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IMPROVING FARM PRACTICES AND PRODUCTIVITY THROUGH TRAINING NEEDS ASSESSMENT OF SUGARCANE FARMERS: THE CASE OF DAVAO MILL DISTRICT, THE PHILIPPINES

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ABSTRACT

The need to improve the farm practices and productivity in the Davao mill district was examined through Training Need Assessment. The aim is to develop a well-designed and need-based training program for its sugarcane farmers. A two-stage stratified random sampling technique was employed to select 112 respondents. A well-structured questionnaire was used, and data were analyzed using Likert Scale and multiple regression analysis. The areas of training needs identified for sugarcane production were on the application/computation of chemical fertilizer, soil fertility management, selection of varieties, seizing fertilization and irrigation before harvesting, managing disease control and designing a weed control program. The information on the processing of sugar, the current situation of the sugarcane industry in the domestic and world markets, and farm plan and budgeting were also identified. For other crop production, the training needs were on swine, corn production and poultry raising. Farmers also need training on product quality and packaging and marketing for muscovado, vinegar and wine making for their source of livelihood. The relational analysis showed a positive and significant relationship between age and access to high yielding varieties with training needs expressed by the farmers on sugarcane production. Training could be more effective by targeting older farmers as they seemed to be more receptive to technology although young farmers also need to be trained due to succession in sugarcane farming. The study recommends assessing the interventions given to the Davao MDDC particularly the nursery farms under the Rapid Propagation and Distribution Program of SRA especially on the accessibility of HYV seeds. It also recommends for SRA and the Davao MDDC to increase extension contact and develop training modules and re-orient training schedules with training needs expressed by the farmers to improve the farm practices and productivity in the study area.

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INTRODUCTION

Problems that inversely influence farm productivity are numerous which vary from the use of low yielding varieties, improper application of cultural practices, the

natural calamities such as typhoon, drought, pests and diseases outbreak, lack of farmers' training, and ageing farming population. To increase farm productivity and to minimize the effect of calamities, farmers have to be

convinced to change to certain improved production technologies. In the production of sugarcane, these technologies include among others, the use of farm machines, soil and water management and pest/disease control measures. Convincing farmers to use these production technologies has been a challenge to the Philippine sugarcane industry.

The study was conducted in the Davao mill district which was purposively selected being one of the lowest sugar producing districts in the country. The district's average productivity is 38.42 tons cane per hectare (TC/HA) while in terms of sugar, 73.25 per 50 kilo bag/hectare (LKg/HA). The national average is 56.03 TC/HA and 103.62 LKg/HA (SRA Crop Estimation Report (2020)). The district is located in the Mindanao island, the second largest island in the Philippines which is situated in the southern part of the country. It covers 3 provinces covering 17 municipalities with around 9,226 hectares of sugarcane land and approximately 3,275 farmers. The lone mill employs around 300-400 workers (DMDR, 2019). Evidently, many people are directly and indirectly dependent on sugarcane crop for their economic existence making it as one of the most important cash crops in Mindanao. In view of the vital contribution and role of the industry to the island's economy, the sugarcane farming must be given proper support by the government for the farmers to improve their productivity significantly.

Extension delivery in the district is essentially driven by both private and public sectors since 1992. The private sector- Davao Mill District Development Committee (DMDDC) which serves as the focal point in the development of the district along with the public sector- Sugar Regulatory Administration (SRA) have been giving extension and training services to the farmers. They conduct demonstration farms on improved varieties, establish nursery farms and continuously distribute planting materials, provide fertilizer and tractor services at subsidized costs and conduct trainings/seminars especially to small sugarcane farmers. Yet, despite these interventions, the mill district's productivity performance remains below par. The average farm productivity of the smaller farm size (less than 5 hectares) is way below the district productivity level. Even the biggest farm size (above 100 hectares), its average farm productivity is just a little bit higher than the mill district's average (Ibid, 2019).

One way to increase agricultural productivity is through technology adoption and proper farm practices by farmers (The World Bank Report, 2019). Technology adoption, however, is a broad concept. It is affected by the dissemination and application at the farm level, education, training, advice and information which form the basis of farmers' knowledge (Wageningen Workshop Proceedings, 2000). Chi and Yamada (2002) examined the factors affecting farmers' adoption of technologies in the farming system in OMon District, Mekong Delta and observed that farmers' change in the use of technology is influenced by technical dissemination such as technical training, meetings and oral transmission. Nakano et. al. (2018) dissected the technology dissemination pathways among smallholder rice producers within a rural irrigation scheme in Tanzania by comparing the performance of the three categories of farmers: key farmers, who receive intensive pre-season training at a local training center; intermediate farmers, who are trained by the key farmers; and other ordinary farmers. They found that the ordinary farmers who were a relative or residential neighbour of a key or intermediate farmer were more likely to adopt new technologies than those who were not. As a result, while the key farmers' technology adoption rates rose immediately after the training, those of the non-trained ordinary farmers caught up belatedly. As the technologies disseminated, the paddy yield of the key farmers increased higher than the yield of the ordinary farmers. It can be inferred that once farmers bring production technologies into practice; they can further diffuse to other farmers thereby improving the productivity and production of the other members of farming community.

Agricultural training is a potentially effective method to diffuse relevant new technologies (Nakano *et al.*, 2018; Tambi, 2019). Shibu and George (2013) as cited in Raza *et al.* (2017) defined training as an organized activity designed to enhance the knowledge, skill and competencies of a person for improving his/her performance. While Adesoji *et al.* (2006) defined training as an essential resource, which will direct knowledge and skill towards production. In short, training provides farmers with the knowledge and skills they need in using the new technology to enhance their farm production and productivity.

The gap between the present status and desired status may indicate problems that in turn can be translated

into a training need (JICA, 2016). One method to determine if a training need is required is the Training Needs Assessment (TNA). It identifies the area of farmers' interest and determines the priority of changes in knowledge and skill (Sajeev *et al.* (2012) hence one can design and develop the curriculum that can best suit to the existing "real" conditions of farmers. Thus, training needs assessment has to be carried out to design relevant and need-based training programs that can accommodate changes over time. A Training Needs Assessment acts as an integral guide to developing programs so that appropriate content is generated (Okwoche *et al.* (2015).

The impact of agricultural training on farm productivity is noteworthy. As examined by Ibitoye and Onimisi (2013) on farmers who are in poultry production in Kogi State, Nigeria, they found that training significantly improved poultry production practices through better adaptation of new techniques. Hence, they strongly recommended that farmers should be regularly trained by the extension agents. Noor and Dola (2011) examined the impact of training on farmers' perception and performance on Malaysian livestock farmers and concluded that training provided to the farmers has not only helped them improve their individual capabilities, but more importantly, boost their morale and motivation that clearly contributed to their positive performance level. In the Philippines, Padilla-Fernandez and Nuthall (2001a) explored the causes of farmers' efficiency in the production of sugarcane in Central Negros and found that productivity increased as farmers become more educated and well-trained. While considering these issues in mind, the study perceived that farm practices and productivity in sugarcane farming could be enhanced on a well-designed and need-based training. However, no research has been conducted regarding Training Need Assessment for sugarcane farmers in the country. Therefore, the study aimed to achieve the following specific objectives:

- a) To identify the training needs of sugarcane farmers that can be used in the planning of future training programs to improve the farm practices and productivity in sugarcane farming in the Davao mill district.
- b) To identify important variables to be considered when organizing training program for sugarcane farmers in the Davao mill district.
- c) To examine the socio-economic characteristics of

sugarcane farmers in the Davao mill district and relationship with their training needs.

Scope and Limitation of the Study

For the study to be manageable and meaningful, the following limitations were established:

- a) The study was intended for sugarcane farmers of the Davao mill district only.
- b) The calculation of the sample size was based on the cost and time invested.
- c) Only few socio-economic characteristics were selected for investigation.
- d) The study considered the influence of socio-economic characteristics of farmers to the training need in sugarcane production only in response to the objective(a) set in this paper. The training needs for other crop production, other sources of livelihood, production technology and sugar related information and business management were also regressed with the socio-economic characteristics however, these variables did not improve the model, hence, were excluded.

METHODOLOGY

The Davao mill district has three provinces namely, Davao del Sur, General Santos and Sarangani with 17 municipalities. A two-stage stratified random sampling technique was employed. First, five municipalities namely, Hagonoy, Kiblawan, Matanao (Davao del Sur), Malungon (Sarangani) and Gensan (General Santos) were selected being the biggest sugarcane producing municipalities in the provinces. Secondly, from the Davao Mill District Planters' Directory for Crop Year 2016-17, farmers were classified according to farm size, namely: less 5 hectares; less than 10; less than 25; and less than 50. The size of the sample was determined using the simplified formula for n in sampling for proportions given by Cochran (1977) with the acceptable error being set at 15 per cent. Around 22-23 sugarcane farmers in each municipality were randomly selected across farm size to reach a total of 112 respondents. Only a few respondents were replaced due to unavailability and the replacements were taken from the same farm size and location.

Data collection from randomly selected respondents was done using pre-tested structured questionnaire through the personal interview method. The questionnaires were pre-tested on a sample of farmers

in the study area. The duration of data collection was from October 9 to 15, 2019. This was implemented with 20-30 farmers at a time, with five facilitators supporting the process and assisting illiterate farmers. Survey respondents were assured of the confidentiality of their responses.

Farmers were requested to self-assess their personal knowledge (competence) on different areas of training needs and rate its importance. Respondents' assessment of the importance of the training areas was measured on a three-point Likert-type scale with response options, from not needed to most needed. Respondents were required to place a 'tick' in the relevant response category. Besides closed questions, additional space for other answers or remarks was also included.

The major training needs components identified for the study were sugarcane production, and other crops such as rice and corn production, small and big ruminants, poultry and swine. To improve the quality of the respondents' other livelihood sources (sugar by-products), training on product quality, packaging and post-production needs were identified. Training needs on specific production technology such as soil management for sugarcane growing, effect of soil pH on plant nutrients, best management practices for fertilization and etc. were also determined. Training on farm plan and budgeting, record keeping, access to credit and information on the world of sugar which would support farmers' business management were also sought. The venue of training, time and methods were also assessed in order of preference that ranged from not preferred to most preferred. This is for the future training program to be more effective and efficient.

Data from the study were analyzed using frequency distribution, percentages and mean scores. A mid-point was obtained from the 3-point Likert type scale of highly needed = 3, fairly needed = 2 and not needed = 1. Thus: $3 + 2 + 1 = 6/3 = 2.0$. Any mean score of 2.0 and above implies needed training while below 2.0 suggests that it is not needed.

Multiple regression analysis was used to test the hypothesis to determine the socio-economic factors influencing the training needs of sugarcane farmers in the study area.

Multiple Linear Regression Model is as follows:

$$Y = \alpha + \beta_1X_1 + \beta_2X_2 + \dots + \beta_kX_k + \varepsilon$$

Where,

Y is the Mean counts of training needed by sugarcane farmers.

X1, X2, ... Xk are the socio-economic characteristics of the sugarcane farmers.

α , β_1 , β_2 , ..., β_k are population coefficients that need to be estimated using sample data.

ε is the error term.

Research Hypotheses

The null hypothesis for the research was that there is no relationship between some selected socio-economic characteristics of the sugarcane farmers and their training needs in sugarcane farming against the alternative hypothesis that there is relationship.

Empirical Literature Review

Agricultural education and extension have relation with farm productivity and efficiency (Padilla-Fernandez and Nuthall (2001b); Ahmad *et al.* (2007), farm management (Kilpatrick (2000), technology adoption (Hulukha and Negatu (2016) and other related factors that need improvement to achieve agricultural development. These studies confirmed the positive effects of agricultural training hence it is worth determining its impact on sugarcane production in the Philippines. However, Training Needs Analysis should have been identified first for curriculum development which is the most important part in a training program.

Adesoji *et al.* (2006) assessed the training needs of Fadama farmers for future agricultural extension development in Osun state, Nigeria. Areas of training needs identified include: chemical control of insect pest, use of appropriate chemical and correct dose of application; appropriate herbicide to be used to reduce drudgery and storage of Fadama produce. The study concluded that extension agents and agencies should design regular training programmes for Fadama farmers in the area of deficiencies identified and strengthen Fadama associations such that tripartite problems of lack or high cost of inputs, lack of starting and operating capital and Fadama land could be reduced/solved.

Sajeev *et al.* (2012) investigated the training needs of farmers and rural youth in Manipur State, India. Farmers sought maximum trainings on integrated farming systems, integrated pest and disease management and technologies for soil and water conservation. Nursery management topped the list under horticulture while

training with respect to rearing of piggery was the most important one under animal sciences. Income generating activities for empowerment of rural women, formation and maintenance of SHGs and training on small scale processing and value addition were also in high demand. The KVKs have to re-orient their trainings based on these findings to reduce the existing technological and adoption gap among the farmers in Manipur. Kshash (2016) assessed the training needs of rice farmers in Mahanawiyah District, AL-Qadisiya Province, Iraq. Findings revealed that majority of the farmers had medium level of training needs. Weed management, disease and pest control, seed and seedling were the top most training needs of the farmers and the least training need was land preparation. The variables educational attainment, area cultivated with rice, and annual revenue from rice cultivation had positive and significant association with the training needs. Past studies had earlier shown that it is important to determine the training needs of farmers for agricultural development. Training needs thus identified knowledge and skill gap between what is and what ought to be in the execution of specific tasks towards the achievement of set goals and objectives. It can be considered a condition in which there is a difference between “what is and what should be” (FAO, 1991 as cited in Oyeyinka and Bolarinwa (2015).

RESULTS AND DISCUSSIONS

Demographic Characteristics of the Respondents

Table 1 shows the profile of the respondents in the survey areas. Majority (63.39%) of the respondents were men, which tends to mirror the gender composition of sugarcane farming in the country. Majority (88%) were married. Around 54% of the respondents belonged to the 50 years old and above category. Mean age is 53 years old. While looking at the educational status of the respondents, results revealed that majority (around 52 %) of them were literate (up to high school), elementary, 27% and only a few (13%) reached college. Only 5% have no formal education. Mean years in school is 7.43. These suggest that many farmers in the target groups were functionally literate which may impact on their ability to access different types of training and information. The low percentage of those with formal education may adversely influence the respondents' change to innovations in sugarcane production. However, this may be compensated by the length of farming experience (11-20 years) by majority (45.54%) of the respondents and around 31% with more than 20 years of farming experience. Mean farming experience is 19 years.

Table 1. Profile of the respondents' farmers in the survey areas.

Characteristics	Frequency	%
Sex		
Male	71	63.39
Female	41	36.61
Marital Status		
Married	98	87.50
Single	5	4.46
Age (years)		
Less than 30	2	1.79
31-40	17	15.18
41-50	33	29.46
50 above	60	53.57
Years in School		
No formal education	5	4.46
1-6	30	26.79
7-10	58	51.79
11-14	15	13.39

15 or more	4	3.57
10 and below	26	23.21
Farming experience (years)		
11-20	51	45.54
Above 20	35	31.25
Household size		
2 and below	16	14.29
3	16	14.29
4 or more	80	71.43
Farm size (hectares)		
5 and below	45	40.18
Less than 10 and greater than 5	38	33.93
Less than 25 and greater than 10	20	17.86
Greater than 25	9	8.04
Tenurial status		
Private-leased	59	31.89
Owned & individually managed	78	42.16
CLOA holder & individually managed	48	25.95
No. of Trainings in the Past 5 years		
None	45	40.18
1 - 3	21	18.75
4 - 6	46	41.07
Membership in Cooperatives/ Associations		
Access to Extension Services	50	63
Ratio of YES over NONE	0.79	
Access to improved varieties		
Access to improved varieties	62	51
Ratio of YES over NONE	1.22	
Access to tractor services		
Access to tractor services	49	64
Ratio of YES over NONE	0.77	

Table 1 also revealed that majority (40%) of the respondents were small landholders. Majority (80%) of the respondents had four or more than four family members as well. Result on tenurial status showed that majority (42%) of the respondents' farms are owned and individually managed while around 32% of the respondents leased their farms from the private owners; few (4%) also leased from some Certificate of Land Ownership Award (CLOA) holders.

Majority (40%) of the respondents do not have trainings for the past 5 years although around 41% of the respondents have 4-6 number of trainings attended. The study also showed that only around 26% of the respondents were members of local farmers'

organizations. Majority were non-members since they mill directly to the sugar mill which takes care of their farming needs. Half of the respondents have access to extension services, improved varieties and tractor services.

Training needs

The training needs of the farmers in all areas except in other crops and sources of livelihood are presented in the form of average weighted mean scores. Weighted Scores were ranked within each area and the rankings were identified as training needs of the respondents, 1 being the most needed. For other crops and sources of livelihood, the training needs are presented in the form

of the ratio of the needed over not needed. The following are the areas where there are high training needs among the respondents.

The highest-ranking training needs, as determined by the average weighted mean score is in specific production technology and sugar-related information, followed by business management (see Table 2). Training on sugarcane production was the lowest-

ranked needs as expressed by the respondents. This is due to their familiarity with sugarcane production (the mean farming experience of the respondents is 19 years). Between the training on the production of other crops (rice, corn, cattle, etc.) and other livelihood projects (sugarcane-based such as muscovado, vinegar and wine making), the respondents put higher need to the latter.

Table 2. Training needs of respondents in all areas.

Area	Total			Average Weighted Mean Score	Rank
	Not needed	Fairly needed	Most Needed		
Sugarcane farm management	438	1533	2509	2.46	3
Specific Production Technology & Sugar Related Information	26	122	636	2.78	1
Business Management	19	169	484	2.69	2

Area	Total		Ratio (Majority if >1)	Rank
	Not Needed	Needed		
Other crops (rice, corn, cattle, etc.)	377	295	0.78	2
Other source of livelihood	294	266	0.90	1

Sugarcane production

Looking in more details at the training needs of the respondents in sugarcane production, the survey showed that training on fertilizer and soil fertility management were the most sought-after by the respondents, followed by selection of varieties of

sugarcane, and training on seizing irrigation and fertilizer before harvesting (Table 3). Training on managing disease using chemicals and designing weed control program closely followed. Training was least sought for irrigation method, how to prepare the field and time of planting.

Table 3. Training on selection of varieties, planting time, irrigation and fertilizer.

Area	N	Not needed	Fairly needed	Most Needed	Score	Weighted Mean Score	Rank	Top 10
1. Selection of land for sugarcane growing	112	18	40	54	260	2.32	24	
2. How to prepare the field								
a) Mechanized plowing	112	22	43	47	249	2.22	27	
b) Mechanized harrowing	112	22	45	45	247	2.21	28	
c) Furrow layout	112	25	52	35	234	2.09	31	
3. Planting time	112	25	46	41	240	2.14	30	
4. Selection of variety								
a) High yielding	112	11	23	78	291	2.60	7	7
b) Early, mid and late maturing	112	16	36	60	268	2.39	21	
c) Pest/disease resistant ability	112	14	27	71	281	2.51	13	
d) Drought/water resistant	112	15	21	76	285	2.54	9	9

5. Planting method								
a) Dry & wet season	112	11	37	64	277	2.47	16	
b) Whole stalk, seed pieces, etc	112	11	42	59	272	2.43	18	
6. Irrigation method								
a) Drip irrigation	112	12	46	54	266	2.38	22	
b) Furrow irrigation	112	15	41	56	265	2.37	23	
c) Sub-surface irrigation	112	20	43	49	253	2.26	26	
7. Fertilizer management								
a) Types of chemical fertilizers	112	3	23	86	307	2.74	1	1
b) Content in chemical fertilizers	112	4	22	86	306	2.73	2	2
c) Method of fertilizer application	112	4	26	82	302	2.70	4	4
d) Fertilizer computation	112	6	19	87	305	2.72	3	3
e) Partitioning and time of application	112	7	26	79	296	2.64	6	6
8. Managing Soil Fertility								
a) Trash mulching	112	3	41	68	289	2.58	8	8
b) Application of mudpress-dose/hectare	112	5	26	81	300	2.68	5	5
9. Managing Weeds								
a) Cultural control	112	6	47	59	277	2.47	16	
b) Biological control	112	9	51	52	267	2.38	22	
c) Mechanical control	112	8	49	55	271	2.42	19	
d) Chemical control- types/time of application	112	12	34	66	278	2.48	15	
e) Organic herbicides	112	14	51	47	257	2.29	25	
f) Designing weed control program	112	7	39	66	283	2.53	10	10
10. Managing Pests								
a) Cultural control	112	9	47	56	271	2.42	19	
b) Biological control	112	10	46	56	270	2.41	20	
c) Mechanical control	112	11	41	60	273	2.44	17	
d) Chemical control	112	8	39	65	281	2.51	13	
11. Managing Diseases								
a) Cultural control	112	9	35	68	283	2.53	11	10
b) Biological control	112	7	42	63	280	2.50	14	
c) Mechanical control	112	8	40	64	280	2.50	14	
d) Chemical control	112	8	36	68	284	2.54	9	9
12. Irrigation/drainage management								
112	30	32	50	244	2.18	29		
13. Harvesting								
a) Maturity signs	112	3	48	61	282	2.52	12	
b) Maturity index	112	4	46	62	282	2.52	12	
c) Time of seizing fertilizer	112	3	40	69	290	2.59	8	8
d) Time of seizing irrigation	112	3	45	64	285	2.54	9	9

Under the fertilizer management, the type of fertilizer to use, its contents, computation, proper application and

partitioning/time of application were the highly needs. Farmers know the importance of fertilizer however, they

may not know the right timing, type, and amount of fertilizer to use. Urea is the most important nitrogenous fertilizer in sugarcane production, with the highest Nitrogen (N) content (about 46 percent), however, farmers usually settle for 18-46-0 fertilizer which is cheaper without considering the N content of the fertilizer and the N requirement of the soil. Padilla-Fernandez and Nuthall (2001a) reported that sugarcane farmers in Central Negros, appears to apply NPK fertilizer in surplus. This resulted to a waste. Knowledge on the computation of fertilizer could help farmers identify which and how much fertilizer or right fertilizer/combination to use.

The proper application of fertilizer is very crucial for farmers to realize the efficacy of fertilizer usage while minimizing the bad effects of improper application especially of the chemical fertilizer. In basal application, before planting the cane points, the applied fertilizer is covered with a thin layer of soil to prevent injury to the buds. However, most often, farmers immediately lay out the cane points instead of covering the fertilizer applied with soils. This is to immediately finish the job as payment is on a per hectare basis. While in top dressing, farmers usually place the fertilizer near the base of the plant for its easy absorption. Fertilizers should be applied 8-20 cms away from the base of the plant to avoid salt injury to the plant (Ang Tamang-Pagtutubuhan (2019).

Training on partitioning fertilizer and its time of application is also critical as this practice depends on the moisture content and the type of soil. Full dose is usually being practiced by the farmers to reduce the cost of fertilizer application. However, in sandy soil, this practice is not applicable. For light textured or sandy soil, split application of N and potassium (K) fertilizers is recommended. When much rainfall is expected or on irrigated farms, the first dose is better applied after the first weeding. When not, much rain is expected, the first dose of fertilizer maybe applied at planting or ratooning as there are less chances of leaching and weed competition is minimum. Application of fertilizer during the peak of the dry season is not advisable, it will be better to apply the first dose at the onset of rain. In all instances, the second dose is best applied immediately after the last weeding before closing the field by the last hilling-up cultivation. All the fertilizers must be applied within 3 to 5 months after planting or ratooning (Ibid).

On the other hand, heavy – textured or clayey soils have high water and nutrient holding capacities and

application of fertilizers maybe done in a single dose. Full dose of fertilizers is better applied after the first weeding during the early and late milling seasons when much rainfall is expected or on irrigated farms. Fertilization may be done at planting time or immediately after stubble-shaving of the ratoon crop during the early part of the dry season when there is still enough soil moisture to dissolve the applied fertilizer. Sugarcane crop established during the peak of the dry season will be better fertilized at the onset of the rainy season when unirrigated (Ibid).

Under the soil fertility management, the use of trash mulching and the application of mud press were the highly needs. Concern was raised regarding the degree of soil degradation that can occur under sugarcane production due to continuous cultivation. Farmers have thought that the most serious factor associated with soil degradation under sugarcane is the loss of soil fertility especially the organic matter. Trash mulching and the application of mud press improves soil properties. Trashes which are incorporated to the soil are decomposed into humus thus improving the fertility, texture and structure of the soil. Soil tilth is improved which decreases the need for tillage intensity, enhanced water infiltration and water retention. This allows sugarcane to tolerate drought especially during the El Niño years (Mendoza *et al.* (2001).

For the selection of variety, training needs were put the drought/water resistant and high yielding varieties (HYVs). Majority of the respondents were aware of this improved technology and would even adopt it in order to cope with climate change. However, farmers lack knowledge in variety selection plus the fact that planting HYVs command more inputs and judicious appropriate cultural practices to maximize its potential hence, the need on training on such technology.

Training on seizing fertilizer and irrigation before harvesting were also regarded as the highly needs of the respondents. When farmers were informed that these practices could help increase sugar yield, they expressed interest on the topics. There are detrimental effects of these two practices when improperly applied. Excessive application of N fertilizer few months before harvesting is harmful to the crop as it prolongs vegetative growth thus, delays maturity and ripening, increases reducing sugar content in juice thus lowering juice quality and increases soluble N in juice affecting its clarification during the manufacturing of sugar. While seizing irrigation before

harvesting induces maturity in sugarcane by reducing the rate of vegetative growth thus, forcing the conversion of total sugars to recoverable sucrose thus increases sucrose yields.

Only a few farmers are irrigating their farms. All they know is that when rain comes a few months/days before harvesting, their cane will surely have a much lower sugar yield.

Respondents have expressed the importance of an integrated weed control management since manual weeding is laborious and time consuming while chemical treatments must typically be administered several times to prevent the weed from re-establishing. Designing an integrated weed control management is economically efficient as it involves integration of cultural, manual, mechanical and chemical methods which are applied depending on the age of crop and available resources.

Training on disease management using chemicals was also expressed. Respondents realized that chemicals act very fast and when selected properly they are highly effective in eliminating the diseases of sugarcane however, respondents lack the knowledge and skills. For those respondents who do not want to use chemicals, they sought training in using cultural practices for disease management. These practices include planting of resistant varieties, using clean seedpieces by securing from disease-free nurseries and treating seedpieces with fungicide before planting to prevent smut. Moreover, practicing good farm hygiene to minimize the incidence

of alternate hosts such as "talahib" and "aguingay", and destroying (rogue and burn infected stools) diseased crops in abandoned fields.

Most of the sugarcane farms in the Davao mill district are non-irrigated. In Digos City alone, Trondillo *et al.* (2019) found that of only 1,855.53 hectares are highly suitable and 14,377.55 hectares are not suitable for pump irrigation system from open source (PISOs). This may be the reason why training in irrigation method was not given much importance by the respondents. Furthermore, less training need has been perceived for proper method of land preparation. Majority of the respondents practice custom plowing which is usually access through tractor rental service.

Other crops (rice, corn, cattle, small ruminants, etc.) production

Training needs on pig production was the most sought-after, with 1.29 ratio of needed over not needed by the respondents expressing needs in training in this area (Table 4). This was followed by corn production, poultry and cattle production. Training needs on rice production was sought-after by few respondents. This may reflect their familiarity in rice production or others may not be producing it at all. Training on swine and poultry were also ranked as highly needs. Chickens and pigs are usually raised and sold by women and children, hence an important source of income for the family.

Table 4. Training needs of respondents in other crops (rice, corn, etc).

Area	N	Need		Ratio of Needed Over Not Needed	Rank
		Not Needed	Needed		
1. Rice production	112	74	38	0.51	VI
2. Corn production	112	56	56	1.00	II
3. Cattle production	112	66	46	0.70	IV
4. Small ruminants production (Goat)	112	69	43	0.62	V
5. Poultry production	112	63	49	0.78	III
6. Swine production	112	49	63	1.29	I

Other sources of livelihood (sugar by-products)

To improve the quality of farmers' other livelihood activities such as food processing using sugar-based by-products such as muscovado sugar, vinegar and wine making, the respondents were asked to assess their training needs on product quality, packaging and post-production (marketing information and processing facilities). Training on the development of product

quality appeared as the most important need, with 1.04 ratio of needed over not needed by the respondents (Table 5). This reflects the desire of the respondents for their products to be more competitive in the market. The respondents may have considered the potential, especially of the muscovado sugar, in the domestic and international markets due to the trend toward healthy lifestyles all over the world. This was followed by a need

to have training in product packaging to protect their product from damage during transit and also as part of the promotional strategy. Training on better market information was also expressed as a need. Market information regarding demand and prices may encourage more farmers to engage in other income-

generating livelihood projects especially in the production of muscovado sugar. Training on the processing facilities was the least need of the respondents, which may reflect the non-ownership so they don't need training on the said facilities.

Table 5. Training needs of respondents for other source of livelihood

Area	N	Need		Ratio of Needed Over Not Needed	Rank
		Not needed	Needed		
1. Product quality	112	55	57	1.04	I
2. Product packaging	112	57	55	0.96	II
3. Post-production needs	112	62	50	0.81	IV
a) Market information	112	58	54	0.93	III
b) Processing facilities	112	62	50	0.81	IV

Specific Production technology and sugar related information

The survey showed that training on sugar manufacturing was the most needed by the respondents (Table 6). Generally, only few people can enter the sugar mill to witness the processing of sugar. This is very critical for the farmers because the sugar recovery as

reflected in the mill production report formed the basis of their proceeds. The production sharing system in the Philippines is 60:40 or 70:30, where the smaller share serves as the payment for processing the sugarcane. Such arrangement makes farmers speculate on the validity of the production report as being issued by the mill.

Table 6. Training needs of respondents in production technology.

Area	N	Not Needed	Fairly Needed	Most Needed	Score	Weighted Mean Score	Rank
1. Soil Structure & Texture for Sugarcane	112	1	25	86	309	2.76	IV
2. Soil pH & Availability of Nutrients	112	3	20	89	310	2.77	III
3. Soil Acidity & Application of Lime	112	3	24	85	306	2.73	V
4. Soil Nutrient (NPK) and its Mobility	112	4	11	97	317	2.83	II
5. Deficiency Symptoms of NPK	112	7	13	92	309	2.76	IV
6. How Sugar is Manufactured in the Mill	112	3	8	101	322	2.88	I
7. Sugar Regulation	112	5	21	86	305	2.72	VI

Soil nutrients and its mobility play a key role in plant nutrition. Sugarcane needs nutrients to be able to grow and produce biomass. The major nutrients (NPK) are usually lacking in the soil because sugarcane use large amounts for growth and survival. Thus, it is important for sugarcane farmers to know the NPK content of their soil, to determine how much N, P and/or K to be applied to optimize crop growth and yield. A soil test is applied to determine the nutrient available.

Knowing soil nutrient and its mobility is helpful in

diagnosing plant nutrient deficiencies. Nitrogen is mobile and N-deficiency symptoms are first observed on older leaves. Leaf blades become uniformly pale-green to yellow. Phosphorus is also mobile. Older leaves become slender and blue green in color. Red or purple color may also be seen, particularly at tips and margins exposed to direct sunlight. Potassium is also mobile. Deficiency can result in "firing" (an orange or reddish-brown discoloration) on older leaves. Young leaves are generally all dark green (Ang Tamang Pagtutubuhan (2019).

However, excessive application of N fertilizers is also detrimental as it increases soil acidity. Actually, most of sugarcane farms in the country are acidic that is why, one of the SRA's priority programs at this point is on soil rejuvenation. Soil pH also plays an important role in the availability of nutrients essential for plant growth. The major nutrients NPK are not available in highly acidic soils. Information on soil pH (soil acidity) can also be known in soil test.

The least training need identified under this area was on sugar regulation. "Quedans" are perceived to be negotiable instruments used in trading and not the physical sugar. Most sugarcane farmers especially the small ones are not aware on how their sugar "quedans" are being sold as trading is being handled by their cooperatives/associations.

Business management

Table 7 revealed that the respondents would like to know the current situation of the Philippine Sugarcane Industry being the major source of their income. Also, how the supply and demand of sugar in the world market is influencing the pricing of sugar in the country. However, the respondents expressed a limited need for training in accessing credit and record keeping which reflects the effect of the information drive on the SIDA-Socialized Credit Program being conducted recently by SRA. Financial literacy training is included in the program where farm record keeping is one of the subject matters. It is important that farm records be kept in order for farmers to be able to monitor and evaluate the performance of their crop production and make well-informed decisions about their farm enterprises.

Table 7. Training needs of respondents in business management.

Area	N	Not Needed	Fairly Needed	Most Needed	Score	Weighted Mean Score	Rank
1. Farm Plan and Budgeting	112	0	27	85	309	2.76	III
2. Record Keeping	112	3	40	69	290	2.59	V
3. Access to Credit	112	4	39	69	289	2.58	VI
4. World Sugar and How It Affects Domestic Markets	112	4	18	90	310	2.77	II
5. Philippine Sugarcane Industry	112	3	19	90	311	2.78	I
6. Sugar and By-products	112	5	26	81	300	2.68	IV

Place of training preferred

The respondents stated that they preferred to hold the training in the Barangay Hall, followed by function hall/hotel and then the MDDC training room (Table 8).

Barangay hall was preferred because farmers could easily reach the place of training since it was organized within their village. It also eliminates the problem of transport.

Table 8. Venue of training.

Venue of training	Ranking (May only choose 3 venues per head, N<112)			Rank
	1st	2nd	3rd	
1. MDDC office	24	26	19	III
2. Planters' cooperative/Association's meeting area	1	14	34	
3. Barangay Hall	51	27	5	I
4. Farmer leader's residence	7	8	6	
5. Function Hall/Hotel	29	2	0	II

Months of training preferred

The respondents stated that they preferred to attend training in the months of May, November and December (Table 9). The milling season in Davao starts in January

and usually ends in April. Thus, May till December is when farmers are not busy in the farm and have enough time to attend to other activities such as trainings, seminars and farmers fora.

Table 9. Month of training preferred.

Month	Count	Percentage	Rank
January	1	0.89%	
February	0	0.00%	
March	0	0.00%	
April	4	3.57%	
May	31	27.68%	I
June	9	8.04%	
July	3	2.68%	
August	3	2.68%	
September	3	2.68%	
October	5	4.46%	
November	26	23.21%	III
December	27	24.11%	II
Total	112	100.00%	

Duration of training preferred

Majority (around 51%) of the respondents preferred one-day training and half-day however in the morning (Table 10). The respondents since being pre-occupied doing both productive and reproductive work would not

have much time to spend for other activities. Spending much time would hinder their routine work. Time specific farm operation may suffer. This may be the reason for preference of training by respondents for less than a day.

Table 10. Duration of training preferred.

Duration	Count	Percentage	Rank
Half-day morning	25	22.32%	II
Half-day afternoon	14	12.50%	IV
1 day	57	50.89%	I
2 days	16	14.29%	III
Total	112	100	

Training methods preferred

The respondents were asked to select the preferred training methods. Formal research lecture with the Mill District Officer/Agriculturists (field extension personnel) was the most popular method for receiving training, followed by formal research lecture with OPSI Core group (select research and extension personnel) and practical on-site technology demonstration (Table 11). Informal group discussion was ranked as the lowest. The findings on the preferred training method indicate that majority of the respondents preferred personal locals (Mill District Officer/Agriculturists) rather than outside trainers as they could converse freely. Moreover, farmers preferred more practical

training methods to enhance their learning experience. More than half of the respondents also preferred formal research lecture with the Outreach Program of the Sugarcane Industry-OPSI Core group which indicates that a scientific way of sugarcane production is appreciated. Only few preferred the hand-to-hand distribution of comics ("Ang Tamang Pagtutubuhan"). Similarly, informal group discussion was not preferred. The respondents claimed that although informal group discussion promotes social relationship among themselves, most often, the information being talked about is incomplete which sometimes creates confusions and as a result, they may remain separate without any co-operation.

Table 11. Training methods in order of preference.

Training Methods	N	Preference (May have same answers in different preference)			Rank
		Not Preferred	Fairly Preferred	Most Preferred	
1.) Formal Research Lecture with OPSI Core Group	112	53	5	54	II
2.) Formal Research Lecture with MDO/Agri	112	14	20	78	I
3.) Informal Group Discussion	112	91	13	8	
4.) Practical On-Site Technology Demonstration	112	71	10	31	III
5.) Hand-to-hand Distribution of Comics	112	75	8	29	

Relationship between socio-economic characteristics of respondents and their training needs.

Data depicted in the Table 12 shows the regression estimates of the determinants of training needs among sugarcane farmers in the study area. The R² value of 34% and the adjusted R² value of 0.276 or 28% variability in training needs were explained by the

independent factors. This implies that the selected socio-economic variables explain the behaviour of the interest of farmers in receiving training. The F value of 5.23 was significant at 1% level indicating goodness of fit of the regression line. Only 3 variables were found significant. Some of the variables in the equation were included as they improved the explanatory power of the model.

Table 12. Results of regression analysis showing relationships between investigated variables.

Variables	Parameter Estimate	Std. Error	t	Sig.
(Constant)	2.051	.154	13.340	.000
Age	.005**	.003	1.719	.089
Sex	.068	.057	1.196	.234
Years in school	.006	.008	.722	.472
Years in sugarcane farming	.001	.003	.300	.765
No. of trainings in the past 5 years	-.048*	.014	-3.333	.001
Farm size	.002	.003	.523	.602
Dummy variable proxied for Tenurial Status (DTS = 1 if the farmer leased the farm, otherwise zero).	-.071	.056	-1.271	.207
Access to extension services	.111	.078	1.424	.158
Access to improved varieties	.327***	.060	5.454	.000
Access to tractor services	-.090	.057	-1.572	.119

* Significant variables at p < 0.05

The coefficient for age was positive and significant at 10% level of probability. This implies that the older the sugarcane farmers, the more training needs they have. This may also infer the receptiveness to farm innovations as farmers aged. The result supports the findings of Oyeyinka and Bolarinwa (2015) which implied that as cassava farmers get older, more training is required in the areas of need identified so as to keep them abreast of the latest development and improvement on cassava cultivars. However, this is in contrast with the findings of Pierre-André *et al.* (2010) who used a sample of farmers from the South-west region of Cameroon and observed a negative relation

between age and training needs on rubber production. The coefficients for years in school and number of farming experience were positive however, not significant. This implies that more educated and experienced farmers may take more risks in adopting new innovations thus, wanted to learn more knowledge and skills while farmers with a low level of education and less-experienced may take less risks thus uninterested to trainings. This proved the findings of Okwoche *et al.* (2015), who observed the positive relations between years in schooling and training needs of livestock farmers in Benue State, Nigeria. The coefficient for the number of training attended for

the past 5 years was negative and highly significant. This suggests that the higher number of trainings participated in by the farmers, the less the training needs. This is expected because farmers who have attended various trainings from the past five years have already gained knowledge and skills in the areas of need identified. This contradicts the findings of Adesoji *et al.* (2006) who concluded that the more the training attended before, the more the training needs of Fadama farmers in Nigeria. This is obvious in that if training attended meets the immediate needs of an individual, that individual would want more training so as to meet future needs.

The coefficient for farm size was positive but no significant impact on training needs. Big scaled-farm owners/operators seemed to need more knowledge in the areas of need identified training in order to be more productive and efficient. This conforms the findings of Owona Ndonga *et al.* (2010) which showed that the size of rubber farmland had a positive but no significant impact on farmers' training needs. Large farms desire to acquire knowledge in order to improve their production and be able to pay for farm inputs such as the hired laborers.

The coefficient for tenurial status was negative and also not significant. This infers that farmers who lease land for farming have lesser training needs than the landowners. This may be related to land ownership. Empirical evidence suggests that farmers who lease land for farming are less likely to invest in land improvement activities (Abdulai *et al.* (2011). This may be due to lack of security and absence of sufficient incentives for and returns from investment, thus farms operated by lessors run inefficiently (Otsuka and Hayami (1988). Land ownership is likely to raise investments and so with the farmers' training needs for the efficient use of farm inputs and improved technology.

The coefficient for access to high yielding planting materials was positive and highly significant at 1% level of probability. This implies that any increase in the access of high yielding planting materials will lead to increase in training needs among the farmers in the study area. This is expected as sugarcane farmers need knowledge and skills on how to select and grow the new varieties.

Therefore, the result of the hypothesis which states that the socio-economic characteristics of sugarcane farmers do not influence their training needs is rejected.

CONCLUSIONS AND RECOMMENDATIONS

A number of training needs in the survey area was identified which indicates a gap in farmer's knowledge and actual information. This needs to be addressed through designing and developing a training module. The SRA and the Davao MDDC can re-orient their training schedule and subject matter based on the findings to deepen farmer's knowledge on improved farm production technologies in sugarcane farming.

Farmers' high need for training on fertilizer and soil fertility management could be attributable to the recent quest for soil rejuvenation by the Philippine Department of Agriculture. Therefore, a training module should be developed on soil and nutrient management for sugarcane production. In the training schedule, the following should be included: types of fertilizers, computation, proper application to increase fertilizer use efficiency, trash mulching and the application of mudpress to increase organic matter in the soil, soil nutrients (NPK) and its mobility as plant grows and soil pH as it influences the availability of nutrients in the soil. Farmers' need for training on the selection of variety especially on the drought/water resistant variety could be due to the detrimental effect brought about by climate change in sugarcane farming. Thus, a training module should be developed for Variety Selection with consideration to choosing the varieties with high yield, disease resistance and adaptable in the district. Improper choice of the variety would result in low productivity, even when adequate quantities of inputs are applied.

A training module should also be developed on care and maintenance for sugarcane to cover weed and disease management. The former, with more focus on the development of an integrated weed control management. While in managing disease control, emphasis should be on the cultural practices as expressed by the farmers. These include planting of resistant varieties, using clean seedpieces, treating seedpieces, practicing good farm hygiene by minimizing the incidence of alternate hosts such as the coarse grass, and roguing and burning of infected stools.

A training module on how to increase accumulation of sugar in the crop is also worth recommending. Actually, there are many techniques, but for Davao mill district, seizing fertilizer and irrigation before harvesting should be given attention. No N fertilizer should be applied a few months before harvesting for plants to mature and

become ripe. Likewise, withholding irrigation before harvesting is also important for inducing maturity in sugarcane by reducing the rate of vegetative growth, dehydrating the cane and forcing the conversion of total sugars to recoverable sucrose. Imposing water stress during the maturation phase increases sucrose yields.

A mill tour should be included in the training program coupled with lecture on sugar processing. The production sharing system in the district should also be taught to the farmers. Training schedule should include the current situation of the sugarcane industry in the domestic and world markets as this may contribute to their decision-making in their farming business.

Farmers also gave preference to other livelihood activities such as food processing for sugar-based by-products such as muscovado sugar, vinegar and wine making and raising of other crops as training needs to undertake diversified agricultural activities since it may supplement family income. Therefore, training schedules for livelihood programs should include the development of product quality, product packaging and marketing. These technologies could be sourced from the Department of Science and Technology. While for raising other crops, technology on swine, corn, poultry and cattle production must also be disseminated to the farmers. Training modules on these technologies could be taken from the Bureau of Plant Industry and Bureau of Animal Industry.

Most of the training activities should be provided in the months of May, November and December before the start of milling when farmers are not busy in the farm and have enough time to attend such activities. Most of the sugarcane farmers preferred one-day training and half day however, in the morning and to be conducted at the Barangay Hall. Farmers prefer more practical training methods to enhance their learning experience although some farmers also preferred formal research lecture with the OPSI Core group which indicates that a scientific way of sugarcane production is also appreciated.

Abdulai, A., V. Owusu and R. Goetz. 2011. Land tenure differences and investment in land improvement measures: Theoretical and empirical analyses. *Journal of Development Economics*, 96: 66-78.

Adesoji, S. A., A. J. Farinde and O. A. Ajayi. 2006. Assessment of the Training Needs of Fadama Farmers for Future Agricultural Extension Work

The study concludes that there were significant relationships between farmers' characteristics and their training need. Variables such as age, the number of trainings attended in the past 5 years and access to HYVs were found significant to explain farmers' training needs. Training could be effective by targeting older farmers because they seemed to be more receptive to technologies although young farmers also need to be trained due to succession in sugarcane farming. Training should be provided to those farmers with few or no training at all to increase their knowledge and skills.

The study also recommends to assess the interventions given to the Davao MDDC particularly the nursery farms under the Rapid Propagation and Distribution Program of SRA especially on the accessibility of HYV seeds. One way to induce farmers to adopt improved technology is by making it accessible. Padilla-Fernandez and Nuthall (2001b) observed that the difference in the adoption of modern technology by the large farms and the small farms is not caused by the technology itself, it being neutral to farm size, but in the differences in the degree of access to modern technology. It also recommends for SRA and the Davao MDDC to increase extension contact and develop training modules and re-orient training schedules with training needs expressed by the farmers to improve the farm practices and productivity in the study area.

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