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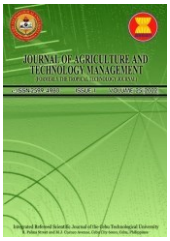

Original article

Integration of construction and agricultural technology: Utilization of hydroponic gardening system for alternative food production

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ABSTRACT

This project aims to design and construct a hydroponic system that is fully utilized that can be integrated into the agricultural and construction technology curriculum while introducing entrepreneurial skills all the same. The hydroponic gardening system is another means of the food-producing system through agriculture that doesn't require a significant area of land. On the other hand, this gardening system does not need heavy soil cultivation but instead integrates construction technology through its structure. It is easy to manage by women and can be set up in a little area in the front or backyard of each household. This type of agricultural system can somehow augment the needs of every family since men are not usually needed for this gardening system and they can freely perform their every duty in their respective companies while left in the care of wives. Therefore, it is recommended to fabricate the hydroponics gardening system and share the technology with another municipality not for household use but for entrepreneurial purposes.

KEYWORDS: *Hydroponics, gardening, construction technology, Alternative food production, sustainability*

1 INTRODUCTION

Every day people are bound to their respective activities on the farm or in the workplace (Ml Caldwell, 2014). Though people have their source of living, they still do not have enough for their basic needs. This problem has become very common and has a hard impact on their children, primarily students. Based on this situation, an alternative way for sustainability is needed to address their problem (AM Hamelin, et al., 2002). A proposal to augment the need of the people in the community is being proposed. An alternative farming method that integrates agricultural gardening and construction technology is introduced. This system is called the Hydroponics gardening system (Fatemeh Kalantar et al., 2017. It is a system of agriculture without the need for soil for planting. Flowers, herbs, and vegetables are planted in inert growing media and supplied with nutrient-rich solutions, oxygen, and water. This system fosters rapid growth, substantial yields, and superior quality plants (A. Stankus, 2013).

Hydroponics gardening is already practiced in some places in the country and outside. This proposal is different from another because it is integrated with construction technology. On the other hand, construction technology is the collection of innovative tools, machinery, modifications, and others used during a project's construction phase that enables advanced construction methods semi-automated construction equipment (F Vahdatikhaki, 2017). The researcher conducted the training in the locality of Pinamungajan regarding this agricultural technology system. Knowledge of this system will help them raise additional income to sustain their needs (LJA Mougeot, 2006).

2 MATERIALS AND METHODS

Respondent were taught of the competencies for enhancement. These competencies include basic measurement systems, the safety of the workplace, basic quantity estimates, and critical positioning of the working area (G.Briscoe et al., 2001). Use of personal protective equipment or PPEs was demonstrated, and perform measuring, marking, squaring, cutting, boring, and installing electrical water pumps system (A. Davies, 2012). Correct reading and interpretation of drawings and project details are also part of the construction of this project (GM Winch, 2009). Before the construction of the hydroponics system, participants must have seeds for cultivars (MB Pudup et al., 2008). Tools and materials must be familiarized, it their uses and processes (B Hardin, et al., 2015).

The wooden A-frame structure of the hydroponic must be stable and level and needs to be checked regularly (C. Somerville, et al., 2014). The reservoir made of PVC m made of PVC must be adequately laid along with the structure's proper position and e plastic

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containers using water pumps (H Kinkade et al., 2007). Water will pass through the slicd foam or Styrofoam that serve as pots for the seedlings (BA Kratky et al., 2010). Once hydroponic gardening is set up, monitoring is necessary until it is time for harvest(D. Gould et al., 2012).

Research design

This study used the Quasi-method of research to gather facts relevant to attaining the details in planning, designing, fabricating, and utilizing Hydroponic Gardening System for Alternative Food Production. The normative survey is the mode of acquiring data, and the questionnaire serves as the main instrument.

Quasi-experimental methods, notably survey research, were employed in this study. Questionnaires were assumed to 150 farmers and 50 construction workers for evaluation. Respondents were chosen randomly and gathered data were treated using total weighted points, weighted mean, and t-test.

Research environment

This research was conducted at the Brgy. Pandacan, Pinamungajan Cebu, Philippines. Its primary source of income is through agriculture though some depend on construction and labor. This study was first introduced to Brgy. Pandacan during the conduct of the extension program. Farmers and wives gathered looking for an alternative way to augment their income and sustain their needs. Pinamungajan recently is becoming Cebu made becoming Cebu midwest's agro-industrial center since a local company's industries municipality. There are 26 barangays in this municipality and the total population is 75,131. The researcher conducted the research to educate and maximize the time in utilizing the technology to plant vegetables using a hydroponics gardening system in the backyard. To test the acceptability of the hydroponic gardening system in terms of performance.

Research respondents

The study respondents were determined by randomly selected techniques as a requirement for the intended study. There were 150 agricultural farmers and 50 construction workers whose households were personally visited by the researcher. Interviews were conducted about the stability of their daily needs and discussed opportu. They discussed an alternative way to survive their families' needs while working at construction workplaces far from home.

Research instrument

This study used a descriptive method hence, will be supplied with its documentation and appropriate content analysis that will support the given interpretation. To have quantified results, the researcher was using survey questionnaires that hold questions that supported the basis for the drawing of a conclusion. There were three – sets of questionnaires- one for the farmers and construction workers. The questionnaires for farmers and construction workers have the proximity of content. It asked for responses only on the utilization of the hydroponics gardening system. It differed only on the last part of the questionnaire used for informal and formal interviews and other documentary analyses to clarify uncertain information.

Research procedure

The research procedures were intended for those individuals from the selected Agricultural Farmers and the construction workers. The researcher distributed questionnaires to the community where the farmers and construction workers were at home on days and days. The discussion was shared with the respondents and conducted on issues related to farming with the use of the hydroponic device as an alternative way of sustainability.

The fabrication procedures of the structures are the following:

1st process, the researcher prepares the detailed plans, elevation,s, and materials needed;

2nd, compose a cutting list of the materials and accessories;

3rd acquires submersible pump and other electrical accessories;

4th Assemble wooden structures, Polyvinyl Chlorides, fittings, plastic containers, and hoses;

5th, check the levelness of the pipe chambers with potholes; and

6th dry run the hydroponics with water.

The drawing presented below is the following: The top View represents the picture of the hydroponics garden when the observer's position is on top; the Front View represents the means of the 6 PVC chambers with the PVC Gate Valves, and the Right-Side View means the lengths of the PCV and the potholes for the garden.

The devices stated are the whole hydroponic garden device used for a short area for gardening. The materials used are wood, PVC, Pumps, Plastic pails, and net pots.

Data processing and analysis

Treatment of Data. The data gathered from the survey questionnaire were tallied, collated, tabled, and subjected to the following statistical treatments.

Weighted Mean. This was used to determine the respondents' utilization of the applicability level and the acceptability of the hydroponics gardening system.

t-test. This determined the significance of the mean validation on the practices of the Technology adoption of planting vegetables as alternative food supplies using

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hydroponics gardening system and its performance.

Ethical coethicalations

This research was guided by the principles of Helsinki Declaration and those set forth by the Philippine Health Regulation Ethical Board (PHREB) and the Republic Act 10352 (Philippine National Health System Research Act of 2013).

3 RESULTS AND DISCUSSIONS

Table 1 categorized the profile of the respondents was the age bracket of male and female. The result shows that the hydroponic gardening system was utilized mainly by female farmers and had the same rate for male farmers and construction workers. The survey concludes that the utilization of the Hydroponic Gardening System in planting vegetables was manageable for farmers, construction workers, and even homemakers who are busy with household activities.

The second category is the Educational Attainment of the respondents. The survey shows that male farmers who graduated from high school have the highest response in the utilization of hydroponics and the lowest rate was from the construction workers who graduated from college. Therefore, this gardening is gardening type applies to communities, regardless of their educational level. The last category for Utilization of the Hydroponic Gardening System to plant vegetables is the combined income of the respondents. The survey reveals that farmers and construction workers receive insufficient income, and augmentation is needed.

Therefore, a hydroponic gardening system could be an alternative way to augment income and be easy to manage for farmers and construction workers.

Table 2 reveals the different attributes of the `Perceived usefulness of using Hydroponic Gardening System for Alternative Food Production. The survey used a Likert Scale and gave ratings according to its category. Based on the respondents' responses, Hydroponic Gardening System is Very Highly Acceptable, innovative, Useful, Aesthetic, Precise, Unremarkable, Authenticity, long-lasting, and Environmental-friendly.

Therefore, Hydroponic Gardening System for Alternative Food Production is Very Highly Acceptable to the people in the community that can be used for productivity.

According to the survey, table 3 shows the ease of use of the hydroponics gardening systems. Based on data, the hydroponics gardening system is safe, comfortable to use, rigid, durable, applicable, easy to assemble, feasible, and hassle-free. It can be mounted in small and large-scale areas and large-scale Highly Acceptable for end users. Figure 1 shows the locational of the municipality of Pinamungajan is located in the Southwestern part of Cebu. It shares its boundaries with Toledo City, Naga City, Aloguinsan, the Municipality of San Fernando, and Carcar City in some portions. It has a total land area of 11,725. 27 hectares with 26 barangays. The people of Pinamungajan depended on their daily livings in farming, fishing, and construction work in the city of Cebu. Yet they have generated income in what they do, but still, it is not enough to provide for their needs from day to day.

Figure 2 shows the detailed drags and the pictorial view of the hydroponics gardening system. This figure illustrates so that the respondents understand the system. It is shown in the picture of the hydroponics system processes. The system of the study was to fabricate A-Frame structures as the main structural frameworks that hold PVC and plastic pots with flowing water and plant liquid ingredients A-Frame with structural sway diagonal braces and horizontal wooden supports to hold the PVC as chambers and to prevent collapse. The A-frame hydroponics attached the reservoir on the ground level with water and liquid ingredients with water pumps inside the reservoir. When the water pumps operate, the water will be distributed to plastic cups where the cultivar is placed. Water that flows into the system contains nutrients for the seedlings.

Similar to the study of (M. Fecondini et al., 2010) about crop production using hydroponics and technical aspects as regards the utilization of the pump that serves as the key of a hydroponic system because if it does not work, the plants will not receive water and nutrients. The subsequent production losses are fast and substantial.

Table 1. Profile of the selected respondent groups on the Utilization of the Hydroponic Gardening System to plant vegetables

Age Bracket	**Farmers (150)**				**Construction Workers (50)**			
	Male		Female		Male		Female	
	F	%	F	%	F	%	F	%
51 - Above	5	11.11	5	4.76	5	11.11	0	0
41-50	10	22.22	20	19.04	25	55.55	1	20
31-40	15	33.33	50	47.61	10	22.22	2	40
21-30	10	22.22	20	19.04	5	11.11	1	20
20 - Below	5	11.11	10	9.52	0	0	1	20
Sub-total:	45		105		45		5	
Educational Attainment of the selected respondents	Farmers (150)				Construction Workers (50)			
	Male		Female		Male		Female	
	F	%	F	%	F	%	F	%
College Graduate	5	2.50	6	46.50	1	0.50	2	1.00
High School Graduate	45	22.50	31	15.50	15	7.50	12	6.00
Vocational Graduate	7	3.50	10	5.00	4	2.00	3	1.50
Elementary Graduate	30	15.00	16	8.00	10	5.00	3	1.50
Sub-total:	87	43.50	63	31.50	30	15.00	20	10.00
Combined Income per Month	Farmers (150)				Construction Workers (50)			
	F		%		F		%	
5,001 and Above	15		7.50		15		15.00	
4,001 to 5,000	20		10.00		20		10.00	
3,001 to 4,000	25		12.50		10		5.00	
2001 to 3,000	20		10.00		5		2.50	
1,001 to 2,000	35		17.50		0		0.00	
1,000 and below	35		17.50		0		0.00	
Sub-total:	150		75.00		50		25.00	

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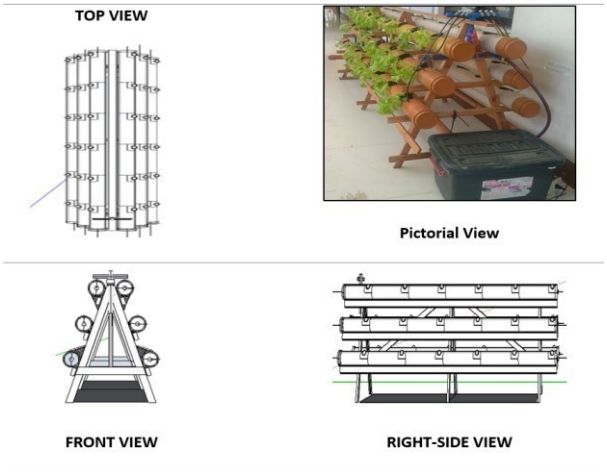
Table 2. Perceived usefulness of the utilization of Hydroponic Gardening System for Alternative Food Production for pangkabuhayan N=200

Attributes of perceived usefulness	Choices 5	4	3	2	1	WM	DR
Utilization of Hydroponic Gardening System for Alternative Food Production is Innovative.	40	65	65	20	10	3.52	Highly Acceptable
Utilization of Hydroponic Gardening System for Alternative Food Production is useful.	30	75	65	20	10	3.48	Highly Acceptable
Utilization of Hydroponic Gardening System for Alternative Food Production is Aesthetic.	35	70	60	25	10	3.48	Highly Acceptable
Utilization of Hydroponic Gardening System for Alternative Food Production is precise.	35	70	60	20	15	3.45	Highly Acceptable
Utilization of Hydroponic Gardening System for Alternative Food Production is Unremarkable.	35	77	63	15	10	3.49	Highly Acceptable
Utilization of Hydroponic Gardening System for Alternative Food Production is Authenticity	40	70	65	15	10	3.50	Highly Acceptable
The utilization of the Hydroponic Gardening System for Alternative Food Production is long-lasting.	30	70	70	20	10	3.45	Highly Acceptable
Utilization of Hydroponic Gardening System for Alternative Food Production is Environmentally-Friendly.	45	70	65	15	5	3.68	Highly Acceptable

Figure 1. The map of Barangay. Pandacan, Pinamungajan, Cebu.

Figure2. Orthographic Views of Hydroponics Wooden Structures



4 CONCLUSIONS

This research aims to use the hydroponic gardening system as an alternative for sustainability, not only for farmers and Laborers at Barangay Pandacan, Pinamungajan, Cebu, Philippines. Another benefactor of this research is those people in the rural areas who do not have a place for planting. This gardening system does not require heavy work in cultivation but needs only monitoring. So this system will let the farmers and laborers multi-task while waiting for the harvest (V Valenzano, et.al, 2018).

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