APRIL 2020

DISCUSSION PAPER SERIES NO. 2020-10

Barriers to Application of Weather and Climate Information in Cut Flower Production in Benguet

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April 2020

Abstract

The province of Benguet holds a competitive advantage in the production of cut flowers because of its unique weather and climate; however, the access to and use of information on weather and climate phenomena in agricultural decision making is not guaranteed despite its provision. This presents a critical issue to examine given that the changing climate situation in the region could adversely affect production and living standards without reliable sources of information for the same. In this paper, the researchers thus aimed to explore the barriers in the applications of weather and climate information to cut flower production in Atok, Benguet. It was found that while barriers also exist on the side of hydrometeorological information producers' dissemination of information, there also exist significant financial, infrastructural and capacity barriers that include lack of working capital to implement optimal decision alternatives dictated by adverse weather conditions, the lack of reliable phone service and power to disseminate and access the information, and the absence of forecasts translated into the vernacular or laymanized.

Keywords: Cut flower production, weather and climate information, agriculture, smallholder farming,

Contents

Barriers to application of climate information in cut flower production in Benguet[1]

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1. Introduction

The Philippines is a disaster-prone country that is also particularly vulnerable to climate change. In 2013, it was already estimated that 50.3 percent of the country's total area and 81.3 percent of the population were likely to be severely affected by growing changes in temperature and weather patterns (Dait 2015a), and in 2018, it ranked 3rd of 171 countries in the World Risk Index, indicating an extreme exposure to climate change events and lacking capabilities for coping and resilience.

The changes in temperature and weather patterns in the country lean into the side of more severe weather events, sometimes with dire implications on human security and livelihood. Now, parts of the Philippines are experiencing more rain than in the past while some are experiencing less. Tropical cyclones are decreasing in quantity overall but increasing in intensity, with an increase in the number of storms with winds exceeding 170 kph (PAGASA 2019a); yet in spite of this all, the Philippines is still reliant on climate change-sensitive sectors such as agriculture, which employs close to 30 percent of the working population and comprises around 11 percent of the country's GDP (Dait 2015a).

To illustrate, the Philippines is home to close to 11.8 million smallholder farmers: farmers tilling less than five hectares of land. Following trends in the ASEAN region, smallholder farm efficiency is much lower, where they may achieve less than 20 percent of possible yields. Smallholder farmers have significantly less access to modern farming practices, market information and working capital than their larger counterparts—thus it has been repeatedly demonstrated that engaging smallholder farmers and enriching their yields and livelihood is crucial to food security in the region. Providing farmers access to relevant, timely and useful climate forecasts could be one such way to help them better manage their farms and stabilize yields in the seasons to come (Teng 2016).

The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) is one such organization equipped to collect and distribute this information to relevant stakeholders as the Philippine government's agency authorized to study, produce, and disseminate weather advisories and forecasts. PAGASA's services include tropical cyclone warnings, flood bulletins and advisories, El Nino Southern Oscillation (ENSO) status, as well

[1] This paper is part of the preliminary output for the project, "Action ready climate knowledge to improve disaster risk management for small holder farmers in the Philippines", funded by the Australian Centre for International Agricultural Research (ACIAR). This project is a partnership among the following institutions—South Australian Research and Development Institute, Charles Sturt University, Department of Science and Technology – Philippine Atmospheric, Geophysical, and Astronomical Services Administration, Philippine Institute for Development Studies (PIDS), University of Philippines Los Baños, Department of Agriculture – Agricultural Training Institute, and Benguet State University.

[2] Senior Research Fellow, former Supervising Research Specialist, former Research Analyst, Supervising Research Specialist, Research Analyst, and President, respectively, at PIDS.

as more specialized reports such as forecasts for shipping and agriculture, among other things. PAGASA distributes these products and bulletins through media such as radio, TV, and SMS; their functions beyond this include conducting training for personnel to better measure and report the weather, and for their constituents regarding the creation and use of their products and services. All in all, they are mandated to provide these services to "afford greater protection to the people." (PAGASA 2019b)

The provision of this climate information, however, does not necessarily guarantee its proper use; that is, despite the presence of usable information, there may exist constraints for farmers and other stakeholders to act on this. Stakeholders may lack more knowledge, manpower, or financial resources to implement solutions to the climate-driven problems they know they will encounter. In this paper, we examine these constraints in the context of the use of climate information in cut flower production in Benguet.

The paper is divided into the following sections: Section II, a review of related literature; section III, a discussion of the cut flower industry in Benguet; section IV, the study's methodology; section V, the results and discussion; and section VI, conclusions.

1.1. Background of the Study

This study is part of the project Action Ready Climate Knowledge to Improve Disaster Risk Management for Smallholder Farmers in the Philippines. The project has operated in study sites such as Oriental Mindoro and Benguet, which produce a high volume of their respective crops yet rely primarily on rainfall as a source of irrigation. This is in line with the project's goal to improve the value of weather and climate information flows between PAGASA and key agricultural decision makers; that is to more efficiently coordinate and facilitate the information's use among these stakeholders.

Specific objectives of the project include:

1. Understanding the current status of DRR and CCA for smallholder farmers in case study sites,
2. Analyzing the potential and realized value of weather and climate information flows, and
3. Piloting communication materials and scaling up findings to other LGUs and farming organizations.

This paper folds in to the first objective of the project specifically.

Beyond this, the project focuses on extension workers as agents of change, and further aims to identify how they among other key decision makers interact with weather and climate information in the context of agriculture. Understanding the barriers and opportunities to the access and use of weather and climate information is tangent to this and other components of the project, such as the analysis of climate-sensitive decisions, the development of decisionmaking tools, and a social network analysis of Atok, Benguet that investigates the pathways of weather and climate information in the community.

2. Review of related literature

2.1. Climate change and the cut flower industry

Weather is a huge consideration in the production of cut flowers, and given the rapidly changing climate, the provision of accurate information on weather conditions and understanding the decisions made based on that would make the difference in producing a good versus no yields at all. Mainly, changes in weather and temperature patterns across the year may cause in flower production a lack of blooms, smaller blooms, a shorter blooming period, discoloration of the flowers, dull shades in flowers, a change in regular fragrances and shorter post-harvest life among other issues. (De 2018)

Published interviews with prominent players in the cut flower industry, such as Puentespina Orchids and Tropical Plants Inc, have also yielded insights into the effects of climate change to the production of ornamental plants. Warmer temperatures, for instance, bring in more insects, leading to increased need for insecticides. Roses in particular are also susceptible to increasing temperatures, and cannot grow in areas that are too warm. Winds are now also stronger, more frequent and longer-ranged, meaning delicate flowers need more than just the traditional plastic shades used in Benguet.

While these are the direct impacts of climate change, there also exist indirect or market impacts: Road closures and price fluctuations born from extreme weather events also negatively affect the efficient production and distribution of cut flowers, for example.

The following section discusses the decisions points that are heavily influenced by climate and weather scenarios across the cut flower growing process, and details the constraints to using weather and climate information in implementing the decision alternative that best addresses the above problems.

2.2. Barriers to implementation of climate information in the cut flower industry

Information on existing constraints comes from case studies of provinces near Benguet; published interviews with cut flower industry experts; and studies of cutflower industries abroad, namely in the African continent.

Dait’s (2015b) review of the trends and issues in the cut flower industry in neighboring Nueva Vizcaya identifies climate-sensitive decisions and the factors that stop actors from choosing the optimal alternative. For instance, the study cites irrigation problems in rain-visited areas that cannot be rectified because of the lack of financial resources. Moreover, it emphasizes the lack of a venue for acquiring these funds as well as any subsequent collective action: Farmers in Nueva Vizcaya do not have many cooperatives, which reduces their access to credit, knowledge, and economies of scale for potential value-adding activities and the transport of their goods to the market. The lack of farm to market infrastructure also affects harvesting decisions beyond rain forecasts, and may be an important consideration in further reducing crop and profit losses post-harvest.

Cut flower producers for private corporations have also described their experiences with the changing industry landscape amid climate change. First, they state that the cut flower industry as a whole is one that requires technology and specialized knowledge; thus, even given climate information, there may still be too many gaps in available knowledge and technology to implement the best decision alternative. Specifically, they also name the increasing costs of fertilizer, chemicals and labor needed to put in the extra work to appropriately prepare flowers for special weather conditions (Cardeno and Fernando 2018).

They also cite quite a few indirect or market conditions that would affect this capability. Choosing land to plant in to begin with is growing harder, as a lot of suitable cool-climate plots are being converted to subdivisions and living spaces. With regard to post-harvest operations, the increasing prices of oil and gasoline are prompting decision makers consider harder how they get produce to the market for less costs, and without too much spoilage.

Cut flower industries abroad also face challengers that can be relevant even in the Philippine context. A study done by the Kenya Flower Council (2018) notes the lack of tools and capacity building that allow farmers to better their plots and protect themselves from extreme weather events. Building on this, they also note the lack of national legislature to grant support to these cases, and more notably the lack of involvement of the flower production industry in the discussions that produced existing legislations.

Patt and Gwata (2002) examine these constraints for subsistence farmers in Zimbabwe as well, summarizing problems similar to the above into six barriers to the effective application of seasonal climate forecasts. These six barriers are problems with forecast credibility, legitimacy and scale; as well as problems in stakeholders' cognitive capacity, the presence of procedural and institutional barriers, and the lack of available choices. Forecast credibility refers to whether or not the forecasts are believable; sometimes, this stems from how forecasts are simplified to be more deterministic instead of probabilistic, which may cause users to conclude that a forecast is definitively wrong when the forecasted conditions do not occur. Legitimacy, on the other hand, tackles the question of who truly benefits from the forecast. Climate forecasts would only be useful if a farmer can benefit from it, and occasions where credit is restricted from them when droughts are forecasted, or when corporate markets and national level policy-makers do not have the same end goals or responses as the farmers would lead farmers to believe the forecast serves ulterior motives. Aside from this, problems in scale refer to when national-level forecasts may not be applicable to smaller localities, and is further constrained by climate variability across geography, limited capacity to measure weather in rural areas, how it may not be possible to downscale some forecasts, and how farmers may not even use the same metrics to gauge weather events. This also leads us to the problem of cognition, which is a question of whether or not a farmer understands the forecast. Problems in procedures, beyond this, occur when the use of forecasts are impeded by standard operating procedures or bureaucracy, such as when forecasts only become available after a series of meetings, by which time some farmers will have already purchased seeds for their crop of choice. Moreover, the authors of the study noted that hardly anyone actually optimizes their decisions, and instead "satisfices," settling for the decision alternative that not necessarily maximizes yield or profit but instead gets them by. This is often the most cost-effective over the most beneficial, or the choice that has worked the best in the past, and describes the problem of choices available that the authors identified.

The authors purport that these problems can be solved mainly through participative and repetitive communication between climate analysts, the extension workers dispersing the information, and the farmer end users. Credibility can be fostered by giving probabilistic forecasts through trusted communicators, while teaching farmers to best interpret this with repetition encouraging learning and correction of mistakes tackles the problem of cognition. Legitimacy, scale and procedural barriers can be addressed by working with users to analyze the forecasts implications for their locality, and further involving them in developing response strategies that resolve both end goals and timing conflicts. Problems in choices are alleviated by improving forecast skill, communicating strategies to overcome constraints, and encouraging farmers to make incremental decisions off the forecasts.

3. Cut flower production in Benguet

3.1. Benguet province comparative advantage in flower production

Benguet is a high-elevation, temperate climate province located in the southern part of the Cordillera Administrative Region (CAR). It is situated 200 to 2,796 meters above sea level, with its highest point being the peak of Mt. Pulag. Temperatures in the province range from 8.6 degrees Celsius in January to a high of 26 degrees Celsius in April. It is further classified as a Type I Climate in the Corona system of classifications, meaning it experiences rains from May to October and drier times the rest of the year[3]. These conditions position the region as a high-performing producer of high value crops such as cabbage, carrots and potatoes; as well as cut flowers like roses and anthuriums. Politically, the province is divided into 13 municipalities and 140 barangays focused mainly on agriculture, with trade boosting the provincial economy as well.

The geography and climate in the region has made it more difficult to develop agriculturally, however. CAR is comprised of around 71% of steep slopes, and infrastructure can be 30% more expensive to build as a result. The region is also quite vulnerable to earthquakes, and is situated along branches of the Digdig fault. Climate change, specifically the increase in occurrence, intensity, and length of rainfall has caused more vulnerability to landslides, erosions and crop diseases. More extreme temperatures in Benguet have also been documented to cause crop failures (Sandoval & Baas 2013).

3.2. Description of types of flower grown

3.2.1. Roses

Roses come from a prickly shrub and are often displayed as a plump bud on a long, thorny stem, and are valued for their colors, fragrance and long-lastingness. They are considered a popular gift flower for festive occasions such as Valentine’s day, Mother’s Day and birthdays.

[3] https://www.dilgcar.com/index.php/2015-07-10-07-24-09/province-of-benguet

Roses are best grown in more temperate climates and are hence not endemic to the Philippines, but the flowers do thrive in certain areas like Benguet. In general, roses do well where day temperatures range from 24 to 28 degrees Celsius and night temperatures range from 15 to 18 degrees Celsius, while higher temperatures result in faded flower colors, shorter stem lengths and more dropping petals.

The plants require much care further into the growing and harvesting process. They must be watered early in the morning and late in the afternoon, and the soil kept moist at all times to ensure better quality flowers as well. In the Philippines, moreover, more costs and efforts are sunk into the production of roses, considering they do not grow here naturally. Beyond this, to further ensure quality upon purchase, flowers are harvested closed for transport to farther markets, and opened for nearer markets. Upon harvest the flowers are sorted and graded into Class A, B and C, where Class A flowers have large buds and longer stems, Class B flowers have medium buds, and Class C flowers have smaller buds and shorter stems.[4]

3.2.2. Anthuriums

Anthuriums are unique flowers consisting of a spadix, a spike-like appendage that bears the petal; and the spathe, a modified, typically heart-shaped leaf that serves as the petal. The spathes usually come in pink, white, green and red. In the Philippines these flowers are often popular as offerings on occasions like All Souls and All Saints Day.

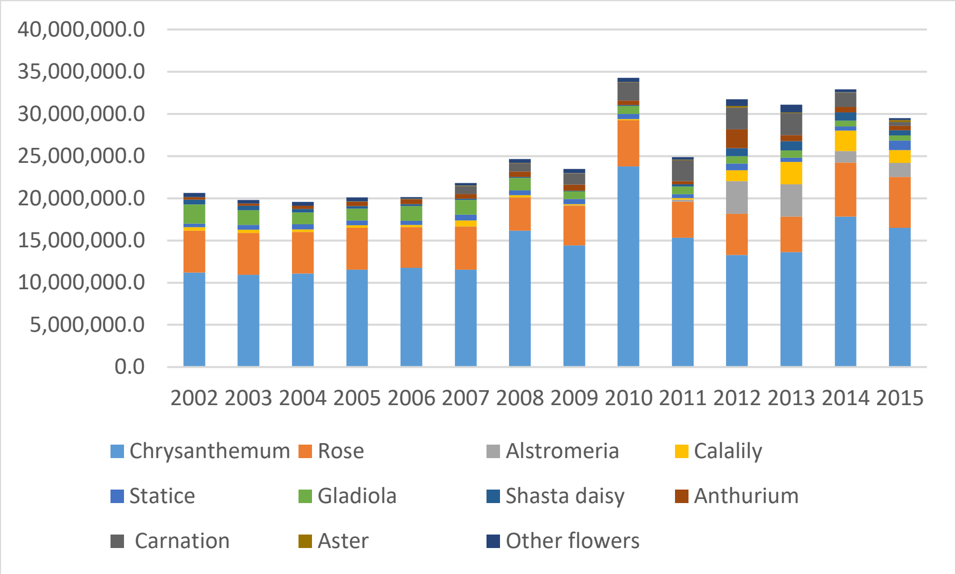
Anthuriums are regularly grown in climates of 27 to 30 degrees Celsius day temperature and ten to 20 degrees Celsius night temperature. The amount of watering depends on the prevailing climactic conditions, but anthuriums do need watering at all stages of growth and further requires high levels of relative humidity. Anthuriums in Benguet, however, do need rain shields to protect them from the combination of the harsher rains and winds in the province; these rain shields range from full-blown greenhouses to thin plastic sheets held up over the plants by wooden frames. [5]

3.3. Cut flower production in Benguet

Benguet is a foremost producer of cut flowers in the Philippines given its comparative advantage of geography and climate. It is estimated that Benguet produced 354 million dozen of various cut flowers throughout 2002 to 2015, averaging 25 million dozen of cut flowers yearly throughout this period. 2015 production came up to 29.7 million dozen, with the production of chrysanthemums across municipalities leading at 16.5 million dozen. Though overall production was down 10% year-on-year from 2014 levels, production quantities do vary following a number of factors, weather being one of them.

[4] https://businessdiary.com.ph/9929/grow-roses/
[5] https://businessdiary.com.ph/1390/anthurium-production-guide/

Figure 1. Most Produced Flower Varieties in Benguet, in dozens



Source: Office of the Provincial Agriculturist, Benguet, 2017

Figure 1 shows the most produced varieties of flowers in Benguet. The most produced variety by a far lead is chrysanthemum, followed by roses, then alstromerias. Of late, there also seems to be a growing number of harvested calla lilies.

Table 1. Average Production of Flower Varieties in Benguet

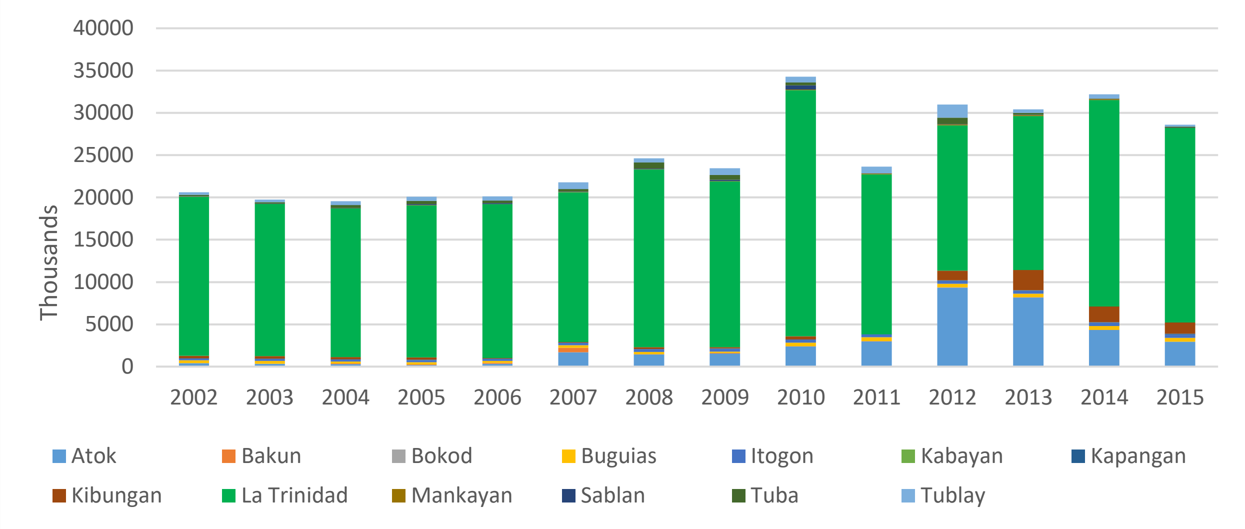
Cut flowers (dozens)

Cut flowers	**2002-2006**		**2011-2015**		**2002-2015**
Chrysanthemum	11,308,154	Chrysanthemum	15,303,894	Chrysanthemum	14,206,381
Rose	4,914,488	Rose	5,164,907	Rose	4,976,383
Gladiola	1,716,943	Alstromeria	2,181,870	Gladiola	1,252,636
Statice	531,204	Carnation	1,960,734	Carnation	1,090,953
Anthurium	411,412	Calalily	1,628,725	Calalily	791,231
Shasta daisy	409,187	Anthurium	912,850	Alstromeria	780,910
Other flowers	401,152	Shasta daisy	779,761	Anthurium	647,874
Calalily	330,141	Gladiola	770,072	Statice	610,751
Carnation	14,348	Statice	682,278	Shasta daisy	456,799
Aster	8,158	Other flowers	518,916	Other flowers	448,902
Alstromeria	0	Aster	113,724	Aster	56,450

Source: Office of the Provincial Agriculturist, Benguet, 2017

Analyzing average production as presented in Table 1 shows that more or less the same types of cut flowers are being produced in Benguet across time. The volume of roses harvested has not increased in magnitudes comparable to other popularly grown plants, incidental with reports on the increasing costliness of maintaining the plant.

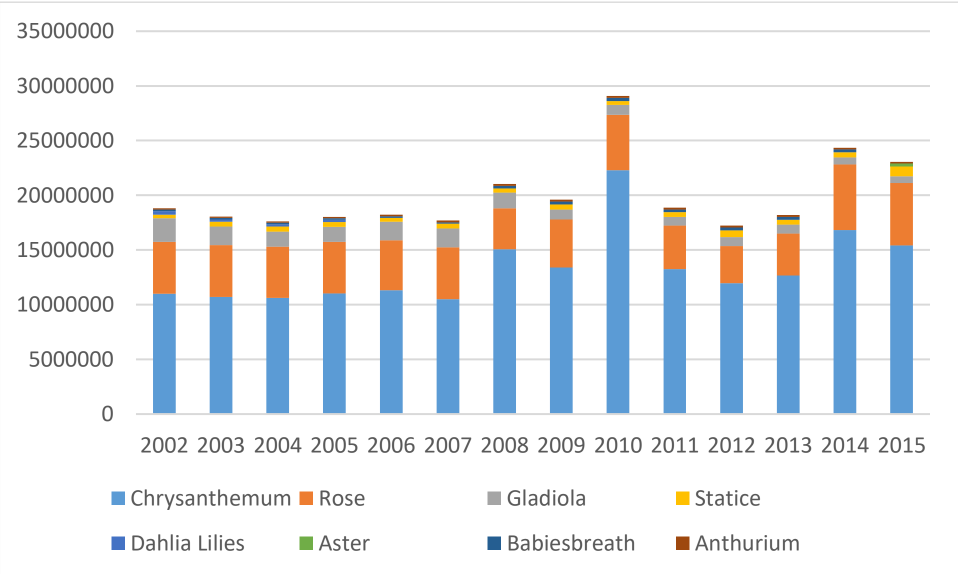
Figure 2. Cut flower production per municipality in Benguet, in dozens



Source: Office of the Provincial Agriculturist, Benguet, 2017

Figure 2 further disaggregates cut flower production per municipality in Benguet. The clear leader in cut flower production is La Trinidad, producing 23 million dozen cut flowers in 2015, stemming from a yearly average of 20 million dozen cut flowers. This is close to 80% of Benguet's total production. These levels are followed by production in Atok (2.6 million dozen), Kibungan (625.9 thousand dozen), Tublay (620.7 thousand dozen), and Sablan (400.4 thousand dozen).

Figure 3. Cut flower production by variety in La Trinidad, Benguet, in dozens



Source: Office of the Provincial Agriculturist, Benguet, 2017

Figure 3 presents a breakdown of the cut flower varieties planted in La Trinidad. The municipality produces mostly chrysanthemums, harvesting 15.4 million dozen in 2015, and a yearly average of 13.3 million dozen. La Trinidad is also home to the "rose capital of the Philippines," Barangay Bahong, and the municipality as a whole, produces on average 4.6 million dozen a year and an above-average yield of 5.7 million dozen in 2015 to follow chrysanthemum production. The third most produced flower in the municipality by yearly average is Gladiola with 1.2 million dozen produced yearly, though in 2015 statice production overtook the production of gladiolas, with 929 thousand statice flowers harvested as opposed to 605 thousand gladiola flowers.

4. Methodology

The data used in this study was collected through focus group discussions (FGDs) and key informant interviews (KIIs) with farmers, municipal agriculturists, municipal agricultural technicians, and the representatives from the provincial agriculture office in La Trinidad, Benguet. Data elicited from the participants include information on their perceptions of climate change in Benguet, their use of PAGASA products in decision making, and common practices in cut flower farming, among other things. These discussions took place within the time frame of May 2017. One limitation of this data collection process, though, is that it would not be easy to verify information gathered through word of mouth, as opposed to collecting historical observations.

The study also utilizes data from a survey undertaken from May to August 2018. Respondents to the survey included farmers in La Trinidad who listed their main source of livelihood as "cultivation of ornamental plants for sale." Including farmers in Atok, Benguet who listed their livelihood as cultivation of cabbage, carrot and potato or chayote, the survey has a total of 254 completed interviews, with interviewees determined by the rand command in Microsoft Excel to meet the goal of 50 interviewees per cultivated crop. These interviews were programmed electronically in to CSPro and conducted face-to-face, through field enumerators using a tablet to record answers. The survey captures data on the profiles of farmers in La Trinidad and Atok, their income, crop production per weather scenario, and farm management decisions vis-à-vis extreme weather events, seasonal forecasts and climate change.

Beyond this, preliminary results from the National Stakeholders Workshop on Barriers and Opportunities on the Access and Utilization of Weather and Climate Information have been incorporated into the results and discussion. This workshop took place in May 2019, and gathered participants from a multitude of stakeholder organizations such as the Food and Agriculture Organization – Philippines (FAO – Phil.), the Office of Civil Defense (OCD), the OML – Climate Change Adaptation and Disaster Risk Management Foundation Inc. (OML – CCADRM), and so forth to discuss the barriers and opportunities to successfully utilizing weather and climate information that they had encountered in their line of work. The workshop activity consisted of dividing participants randomly into groups and having them identify barriers to access, barriers to use, opportunities to access, opportunities to use, recommendations to access and recommendations to use of weather and climate information for each classification of PAGASA products. To accomplish this, participants were made to fill a matrix with these data requirements as headings, where PAGASA weather products were classified with regard to lead time as weather warnings (shorter forecast lead times for more severe weather conditions), weather forecasts, seasonal climate forecasts and climate projections (these usually denoting the effects of climate change).

The study also draws from results of the Local Workshop on Barriers and Opportunities on the Access and Utilization of Weather and Climate Information, which took place in Atok, Benguet in July 2019. This workshop followed mechanics similar to the national one, but was attended instead by stakeholders from Benguet province such as representatives from the Office of the Municipal Agriculturist and the Municipal Disaster Risk Reduction and Management Office from Benguet's different municipalities; PAGASA; Agricultural Training Institute -Central Office (ATI) and the ATI-Cordillera Administrative Region.

Also included in the study are preliminary findings from ongoing discussions with the municipal agriculturist's office of Atok, Benguet.

5. Results and discussion

5.1. Climate change in Benguet context

The respondents of the survey in La Trinidad have observed certain changes in weather conditions over time. They report that there is now more frequent rain the summer, while it is warmer in the rainy season. They also note stronger typhoons with a shift in timing from July to October. Beyond this, common adverse weather occurrences are heavy rain, strong wind, typhoons, landslides and soil erosion, and the occasional hail storm. They believe frost is also a common experience for them that is often blown out of proportion by the media. Survey results corroborate these findings and show that most farmers perceive climate change as changes in temperatures, the timing of the weather, and change in rainfall intensity. 54 percent of farmers believe that human activity is the cause of climate change, while 32 percent have no idea of the causes.

Stakeholders in the province utilize mainly tropical cyclone warnings, rainfall and temperature forecasts, but are unaware of the existence of monthly, annual, regional and agriculture-specific climate forecasts. The most common sources of these climate forecast are radio, television and mobile phones, though 56 percent of respondents use more than two sources.

5.2. Identified climate-sensitive decisions in cut flower production in Benguet

Analyzing the production process of cut flowers show us several decisions that can be affected by climate.

First, field preparation is dependent on the amount of rain forecasted. More rain warrants a decision between keeping the field open versus installing rain shields. This, in turn, leads to a second decision on which flower to grow. Installing a rain shield means optimal growing conditions for anthurium, while open fields are better for roses. On the other hand, less rain leads to an assessment of whether or not an irrigation system must be installed.

The growing process implies further climate-sensitive decisions. The type of irrigation system that may be installed must be decided upon, whether it be a flood type or an overhead irrigator, among others. Fertilizing the plants, though usually regularly scheduled in the case of cut flower production, may or may not push through based on the rain as well, as the rain tends to wash away fertilizer; thus, the frequency of fertilizer applications might vary as well. Warmer temperatures also bring in more insects, prompting application of more insecticides. Whether or not this pushes through on schedule is also dependent on the rain.

The harvest process is also dependent on the season, with threats of typhoons or extreme weather events sometimes prompting early harvests to mitigate crop losses. Some flowers also require a specific kind of storage (i.e., some place well ventilated, or the provision of plastic tubes with water), making this another decision on whether or not it is possible to proceed from harvest to storage.

Post-harvest-wise, transportation also depends on favorable weather conditions. Heavy rains and the resulting floods and landslides make it hard to transport produce and flowers, and farm to market travel may need more careful scheduling in the light of shifting weather patterns both for the sake of human safety and reduction of spoilage. These conditions might also affect whether farmers bring their wares to the trading post themselves, sell them to a middleman, or store the flowers for a little longer before being able to dispose of them. The quantity one is able to safely transport at any time may also be a consideration in light of climate conditions[6].

5.3. Barriers to access of climate information

Accessing climate information is naturally an important precursor to its use; however, many barriers exist preventing stakeholders from obtaining the weather and climate data they need to enact informed decisions. The barriers to access of weather and climate information range from the shortcomings of the data producer on one end to the faults of the recipient on the other, and the failures in infrastructure or technology in between.

On the producer's side lies some room for improvement in the availability of PAGASA's data. The participants of the National Stakeholders Workshop on Barriers and Opportunities on the Access and Utilization of Weather and Climate Information frequently mentioned that beyond the weather forecasts provided by PAGASA, they would have preferred to have access to the raw climate data as well. UPLB – Smarter Approaches to Reinvigorate Agriculture as an Industry in the Philippines (UPLB – SARAI), for instance, shared that with more access to raw climate data they could generate useful agricultural advice such as the amount of fertilizer to apply, the amount of pesticide to spray, and the date to begin planting. Other organizations also reported PAGASA website glitches, delays in PAGASA information, and the unavailability of

[6] This subsection borrows

PAGASA-run monitoring and receiving stations in the offices of the provincial and municipal agriculturists.

Problems in dissemination and receipt, on the other hand, usually refer to how some stakeholders feel like information is being coursed through inappropriate channels. The bulk of PAGASA's information is available online, for instance. Even with internet access, most farmers favor the cheaper bar phones (that receive weather warning SMS) over smart phones that can access the complete set of PAGASA information. This information is distributed through radio and television beyond this, and may still not be fully available to the stakeholders who arguably need it the most. Moreover, local workshop stakeholders reported power outages across the province that make it harder to access electronic sources. Participants in the national workshop as well as the agriculturists in Atok also mentioned that the information distributed through these mainstream media tends to be biased in favor of Metro Manila, and is sometimes inapplicable for their specific localities. Beyond this, some stakeholders are simply unaware that certain types of forecasts exist and do not seek them out. Farmers in particular also have a mentality that farming is more of a gamble than a science, and likewise do not seek out additional information.

It is important to note that that farmers did tend to skip out of extension services such as farmer field school, and this is likely part of why AEWs were not mentioned as sources of weather and climate information during the national workshop. Beyond this, it has been found in discussions with the Atok MAO that Atok farmers are visited and advised more often by chemical company sales representatives than the government extension workers. This specific problem of access is an interesting one, as it entails a multifaceted approach to improvement where AEWs must both be given access to comprehensive and applicable data as a consumer and taught to properly utilize and disseminate it in the most effective ways possible.

5.4. Barriers to implementation of climate information

The respondents of the survey and participants of the FGDs and KIIs identified constraints to the application of the climate information they received from PAGASA across a number of sources.

The most frequently cited reason for non-implementation of climate information is the lack of financial resources. This starts in the field preparation stage, for instance, where even the decision between creating a rain shield and not implies costs regardless of the amount of rain one is going to receive, as rain shields cost up to PHP 1,600.00 per square meter. The following decision is no less expensive: planting anthurium requires less maintenance, but roses are known for their costly and labor-intensive upkeep. Moreover, irrigation for these flowers can range from PHP 25 to PHP 30 per water drum delivery in La Trinidad, without installing a system. Even experimenting with new variants that may be cheaper or more resistant to weather is also a problem for smallholder farmers, and new variants may not even be available in the market and the opportunity cost of the six-month trial and error period runs high. That the participants of the FGD estimated that the costs of farm inputs are 60% of their revenue in general is also a constraint to changing behavior so quickly.

A farmer's ability to secure credit also plays into this. Loans from traders are common in La Trinidad, as per the focus group discussion, but this significantly reduces a farmer's bargaining power in the post-harvest process and allows the trader to declare their own prices. While loans from the government are possible, farms and farm buildings will need to pass a Department of Science and Technology (DOST) quality test to be granted a credit line; smallholder farms may be at a disadvantage here, as the lack of resources to begin with means their plots could be substandard.

This brings capability and knowledge into the set of possible constraints as well. The lack of resources and knowhow to further improve their production of flowers was observed in both the surveys and the focus group discussions. For example, the La Trinidad Municipal Agricultural Office and the Agricultural Training Institute do offer training on disaster risk mitigating farming, but find that it is hard to convince farmers to attend the sessions that will help them. Furthermore, farmers were asked about their willingness to practice certain adaptation measures in the survey. While most were willing to adopt measures such as installing irrigation, deterrents they identified were the perception that they do not need to practice said measure, or again lack funding especially for measures that require building or installing structures, like rain shields. DRRM officers at the local workshop also related experiences where farmers ignored weather warnings in favor of prior, long-term experience that has shown them a particular weather event might not be so severe or dangerous. Farmers also did not know that they could avail of crop insurance, or wrongly perceived that they were not qualified. Stakeholders were aware that they do need capacity building in some cases, though, and have pointed out that learning to add value to their products such as in extracting perfume from their flowers will drastically reduce the need to ship all the flowers all at once to avoid spoilage.

Access to credit, knowledge, training and value added activities might be easier were the farmers part of agricultural organizations or cooperatives, but both the discussions and surveys revealed that not many farmers are indeed part of such organizations. Only 48% of the respondents between Atok and La Trinidad were members of any affiliation or organization, and of this, only 47% are members of farmer's organizations or multi-purpose cooperatives. The FGDs also revealed that farmers believed the aid from participating in disaster relief programs was insufficient. This seems to be a problem that extends into neighboring Nueva Vizcaya region, harkening back to Dait's (2015b) study.

One more important factor in the non-implementation of climate change information in cut flower production is that the climate forecasts circulated in Benguet may be perceived as not relevant, accurate or applicable to the specific locality. We can consider this a problem of credibility and scale, as identified by Patt and Gwata (2002). Of different types of weather products released by PAGASA, only the tropical cyclone warning was rated as reliable by more than 60% of the survey respondents in Atok and La Trinidad. FGD participants also express the same sentiments. Participants of the FGD also described the weather forecasts they get from the television particularly are rarely tailor-made to Benguet region, and focus more on Metro Manila; it was noted during the national workshop that even a “blanket” phenomenon like El Nino has effects that vary from place to place, and should be reported as such. Participants of the national workshop further shared that the utilization of any such information varies depending on lead time and perceived impacts: while weather warnings display a real and immediate threat, climate change projections are often deemed too far in the future and too abstract to warrant any present action. The need for the laymanization of the forecast also grows as it becomes more technical and more forward-looking. This problem also includes that weather and climate information are not translated into local languages such as Ilocano and Kankanaey, making it harder for local stakeholders to understand the forecast.

Benguet’s geography as a province also makes it more difficult to collect and disseminate data: In the discussions it was raised that constraints to accurate data gathering include where to put the equipment in Benguet’s topography where it will be safe from weather and geographical hazards, and also where it will not be vandalized. Partnering with local government units does not also guarantee the maintenance of the equipment when the incumbent leaders leave their positions. It is also difficult to set up supplemental irrigation in Atok particularly, because they have little to no other sources of water than the rain.

Aside from this, the local political landscape adds barriers to the utilization of the information as well. While weather and climate information are used in local DRR as well as development and land use plans, it is usually easier to contextualize in human safety during bad weather than the protection of agricultural commodities. Furthermore, while the plans may look good on paper, their implementation depends largely on the capacity of the local government unit, and on whether new elects choose to continue their predecessor’s projects. Even within the timeline of one administration, red tape and the lack of forecast understanding can result in the low utilization of disaster risk reduction funds in the municipality.

5.5. Responses to barriers in climate information application

Changing how weather forecasts are reported could greatly improve stakeholders’ utilization of weather and climate information. Impact-based forecasts presented in the local dialect are already large steps towards greater understanding of the forecast message. Cascading this information and the raw data behind it to more organizations could also help scale up DRR and CCA initiatives as the information helps not only end users, but project planners that can augment end use of the data. Finding the correct channels for weather and climate information, or even providing end users with the technology to access it in its current state, may also greatly help.

On the producer’s end, further tailoring these forecasts to fit the locality’s climate would make them more useful for stakeholders as well. Tailored forecasts might also lead to more mainstream use of even long-term weather and climate information in local DRR, development and land use plans that are also more actionable.

The documentation and institutionalization of interventions from both the LGU and other stakeholder organizations can also concretize the utilization of weather and climate information and encourage replication. DRRM officers at the local workshop also wished to scale up the dissemination of weather and climate information through partnerships with other organizations such as the Department of Information and Communications Technology (DICT) to leverage mass information technology, and down to the *barangay*-level by choosing a point person for on the ground communication and dissemination.

Government subsidies and initiatives to address farmers' access to credit include loan programs such as the Production Loan Easy Access (PLEA) and the Survival and Recovery (SURE) loan assistance. Both programs cater to smallholder farmers specifically, and are subject to 6 percent p.a., uncollateralized; and zero interest, respectively. PLEA, in particular, also includes terms on free crop insurance when availing the loan. These are concrete steps to improving farmers' cash flows and post monthly repayment rates of 97-100 percent. This and similar initiatives would benefit from conversations with farmers on their grievances, however, including how assistance given is often still not enough, how seeds doled out are subpar, and how modern farming input is quite hard to procure in the country. The need for both specialized aid and improved ease of access to capital markets like loans and crop insurance being identified needs, communicating farmers' responsibilities to them while receiving feedback for the financing institution's part may lead to agreements beneficial for both.

Participative, repetitive communication with stakeholders and the development of climate services through co-learning might also lead to tailored and effective solutions to identified barriers. Fostering partnerships with key organizations will be important, such as how discussion participants suggested a partnership with farmers' organizations to better place and maintain climate measurement technology and create a memorandum of agreement with the local government unit. Opening up venues with the ATI and the MAO for constant back and forth communication and capacity building could also solve problems of cognition, and also connect the farmers to each other for knowledge sharing and collective action. These workshop venues that build capacity will hopefully also influence farmers to have confidence in forecast use and satisficing less.

6. Conclusions

The shifting climate may have adverse effects on the production of cut flowers, meaning accurate, timely and relevant climate forecasts can be an invaluable tool in making educated decisions to keeping and improving yields in the seasons to come. The provision of such information, however, does not necessarily guarantee its proper use, and the study aimed to identify the reasons this is so.

Constraints to the utilization of climate information in decision making in the cut flower industry in Benguet include 1) limited financial resources, and following this, farmers' lack of access to credit; 2) the knowledge and capacity of the farmers themselves, and the lack of suitable organizations and venues to upgrade these; and 3) the need for PAGASA to close the gap between their understanding of decision makers' needs and the production of usable, reliable and timely forecasts for the farmers to use in their decision making. These constraints are prevalent throughout the process of cut flower production and anchored in climate-sensitive decisions from land preparation to post-harvest activities. These results are also consistent with findings in a case study of a neighboring province, and statements from key players in the cut flower farming industry.

Moving forward, opening up constant discussions between key stakeholders will be critical in developing solutions to these barriers identified. Understanding the costly decisions farmers have to make in relation to the changing climate would be helpful for many of the stakeholders: for farmers, to understand explicitly what options are available to them and what consequences stem from these; for financiers, to understand the risk and return farmers face in light of weather and climate phenomena; and for information producers to understand the needs of their constituents as a foundation for stronger service provision in the future. That farmers themselves are involved in the strategizing is also key in addressing problems of forecast credibility, scale, and interpretation. Another useful next step would be considering the channels through which this information would be most efficiently delivered, and the style of reporting (such as impact-based approaches) that would best get the message across to stakeholders.

7. References

Business Diary Philippines. 2018a. Anthurium production guide. https://businessdiary.com.ph/1390/anthurium-production-guide/ (accessed on January 14, 2019)

Business Diary Philippines. 2018b. How to grow roses. https://businessdiary.com.ph/9929/grow-roses/ (accessed on January 14, 2019)

Cardeno, J. and Fernando, M. 2018. Climate change, land lack nip floriculture sector in the bud. Business Mirror. August 8. https://businessmirror.com.ph/climate-change-land-lack-nip-floriculture-sector-in-the-bud/ (accessed on January 14, 2019)

Dait, J. 2015a. Effect of climate change on Philippine agriculture. *International Journal of Science and Research* 4 (9): 1922-1924. https://www.ijsr.net/archive/v4i9/SUB158497.pdf (accessed on January 14, 2019)

Dait, J. 2015b. Trends and issues of the cut flower industry of Nueva Vizcaya. *International Journal of Novel Research in Marketing Management and Economics* 2 (3): 25-51. http://www.noveltyjournals.com/download.php?file=Trends%20and%20Issues%20of%20the%20Cut%20flower-372.pdf&act=book (accessed on January 14, 2019)

De L.C. 2018. Impact of climate change on floriculture and landscape gardening. *International Journal of Agriculture Sciences* 10 (11): 6253-6256. https://bioinfopublication.org/files/articles/10_11_19_IJAS.pdf (accessed on January 14, 2019)

Department of Interior and Local Government, Cordillera Administrative Region – Local Government Resource Center. "Benguet Province Physical Profile." https://www.dilgcar.com/index.php/2015-07-10-07-24-09/province-of-benguet (accessed on January 14, 2019)

Kenya Flower Council. 2012. Enhancing competitiveness of the Kenyan flower industry. http://www.kenyaflowercouncil.org/presentation_nov_2012/2-Draft%20KFC%20presentation%20-%20National%20Conference%20(13.11.2011).pdf (accessed on January 14, 2019)

PAGASA. 2019a. "Climate change in the Philippines." http://bagong.pagasa.dost.gov.ph/information/climate-change-in-the-philippines (accessed November 11, 2019)

PAGASA. 2019b. "Mandate and functions." http://bagong.pagasa.dost.gov.ph/mandate-and-functions (accessed on December 9, 2019)

Patt, A and Gwata, C. 2002. Effective seasonal climate forecast applications: examining constraints for subsistence farmers in Zimbabwe. Global Environmental Change 12 (2002): 185-195.

Sandoval, Roberto Jr., Baas, Stephan. (2013) Adapting to Climate Change: the Cordillera Experience.Agriculture and Development Notes on Climate Change Adaptation, Vol. 3 No. 2. SEARCA, College, Laguna, Philippines.

Teng, P. 2016. Efficient agriculture, stronger economies in ASEAN: Private sector perspectives for policy makers. Syngenta and the Business Council for Sustainable Development Singapore White Paper. http://www.aprilasia.com/id/images/pdf_files/BCSD/BCSD_white_paper.pdf (accessed on January 10, 2019)