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# INSTRUMENT - ERGONOMIC ISSUES (IEI) INTEGRATING MIXED MODE OF RESEARCH IN INSTRUMENT CONSTRUCTION

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Oil palm plantations operations are labour intensive. Due to its remote habitation, mechanization is difficult to implement. There are several issues related to ergonomics in oil palm plantations. Inorder to measure the causative factors of ergonomics quantitative measurements are hardly ever exists. A cross-country study was conducted to identify the root cause of ergonomics issues in oil palm plantations, with an objective of defining properly the concept ergonomics issues, contextualizing the topic to oil palm plantations. The study followed mixed methodology integrating quantitative methods. Following the triangulation method, the study followed grounded theory, case studies and Delphi to identify and fix the variables in relation to ergonomics issues and further to test, the reliability and validity the study followed factor analysis. The outcome of the study is the development of an instrument that to measure ergonomics issues in oil palm plantations.

***Keywords:*** Ergonomics, workers oil palm plantations, instruments, work design, postures, Musculoskeletal Disorders (MSD)

## Introduction

Ergonomics is the branch of science, which deals with safe and comfortable machines for humans. The ergonomics approaches have given importance to the designs, which matcheswith the strengths and capabilities of workers that to minimize the effects of their limitations, rather than compelling them to adapt. We are aware that the three are so many issues related to the work-designs and leading to several psychosomatic disorders. Ergonomics covers all aspects of a job, from the physical stresses it places on joints, muscles, nerves, tendons, bones and the like, to environmental factors which can effect hearing, vision, and general comfort and health. Though such issues are well discussed in the manufacturing sector, very less number of studies reported in oil palm plantations. A Major factor behind such lack of information related to the ergonomics issues are due to lack of instrument to measure the causative factors. The outcome of the study is the development of an instrument that to measure ergonomics in oil palm plantations.

## Literature Review

### *Ergonomics Issues*

As the oil palm trees grow, the height at which the Fresh Fruit Bunches (FFBs) are located increases correspondingly. At 6–7 years old, the fruits of the palm tree are

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approximately 3 meters above the ground. At this time, the fresh fruit bunches cutter uses either a chisel or sickle, switching among the two depending on whichever is more convenient for performing the job tasks. For trees beyond 7 years old, the fresh fruit bunches cutter will only use a sickle. At the height at this age, they naturally tilt their heads upward in order to locate ripe fruits (Ng, *et al.,* 2013).

***Ergonomic Problems during Harvesting: FFB Cutter***

It has been pointed out by Kotowski *et al.*, (2009) that that oil palm harvesters are exposed to manifold ergonomics risk factors that leading to musculoskeletal disorders. This is factual in the case of fresh fruit bunch cutters stooping, that seems to be the most important posture at the initial phases of harvesting. Furthermore, for the period of cutting, the trunk and neck were also viewed to be somewhat rotated and being bent forward while the hand was vehemently pushing-pulling/swinging the chisel outside or across the body midline. The degree of the trunk flexion varies according to several factors, harvester's height, the height of the fresh fruit bunches on the palm trees and the work environment. In terms of work situation, the branches of fresh oil palm trees branch out in a canopy arrangement. This indirectly promotes further bending as harvesters avoid the pointy and sharp leaves of the palms which may cause cut-type injuries to the skin (Ng,, *et al.*, 2013). In the early stage of harvesting, the fresh fruit bunch cutter suffers especially from postural stress due to awkward postures and stooping in addition to forceful exertion and a rapid work pace. The body areas potentially affected during this harvesting stage are the lower back, upper back, hands and arms due to the nature of the job or task requirement, the worker harvests the oil palm fruit typically at knee level in the early stage (Ng,, *et al.*, 2013).

***Ergonomic Problems during Harvesting—FFB Collector***

The ergonomics issues are widely neglected by the plantations prior to the 20th century. It has been pointed out by Rainbird, *et al.*, (2001) that musculoskeletal disorders and ergonomics in agricultural were an area deserted despite being the ones that warrant substantial attention. Further, Chapman L, & Meyers J. (2001) report that the common view of health care providers was normally to emphasis on signs of pesticide exposure with the notion that musculoskeletal disorders occur in combination with agricultural manual work activities. Earlier reports have shown that harvesting tasks have been related to the risk of developing musculoskeletal disorders. These illnesses are typically the consequence of recurrent acquaintance to strain that develops slowly over time (Davis & Kotowski 2007). Mainly, pain in the hand, arms, shoulders, neck, back and waist are the most commonly reported symptoms in association with production agriculture (Kirkhorn, *et al.* 2002; Sesto M. 2012; Osborne, *et al.*, 2012). Several researchers have pointed out the risk

factor associated with the oil palm work. Risk aspects such as rapid, repetitive motions, sustained static loading, awkward posture, externally applied compressive forces and vibration or any combination of them have also been reported to be stressful to one or more body regions (Kirkhorn, *et al.* 2002; Sesto, M. 2012).

It is observed from the oil palm plantations that the plantation work is more labor intensive. It is reported that in the initial stages of harvests, a fresh fruit bunch cutter can weigh an average of about 5 kg. Though, as the trees become older, the size and weights of fresh fruit bunches increase. This growth can be correlated with FFB of the oil palm tree at >15 years old weighing as much as 50 kg. It has been pointed out by (Ng, *et al.*, 2013) in their study that during the initial stage of harvesting, the fresh fruit bunches cutter suffers particularly from postural strain due to awkward postures and stooping further to vigorous exertion and a high work pace. It is indicated that the body portion which would be drastically affected during this harvesting phase are the lower back, upper back, hands and arms due to the nature of the task or task requirement. Further referring to the injuries or disorders of the locomotive apparatus, the muscles, nerves, tendons, joints and cartilage, of the upper and lower limbs, neck and lower back, musculoskeletal disorders or work-related musculoskeletal disorders (Bernard BP, *et al.*, 2001) have commonly been associated with agricultural practices corresponding to rigorous labor-intensive work tasks in terms of a multitude of ergonomic risk factors (Fathallah, *et al.*, 2012).

Considering the related risk factors, the National Research Council and Institute of Medicine (2001) has proposed a conceptual model illustrating the complex interrelationship of workplace, organizational and social factors as well as individual factors that may contribute to the development of MSD. In addition, the harvesters may also concurrently be affected by different cultural, organizational, psychosocial and individual risk factors. Specifically, where foreign labor is involved, home-sickness, health and socioeconomic well-being of the family as well as smoking habit and being overweight may increase the risk of developing an MSD. These risk factors have been shown in various studies to be significantly associated with MSD (Bernard, *et al.*, 1995; Sesto 2012).

**Research Methodology**

In order to arrive at the instrument on ergonomics, this particular study follows mixed method of research. Mixed-Method studies have emerged from the paradigm wars between qualitative and quantitative research approaches to become a widely used mode of inquiry. Depending on choices made across four dimensions, mixed-methods can provide an investigator with many design choices, which involve a range of sequential and concurrent strategies. Studies that are products of the pragmatist paradigm and that combine the qualitative and quantitative approaches within different phases of the research process. (Tashakkori & Teddlie, 2008).

Mixed methods are inherently neither more nor less valid than specific approaches to research. As with any research, validity stems more from the appropriateness, thoroughness and effectiveness with which those methods are applied and the care given to thoughtful weighing of the evidence than from the application of a particular set of rules or adherence to an established tradition (Bazely, 2004).

**Qualitative Research Questions**

1. How do you define ergonomics?
2. What are the factors that closely related to ergonomics in general?

***Triangulation***

Triangulation refers to the use of more than one approach to the investigation of a research question in order to enhance confidence in the ensuing findings. Since much social research is founded on the use of a single research method and as such may suffer from limitations associated with that method or from the specific application of it, triangulation offers the prospect of enhanced confidence. Methodological triangulation is defined as the use of more than two methods in studying the same phenomenon under investigation (Mitchell, 1986). This type of triangulation may occur at the level of research design or data collection (Bums & Grove, 1993). This particular study followed grounded theory, case studies and Delphi as the triangulation methods that to identify and fix the variables and categories in relation to ergonomics.

***Grounded Theory***

Grounded Theory "is an in inductive, theory discovery methodology that allows the researcher to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data" (Martin & Turner, 1986, p. 141). Grounded Theory provides a detailed, rigorous, and systematic method of analysis, which has the advantage of reserving the need for the researcher to conceive preliminary hypotheses. It therefore provides the researcher with greater freedom to explore the research area and allow issues to emerge (Bryant, 2002; Glaser, 1978, 1992, 1998, 2001). The process of Grounded Theory encompasses an acknowledgment of the researchers' bias, the selection of a data collection site, the data collection process, the process of coding and analysis, and the compilation of results. Coding and analysis includes three stages: open coding, selective coding, and theoretical coding. Open coding employs constant comparison, memoing, and results in themes, sub-categories, and core categories. These results guide the subsequent sampling of participants through theoretical sampling. The next stage of coding – selective coding – also employs constant comparison and memoing. This stage results in dense, saturated core categories. The core categories are then sorted, written, theorized, and cross-referenced with

literature, during theoretical coding. The results of this last stage of coding are provided basic understanding the on concepts under study and a theoretical model. With the support of grounded theory methodology this particular study identified the factors and the themes related to ergonomics.

***Case Study***

In the initial stage, the researcher has conducted preliminary five case studies that to explore factors related to ergonomics. The case studies have supported the research to get a grip on the topic under study with the content. Thus the first criteria used by the researchers include the short interviews with the employees from different workers in the plantations and developed short case-lets.Based on the number of workers the study considered 5 workers incorporating the representation from all. Through the interviews short- cases have been developed. Case study interviews are often used as part of the initial assessment and arriving at explicit and implicit variables based on the topic under study.Some of the case study content, which supported the researcher to get some insight into the ergonomics and allied factors, has come up from case studies among the workers working in the oil palm plantations.

***Worker 1***

I'm Abbas Ali, 33 working in oil palm plantation almost 10 years. I have changed almost change 3 plantations. I'm working as a harvester for a contractor. I'm paid in "pajak" - piece rate as it depends on our hard work, and performance. I am putting my every effort to earn maximum from the plantation job, since I don't have any intention to stay back a few more years. I am separated from my family. I have to go back to my home country. I was very much healthy, when I came here. But due to heavy work and my interested to earn more made me to diminish my health condition. Since, due to heavy change in the climatic condition of in plantations like rainfall, humidity, and sunny days, and I used to face illness. Ignoring those illnesses, I have to work, or else, mandor terminates my work.

***Worker 2***

My name is Ali, 28 with 3 children and my wife working on daily bases with nursery at the plantation. I am working under the section on loading the palm oil fruit to the truck or lorry. It has been 6 years in the plantation. Wage is quite good compared with other task in the plantation, except harvesting. Monthly I can earn up to RM1300. I am engaged in loading and unloading activities of fresh fruit bunches. It creates heavy neck, shoulder and body pain, since the truck that is higher than me. One bunch of oil palm fruit is from 10kg -20 kg it is so difficult to carry to the truck. This is some time leading to conditions of breathlessness. Muscle crunch and Muscle pull are quiet common.

***Worker 3***

I have been working on the plantation job for the past 13 years. I am engaged in harvesting job. It is a tough job, as it needed healthy physique to bring down 20kgs to 40kgs of fruit from a tree, which very much taller than us. Due to our carelessness and some time because of poor equipments that we use in the harvesting activities, we are exposed to several physical injuries. For the first week when I start holding the long cutter " tumbak" my hand was bleeding and skin torn off and in plantations the is little facilities to get the right aid in right time. Walking with the long "tumbak" and heavy tool, we feel very much tired during the work. In order to reduce the high pacing, I have purchased a bicycle. But carrying heavy equipments and cycling together is very much tedious task.

***Delphi***

Delphi is one of the reliable qualitative research technique made by researchers with the expert opinion (Kumar, 2013). The methodology of research followed in this study was Delphi technique, which provided exploratory insight into major factors of task, tool and environment. The Delphi technique, mainly developed by Dalkey and Helmer (1963) at the Rand Corporation in the 1950s, is a widely used and accepted method for achieving convergence of opinion concerning real-world knowledge solicited from experts within certain topic areas. Predicated on the rationale that, "two heads are better than one, or...n heads are better than one" (Dalkey, 1972), the Delphi technique is designed as a group communication process that aims at conducting detailed examinations and discussions of a specific issue for the purpose of goal setting, policy investigation, or predicting the occurrence of future events (Ulschak, 1983; Turoff&Hiltz, 1996; Ludwig, 1997).

This research engaged semi-structured interviews. Based on the suitable time for the resource person interviews were arranged, during March 2013 to middle November 2013. Direct interview is conducted to gather information from the workers. 20 experts from the Plantation Managers, Plantation Workers, Mandors of Plantations, Officers of Consulate Indonesia, Contractors of Housing, Faculty Members and Dean of Social Sciences Universiti Malaysia, Sabah (UMS), MPOB officer and Research Scholars were identified and approached by email, meeting face to face or telephone and were invited to take part in the study. All the clarifications related to the objective of the study were made by the researcher. However, 30 experts were being interacted and communicated, only 20 experts shown their willingness to participate in the discussion. Finally, 20 participants were interviewed directly. The conversations taped recorded, and manually analyzed. The procedural steps in adopting the Delphi technique were as follows.

### *Expert Panel Identification*

The group of professional was made from specialists having high knowledge and expertise in plantation related. They are closely associated with plantation, as consultants, government body, Top-level managers, Professors, Researchers and Academicians. The specialized areas of these expert members include, 12 male members (60%) and 8 female members (40%). These dynamic groups of panel of experts are knowledgeable and familiar to give relevant opinions and an admissible understanding of the business incubation centers.

## Rounds

### *Round 1*

In the first round, the Delphi process traditionally begins with an open-ended questionnaire. The open-ended questionnaire serves as the cornerstone of soliciting specific information about a content area from the Delphi subjects (Custer, Scarcella, & Stewart, 1999).

### *The Questions*

1. How will you define ergonomics?
2. Which are the factors related to ergonomics in oil palm plantations?

### *Round 2*

In the second round, each Delphi member receives a second questionnaire and is asked to review the items summarized by the investigators based on the information provided in the first round. Accordingly, Delphi panelists may be required to rate or rank-order items to establish preliminary priorities among items. Because of round two, areas of disagreement and agreement are identified (Ludwig, 1994). In this round, consensus begins forming and the actual outcomes can be presented among the participants' responses (Jacobs, 1996). Information regarding the ergonomics collected from the experts. The process identifies 128 categories, which are having items with high and low proximity of task, tool and environment identified. Rating process further identified in the categories and items identified.

### *Round 3*

In the third round, each Delphi panelist receives a questionnaire that includes the categories and items ratings, summarized by the investigators in the previous round and are asked to revise his/her judgments or "to specify the reasons for remaining outside the consensus" (Pfeiffer, 1968). This round gives Delphi panelists an opportunity to make further clarifications of both the information and their judgments about the relative importance of the categories and items. Second level

screening of the 128 categories, which were having a high and low influence on ergonomics identified with corresponding items. The process further identified 64 categories, which are having high and low proximity of the ergonomics identified. Classification of the items in 64 categories of 2 factors was being made with appropriate loaded items. Thematic presentation and the categorization of the items were done.

### *Round 4*

In the fourth and often final round, the list of remaining items, their ratings, minority opinions, and items achieving consensus are distributed to the panelists. This round provides a final opportunity for participants to revise their judgments. It should be remembered that the number of Delphi iterations depends largely on the degree of consensus sought by the investigators and can vary from three to five (Delbecq., Van de Ven, Gustafson, 1975; Ludwig, 1994). During fourth level, screening of the 31categories, which were having, items with high and moderately high proximity of the ergonomics identified. Sought the expert opinion on the appropriateness of the core factors selected for the study.

TABLE 1: ERGONOMIC FACTOR CATEGORIES

| *Ergonomics S/N* | *Factors* | *Categories* | *No. Items* | *No of Experts (N=20)* | *% of Experts* |
|---|---|---|---|---|---|
| 1 | Environment | Frequent Climate variations | 2 | 17 | 85% |
| | | High Humidity | 2 | 17 | 85% |
| | | Heavy rain fall | 1 | 16 | 80% |
| | | Dusty work atmosphere | 2 | 16 | 80% |
| | | Danger from Wildlife | 1 | 15 | 75% |
| 2 | Task | Harvesting hazard | 1 | 18 | 90% |
| | | Collecting heavy FFB | 2 | 18 | 90% |
| | | Pruning related hazard | 3 | 18 | 90% |
| | | Pesticide spraying | 2 | 18 | 90% |
| | | Herbicides spraying | 3 | 18 | 90% |
| | | Heavy use of fertilizing | 2 | 17 | 85% |
| | | Planting work | 2 | 16 | 80% |
| | | Too much walk-pacing | 2 | 18 | 90% |
| | | Loading & unloading heavy FBB | 2 | 18 | 90% |
| 3 | Tools | Poorly maintain equipment | 2 | 16 | 80% |
| | | Heavy equipment | 3 | 18 | 90% |
| | | Sharp equipment | 2 | 17 | 85% |
| | | Use of Long equipment | 3 | 14 | 70% |

The first factor considered for the study was the ergonomics problem in a plantation, which divided into three factors environment, task and tools, used in the plantation. The experts acknowledged 6 items for the environment, 19 items in

the task and 10 items for explaining the tools nature that's might affect the ergonomic of the workers. The major factor of environment consists of 5 categories. Frequent climate variations (85%) and high humidity (85%) the two major categories in an environment under ergonomic, identified by the experts in the related to plantation setting. Second categories like dusty work atmosphere (80%) and heavy rainfall (80%). And the final categories in environment related factor is the danger from wildlife (75%).

The second factor considered for the study was the task related directly to ergonomics. Within the second factor the experts identified 17 items that are closely related to Ergonomics. The major factor of task consists of 9 common categories. The table showed that harvesting hazard (90%), collecting heavy FFB (90%), pruning related hazards (90%), pesticide spraying (90%), herbicides spraying (90%), loading and unloading heavy FFB (90%) and too much walk's pacing (90%) as the prominent factor which closely knit with ergonomics issue among workers. Further the study pointed out the categories like heavy use of fertilizing (85%) and planting work (80%) impact of ergonomic issues need to be highlighted. Besides that, tool use in the field indirectly imposed or contributed to ergonomics issues as identify by expert by 10 items and 4 categories which involved heavy equipment (90%), sharp equipment (85%), poorly maintain equipment (80%), and use of long equipment (70%).

The final factor considered for the study was the tools related directly to ergonomics. The experts have identified 10 items and 4 categories closely related to ergonomics. The major issues highlighted by experts is a heavy equipment (90%), sharp equipment (85%), poorly maintain equipment (80%) and use of long equipment (70%).

## Ethical Considerations

In both the phases, the ethical considerations were well followed by the researches due to the sensitive issues related to the topic. This sensitivity is perceived from the point of 'workers'. Workers aspired to ensure their anonymity during all stages of research. The workers were assured that the summary data would not be disseminated to the management and further in no way the responses of them can be identified. It is also assured that the data will be destroyed keeping the documents after a reasonable period. Instead of the names of the workers the data coded with numbers to ensure the anonymity both in case studies as well as quantitative data collection procedures.

## Quantitative Research Method

For the purpose of testing the factors identified by the researcher through qualitative triangulation method, several statistical tools and methods employed. These include reliability and factor analyses to test the goodness of measures.

**Factor Analysis and Reliability Test**

Prior to any validity and reliability tests, the tests of assumptions for multivariate analysis will be conducted to ensure that the data met the normality, linearity, multicollinearity, and homoscedasticity assumptions. The next important step in data analysis is to understand the dimension of the variables in the proposed framework or relationships posited in empirical research (Hair *et al.*, 2010). In other words, factor analysis should be performed to identify the structure of interrelationship among a large number of items in the study. This may be done by defining common underlying dimensions, commonly known as factor (Hair *et al.*, 2010). Another purpose for performing factor analysis is to determine whether the data could be condensed or summarized into smaller set of factors (Malhotra, 2010). The dimensions of the scale were examined by factor analyzing the items using the principal components analysis with Varimax rotation. Minimum eigenvalues of 1.0 helped determine the number of factors or dimensions for each scale (Hair *et al.*, 2010). Although factor loadings of 0.30 to 0.40 are considered acceptable, however, factor loadings greater than 0.50 are generally necessary for the practical significance (Hair *et al.*, 2010). Hence, the items for a factor will be retained only when the absolute size of their factor loading is above 0.50.

To test the internal consistency of the measurement, reliability analysis is performed on the factors extracted using the benchmark suggested by Nunnally (1978). Generally, the closer reliability score gets to 1.0, the more reliable the scale would be. According to Nunnally (1978), the reliability score of 0.70 and above is acceptable and those above 0.80 are considered good. As noted by Peter (1979), reliability scores that less than 0.60 is still considered acceptable for social science studies. Following the literature, a reliability score of 0.70 is used as the benchmark for this study. It should be noted that all the negatively worded items in the questionnaire were first being reversed coded prior to the reliability test. In the case of coefficient alpha value is smaller than 0.70, the item with the lowest corrected item-to-total correlation is removed until then 0.70 levels are met (Pallant, 2001).

**Validity and Reliability**

Validity is the ability of a tool to measure what is supposed to measure. The validity of an instrument is the degree to which an instrument measures what it is intended to measure (Polit & Hungler 1993). Validity tests, then compare and measure the concept that a researcher supposed measure with its accuracy. Precisely the degree to which an instrument used by the researcher measures what he/she intended to measure. It is expected that the instrument should ensure content, construct and face validity.

**Dealing the Content Validity**

The objective of this phase was to get the agreements of experts on the concept, constructs and content of the items selected in the draft ‘ergonomics issues’ in oil

palm plantations. To get the content validity, in addition to the literature review, the study was incorporated triangulation method of qualitative research in which expert identification of the variables that selected under organizational and individual factors related to 'ergonomic issues' were made. The Delphi technique, content analysis, and short case study method followed thorough interviews and discussion techniques supported the researchers to ensure content validity of the variables considered for the study. Especially, the Delphi Technique followed in the research was supported to get the right content of each item that incorporated in the each factor. Thus, in general, the constructs and the content of the items were agreed upon with the correction and consent from the experts. Based on their comments on each parameter and items rewording of the items were made which was further fine-tuned for development of the instrument.

**Dealing the Face validity**

The study further ensured face validity by examining the instrument looks as though it is measuring what it was supposed to measure. Face validity is a necessary procedure in any instrument development process (Benson & Clark 1983). To get the face validity, experts in the field of management and human resources areas, statisticians, and academicians were identified. Thus the experts in the field of management and human resources areas, statisticians, and academicians were cross verified the face validity of the instrument. To end with, the construction of the items based on the concepts of the constructs, sub-constructs that developed out of the literature review and case interviews, was made. It was pointed out by the experts that in order to develop these items into an instrument mode, factor analysis to be conducted in the later stage. It was also suggested by the experts that the item's length, which was observed during the Delphi technique to be shortened before factor analysis application that ensure better understanding to the respondents.

**Dealing the Construct Validity**

To test the construct validity the instrument is well correlated to the underpinning theories like, job demand and resource theory, work stress, which were closely knit with the concept organizational factors and individual factors in relation to workers 'perception towards ergonomic issues that correlated to working condition. Validation of the instrument and the concept both were done on factors related to members 'Ergonomic Issues'.

**Reliability**

Reliability means the consistency or repeatability of the measure and the confidence we can place on the measuring instrument to give the same numeric value when the measurement will be repeated on the same subject. The purpose

of this procedure was to determine which items should be retained and which items should be dropped based on the values of the Cronbach Alpha (Creswell, 2008; Gall & Gall, 1998). A reliable instrument is one that would provide the identical results if used recurrently by the same group. When the researcher started qualitative research through interviews, case studies and field observation, the researchers developed well acquaintances with the workers working in the plantation. By ensuring adequate privacy to the workers in the organizational environment, the researchers ensured better psycho-social environment for data collection.

TABLE 2: ITEMS, THEORETICAL RANGE AND CRONBACH ALPHA-INSTRUMENT –ERGONOMICS ISSUES (IEI)

| *Sl. No* | *Factors* | *No of Items* | *Theoretical Range* | *Standardized Alpha* |
|---|---|---|---|---|
| 1 | Task | 17 | 17-170 | .812 |
| 2 | Tool | 7 | 7-70 | .803 |
| 3 | Environment | 4 | 4-40 | .799 |

**Dealing the Item's Reliability**

The study followed three stages. In the initial stage, the study considered 38 items under 3 factors and subjected to pilot testing with thirty respondents from the organization. A bipolar interval scale was used representing with 1 as 'Strongly Disagree' and 10 representing 'Strongly Agree'. The instrument retained the same order of response categories to minimize confusion amongst respondents. Later, with due consideration to the Cronbach Alpha values of each item in the draft instrument, some of the items, which were having less than 0.5 dropped and others were gathered into. A 10-point interval scale with 28 items were finally considered.

**Managing the Standardization Process**

In order to establish the standardization process, the oil palm plantation in four countries identified. To make a comparative analysis five groups of workers from different countries was selected with a size of 30 workers from each plantation. As indicated above these plantations are located in different countries that to ensure the regional representation where oil palm plantations are located. Further, an instrument of 38 items and 10 point interval scale scales were administered into these five groups. It was observed that the Cronbach Alpha values of the items remained almost the same. Based on the inference it is further inferred that this instrument is highly reliable to be used in any oil palm plantations across the countries in Asian region. Table3 shows that the values of the Cronbach alpha of the constructs for five group in the five different countries when compared were more or less the same.

TABLE 3: ERGONOMICSISSUES(EI) IDENTIFIED AMONG FIVE GROUPS: FACTOR ANALYSIS PROCEDURE (N=30)

| *Sl. No* | *Constructs* | *Cronbach Alpha (% Point Likert Scale)* | *Malaysia 1* | *Indonesia 1* | *Indonesia 2* | *Thailand 1* | *Nigeria 1* |
|---|---|---|---|---|---|---|---|
| 1 | Task | .812 | .832 | .809 | .822 | .807 | .821 |
| 2 | Tool | .803 | .816 | .801 | .801 | .810 | .827 |
| 3 | Environment | .799 | .797 | .789 | .795 | .789 | .805 |

## Factor Analysis Procedure

The study intended to measure workers perception on Ergonomic Issues (IE) and develops an instrument (IEI). Henceforth, the ultimate phase of this process of developing the instruments was to conduct the factorial analysis procedure on this draft instrument and 10-point scales. The objective of doing factorial analysis was to ascertain whether the items for each construct really fit in constructs. This procedure informs which items should be excluded or included with one construct. This was done by measuring the correlation values between the items within the given constructs.

## Factorial Analysis Results for Items Rejected in Each Construct

Further, during the factor analysis, those items that were scored 0.5 and below were automatically rejected. Initially, the draft questionnaire was consisted of 38 items. The total number of items rejected based on the draft instrument with 38 items and 10 point interval scales were 10. The total variance explained for all the factors under consideration in the study is 0.669. The final instrument after rejecting the items, which were scored more than 0.5 under 3 sub-variables of major variable 'Ergonomic Issues' further mentioned below.

## Interpretation of the Index Level of Ergonomics Issues

### *(a) High Scores: At the Highest Level*

*High Scores:* A self-rating score within this range indicates the plantations having a working condition, whichdevelop high ergonomic issues to the workers. The workers are facing issues related to muscles, nerves, tendons, joints and cartilage, of the upper and lower limbs, neck and lower back, musculoskeletal disorders or work-related musculoskeletal disorders.This indicates that the workers perception and experience related to the work environment is highly taxing to their body. Work postures, work organisation, work design and supportive equipments are highly ineffective.

*Suggestion Proposed:* This type of work environment indicates extreme form of unhealthy working environment prevalent in the plantations. Such environment is totally neglect work organisation and design based on appropriate equipments

TABLE 4: ITEMS FOR THE VARIABLES AND FACTOR ANALYSIS – ERGONOMICS ISSUES

| *Factors and Item no* | *Factor Loading* | *α* | *Eigine Value* | *Explain Variance (%)* | *Total Explain Variance (%)* |
|---|---|---|---|---|---|
| | | TASK | | | |
| TK1 | .801 | | | | |
| TK2 | .788 | | | | |
| TK3 | .777 | | | | |
| TK4 | .831 | | | | |
| TK5 | .822 | | | | |
| TK6 | .805 | | | | |
| TK7 | .799 | | | | |
| TK8 | .783 | | | | |
| TK9 | .797 | | 2.146 | 28.112 | |
| TK10 | .792 | .812 | | | |
| TK11 | .800 | | | | |
| TK12 | .801 | | | | |
| TK13 | .802 | | | | |
| TK14 | .811 | | | | |
| TK15 | .802 | | | | |
| TK16 | .800 | | | | |
| TK17 | .789 | | | | 66.993 |
| | | TOOL | | | |
| TL1 | .800 | | | | |
| TL2 | .796 | .803. | | | |
| TL3 | .822 | | | 22.991 | |
| TL4 | .790 | | 1.832 | | |
| TL5 | .768 | | | | |
| TL6 | .801 | | | | |
| TL7 | .798 | | | | |
| | | Environment | | | |
| EV1 | .799 | | | | |
| EV2 | .789 | .799 | 1.731 | 15.890 | |
| EV3 | .799 | | | | |
| EV4 | .803 | | | | |

and work postures. There is pressing need to institute surveillance in order to determine the current prevalence of ergonomic injuries.Systematic work organisation and design based on work analysis, work- movements and bodily posters need to be ensured inorder to alleviate its effect on work and performance. In the long run, ergonomic issues in plantation will lead to employees absenteeism, presenteeism, absconding and intention to leave.

### *(b) Moderate Scores: At the Moderate Level*

*Moderate Scores:* A self-rating score within this range indicates the plantations having a working condition, which develop moderate level ergonomic issues to the workers. The workers are facing more or less issues related to muscles, nerves,

tendons, joints and cartilage, of the upper and lower limbs, neck and lower back, musculoskeletal disorders or work-related musculoskeletal disorders. Work postures, work organisation, work design and supportive equipments are only moderately effective. A need for improvement in relation to ergonomic issues is there to consider with prime concern to improve the work organisation and work activities .This indicates that the workers perception and experience related to the work environment is discreetly taxing to their body.

*Suggestion Proposed:* As it is pointed out that the workers perception towards a congenial working environment in relation to work organisation, instruments and design is more or less lacking in such environment. A need for improvement in relation to ergonomic issues is there to consider with prime concern to improve the work organisation and work activities. Organisation should look into the possibility of effective work organisation considering all possible options, including, instruments, design, work activities, etc which improve the productivity.

### *(c) Low scores: At the Low Level*

*Low Scores:* A self-rating score within this range indicates the plantations having a working condition, which is congenial to the workers and it extend better work design, work organisation, instrument and work activities to the plantation workers. Seldom had the workers faces issues related to ergonomic issues. This indicates that the workers perception and experience related to the work environment is highly exciting. Work postures, work organisation, work design and supportive equipments are highly effective.

*Suggestion proposed:* In this kind of work environment, the ergonomic issues are less observed. This indicates that the management is well conscious about the issues related to work design, work organisation, instruments and work activities that are extending to the plantation workers. The management should be highly proactive further enough to maintain the present work environment with the sustenance of continues job analysis and work organisations that alleviate the issues related to workers physical comfort in work engagement.

## Conclusion

This particular study has conducted with an objective to understand the ergonomic issues prevalent in the oil palm plantations. Inorder to explore the research the study followed sequential embedded design that to come up with an instrument. The study started with qualitative approached tom dig and relates the factors related to the ergonomic condition. Further, the factors identified and items developed were tested in four countries to establish its reliability. This particular study thus developed an instrument that to measure the ergonomics issues prevalent in the oil palm in particular and plantations in general**.** The instrument's validity and reliability further need to be empirically observed with more number of worker's participants

by integrating extensive level of qualitative and quantitative interventions in various countries for its better standardization and generalization.

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## *Appendix*

INSTRUMENT: ERGONOMICS ISSUES (IEI)

In the following pages, there are number of questions that may reflect your perception in association with ergonomic issues prevalent in the plantation where you employed now. By using a scale ranging from 'strongly disagree' to 'strongly agree', please choose the degree of agreement with your current circumstances by ticking (✓) on the right number (a number between 1 to 10) every question that most accurately reflects your perceptions. If you have trouble in understanding a question, answer to the best of your ability. You are required to answer these questions, which truly describe yourself. Your answers are very important to the accuracy of this study. (Please return the completed questionnaire in the enclosed self-addressed envelope at your earliest convenience).

| | **Questions** | |
|---|---|---|
| | Long exposure to manual harvesting created high physical strain on my body<br>1 2 3 4 5 6 7 8 9 10 | |
| | Repeated pull and push force during cutting job cause severe shoulder, muscle, neck and body pain<br>1 2 3 4 5 6 7 8 9 10 | |
| | Tasks of using either a hook or metal pole for loading FFBs from the ground invites frequent bending forward develop high physical strain on my body<br>1 2 3 4 5 6 7 8 9 10 | |
| | Tasks of using either a hook or metal pole for lifting with a twisting posture during lifting develops high physical strain | |
| **Strongly** | on my body | **Strongly** |
| **Disagree** | 1 2 3 4 5 6 7 8 9 10 | **Agree** |
| | Manual labor related to pruning activities develop high physical strain on my body<br>1 2 3 4 5 6 7 8 9 10 | |
| | Continuous tilting of head upward as they cut the stalks of FFBs on the trees including during pruning develops high physical strain on my shoulders and neck<br>1 2 3 4 5 6 7 8 9 10 | |
| | Carrying heavy loaded pesticide tank gives heavy lower back pain<br>1 2 3 4 5 6 7 8 9 10 | |
| | Work pacingwith heavypesticide tank as gives heavy shoulder, spine and neck pain<br>1 2 3 4 5 6 7 8 9 10 | |
| | Poor maintenance and leaks in the sprays develops high | |

| | | |
|---|---|---|
| | chemical diseases to my skin and body<br>1 2 3 4 5 6 7 8 9 10 | |
| | Work pacing with high volume of chemical fertilizer in pail develops heavy pain in muscle, shoulder and body pain<br>1 2 3 4 5 6 7 8 9 10 | |
| **Strongly Disagree** | Bending, leaning and exerting postures with tools during planting activities develop physical strain on my neck, back and shoulders.<br>1 2 3 4 5 6 7 8 9 10 | **Strongly Agree** |
| | Awkward positions during planting movements with tools affect nerves, tendons, and muscles, especially in the arms, hands and wrists.<br>1 2 3 4 5 6 7 8 9 10 | |
| | Rapid work pace and forceful exertion with tools potentially affect the lower back, upper back, hands and arms<br>1 2 3 4 5 6 7 8 9 10 | |
| | Repetitiveness and pace of work for long periods in a standing and moving position develops sore feet, general muscular fatigue, and low back pain<br>1 2 3 4 5 6 7 8 9 10 | |
| | Loadingfruits develops bending and awkward posters causes heavy pain in muscle, shoulder and body<br>1 2 3 4 5 6 7 8 9 10 | |
| | The task of pushing fully ***loaded*** wheelbarrow with back posture bent forward causes heavy pain in muscle, shoulder and body<br>1 2 3 4 5 6 7 8 9 10 | |
| **Strongly Disagree** | Repeated forceful manual collections of the fresh fruit bunches with develop heavy muscle, and body pain<br>1 2 3 4 5 6 7 8 9 10 | **Strongly Agree** |
| | Poorly maintained equipments necessitate push and pull forces and which causes heavy pain to muscle, shoulder, hand and body<br>1 2 3 4 5 6 7 8 9 10 | |
| | Lifting heavy polerequires to squat, bend, kneel, and twisting, further leading to heavy back pain<br>1 2 3 4 5 6 7 8 9 10 | |
| | Fresh fruit cutter using sharp sickle, naturally tilt their heads upward in order to locate ripe fruits build up neck and spine pain<br>1 2 3 4 5 6 7 8 9 10 | |
| **Strongly Disagree** | Bending, twisting, looking ahead and forcefully pushing-pulling/swinging the chisel outside or across the body midline causes injuries to the skin<br>1 2 3 4 5 6 7 8 9 10 | **Strongly Agreed** |
| | Balancing and maneuvering long sickle to erect pole for harvesting task build up hand, neck and shoulder pain<br>1 2 3 4 5 6 7 8 9 10 | |
| | Use of equipments during canopy arrangement of oil palm plants affect the posture issues<br>1 2 3 4 5 6 7 8 9 10 | |

Stooping while performing harvesting task with poles causing heavy neck, shoulder spine and body pain.

1 2 3 4 5 6 7 8 9 10

Frequent climate variations like heavy rain affects the body temperature and develops high join pain especially on shoulders and legs

1 2 3 4 5 6 7 8 9 10

Intolerable level of temperature during humid climate environment develop body pain and related illness

1 2 3 4 5 6 7 8 9 10

**Strongly Disagree**

During heavy rain season the harvesting visibility is poor and have to tilt their head and neck looking at top to perform the work, develop severe neck, and body pain

1 2 3 4 5 6 7 8 9 10

Dusty work environment causing health disorders leading to body pain and related illness.

1 2 3 4 5 6 7 8 9 10