the area planted with dragon cactus by the respondents ranged from .0002 to 3.00 ha for an average of .44 ha per grower. The area planted has significantly changed the agricultural map of Ilocos Norte for a period of three years. At present, an average of 1.02 ha has been planted with the respondent having the least area



International Journal of Engineering Researches and Management Studies

planted of .02 ha and the largest at 13 ha. At the start, only 8 percent of the respondents planted an area of 1.01 and above. At present there are 23 percent of them, which indicates that their dragon fruit farms have expanded to utilize idle or less productive areas.

The respondents mentioned that some of these areas were left uncultivated since they are situated in slightly rolling areas where trees grow and are harvested as firewood. Other areas were planted with bamboo which gave them income much less than what they could generate from dragon fruit farming.

Table 2. Land area planted with dragon fruit, initial and at present, by the growers in Ilocos Norte, 2014.

Land Area (ha)	Initial		At Present	
	Frequency	Percentage	Frequency	Percentage
1.01 and above	4	8	13	23
.51 - 1.00	10	20	10	17
.26 - 0.50	4	8	4	7
.05 - 0.25	22	43	24	42
.04 and below	11	21	6	11

Number of posts planted with dragon fruit, initial and at present

Many of the dragon fruit farmers (76%) started planting dragon fruit cactus in 1-250 posts and a mere 3% of them planted in 1,251 to 1,500 posts. The average number of posts initially planted is 277. At present, the number of growers who have only 1 – 250 posts decreased to 41%, and those with 1,251 to 1,500 posts increased to 18%. The average number of posts increased to 1,225(342%). It was noted that one of the respondents started with 20 posts and now 17,500 posts are planted.

These data show how rapid the technology was accepted by the farmers, that some of them decided so easily to convert their corn and farmland into dragon fruit farms. This has dramatically changed the status of an idle land into a very productive one. It has also encouraged the dragon fruit growers to purchase adjacent idle lots as their expansion sites.

There are some respondents who mentioned that they planted only in their backyard just to have dragon cactus plants, the fruits of which are primarily for their family consumption. Others who have seen how to grow the crop, planted more posts with the intention of selling their harvest. Having seen the potential of dragon fruit growing in the province and knowing the health and wealth benefits of it, these respondents grew more dragon cactus because they believed that it would be of great help not only to their families but for the whole province.

Table 3. Number of posts planted with dragon fruit by the respondents, initial and at present, 2014.

	INITIAL		PRESENT	
	FREQ (n=73)	PERCENT	FREQ (n=73)	PERCENT
1,251 - 1,500	2	3	13	18
1,001 - 1,250	1	1	4	5
751 - 1,000	3	4	5	7
501 - 750	5	7	5	7
251 - 500	7	10	16	22
1 - 250	55	75	30	41

Harvesting months and volume of harvest of dragon fruit

Generally, the harvest season lasts for 6-7 months (ILARRDEC-MMSU undated). However, the fruit can be harvested all-year round already due to the use of light bulbs that are being lighted at 10:00 o'clock in the evening up to 2:00 o'clock in the morning. This innovation in the dragon fruit technology is the result of the research conducted by MMSU (Pascua et al, 2012). This technology allows for the continuous supply of the fresh dragon fruit, although it entails a huge amount of capital outlay. One of the respondents mentioned of the possibility of exploring the use of solar panels to generate the electricity needed for this purpose.



International Journal of Engineering Researches and Management Studies

This survey showed that there are only two (2) of the respondents who harvested dragon fruit all year round, though minimal. The harvest months start from April and ends in November with July as the peak harvest month. Among the respondents, for the whole harvest months, the average harvest is almost 3,000 kg. It was mentioned by some of the respondents who started planting in 2012 that their dragon cactus did not bear so many fruits yet, and those who just planted in 2013 started harvesting in August or September, but only few. The volume of harvest per post varies as it is dependent on the number of stems of dragon cactus in a post. The original four stems when planted will multiply and the stems extend upwards to the crown. The more matured the dragon cactus is, the more stems it grows and so the more fruits it bears. It was also mentioned that for the first year, the four stems planted in a post would bear a maximum of 10 kg and it increases as it grows more stems. Further, the respondents mentioned that on the 3rd crop year, each post could yield 50 kg.

Table 4. Harvesting months and average volume of dragon fruit harvested by the farmers, 2014.

PARTICULARS	FREQUENCY*	PERCENTAGE	AVE. VOL OF HARVEST (kg)
January	3	4	67
February	2	3	55
March	2	3	60
April	6	7	86
May	31	42	292
June	57	77	321
July	65	88	497
August	69	93	385
September	69	93	263
October	64	88	251
November	47	64	190
December	8	11	73

*Multiple responses

Percentage of marketable harvest

Majority (78%) of the respondents considered 81%-100% of their harvest as marketable, which means that these are of good quality and therefore could be immediately sold. There are 12% of them who claimed that 61-80% are of good quality and/or marketable and the rest (10%) had only 41-60%. They revealed that sometimes the fruits are attacked by fruit flies and ants which affect the quality and shelf life.

For the non-marketable fruits, these are being consumed by the family, given as gifts to relatives, friends and officemates, or given as freebies to their customers while some of them processed into ice candy or shakes.

Reasons for Planting Dragon Fruit

Most of the respondents (81%) considered the economic benefits of the dragon fruit as the main reason for venturing into dragon fruit farming. They revealed that they just found themselves increasing their area planted with dragon fruit through the income generated from selling the stems as well as the fresh fruits. Many of them have already considered dragon fruit farming as their main source of income.

Dragon fruit is known for its health benefits which was considered by 64% of the respondents. It was mentioned by most of them that it can boost the immune system, helps in digestion, prevents cancer, being high in anti-oxidant, it helps to lower blood glucose levels, helps to control cholesterol level, promotes healing of wounds and cuts, aids in weight reduction and improves appetite, eye sight and memory. In addition, the following are the health benefits from the fruit: enhances metabolism of carbohydrates and produces energy (Vitamin B1), strengthens bones, enhances teeth development (Calcium), and improves tissue development (phosphorous), reduces hypertension (B-Sitosterol) and aids in liver, digestive and endocrine problems (hepatoprotective effects).



International Journal of Engineering Researches and Management Studies

Other reasons include aesthetic (21%) as it provides attraction especially when the flowers are in bloom, for curiosity (18%) as they would like to try what others have tried in their farm and some (16%) mentioned that they were just going with the trend/fad in the farms.

For the other respondents (42%), their reasons are personal. They plant because they are fruit-lovers, flower-lovers, it is their past-time (work after office) and fruits are for consumption only (family, friends and officemates).

Table 4. Reasons for planting dragon fruit by the growers in Ilocos Norte, 2014.

REASONS*	FREQUENCY (n=73)	PERCENTAGE
Economic benefits	59	81
Health benefits	47	64
Aesthetic	15	21
For curiosity	13	18
Just going with the trend/fad	12	16
Others	31	42

*Multiple responses

C. Marketing intermediaries

As gleaned from Fig 4, the dragon fruit growers are indirectly linked with the customers through the marketing intermediaries. These intermediaries provide relevant information necessary in the planning and execution of marketing activities. They also perform marketing functions such as: demand forecasting, order-taking, assembling, transporting, warehousing and selling. They also do facilitating functions such as financing and risk taking.

KASA Coop and SAGRAP

Most of the growers are members of the KASA Coop and SAGRAP. These organizations serve as the marketing arms of the growers. They do the following functions: collect, assemble, sort or classify, transport and deliver the dragon fruit produce to wholesalers, retailers and other previously identified markets.

Wholesaler/retailers

Of the dragon fruit growers, 44% sell to wholesaler, institutional buyers and processors. These wholesalers in turn sell the product to their identified customers.

Table 6. Customers/buyers of dragon fruit in Ilocos Norte, 2013.

CUSTOMERS/BUYERS*	FREQUENCY (n=73)	PERCENTAGE
Final Consumers	35	48
Retailers	27	37
Wholesalers	15	21
Institutional buyers	13	18
Processors	4	5
Others	2	3

*Multiple response

The institutional buyers include Eden Corporation in Manila and Robinson's Supermarket. On the other hand, 37% of the dragon fruit growers sell to retailers who would buy for resell to the ultimate consumers. The retailers are either friends or relatives of the growers, stalls along highways and tourism destination areas, in the public market and during trade fairs

Pricing

The price of dragon fruit varies as the product moves from one channel to another. The farm gate price (FGP) per kilo ranged from P80 to P100. The marketing intermediaries set a mark up ranging from 50% to 80% of the FGP, depending on the demand and competition. If the demand is high, and competition is low, the growers and marketing intermediaries increase prices and vice versa.



International Journal of Engineering Researches and Management Studies

Characteristics of the Dragon Fruit Supply Chains

Generally, a supply chain is composed of interconnected and interlinked networks/ channels that are involved in the provision of goods and services required by the end customers. These members perform the respective roles and tasks necessary in the planning, control and monitoring of supply chain activities with the objective of creating net value from synchronizing supply with demand. It was found out that the dragon fruit supply chain is long and fragmented. There are some cases of direct linkage, indirect and fully integrated.

Directly linked supply chain.

The findings show that most of the small dragon fruit growers directly transact with the dragon fruit consumers. They sell immediately and directly to the customers who sell immediately and directly to the customers.

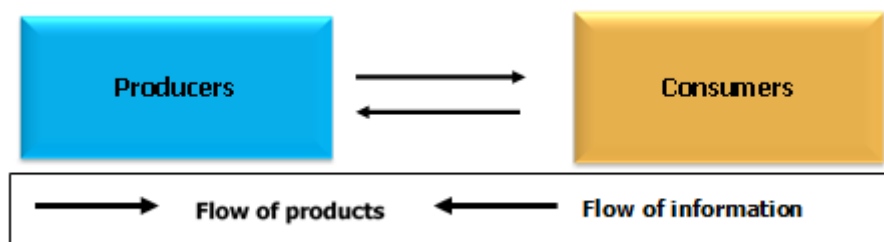


Fig 5. Directly Linked Supply Chain

Indirectly linked supply chain.

In some cases, fresh dragon fruits pass through different marketing intermediaries such as the KASA Coop, assemblers, wholesalers/retailers before reaching the consumers. These channels assemble, transport distribute and sell the products to their respective markets.

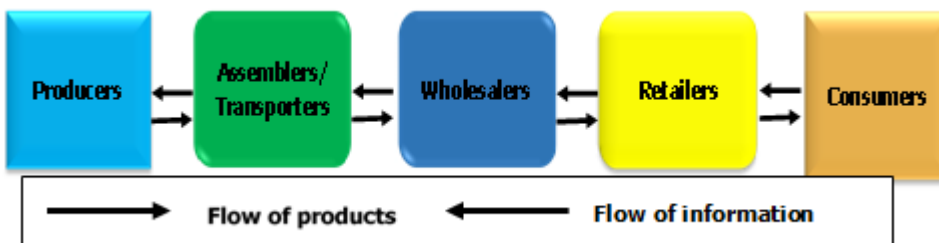


Fig 6. Indirectly Linked Supply Chain

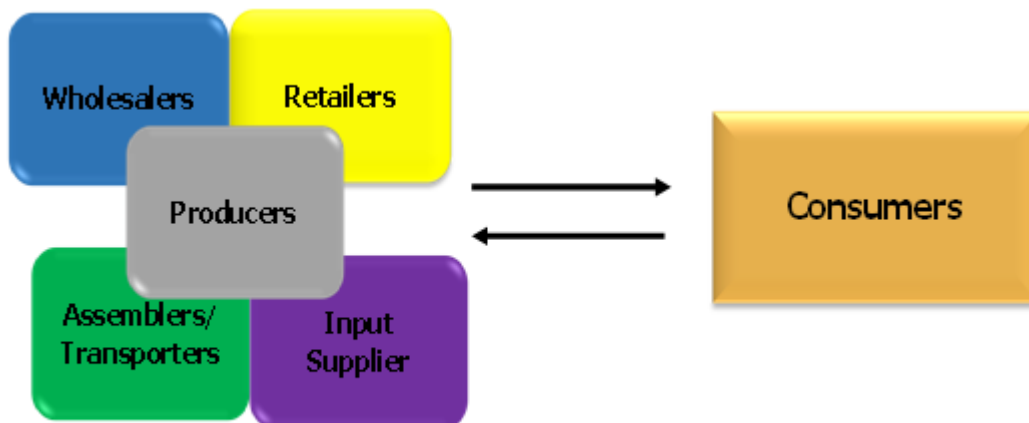


Fig 7. Fully Integrated Supply Chain



International Journal of Engineering Researches and Management Studies

REFMAD, a dragon fruit enterprise in Burgos typifies this chain. The owner, a registered processor, maintains the widest plantation of dragon fruit in Ilocos Norte and has adequate training and experience in running a dragon fruit farm business and processing ventures. It maintains a crew of trained manpower in dragon fruit plantation management, harvesting and processing and provides technical support. She provides the technology and other farm requirements, sells fresh dragon fruit and stems, processes the harvest into value adding products and sells the same. Due to the diversity of dragon fruit –related activities undertaken, she is assured of the quality of the harvest as well as that of the processed products. At the same time, she commands the highest price of the different products. She encouraged others to plant to be assured of a ready and continuous supply of fresh dragon fruit as well as the raw materials for processing.

The efficiency of the supply can be determined by examining the activities carried out in the chain. In this context, a chain is considered efficient only if the necessary players carryout the activities important in delivering the fruits to the intended consumers. In this study, the fully integrated and the directly linked chain are the ones that carry out the necessary activities.

Issues and Concerns Along the Dragon Fruit Supply Chain

Logistics Problems

Only 12% of the respondents indicated problems along logistics such as lack of storage facilities (55%). These are the growers who are also processors. They need processing area, space to place their storage facilities as well as processing equipment. Another problem is no readily available transportation facilities (33%). The farms are located far from the national or barangay roads. Other farms are located far from the narrow roads in the farms, wherein no vehicle could reach the place, hence, poor road conditions (22%) is another problem. Lack of credit sources (11%) is also encountered by those who would like to expand operations or venture into processing of the dragon fruit.

Table 7. Logistic problems encountered by the growers in Ilocos Norte.

LOGISTICS PROBLEMS*	FREQUENCY (n= 9)	PERCENTAGE
Lack of storage facilities	4	55
No readily available transportation	3	33
Poor road conditions	2	22
Lack of credit sources	1	11

*Multiple responses

Production Problems

The dragon fruit grower-respondents claimed that their main problem is the presence of insects/pests (71%) such as fruit flies and ants, however they have found a way to somehow control it by spraying organic insecticide, sevin, liquid detergent soap/downy solution, and pounded *madre de cacao* leaves mixed with chilli, detergent soap and water. Others also use fruit fly catcher, insect trap, and ant repellent and attractants.

Another problem is the lack of water supply (42%) in the farms, however, they use their own water pumps especially during summer. For some who lack water pumps, they manually water their dragon cactus every two days. Some respondents are considering the installation of drift irrigation systems to facilitate the watering of their dragon cactus. This involves a large amount of capital outlay however, it will reduce the cost of labor

Although not a severe problem, insufficient capital to buy inputs (15%) is also mentioned because the growers could not immediately accumulate through their operating income, the funds needed to buy the increasing volume of organic fertilizer requirements as well as the cutting materials for their expansion.

Another problem is bad weather (11%). The weather condition in Ilocos is perceived to be good for dragon fruit farming. However, during the rainy months, the strong winds cause the destruction of the stems and even the posts. Too much water impounded in the areas where dragon cacti were planted also destroys the plants.



International Journal of Engineering Researches and Management Studies

Other problems considered are lack of available source of planting materials (11%), high costs of posts/tires (8%), lack of expansion area (8%), and difficulty in hiring laborers (5%). Other problems (8%) include the yellowing of branches and weak posts.

The processors had minimal problems such as lack of expansion area since they are using the free spaces in their backyard. Another is the lack of available production materials other than dragon fruit. This is encountered by the most diversified producer, considering the fact that the processing of the varied products makes use of different ingredients and processing materials which are not always available in the local market. The weather condition is also one of the problems mentioned. During rainy season, the dragon cacti are destroyed due to bad weather. The fruits are also affected such that the quality is being impaired due to the disturbance in their growth during rainy days. Likewise, insufficient capital is a problem because the inputs/equipment entail high capital, which the processors could not easily accumulate through their operations. The processors also encountered problem on hiring of laborers. There are specific skills the employee must possess like food processing hence, those with experiences are the priority. This skill is lacking among many prospective employees.

Table 8. Production problems encountered by the growers in Ilocos Norte, 2014.

PROBLEMS*	FREQUENCY(n-73)	PERCENTAGE
Presence of insects/pests	52	71
Lack of water supply	31	42
Insufficient capital to buy inputs	11	15
Bad weather	8	11
Lack of available source of planting materials	8	11
High costs of posts/tires	6	8
Lack of expansion area	6	8
Difficulty in hiring farm-laborers	4	5
Others	8	11

*Multiple responses

Marketing problems

Of the grower-respondents, 49% encountered marketing problems, though not severe. Customers insist of low prices (36%). One reason why there are customers asking for lower prices is that, they are used to have pieces of this fruit as gifts or give-aways. These serve as promotion during early years of harvesting dragon fruit. The customers do not realize that growing dragon fruit entails production costs.

Poor quality of dragon fruits is also mentioned by the respondents (36%) as a problem. This is due to the presence of insects/pests. These fruits of lower quality are sometimes sold at lower prices or these are for consumption by the family or give-aways to friends and relatives. Spoilage of harvested fruits is also encountered by the respondents (34%). To save the fruits, some of the respondents especially for those who have processing know-how and machineries, process into ice candy or shakes but are for family and friends consumption only.

Table 9. Marketing problems encountered by the growers in Ilocos Norte.

PROBLEMS*	FREQUENCY (n=36)	PERCENTAGE
Customers insisting of low prices	13	36
Poor quality of fruits	13	36
Spoilage of harvested fruits	12	33
Limited buyers during peak season	8	22
Non-collectibility of account	6	17
Delayed delivery	3	8
Others	6	17

*Multiple responses



International Journal of Engineering Researches and Management Studies

Other problems indicated are: limited number of buyers during peak season (22%); hence the growers bring their produce to other areas like neighboring towns and even outside the province; non-collectibility of accounts (17%) and delayed delivery (8%).

The processors mentioned poor quality of packaging materials as their problems. The materials they are using to package their products are still improvised such as used mineral water bottles for the liquid soap. For the processed food products, these are packed in styro materials covered with plastic. Labeling of the product is using computerized paper. One mentioned that her business could not meet the demands of the growing number of customers due to limited production brought about by the low capacity of the equipment. Consequently, another problem encountered is delayed delivery. One processor mentioned of the non-collectibility of accounts as another problem. This is caused by the strategy of selling on account in order to increase the volume of sales, but it entails more risk of non-collectibility.

Projected Demand

According to the respondents, their production volume is not enough to meet the increasing demand as dragon fruit has been effectively positioned as an agro-tourism product in Ilocos Norte. The fruit has been positioned as a “fashion” and “passion” fruit preferred by the local and foreign tourists.

One of the respondents mentioned that her production/harvest is not enough to meet orders coming from regular customers and business partners. As a strategy, she assembles the produce of her fellow growers and transport/delivers them to varied markets. She processes a large portion of the produce into wine since it is becoming one of the tourist favorites as it is tagged as a healthy wine.

When asked about how many more produce is needed to fill in orders of customers within and outside the province, most of the respondents were optimistic that even if they double their present production, they still could hardly meet the expected demand especially if the local government will continue its aggressive and sincere support to the industry. They acknowledge the support of the province through the SANIATA Program which envisions Ilocos Norte as the dragon fruit capital in the Philippines.

On the other hand, processed products from dragon fruit likewise gained market acceptance, hence, it is perceived by the processors that demand will increase correspondingly.

VI. CONCLUSIONS

1. Dragon fruit production is an emerging economic alternative among farmers to offset the detrimental effects of climate change on their major crops.
2. Dragon fruit has become popular as an agro-tourism product in the Province, thereby creating more markets for both the fresh and processed products.
3. The dragon fruit supply chain is characterized as simple because it is composed of few players who are directly and indirectly involved in the flow of the products from the point of production to final consumption.
4. Most of the producers perform the functions of the marketing intermediaries such as in assembling, transporting, processing and marketing the produce.
5. The producers sell the fruits raw and fresh directly to consumers. There are only a few who had established market linkages such as the assembler/transporters, wholesalers and retailers within and outside the province.
6. The volume of production, both fresh and processed, is still low to meet the perceived demand requirements.
7. The common production problems encountered by the growers are weather-related. However, the technology interventions of the province, DA, MMSU and other government agencies are helpful to mitigate the negative effects of climate change.



International Journal of Engineering Researches and Management Studies

VII. RECOMMENDATIONS

1. A fully integrated supply chain is recommended to enable the dragon fruit growers and entrepreneurs to plan better their overall production and marketing of their products to maximize their income potentials.
2. The producers should strengthen their cooperative, the KASA COOP, as a marketing intermediary to have a stronger bargaining power in terms of price and supply.
3. The dragon fruit growers should establish linkages, forward and backward, to improve and sustain their production and marketing of the products.
4. The growers should undergo more training on business management, product development, processing and marketing in order to maximize income potentials from the industry.
5. The province should initiate policy recommendations to sustain and protect the industry from the negative effects of competition, and other risks that may arise adversely affecting the industry.
6. Encourage future research endeavors that would be directed to enhance the supply chain of dragon in the province.

REFERENCES

1. Brown E.O. et al. 2011. *Exploring the Opportunities Towards Competitiveness: Supply Chain Improvement in Selected Commodities in AFNR (Phase 1)*
2. Faylon, P. S. 2008. *Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Department of Science and Technology (DOST), Socio-Economics SOA and AB Series No. 8/2008.*
3. Malab, S.C., Lucas, Marilou P., Pacis, B.G. Andres, A.I., and Rabanal, M.M. 2012. *Mariano Marcos State University – Philippine Council for Agriculture and Aquatic Resources Research and Development Collaborative Project, Supply Chain Improvement of Bamboo: A Quasi-Integration Model for Region I.*
4. *Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) Department of Science and Technology (DOST). State of the Art and Abstract Bibliography, Supply Chain Management in the Philippines. Socio-Economics SOA & AB Series No. 8/ 2008*
5. Handfield, Robert. January 11, 2011. *What is Supply Chain Management?*<https://scm.edu/scm-articles/article/what-is-supply-chain-management>
6. *Breaking Down Supply Chain Management.* <http://www.investopia.com/terms/s/scm.aspx>
7. *Supply Chain Management (SCM).* <http://searchmanufacturingerp.techtarget.com/definitions/supply-chain-management>
8. *Department of Agriculture – Office of the Provincial Agriculturist. Report on Dragon Fruit Growers, Number of Posts and Harvest. 2014.*