IMPROVED PRODUCTIVITY AND REDUCED MATERIAL WASTAGE IN CONVENTIONAL PULSE PROCESSING INDUSTRY (DAL MILL) THROUGH PARTICIPATORY ERGONOMICS APPROACH

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Abstract: This study has been undertaken to involve employees of a dal mill in identifying the core reasons for the cause of wastage, to identify and evaluate waste minimization opportunities and causes and amounts of waste in the processes. A participatory approach is followed and to identify the ergonomic issues those hinder the productivity of an employee in general and a process in particular. A tailor made waste minimization methodology for enhancing the productivity is proposed.

Index Terms: Participatory, Ergonomics, productivity, waste minimization.

I. INTRODUCTION

Economic development of any region mainly depends on natural resources available in the region. India has verities of resources differing from region to region. The regions differ in soil, climate, minerals, forest, rivers, topography, human potentiality, agricultural yields etc. The available resources may be used for different industrial purposes. The resource based industries are mainly categorized into agro-based, forest based, mineral based, marine based, animal husbandry and poultry based industry. The agro based industries can be classified as follows:

Agro produces processing units
These units do not manufacture any new products. They merely process the agricultural produces e.g. rice mills, dall mills, decorticating mills etc.

Agro produces manufacturing units
These units produce entirely new products based on agricultural produce as the main raw material e.g. sugar factories, bakery, strawboard units etc.

Agro-inputs Agro-service manufacturing centres
The units which produce goods either mechanisation of agriculture or for increasing productivity e.g. industries manufacturing fertilizers, pesticides and insecticides and all type of industries manufacturing implements, pump-set, etc.

Importance of Agro Based Industries
Agro-industries play a pivotal role in the economic development of an agricultural economy like India. It is not only because of their being labour-intensive and capital saving in character but also because of the fact that they provide better employment opportunities to the surplus agricultural labour during off-seasons. According to the Food and Agriculture Organisation (FAO) these industries provide almost two-thirds of the employment in developing countries[37]. In India these industries account for about 48 per cent of total industrial employment. They claim only 15 per cent of total capital investment and contribute 27 per cent of the gross output. These industries have also proved to be a powerful instrument for a balanced and decentralised growth of economy leading to the creation of both backward and forward linkages on large scale by maximising mutual complementary roles of agriculture and industries. They also help in checking the unplanned migration of people from rural to urban areas by way of generating employment opportunities in rural areas. Their development thus assumes significance for reduction of excessive pressure of population on agriculture and improvement in the standard of living of rural labours which in turn would prove the way for all round development and prosperity of the economy. The concept of agro-industries is confined not only to those industries which are engaged in the processing of agricultural produce as their basic raw materials either for consumption (food crops, sugarcane, oil seeds, fruits and vegetable etc.) or for the use of industry (cotton, jute and other similar products) but also to those industries which produce inputs for agriculture such as fertilizers, pesticides and agricultural implements. In other words agro-industries are those which satisfy the following criteria.

- Encourage greater inputs into agriculture
- lead to better processing and conversion of agricultural produce or outputs,
- Insure high returns on processed goods; and
- Increase agricultural production.
Thus, agro industries depend not only on the output of agricultural activities but also on markets for their output which serve as inputs in agricultural implements, fertilizer and pesticides. It is generally supposed that in developing countries like India, where labour is surplus and capital is scarce, labour-intensive mode of production would ease out the problem of unemployment and which in turn promote both short-term and long-term development of the economy. It is observed that agro-industries are more labour intensive than non-agro-industries but these labour intensive industries were found to have low labour productivity.

II. DAL MAKING PROCESS

Processing of pulses involves the dehusking grain as cleanly as possible. Pulses have a specific bondage between the hull and cotyledons as well as between two cotyledons. The main objective of pulse processing, therefore, is to remove the hulls as cleanly as possible. This requires working on the hull to make it loose from the cotyledons so that it can be separated by some kind of mechanical action. Process flow diagram for pigeon pea processing is as shown below.

- Cleaning helps in removing the husk, dust, etc. from the pulses and grading is done to segregate the grain legumes of desired shape and size on a rotating type of cleaner.
- An empty roller machine is used for cracking the husk layer and for scratching the clean pulses passing through it. This is done for loosening the husk from sticking to the cotyledons in order to facilitate subsequent oil penetration. Cracking and scratching of husk takes place mainly by friction between pulses as material is passed through narrowing clearance. During the operations, some of the pulses are de-husked and split and are separated by sieving.
- The scratched or pitted material is passed through a screw conveyor and mixing of some edible oil like linseed is done in it. Pulses coming out of the screw conveyor are kept out about 8 to 10 hours to diffuse oil.
- Pulses are conditioned by ultimate soaking / wetting, drying and temporary moisture of 3.5 per cent added after about 8 hours and grain is dried in sun again until all the pulses are sufficiently conditioned. The whole process of alternate wetting and drying is continued for two to four days. Pulses are finally dried to about 10 to 12 per cent moisture content prior to de-husking and splitting.
- For de-husking of conditioned pulses carborundum coated emery rollers are used. In one pass 50 per cent of the pulses are de-husked. The de-husked split pulses are separated by sieving and husk is aspirated off. Un-split pulses and tail pulses are again de-husked and milled in a similar way. For complete de-husking and splitting, the whole process is repeated two to three times.
- Polishing is completed by treating de-husked and split pulses with small quantity of oil. After polishing, the de-husked pulses are packed in bulk or retail packing, as desired. The packing material may be pre-printed or plain packs.
III. PARTICIPATORY ERGONOMICS MODEL

The ergonomic study is aimed at identification of those postures and practices in the process which are creating discomfort for the workers resulting in wastage of the material, degrading quality of the output and productivity.

An ergonomic questionnaire was developed in English on the basis of Nordic Questionnaire and communicated in local language that is Kannada.

The study is based on
- NIOSH discomfort survey and also NORDIC musculoskeletal questionnaire (NMQ) to evaluate the postural discomfort.
- Ergonomic Questionnaire
- Picture based task and workstation analysis

It is useful to realize on your own what is happening at the workstation and ask yourself questions about the work before conducting interviews. The information sought concerns the operators’ characteristics, this will help in locating them for the interviews, and the description of the workplace and of the task. This involves producing a preliminary outline of the job that can be used throughout the analysis. You must describe the workplaces briefly and produce a list of the principal operations performed. Here the list of principal operations performed is provided in the flow diagram of dal making process. In the total dal making process some of the operations are performed by machines and some operations are manually done. We are focusing on the operations that are done manually.

A holistic analysis of the current situation, familiarization with their routine activities and measurement of selected indices and variables with assessment of some selected organizational indices such as the amount of waste of raw material (the Productivity Index) and wastage due to improper housekeeping were performed along with the postures and practices that are causing the wastage.

The following photographs were most indicative of the selected processes that need to be addressed for ergonomic changes. Those equipment, postures and the processes have been photographed and analysed those are acting as hurdles for achieving the defined objectives.

The following picture represents the man checking the dehusking of dal in the pitting process. This is a frequently performed activity and as we can see there is no sufficient grip in the space where the man is standing. Hence this was identified as one important process that needs ergonomic attention. Since this frequent checking is required to adjust the pitting machine to avoid the breakage of dal into small pieces which will be discarded and leads to wastage.

![Figure 2](image)

The following is the image representing the process of pitting of dal. As we can see, the height of the equipment used is not comfortable to the man using it and it was also expressed in the initial meetings conducted.

![Figure 3](image)
The above shown is the image representing the process of pitting of dal. As we can see, the height of the equipment used is not comfortable to the man using it and it was also expressed in the initial meetings conducted.

Following images show the changed equipments

FIGURE. 4
Before the application of participatory Ergonomics and after the application of Participatory Ergonomics approach

IV. RESULTS AND DISCUSSION

Depending on the inputs from the workers after a detailed questionnaire was asked to them in local language, there was a need felt to redesign the equipments for the comfort and productivity of the employees.

REFERENCES