Delivering Department Unit	Visayas State University ● Philippine Root Crop Research and Training Center ● Department of Food Science and Technology
Project Title	VSU Resilient Kamote: Versatile Crop for the Future.
Components:	I. Development of Concept for Smart Sweetpotato Production and Processing Technologies II. Survey of the Consumers' Preferences on Sweetpotato and on Future Processed Products III. Functional Property and Nutrition Facts Analyses of Selected Food Products from Rootcrops IV. Effects of Drought on the Root System Architecture and Nutrient Assimilation During Early Growth Stages of NSIC-Registered Sweetpotato Varieties
Project Proponents (name, designation, affiliation and email address). Include project staff.	Project Leader- Dr. Anabella B. Tulin Component Leaders: Component 1: Dr. Daniel Leslie S. Tan Component 2: Prof. Marlon M. Tambis Component 3: Dr. Ivy C. Emnace Component 4: Ms. Mae Ann A. Bravo Members: Dr. Maria Juliet C. Ceniza Prof. Maria Ophelia Velarde Prof. Alan B. Loreto Ms. Lisa I. Arce
Project Collaborators (name, designation, affiliation and email address)	Office of the Senate through Senator Pia Cayetano

Project Rationale	Sweetpotato (*Ipomoea batatas* Lam) is considered as an important, underutilized and versatile food security crop. Globally, it is one of the seven major world staple crops and is being cultivated in more than 100 countries (Laurie et al., 2015). This crop plays an important role especially in developing countries due its versatility and useful property that can withstand adverse abiotic and biotic stresses, thus is considered to be a famine relief crop (Laurie et al., 2015; Woolfe, 2008). In the Philippines, sweetpotato is considered as one of the most important crops next to rice and corn due to its low input requirement, a cheap source of carbohydrates, vitamins and minerals and most importantly, an excellent crop that contributes to food and nutrition security in times of disasters and calamities (Bertuso, 2019; Flores, 2016). In fact, sweetpotato along with other root and tuber crops served as an important reserve and survival crop in the aftermath of Typhoon Haiyan that devastated the Philippines in 2013 particularly the Eastern Visayas region (Roa et al., 2016). As of 2021, sweetpotato production increased to 157.68 thousand metric tons or by 0.1% compared to the same period of 2020 (PSA, 2021). Sweetpotato is recognized as a super food because of its rich nutrient content and bioactive compounds. *In vivo* studies concluded that carbohydrate from SP stabilizes the sugar levels in blood and decreases the resistance to insulin (Mohanraj & Sivasankar, 2014). Hernández Suárez et al. (2016) reported that SP also provides the substantial quantities of selected vitamins (Vit C and PVA), specific minerals (potassium, magnesium, and calcium), and various bioactive compounds (phenolic acids and anthocyanins [ACN]) for consumers (Neela & Fanta 2019). With its inherent qualities and properties, this crop has versatile applications or uses for future industries. To prepare for our desired future with this crop, smart production and processing technologies should be in place, thereby ensuring food and nutritional security. Future-proofing sweetpotato will require preliminary data gathering to assess the production and processing status, market reach, and undiscovered potential of the

	crop . This will allow stakeholders to anticipate the possible stresses that the future of sweetpotato holds, thereby formulating solutions to minimize the effects. Thus, this project aims to gather and establish sets of data that will be able to guide or assist in the formulation of future RDE activities and policies for sweetpotato. With the advent of scientific and technological advancement, it can be assumed that high-end technologies in production and processing are already available. However, it is essential to know which state-of-the-art production and processing technologies are available and applicable to sweetpotato. A comprehensive review of the available technologies will create a direction to where future research and development should be heading, avoiding the risk of reinventing the wheel. Another important driving force that can influence the future of sweetpotato is the consumer's preference. This is true not only in marketing but also in product and varietal development. Research on consumer preferences will allow marketers, product developers, and breeders to get into the heart of what people really want. Understanding the preferences of the consumers will also help streamline the focus of the businesses, product development, and breeding activities. Consumer preference survey results can help entities, especially research and development institutions, create plans for prioritizing and maximizing the time and resources. The consumer survey, however, should not only tackle the current preferences of the consumers or the customers. It should also anticipate the changing needs of the consumers or check for changes in consumption patterns to be caused by many factors. As reported by Accenture (2020), the current major factor that is causing big changes in consumer patterns or consumer behaviour is the Covid-19 Pandemic. Accordingly, there have been big changes in consumers' purchasing behaviour as consumers now tend to focus on the most basic needs and are buying products that will be helpful for personal and family health. The current trend may be

	an opportunity for sweetpotato and its products because they can be positioned as health food. The Visayas State University through PhilRootcrops and the Department of Food Science and Technology have taken efforts in positioning sweetpotato as health food through developing nutrient-rich food products. In fact, the university has produced commercially viable food products such as vacuum fried SP, SP beverage, SP powder and SP puree. The determination of anthocyanin, beta carotene and dietary fiber of these products to be included in the label will be useful to enhance product promotion and marketability. In order to cater the demand for sweetpotato for processing and other applications, productivity of the crop should be ensured. Productivity of any crop, especially food crops, is challenged by climate change. Climate change affects weather patterns that make it difficult to produce crops in season. Nevertheless, sweetpotato in general, has the potential to thrive in adverse environmental conditions. The crop has a lower sensitivity to increased temperature and typhoons as compared to other staple crops such as rice and corn. Also, sweetpotato as a versatile crop, can grow well and withstand adverse soil conditions such as soil infertility and drought. Drought has been considered as the most disastrous major abiotic stress and a major constraint to root and tuber crop. Several studies of SP under drought stress showed a significant reduction in leaf area index (LAI), stem length, stomatal conductance (Laurie et al., 2009), chlorophyll content (Kivuva et al., 2015), above ground biomass (van Heerden & Laurie, 2008), and in root yield and quality (Zhang et al., 2020). On the other hand, some SP varieties have devised mechanisms of tolerating drought through tolerance, avoidance or recovery (Andrade et al., 2016; Kivuva et al., 2015). Based on preliminary studies conducted by researchers, it can be presumed that tolerance to drought in sweetpotato is genotype dependent. As of now, the National Seed Industry Council (NSIC) registered and released 37 sweetpotato varieties. However, there is no available data on the physiological response of each variety to drought. With the current

	and future effects of climate change, It is important to screen these varieties, identify drought-tolerant traits, and develop varieties which are highly tolerant to this environmental stress. Such steps will help minimize the risk of yield stagnancy and improve the genetic base for overall climatic adaptation of sweetpotato. Also, knowledge on the tolerance of sweetpotato varieties on drought stress can assist in increasing profitability by potentially limiting irrigation and associated production overhead cost.
Project Duration	1 year December 1, 2021- November 30, 2022
Total Budget · **VSU**	**Total Project Budget - Php <u>1,981,206.40</u>** Component I - Php 331,548.80 Component II- Php 322,108.80 Component III - Php 489,548.80 Component IV- Php 838,000.00

I. Proposal Details. *Please state your objectives following the principle of SMART (Specific, Measurable, Attainable, Relevant and Time-bound)*

Logical Framework

Component I. Development of Concept for Smart Sweetpotato Production and Processing Technologies					
Objectives	**Activities**	**Outputs**	**Verifiable Indicators**	**Means of Verification**	**Assumptions**
To describe the global and national state-of the-art of the sweetpotato production and processing technologies	Conduct global technology search online and in printed publications, also including patents.	Information and data on the status of the production and processing technologies of sweetpotato	Gathered information and data from online sources and printed publications	Computer files/ documents, and hard copies of documents	Fast internet connectivity, subscription to journals
	Make a write-up of the state of the art of the global and local sweetpotato production and processing technologies	Write-up of the state-of the-art of the global and local sweetpotato production and processing technologies	Document of the Write-up of the state-of the-art of the global and local sweetpotato production and processing technologies	File of the document or hard copy of the report	Internet connection, computer availability
To develop a concept of the smart sweetpotato production and processing technologies	Making of detailed concept of the smart production technologies	Concept of the proposed Sweetpotato Smart Production Technologies	Document of the detailed proposal	File copy of the proposal/ concept	
	Making of detailed proposal/ concept of the smart processing technologies	Concept of the proposed Sweetpotato Smart Processing Technologies	Document of the detailed proposal	File copy of the proposal/ concept	

Component II. Survey of the Consumers' Preferences on Sweet Potato and on Future Processed Products					
Objectives	**Activities**	**Outputs**	**Verifiable Indicators**	**Means of Verification**	**Assumptions**
To determine the kinds of sweetpotato that consumers generally want to consume or use	Conduct consumer survey	Information on the kinds of sweetpotato varieties needed by consumers	Published information being used by the researchers	Publications and actual activities	Availability of funds
To generate information on the current and future product forms of sweetpotato desired by consumers	Conduct consumer survey	Information on the kind of SP-Based products needed by the current and future markets	Published information being used by the researchers	Publications and actual activities	Availability of funds
To provide inputs to the varietal and product development activities on sweetpotato	Analyze the data and draw conclusions	Information inputs for the varietal and product development	Published information being used by the researchers	Publications and actual activities	Availability of funds
Component III. Functional Property and Nutrition Facts Analyses of Selected Food Products from Rootcrops					
Objectives	**Activities**	**Outputs**	**Verifiable Indicators**	**Means of Verification**	**Assumptions**
To determine the anthocyanin, beta carotene and dietary fiber of vacuum-fried SP, SP	Conduct analysis of anthocyanin, beta carotene and dietary fiber of vacuum-fried SP, SP	Information and data on total anthocyanin, Beta carotene and dietary content of vacuum-fried SP, SP	Results of the total anthocyanin, Beta carotene and dietary fiber	Logbook and Certificate of Analysis (COA)	Efficient procurement process Availability of necessary chemicals and reagents

beverage, SP puree and SP powder	beverage, SP puree and SP powder	beverage, SP puree and SP powder			
To determine the nutrition facts of vacuum-fried SP, SP beverage, SP puree and SP powder for product label specified in AO 88-B s. 1984 or the “Rules and Regulations Governing the Labelling of Pre-packaged Food Products Distributed in the Philippines”	Conduct nutrition facts analysis of vacuum-fried SP, SP beverage, SP puree and SP powder	Information and data on nutrition facts of vacuum-fried SP, SP beverage, SP puree and SP powder	Results of the nutrition facts analysis	Logbook and Certificate of Analysis (COA)	Service laboratory to conduct some functional property analysis
Component IV. Effects of Drought on the Root System Architecture and Nutrient Assimilation During Early Growth Stages of NSIC-Registered Sweetpotato Varieties					
Objectives	**Activities**	**Outputs**	**Verifiable Indicators**	**Means of Verification**	**Assumptions**
Determine the effects of drought on juvenile root system architecture of SP varieties	Root System Imaging and Analysis	Juvenile root trait characteristics SP plants under normal and drought conditions	Compilation of juvenile root images and characteristics	Publication	Efficient scanning and image analysis are available
Assess the effects of drought on nutrient assimilation of SP varieties at early growth stage	Nutrient uptake and assimilation analyses	Agronomic, nutrient uptake and assimilation variation in SP varieties with drought stress	Correlation of agronomic, nutrient uptake and assimilation	Publication	Systematic and reliable laboratory analysis are available

Establish the relationship of spectral signatures and chlorophyll content of SP varieties under normal and drought conditions	Spectrophoto metric data analysis Quantitative chlorophyll determination	Spectral signatures and chlorophyll content of juvenile SP varieties	Correlation of spectral signatures and chlorophyll content	Publication	Efficient spectral imaging and analysis are available

II. Project Details

Target Beneficiaries	• Researchers • Farmers • Students • Product Developers • ICT • Processors • Fabricators • Policy makers • Funding Agencies • Technology Adopter • Consumers
Discipline *(check all that apply)*	
☐Education Science, Teacher Training ☐Fine, Applied Arts ☐Humanities ☐Religion, Theology ■Social, Behavioral Sciences ■Business Administration Related ☐Law, Jurisprudence ■Natural Science	■Mass Communication, Documentation ☐Medical, Applied Professions ☐Trade, Craft, and Industrial Engineering ☐Engineering ☐Architectural, Town Planning ■Agricultural, Forestry, Fisheries ☐Home Economics ☐Service Trades

☐Mathematics ☐IT-Related	☐Maritime ■Others (specify) Food Science and Technology
Priority Area *(Check all that apply).*	
■Health, Life Sciences ☐Improving environmental resilience ☐Improving energy security	■Future cities ■Agritech ■Digital, innovation, and creativity
Responsiveness to UN Sustainable Development Goals *(Depending on the research type and platform, you may check more than one (1) SDG)*	

■ **SDG 1**. End poverty in all its forms everywhere. ■ **SDG 2**. End hunger, achieve food security, and improved nutrition and promote sustainable agriculture. ■ **SDG 3**. Ensure healthy lives and promote well-being for all at all ages. □ **SDG 4**. Ensure inclusive and equitable quality education and promote lifelong learning opportunities at all. □ **SDG 5**. Achieve gender equality and empower all women and girls. □ **SDG 6**. Ensure availability and sustainable management of water and sanitation for all. □ **SDG 7**. Ensure access to affordable , reliable, sustainable and modern energy for all. □ **SDG 8**. Promote sustained , inclusive and sustainable economic growth, full productive employment, and descent work for all. □ **SDG 9**. Build resilient infrastructure , promote inclusive and sustainable industrialization and foster innovation.	□ **SDG 10**. Reduce inequality within and among other countries □ **SDG 11**. Make cities and human settlements inclusive, safe, resilient, and sustainable ■ **SDG 12**. Ensure sustainable consumption and production patterns ■ **SDG 13.** Take urgent action to combat climate change and its impacts □ **SDG 14.** Conserve and sustainably use the oceans, seas, and marine resources for sustainable development □ **SDG 15.** Protect, restore and promote sustainable use of terrestrial systems, sustainable manage forests, combat desertification and reverse land degradation and halt biodiversity loss. □ **SDG 16.** Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels. □ **SDG 17**. Strengthen the means of implementation and revitalize the global partnership for sustainable development.
Explain how the project responds to SDG selected above.	**SDG 1**. *End poverty in all its forms everywhere* The proposed program can help end all forms of poverty everywhere because this

	can increase the consumption and production of sweetpotato which is a very profitable crop especially when applied with the recommended technologies for production. The need for increased production can benefit the small farmers in the countryside and those in marginal lands while the new technologies for the utilization of sweetpotato can also help other players in the value chains such as the traders, processors, traders, and retailers everywhere. **SDG 2**. *End hunger, achieve food security, and improved nutrition and promote sustainable agricultur*e The program will contribute to the development of varieties and products that could stimulate more consumption of sweetpotatoes thereby helping eradicate hunger, achieve food security, improve nutrition and promote sustainable agriculture as sweetpotatoes are very nutritious as well as very easy to produce. The development of smart technologies for the production of sweetpotato is also expected to increase the income or profit of the farmers. **SDG 3**. *Ensure healthy lives and promote well-being for all at all ages* The program will contribute to the development of varieties and products that could stimulate more consumption of the very nutritious sweetpotatoes. Being regarded as one of the superfoods, the sweetpotato is rich in essential vitamins and minerals, high in fiber and has relatively low glycemic index and so fit for the consumption of the general population, at all ages.

	SDG 12. *Ensure sustainable consumption and production patterns* Once the consumption or demand of sweetpotato will increase due to the development of consumer-preferred varieties and products, production of sweetpotato will also need to be increased and be sustained. The climate smart agricultural production technologies to be developed by the program will aid in ensuring that the technologies to be used in the production are sustainable. **SDG 13.** *Take urgent action to combat climate change and its impacts* One of the components of the program will tackle the development of smart production technologies. Among the concerns of smart production technologies is on combating climate change and its impacts.
Explain how the project responds to the *Ambisyon* 2040.	This project should help Filipinos become comfortable in 2040 as this can help end poverty and hunger because sweetpotato is a very profitable crop to produce as well as very healthy for the consumers. The produce can also be very affordable when produced properly using the recommended or smart production technologies.

III. Schedule of Activities

Objectives	Activities	Schedule of Activities											
		1st Quarter			2nd Quarter			3rd Quarter			4th Quarter		
		M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M 10	M 11	M 12

Component I. Development of Concept for Smart Sweetpotato Production and Processing Technologies														
Objective 1: To describe the global and national state-of the-art of the sweetpotato production and processing technologies	**Conduct global technology search online and in printed publications, also including patents.**													
	Make a write-up of the state of the art of the global and local sweetpotato production and processing technologies													
Objective 2: To develop a concept of the smart sweetpotato production and processing technologies	**Making of detailed concept of the smart production technologies**													
	Making of detailed proposal/ concept of the smart processing technologies													
Component II. Survey of the Consumers' Preferences on Sweet Potato and on Future Processed Products														
Objective 1: To determine the kinds of sweetpotato that consumers generally want to consume or use	**Consumer survey or gathering of data using structured interview schedules and consumer testing tools and methods**													
Objective 2: To generate information on the current and future product forms of sweetpotato desired by consumers	**Consumer survey or gathering of data using structured interview schedules and consumer testing tools and methods**													
Objective 3: To provide inputs to the varietal and product development activities on sweetpotato	**Data analysis and report writing**													
Component III. Functional Property and Nutrition Facts Analyses of Selected Food Products from Rootcrops														

Objective 1. To determine the anthocyanin, beta carotene and dietary fiber of vacuum-fried SP, SP beverage, SP puree and SP powder	**Prepare Purchase Request (PR) and PPMP of chemicals, reagents and supplies**												
	Process/prepare samples of products for analysis												
	Conduct total anthocyanin analysis of the SP products												
	Write report												
Objective 2: To determine the nutrition facts of vacuum-fried SP, SP beverage, SP puree and SP powder for product label specified in AO 88-B s. 1984 or the "Rules and Regulations Governing the Labelling of Pre-packaged Food Products Distributed in the Philippines"	**Prepare Purchase Request (PR) and PPMP for nutrition facts analysis by service laboratory**												
	Process/prepare samples of products for analysis												
	Submit samples to service laboratory												
	Write report												
Component IV. Effects of Drought on the Root System Architecture and Nutrient Assimilation During Early Growth Stages of NSIC-Registered Sweetpotato Varieties													
Objective 1: Determine the effects of drought on juvenile root system architecture of SP varieties	**Procurement of supplies and repair of screenhouse**												
	Experimental set-up (staggered planting) and maintenance of SP varieties												
	Root system imaging												
	Data Analysis and Write-up												

Objective 2: Assess the effects of drought on nutrient assimilation of SP varieties at early growth stage	**Experimental set-up (staggered planting) and maintenance of SP varieties**												
	Agronomic data collection and staggered harvesting												
	Plant sample preparation												
	Quantitative laboratory analyses												
	Data processing and statistical analyses												
	Write-up												
Objective 3: Establish the relationship of spectral signatures and chlorophyll content of SP varieties under normal and drought conditions	**Experimental set-up (staggered planting) and maintenance of SP varieties**												
	Spectrophotometric data collection												
	Spectral data analysis												
	Quantitative chlorophyll determination												
	Correlation of spectral data analysis and chlorophyll content												
	Write-up												

IV. Work and Financial Plan

I. Work Plan for the Project		
Activity	**Output**	**Date**
Component I. Development of Concept for Smart Sweetpotato Production and Processing Technologies		
Conduct global technology search online and in printed publications, also including patents.	*Information and data on the status of the production and processing technologies of sweetpotato*	*Dec 2021-Mar 2022*
Make a write-up of the state of the art of the global and local sweetpotato production and processing technologies	*Write-up of the state-of the-art of the global and local sweetpotato production and processing technologies*	*Feb-May 2022*
Making of detailed concept of the smart production technologies	*Concept of the proposed Sweetpotato Smart Production Technologies*	*May-Aug 2022*
Making of detailed proposal/ concept of the smart processing technologies	*Concept of the proposed Sweetpotato Smart Processing Technologies*	*Aug-Nov 2022*
Component II. Survey of the Consumers' Preferences on Sweet Potato and on Future Processed Products		
Consumer survey/data gathering	*Data gathered*	*Dec 2021-May 2022*
Data analysis	*Results of analysis*	*Jun-Nov 2022*
Report writing	*Information ready for dissemination*	*Jun-Nov 2022*
Component III. Functional Property and Nutrition Facts Analyses of Selected Food Products from Rootcrops		
Process/prepare samples of products for analysis	*Products ready for analysis*	*February-April 2022*
Conduct total anthocyanin analysis of the vacuum-fried SP, SP	*Data of Total anthocyanin content of vacuum-fried SP,*	*March-August 2022*

beverage, SP puree and SP powder	*SP beverage, SP puree and SP powder*	
Submit samples of vacuum-fried SP, SP beverage, SP puree and SP powder to service laboratory	*Nutrition facts analysis results of vacuum-fried SP, SP beverage, SP puree and SP powder*	*February-April 2022*
Report Writing	*Written report ready for submission to OVPREI*	*October-November 2022*
Component IV. Effects of Drought on the Root System Architecture and Nutrient Assimilation During Early Growth Stages of NSIC-Registered Sweetpotato Varieties		
Procurement of supplies and repair of screenhouse	*Functional screenhouse, Materials and supplies procured*	*Dec 2021-Feb 2022*
Staggered planting and maintenance of sweetpotato varieties	*Experimental set-up consisting of 37 sweetpotato varieties under controlled conditions*	*Jan-Apr. 2022*
Agronomic data collection and staggered harvesting	*Agronomic sets of data (i.e. main vine length, biomass, dry matter content) for the 37 sweetpotato varieties*	*Jan-Apr. 2022*
Root system imaging and analyses	*Data set on juvenile root architecture of 37 sweetpotato varieties*	*Feb-June 2022*
Spectral data and chlorophyll content determination	*Spectral data and chlorophyll content of the 37 sweetpotato varieties*	*Jan-May 2022*
Preparation of plant samples, laboratory analyses and data processing	*Nutrient uptake and assimilation of sweetpotato varieties*	*Mar-July 2022*
Report Writing	*Written report ready for submission to OVPREI*	*Aug-Nov 2022*

II. Line Item Budget	
Items / Particulars	**Amount**

Component I. Development of Concept for Smart Sweetpotato Production and Processing Technologies	
(1) Science Research Assistant (23,462.40/mo)	281,548.80
Supplies and Materials	30,000.00
Miscellaneous Expenses	20,000.00
Subtotal Component I	***331,548.80***
Component II. Survey of the Consumers' Preferences on Sweetpotato and on Future Processed Products	
(1) Science Research Assistant (23,462.40/mo)	281,548.80
Supplies and Materials	30,000.00
Miscellaneous Expenses	10,560.00
Subtotal Component II	***322,108.80***
Component III. Functional Property and Nutrition Facts Analyses of Selected Food Products from Rootcrops	
(1) Science Aide (23,462.40/mo)	281,548.80
Raw Materials	4,000.00
Packaging Materials	1,000.00
Anthocyanin Analysis' chemicals and reagents	70,000.00
Beta carotene Analysis (4 SP products) @4,000.00	16,000.00
Dietary fiber Analysis (4 SP products) @ 7,200.00	28,800.00
Nutrition facts analysis (3 SP products) @ 25,000/per product	75,000.00

Supplies	5,000.00
Communications	2,400.00
Miscellaneous Expenses	5,800.00
Subtotal Component III	***489,548.80***
Component IV. Effects of Drought on the Root System Architecture and Nutrient Assimilation During Early Growth Stages of NSIC-Registered Sweetpotato Varieties	
(2) Science Aide (17,280.00/mo)	414,720.00
(1) Laborer @ 14,440/mo (12 mos)	173,280.00
Laboratory Analysis (plant tissue, chlorophyll content determination, soil analysis)	150,000.00
Supplies, materials, and hauling expenses	100,000.00
Subtotal Component IV	***838,000.00***
Total Project Budget	**1,981,206.40**

SUBMITTED BY:

DR. ANABELLA B. TULIN
Project Leader

REVIEWED AND ENDORSED BY:

DR. MARIA JULIET C. CENIZA
VP for Research, Extension and Innovation

APPROVED BY:

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