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Needs for Terengganu Sweet Melon Growers for Quality Production using Fertigation System

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ABSTRACT

The Terengganu government needs 100 more fertigation growers of Terengganu Sweet Melon (MMT), to meet the European market demand. Undocumented local growers' needs for MMT fertigation farming hinder the local government's efforts to retain and attract new local growers. Hence, this study's objective was to explore the needs of MMT growers using the fertigation system for quality production in Terengganu. This qualitative study used semi-structured interviews complemented with Participatory Research Appraisal (PRA) tools for data collection. Through purposive sampling, 13 MMT growers volunteered as the study informants. The thematic analysis of the semi-structured interviews extracted six themes on growers' needs. Almost all growers acknowledged MMT has promising prospects for its high market price and cost-effective fertigation system for quality production. However, they expressed six needs to help retain and support MMT fertigation technology adoption for quality production. All growers received a lack of technical consultancy; thus, their top urgent need was the advisory services on the technical knowledge and skills on MMT, fertigation system, and pests and diseases controls. Lack of financial support was also their urgent need for financial assistance to initiate, operate and maintain the high-cost infrastructure of the fertigation farming system. Different roles of agricultural-related and financial institutions were crucial to support their need for professional development, resources, and fertigation farm upscaling. In conclusion, MMT fertigation growers identified six needs that must be addressed for quality production. Their major needs were the technical advisory services on MMT and fertigation system, and financial assistance. Thus, the Terengganu government may incorporate the study findings to formulate an attractive policy for relevant government and NGOs' roles to provide the relevant extension and advisory services, professional development packages, and friendly resources aid for the advancement of existing growers and to solicit new growers' participation.

Keywords: Technology adoption, extension advisory services, Participatory Research Appraisal (PRA), fertigation system, sweet melon growers

INTRODUCTION

Terengganu Sweet Melon or locally known as MMT originates from Terengganu, Malaysia (Muhamad et al., 2018). This variety was developed through a collaboration between a group of fertigation specialists with the Terengganu Department of Agriculture (2021). MMT is one of the rock melon species from the Cantaloupe family with smooth yellow-golden skin with orange-colored flesh (Muhamad et al., 2018). This local government has demonstrated its commitment in many initiatives to increase MMT production including opening and expanding more local fertigation farms for MMT cultivation programs (Bernama, 2017). Joint ventures with a local university to train new young farmers in special fertigation programs, and local agencies commitment are also part of these initiatives.

The introduction of technology innovation in agriculture, such as fertigation systems, is not only meant for higher and quality farm production (Yang et al., 2020; Sravani et al, 2020), but also aimed at resource conservation technology that can control optimum time to root zones and customization use of water, fertilizer and nutrients (Yang et al., 2020; Sravani et al, 2020; Kant & Kafkafi, 2013). Fertigation, also known as drip irrigation, was invented to address the limitations of conventional agricultural practices that frequently involve the overuse of resources that lead to environmental pollution in the long run (Yang et al., 2020; Sravani et al, 2020). Past studies showed that large-scale adoption of fertigation for crop production could save water used (Bafdal et al., 2020; Patel & Rajput, 2019). Recognized as a resource conservation technology for high agricultural production (Yang et al., 2020), fertigation farming is an attractive tool to farmers in many ways; for instance, the highly promising return of investment through higher crop yield coupled with reduced operating cost due to optimal use of fertilizer and nutrients, and reduced labor cost and maintenance resulting from the automated farming system. However, during this study (as of 2020), only 24 MMT loyal growers adopted the fertigation systems. Through an initial face-to-face interview with one of the current growers, several reasons may explain the small numbers of growers in the local MMT production sector. Expensive physical fertigation with rain shelter infrastructure was the major constraint identified by the grower that makes this farming production sector unattractive to potential growers. The growers also faced challenges that included a lack of financial resources for farm upscaling due high cost of fertigation infrastructure, and difficulty in standardizing the MMT quality using the modern farming system. Further, the growers also faced difficulty acquiring product quality assurance certifications like Malaysia Good Agricultural Practice (myGAP). Many studies also reported the promising advantages of this system on crops and fruits in terms of higher yield and quality (Yang et al., 2020; Sravani et al, 2020; Bafdal et al, 2020; Tahir et al., 2020; Suhaimi et al., 2016) thus the high Return of Investment (ROI). Nevertheless, there is still lacking information on the growers' needs to confidently support them to achieve high sustainable production of MMT fertigation for the Terengganu state mission could be manifested.

Thus, the purpose of this study was to explore the needs of MMT growers using fertigation systems for high production in Terengganu. This study can provide critical information to facilitate understanding for the Terengganu government on how to attract more local people to become MMT fertigation growers, and a useful guide for the state government to generate necessary solutions to support farm upscaling among MMT growers.

MATERIALS AND METHODS

Research design, population, and sample

This study employed a qualitative approach with the researchers as the instrument assisted by semi-structured interviews and complemented with Participatory Research Appraisal (PRA) tool (Campbell, 2001). The individual grower served as the unit of analysis in this study. The PRA was employed to enquire the growers' needs by identifying their problems to achieve high production in MMT fertigation farming in a diagrammatical approach. A pilot test on the semi-structured interview guide and the selected PRA tools was done on January 25, 2020, at the volunteer grower's house as requested.

The study location was Terengganu. The study population was the registered members of Cooperative of Terengganu Sweet Melon Growers Limited or Koperasi Pengusaha Melon Manis Terengganu Berhad (KOPMET). This population was selected as it was the only cooperative MMT grower organization in Malaysia around 2020, with the majority dedicated and sustained to planting sweet melons since 2015. The list of growers' names was compiled with the help of a board member of the Cooperative. The purposive sampling technique as recommended by Merriam and Tisdell (2016) was employed to select study informants that reflect the study population. The sample selection criteria were active growers during the data collection and at least having the experience of more than a year of adopting MMT fertigation.

Data collection and analysis

With the researcher as the study instrument, a semi-structured interview and three PRA Tools were used to collect data for the study as presented in Table 1. Prior to the data collection, the MMT growers were contacted through telephone calls and WhatsApp messaging to verify meeting study sample criteria, to solicit their voluntary participation, research briefing, interview approval and meeting arrangement. The semi-structured interviews were performed face-to-face using the local language, Malay with Terengganu slang as per recommended by Nguyen et al. (2006) to use the informant's local language and dialect, and at their most convenient time and places, either on their farm or at their home. Prior to the data collection, a pilot test for the study instrument was conducted for about two hours on January 2020 with one MMT grower at his home in Besut.

Table 1. PRA Tools and its Expected Data

PRA Tool	Expected Data
Problem Ranking	Identify growers' needs by assessing and ranking their problems
Problem Tree	Identify growers need by identifying possible causes of each problem
Venn Diagram	To identify the institutions/organizations existing surrounding MMT grower's community, and define the linkage between those with the community

Data collection took one month from February 1st., 2020 to February 29th, 2020. As the informants requested, the interview sessions were frequently at either their home, farms or outdoors. All semi-structured interviews were recorded using Sony ICD-PX470 Digital Voice Recorded and the interviews lasting from 40 minutes to one hour. These interviews were then transcribed verbatim into Microsoft Words and then analyzed using the thematic analysis (Connor & Gibson, 2013).

Data analysis using the thematic analysis was done manually in six steps as proposed by Nowell et al. (2017) and Connor and Gibson (2013). First, read all 13 verbatim transcripts to familiarize with the data. Second, generate initial codes that capture the qualitative richness that represent the grower's need to achieve high production in MMT fertigation farming adoption. Third, search for themes by sorting and collating all the potentially relevant coded data and then generated into meaningful themes. Fourth, reviewing themes for refinement to ensure a manageable set of significant themes that succinctly summarize the text reflect the evidence in the data set as a whole and distinctly differentiate the meanings. Sixth, producing the report. This study exercised ethical consideration as recommended by Nowell et al. (2017) in regard to the sensitive information revealed during the interview at different stages. Prior to the data collection, the volunteered informants signed a consent form after they agreed to voluntary participated in this study.

RESULTS AND DISCUSSION

Background of growers

Thirteen MMT fertigation growers in Terengganu voluntarily participated in this study. The growers were dominantly males (69%). Their age ranged from 27 to 62 years old, with the average age being 45.5 years old and the majority (39%) fall between 51-60 years old. Youth Societies and Youth Development (Amendment), Act 2019 defined youth cohort groups in Malaysia are those between the ages of 18 to 30 years; hence, only 15 percent of the MMT growers are young. These results suggest that local government initiatives were not yet successful in attracting young people to join modern farming like the MMT fertigation system. Further, the informants had different educational levels, with slightly more than one-half (54%) earning Malaysia Certificate of Education and Malaysian Higher School Certificate. Interestingly, most growers (85%) revealed their former occupations were not associated with agriculture, for instance, Engineers, Architects, and Soldiers. Almost all (92%) were doing MMT planting as full-time jobs. Regarding the farming experience, about 69 percent of them embarked on MMT fertigation in 2016. It was understandable that 62 percent of them stated four years of experience in MMT planting using the fertigation system with rain shelter.

MMT growers' need to ensure high production through fertigation farming system

Generally, this study revealed that the MMT growers experienced six problems that constrained their target for quality MMT production using the fertigation farming system. These problems reflect their needs to be fulfilled to achieve high and quality produced through MMT fertigation. Table 2 presents the experience of all growers (100%), lack of technical consultancy, and lack of financial support on rank 1stand rank 2nd, respectively, on the major problems that constrain their capability for high MMT production through the fertigation planting system.

Table 2. Problem Ranking and Needs for High MMT Fertigation Production among Growers

Problem	Needs for High Production of MMT Fertigation	Headcount (%)	Rank
1. Lack of technical consultancy	1. Extension Advisory services on fertigation system, MMT agronomy, and pests and diseases management for high quality MMT	13 (100%)	1
2. Lack of financial support	2. Friendly financial assistance to initiate and upscaling expensive infrastructure of MMT fertigation system	12 (92.3%)	2
3. Lack of MMT buyers for wholesale purchase	3. Product marketing assistance for wholesale quantity promptly after harvest (niche market not selling)	7 (54.0%)	3
4. Inadequate Institutional Supports	4. Conducive ecosystem with governmental and non-government agricultural agencies to support the advancement and upscaling of MMT fertigation growers	7 (54.0%)	3
5. Lack of trained and hardworking farm workers	5. Trained, dedicated and permanent farm workers to speedy the MMT fertigation farming process	6 (46.2%)	4
6. Lack of proper transport for selling MMT	6. Availability proper transportation enables marketing for bulk fresh MMT farm produced to market	5 (38.5%)	5

Note: n=13 informants

Table 2 also shows that difficulty in securing MMT buyers (54%) and inadequate institutional supports (54%) were on the 3rd in the problem ranking. The lack of trained and hardworking farm operators (~46%) was ranked 4$^{th.}$ while incapacity of proper transportation (~39%) was ranked 5th in problem ranking among growers. The

rest of this section presents and discusses the six problems thus needed for high MMT fertigation production as the reality experienced and perceived by the registered MMT fertigation growers of KOPMET in Terengganu.

Theme 1: Extension advisory services on fertigation system, MMT agronomy and pests and diseases management for high quality MMT

Figure 1 shows that lack of technical consultancy was the major problem hindering the MMT growers in Terengganu from achieving their high production using the fertigation system. In fact, they claimed that receiving poor technical consultancy had severe implications to the production quality and quantity. Since they experienced a lack of technical consultancy, they endured low production and reduced quality of MMT fruits. Another interesting finding captured in this study, all thirteen growers classified the technical consultancy needs into two categories, namely, the technical consultancy on operating MMT fertigation with rain shelter and the technical pest and disease for MMT fertigation. Referring to the former, their needed consultancy ranges from the planting process to harvesting MMT which includes advice on site selection, the precise combination of nutrients and water in growing melons and a harvesting guide to avoiding loss on MMT yield production. Due to a lack of knowledge and skills on pest and disease management among growers, they were struggling to handle pests (E.g.: rats, aphids, thrips, whiteflies) and disease attacks (E.g.: powdery mildew, gummy stem blight) on their MMT farms that they recognized their need for consultancy services to address the problems.

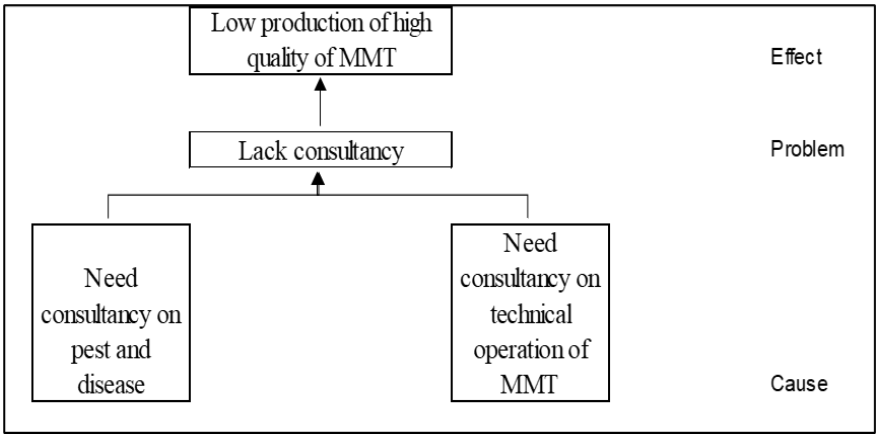

Fig. 1. Problem Tree on Lack of Technical Consultancy with its Cause and Effect towards High MMT Production through Rainshelter with Fertigation System

Growers expressed their frustration with problems related to the MMT fertigation production system due to a lack of consultancy for the technical operation of MMT. As verbatim iteration by Grower 1 on the need for technical advisory for site preparation,

> "When one wants to plant, one first needs to know the A.B.C of planting. If one doesn't have the knowledge, one just does it. We should give advice. This advisory consultancy must be given starting from the site preparation. …"
>
> (Grower 1, Male, 53 years old, 6 years planting experience)

Grower 13 expressed his frustration on the fruit cracking issue due to the absence of guidelines for MMT harvesting suggesting the urgent need for technical consultancy service on MMT fertigation planting to reduce loss in production. As Grower 13 verbatim statement:

> "… MMT maturity is earlier [than the rock melon], 10 days early. So, for the first planting time, I followed the Rock Melon guideline, and the fruits cracked, cracked, cracked. And then the buyer came to test, 'these fruits should already be harvested earlier' ".
>
> (Grower 13, Male, 35 years old, 4 years planting experience)

The technical advisory services on pests and diseases were urgently needed and these needs were expressed by all growers. They believed MMT plants and fruits were pruned to many diseases. For instance, these needs were iterated verbatim by Grower 3:

> "… He/she told all about the diseases. They exist, powdery mildew, and many others, he/she mentioned. But when he/she saw the disease on the plants, 'What's this?' He/she did not know what that was. …"
>
> (Grower 3, Male, 50 years old, 4 years planting experience)

As expected, all growers needed consultancy services to control pests and diseases as well as the technical operation to produce high quality MMT, and this finding corresponds to Lee and Coughlin (2014). Incrocci et al. (2017) study also reaffirmed the need for MMT growers in Terengganu for technical consultancy for optimized fertigation management. Fertigation management addresses crops' needs at different phases of crop development, and minimizing nutrient losses requires the expertise and experience of relevant experts with a scientific background. The need for extension advisory services on the MMT fertigation system, particularly on pests and diseases, reinforced those findings of Tahir et al. (2020) ecology study on MMT plants. They reaffirmed that pests and diseases attack was one of the main limitations in the high production of MMT cultivation in Terengganu. Zainol et al. (2021) study also corroborated these study findings that not only threats of pests and diseases constrain MMT high production but also lack agronomy knowledge and proper practices among growers.

Theme 2: Friendly financial assistance to initiate and upscaling expensive MMT fertigation system infrastructure

Figure 2 displays the Problem Tree that visually captured the cause and effect of lack of financial support as experienced by almost all growers. Despite many advantages of rainshelter combined with a fertigation system, the growers recognized this planting system was an expensive and high-cost planting system. Further, when coupled with a lack of financial support, as experienced by almost all growers refrained from initiating and upscaling their farm size and operating the fertigation system to increase MMT production.

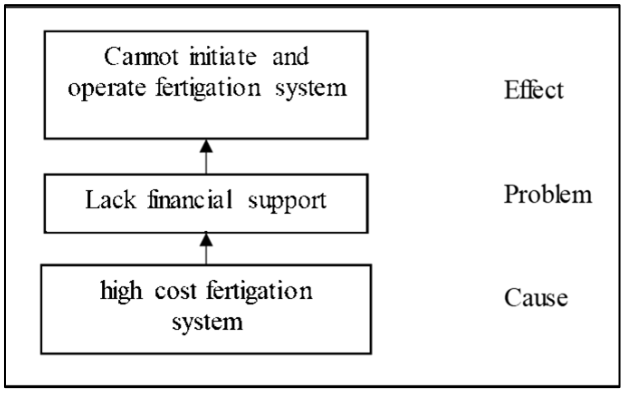

Fig. 2. Problem Tree on Lack Financial Support with its Cause and Effect towards Needs for High MMT Production through Rainshelter with Fertigation System

From the recorded interview sessions, as examples, two growers succinctly mentioned these interrelated issues of lacking financial support affected their goal for high production in their own verbatim statements.

> "… this system. This system ah, capital, if one wants to adopt this system, it surely needs a large amount [capital]. In one unit [rainshelter combined with fertigation system], RM60,000 together with built-in roof. For … huge rain shelter scale size."
>
> (Grower 2, Male, 29 years old, 4 years planting experience)

> "If there is no capital, no job … project will not be able to be implemented. …"
>
> (Grower 1, Male, 53 years old, 6 years planting experience)

This study offers further reaffirmation to studies by Zainol et al. (2021) and Greenland et al. (2019) that a high-cost technology causes low adoption among farmers. Zainol et al. (2021) case study demonstrated that successful high MMT production was constrained by the high cost of farm infrastructure on fertigation system with rain shelter compounded with other farm operating costs that include equipment, maintenance and agricultural inputs. These MMT growers also needed financial support and fund to initiate and operate the high-cost fertigation system. These findings are supported by Mohamed and Temu (2008), Lee and Coughlin (2014) and Mwangi and Kariuki (2015). This finding is also supported by Chandran and Surendran's (2016) study on the constraints experienced by farmers, the particularly high initial cost of farming. Likewise, Greenland et al. (2019) investigation demonstrated that high-cost new technology, such as climate-smart agriculture (CSA) could slow down adoption among Australian farmers regardless of whether the technology provided solutions for sustainable water supply to farms. Further, farmers' insufficient financial resources, coupled with limited access to capital investment for set-up, maintenance, and operation, reduce the rate of technology adoption (Greenland et al., 2019).

Theme 3: Product marketing assistance for wholesale quantity promptly after harvest

The third rank problem reported by slightly more than 50 percent of growers was the lack of MMT buyers. As illustrated in Fig. 3, the informants argued that the availability of MMT buyers was crucial to remove the marketing burden so they could concentrate on the farm operations for high production. Another significant fact was that they specified the importance of wholesale buyers who were willing to buy a large quantity of MMT after harvest to support their high production.

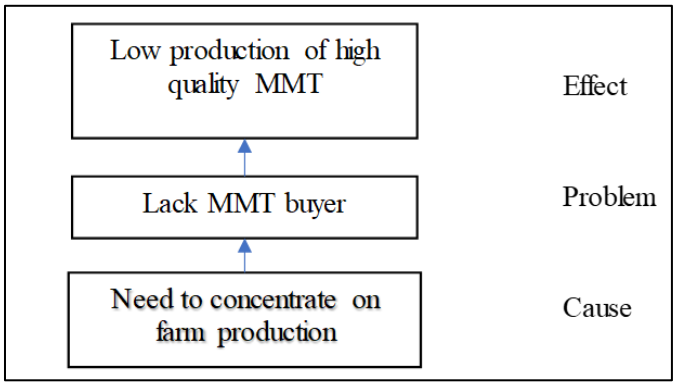

Fig. 3. Problem Tree on Lack MMT Buyers for wholesale purchase with its Cause and Effect towards Needs for High MMT Production through Rainshelter with Fertigation System

Growers 1 and 6 argued and justified their situation of lacking MMT buyers for wholesale purchase as in the following verbatim narration:

> "… concentrate on the planting operation. So, when we …you plant, you sell, you can't concentrate…"
>
> (Grower 1, Male, 53 years old, 6 years planting experience)

> "… other problems … is marketing because we only produce products when people want to buy … initially after the plot test we only produced MMT fruits, and there were buyers, TADC, at that time TADC Terengganu was first initiated.
>
> (Grower 6, Female, 40 years old, 4 years planting experience)

Issues in marketing MMT production as captured in this study was not new among MMT growers in Terengganu. Zainol et al. (2021) concluded that small scale MMT growers also recognized marketing MMT fruit

was a big challenge that must be solved to succeed in this industry. Being young, social media savvy, and having the proximity advantage location in the city of Kuala Terengganu and suburban (Marang and Kuala Nerus), unlike the marketing issues experienced by MMT farmers in this study, Zainol et al. (2021) informant easily resolved his marketing issues through offline—local fruit sellers and middlemen, and online--promoting and selling MMT on social media, that include WhatsApp, Facebook, and Instagram. Further, the informants of this study were dominantly seniors and owned farms away from the city into the rural areas also agreeing with those of Zainol et al. (2021), in terms of recognizing that MMT fruits are premium price and quality thus only meant for 'special customers'. This study also supported Corsi et al. (2018) findings that farm location may affect the demand and support of direct sales. These farmers were keen to remain focused on continuous production rather than small scaling in value-added processes. Among the insight that may be explained these farmers' preferences on products were the many limitations such as the need to have infrastructures for processing, packaging and delivery as illustrated by Boys and Frazer (2019).

Theme 4: Government and non-government agricultural-related institutions' roles in establishing conducive ecosystem support for the advancement and upscaling of MMT fertigation growers

Figure 4 is a Venn Diagram, a PRA tool that captured 11 institutions' roles surrounding MMT fertigation growers with various critical supports to their farming production processes. The different color indicates a different kind of support provided by the institutions that comprise government and non-government agencies. Contrarily, the size of the circle represents the degree of its support to growers. The larger the circle, the higher contribution of the institution supporting the MMT growers in production processes.

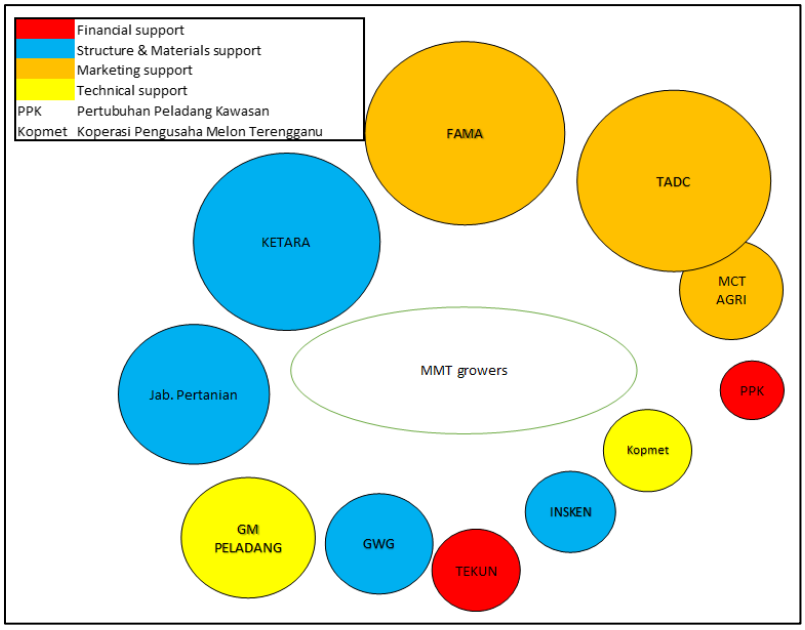

Fig. 4. Venn Diagram on institutions surrounding MMT growers in supporting their fertigation farm production process

Among the four listed supports, almost all MMT growers received support on structure and materials from one or more combination of government agencies. See the blue Venn Diagram in Fig. 4. This study refers to 'structure' as the infrastructure for a fertigation system with a rain shelter. Growers identified Integrated Agriculture Development Area Northern Terengganu (IADA KETARA) and Terengganu Department of Agriculture as the government agencies that provided the fertigation system infrastructure with rain shelter and the land. Growers also named the National Institute of Entrepreneurship (INSKEN) as an agency that can provide financial support to growers in building the fertigation infrastructure system with rain shelter. INSKEN

is a government agency under the Ministry of Entrepreneur Development and Cooperatives (MEDAC). Contrarily, the growers named a profit organization, Green World Genetics (GWG), to supply them with the materials, specifically, MMT seeds. They emphasized that GWG was the only company that sold MMT seeds. GWG is a profit-making research and development company specializing in high-quality seed breeding for a non-GMO tropical hybrid. IADA KETARA, Terengganu Department of Agriculture, INSKEN and GWG were specified verbally by Grower 2, Grower 7 and Grower 12 as the following:

> "… this place. All physical building structure, [owns by] KETARA".
> (Grower 7, male, 41 years old, 4 years planting experience)

> "… [physical structure] Department of Agriculture owns it. The land also belongs to the Department of Agriculture".
> (Grower 12, male, 62 years old, 3 years' planting experience)

> "… yes, GWG. [supply MMT] only the seed. …"
> (Grower 2, male, 29 years old, 4 years planting experience)

Marketing MMT produced was the second most needed support identified by most of the small-scale MMT growers. They highlighted that their produced marketing was dominantly assisted by a state government agency, Terengganu Agrotech Development Corp Sdn. Bhd. (TADC) and federal government agency, Federal Agricultural Marketing Authority (FAMA). In addition, a few farmers mentioned the relatively smaller role of MCT Agriculture Sdn. Bhd. in assisting them to market their MMT produced.

This study unveiled that farmers organization play a crucial role in facilitating the diffusion of innovation like MMT farming fertigation. GM Peladang, a local farmer organization, was mentioned relatively more times than other agencies like Terengganu Department of Agriculture and IADA KETARA by the informants as the organization responsible in providing a comprehensive training package on MMT farming with a fertigation system. To some extent they were exposed to the basic technical knowledge and skills to operate fertigation with rain shelter for MMT farming. In contrast, many of them did not attend formal training, instead they social learning and learning by doing from other MMT growers. Growers 1 verbally iterated that:

> "I enrolled into a training with GM Peladang, Kuala Ibai. At that time, it was a special training on planting MMT using the fertigation system, 10 days …"
> (Grower 1, male, 53 years old, 6 years planting experience)

This study also identified three agencies, namely INSKEN, TEKUN, and PPK were able to meet the MMT growers' need for financial assistance. These financial needs are frequently used for rolling capital and upscaling their farm size. The role of INSKEN was mentioned earlier to support the growers in financing the costly MMT fertigation rain shade structure that costs them up to RM40,000.00.

> "… [we're] are lucky INSKEN helps us. [INSKEN], gave us RM20K, …then RM40K …. [INSKEN] gave us the [physical structure] costing RM40K, then RM20K …"
> (Grower 1, male, 53 years old, 6 years planting experience)

Besides INSKEN, a few growers mentioned the financial importance of TEKUN Nasional and PPK. In the interview, Grower 13 mentioned TEKUN Nasional and District Farmer's Organization (Pertubuhan Peladang Kawasan, PPK). Receiving financial assistance in the form of grants and loans was helpful to get the MMT growers sustained in the industry. This study offers all the possible names of entities and agencies that created a conducive environment for facilitating the adoption and advancement of the MMT production sector among small holder growers in Terengganu. These entities include the supplier inputs such as GWG and other related government agencies (Zainol et al., 2021) for instance, IADA KETARA, GM Peladang, FAMA, TADC, INSKEN, TEKUN Nasional and PPK. Sobhia et al. (2021) classified INSKEN and TEKUN Nasional as rural financing entities that have a positive relationship with agricultural technology adoption like MMT fertigation.

Similarly, Ismail and Daud (2021) also proved that INSKEN and TEKUN National as significant agencies facilitating agriculture entrepreneurial capacity among the B40 community. TADC, the Terengganu state 'trading house' for agriculture produced for farming communities for local and overseas markets; its role was also demonstrated by Arumugam and Shamsuddin (2014) as the trading agent in Terengganu for rock melon contract farmers in early 2000s.

Theme 5: Trained, dedicated and permanent farm workers to speedy the MMT fertigation farming process

The availability of trained and hardworking farm workers was also identified by growers. Figure 5 presents the problem tree if growers experience a lack of trained and hardworking farm workers and its multi-level effects that hinders the high production of MMT through the fertigation system. Six growers identified their need for trained and hardworking workers to meet the high MMT production through the rain shelter with a fertigation system. This need was crucial since they argued unskilled workers caused damage to MMT plants. These growers also explained that they had to put up with difficult workers who were uncommitted to doing work.

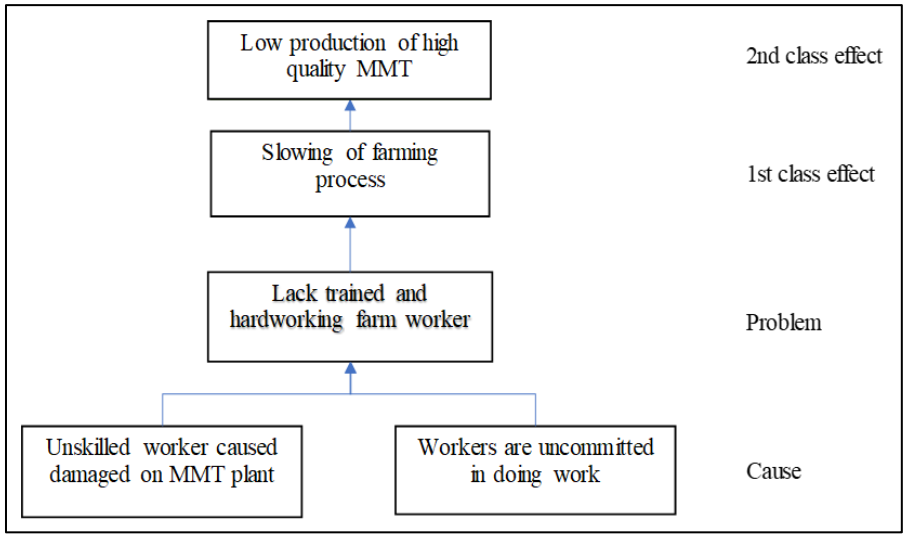

Fig. 5. Problem Tree on Lack of Trained and Hardworking Farm Workers with its Cause and multi-level Effects toward Needs for High MMT Production through Rainshelter with Fertigation System

Grower 7 and 3 explained their need to train unskilled workers, which consumed their time:

> " [the worker] must be taught, need to be educated. Only those who are familiar with this job can be hired. Otherwise, the plants can be completely ruined."
> (Grower 7, male, 41 years old, 4 years planting experience)

> " … must be educated first. Sometimes these young people are mostly playful rather than do the work. Do you know what I meant by playful? Mobile phone in their hands, work … could not finish wrapping even one row of the [MMT] vines to their trellis, this continues till noon, fiddling with their mobile phones".
> (Grower 3, male, 50 years old, 4 years planting experience)

The MMT growers' need for trained and hardworking farm workers was a valid requirement to ensure high MMT production through the fertigation system. While labor was needed and included in the cost structure, Zainol et al. (2021) case study did not offer any detailed aspects of labor that facilitate the farming process. While the few studies on MMT growers in Terengganu nor Malaysia specified this need as a challenge, other agricultural-related technology adoption specified labor-related issues among growers indeed were among the

challenges constraining them from facilitating the farming processes. For this study sample, recruiting foreign workers was not an option due to the high cost of recruitment procedures, thus they have a high dependence on the local labor supply. It is important to highlight that these MMT growers were most likely to hire seasonal farm workers. Thus, the farm positions were likely not permanent. To reinforce job satisfaction and therefore sustain recruitment among farm workers, Moda et al. (2021) concluded farm owners should provide greater stability to their workers through training initiatives, workplace safety and health, and conducive working conditions and well-being. Yuan et al. (2021) illustrated that 'farmers' endowments affected fresh growers' intention to adopt the high-cost fertigation technique. Their study included the labor force as a measurement item in 'farmers' endowments'.

Theme 6: Availability of proper transportation enables fast marketing for bulk fresh MMT farm produced to market

Almost 50 percent of MMT fertigation growers complained that they did not have the proper size vehicle to transport the MMT with the huge amount of MMT production either for direct sales in Farmer' Market or distribution to sellers to various and far location. Figure 6 presents the problem, cause, and effect of lack proper transport the need to facilitate their MMT high production.

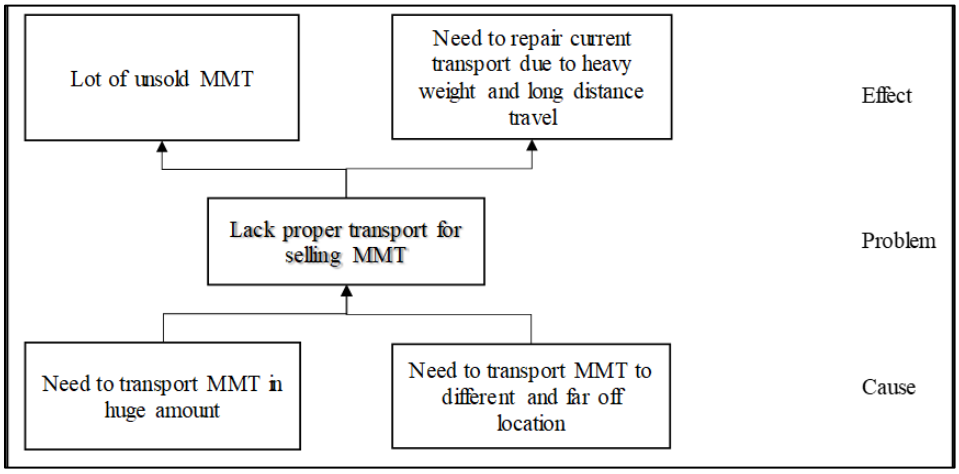

Fig. 6. Problem Tree on lack of proper transport for selling MMT

The need for an appropriate size of transportation to market MMT produced in fresh bulk up to 3 tons was succinctly iterated verbatim by growers for example, by Grower 1 and Grower 6 as the following:

> " … one more thing, … no vehicle to transport [MMT fruits] for sales. No [appropriate] transport"
>
> (Grower 1, male, 53 years old, 6 years planting experience)
>
> " … need to transport 500 kg, perhaps the minimum half a ton or 2 tones or 3 tons not worth it to use our own, but we need [proper] transportation. The problem is that we don't have the [proper] transport ".
>
> (Grower 6, female, 40 years old, 4 years planting experience)

Many local and overseas studies also reported similar challenges experienced by small farmers in transporting their fresh products in the supply chain (Zaridis et al., 2020; Maspaitella et al., 2017; Dreyer et al., 2016; Bacus et al., 2015). Likewise, Dreyer et al. (2016) reported small-scale local Norwegian farmers experienced fragmented and inefficient local supply chains for specialty foods that were affected by similar factors like cost, volume, and inaccessible suitable transport services. This study finding reinforced Bacus et al. (2015) on the importance of improved logistics and better-farm-to-market roads to small holder producers and other factors to ensure high value vegetable production has greater access to high value markets. Zaridis et al. (2020) suggested that these

transportation and logistics problems might reflect more profound issues in this MMT cooperative, specifically absent inadequate strategy in establishing horizontal and vertical supply chain collaborations and alliances to address the transportation, thus improving the agri-food waste. Contrarily, Maspaitella et al. (2017) deduced that neither transportation issues nor location (distance) was a massive problem for Manokwari small holder farmers in Indonesia in marketing their produce. Maspaitella et al. (2017) justified these non-issues may be explained by the availability of relatively food roads, adequate public transport, and membership of farmer groups that facilitate their participation in modern market channels.

Growers' needs were identified using PRA tools, specifically, Problem Ranking, Problem Tree, and Venn Diagram. While more than half of growers confirmed the need for consultancy, financial support, and MMT buyer, less than half of growers confirmed the need for farm workers and proper transport to sell MMT. This study summarized the needs of MMT growers in Terengganu to achieve high MMT fertigation production, as shown in Fig. 7. This study identified new findings of MMT growers need to concentrate on farm production rather than marketing, trained and hardworking farm workers to speed up the farming process, and proper transport for distribution and selling MMT to ensure high production of MMT. This study has one limitation. Since this study was a qualitative study, the findings were limited to be applied to the cooperative members of KOPMET or other similar organizations. Further, their MMT production experiences may differ from those who are not members of the cooperative.

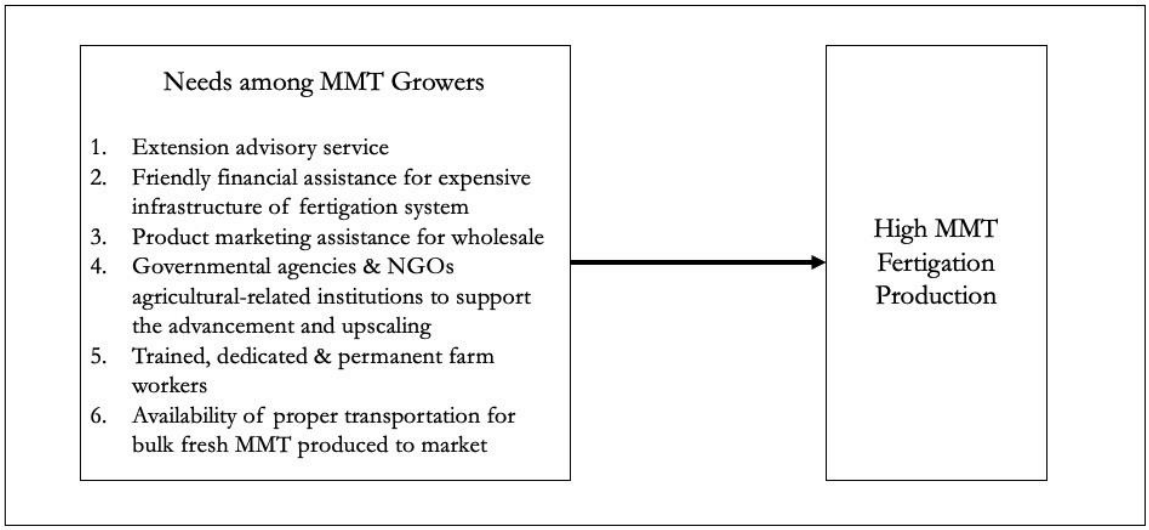

Fig. 7: Needs among Terengganu MMT growers to achieve high MMT production using fertigation system

CONCLUSION

This study concluded that six needs at varying degrees were crucial to be addressed for MMT growers to achieve high MMT production with a fertigation system. Their most critical need for high MMT production was a continuous extension of technical advisory services on handling MMT plants using the fertigation system and its pest and disease management. The availability of financial assistance to initiate and for upscaling expensive infrastructure of MMT fertigation was their second felt need. Their third felt need was the assistance in marketing for wholesale quantity promptly after harvest. Growers' fourth need was a conducive ecosystem of government and non-government agricultural institutions roles that help and support their advancement and upscaling of MMT fertigation high production. To speedy the MMT fertigation farming process, their fifth felt need was for trained, dedicated and permanent farm workers. Finally, the growers identified their sixth need for proper transportation to enable fast marketing of bulk fresh MMT farm products to the markets.

Several practical and research recommendations are derived from the findings that may support high-quality MMT fertigation production for Terengganu small and medium growers. The local government may incorporate these study findings in their strategic framework for relevant government and NGO roles to provide extension and advisory services, professional development packages, and friendly resources to aid in the advancement of existing growers and to solicit new growers' participation. To widen the market for wholesalers' MMT production, relevant agencies and farmers' organizations must help the MMT group secure GAP certification as a ticket to wider local and overseas markets. Further, the high price of MMT fruits requires loyal customers. Qualitative and quantitative studies should be performed to investigate the market segmentation in Malaysia's MMT market based on customer characteristics. These data should be incorporated into the MMT fruit development and fertigation systems to produce MMT quality fruits that meet the needs of loyal customers and position the market that can reach the target customers.

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