

## Importance of Human Factors and Ergonomic Principles in Agricultural Tools and Equipment Design

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### Editorial

It is a known fact that agriculture is the more hazardous industries than others. Working and living conditions of agricultural workers are underprivileged in all over India. Heavy physical work, inadequate working methods, working techniques and tools not only cause unnecessary fatigue and occupational accidents but also leads to low productivity. Some of the crucial factors for poor productivity are like the use of local artisans made tools/equipment; imported tools/equipment which are not suitable for targeted user's physical capacity; anthropometric data are not taken into considerations for tools/equipment design. Compared to other industries, ergonomic interventions and solutions have been late coming into agriculture [1]. Application of ergonomic knowledge from various sub-disciplines of ergonomics, e.g., agricultural ergonomics, occupational health and safety, environmental ergonomics and design-ergonomics might be useful for developing sustainable agricultural practices with better productivity and farmer's wellbeing.

Human factors and ergonomics, they are different terms with the same meaning, concerned with analysing and optimizing the interface between product and its users to achieve the best possible match between them. Human factors also called ergonomics deals with the principle of user-centered design approach based upon the physical and mental characteristics of its human users to minimize the effects of their limitations, rather than forcing them to adapt. In the present era, user-centric tools and equipment design for Indian farmers, considering human factors/ergonomics aspects such as anthropometric and strength variability are need of the hour. The understanding of human beings and tools, equipment, task and work environment with which they interact, human factors play a very crucial role. We usually don't deny of using tools and equipment design without considering ergonomics principle (unless perhaps, it is exceptional) because it gives us no cause to, but we do deny if accidents take place frequently. Designing for need-based tools and equipment to improve human performance is not just an option in today's competitive environment, but it is indispensable. Various vital criteria for ergonomically design tools and equipment are such as functional efficiency (as measured productivity, task performance, etc.), comfort, health and safety, ease of use, quality of working life, etc.

Improving safety, comfort, and quality in agriculture involves gathering information about human abilities, limitations, and other characteristics and applying it to tasks, tools and equipment, environment and the organization. Human is a part of a system and must be fully integrated safely and efficiently into it at the design stage. Therefore, various human factor issues are to be considered by taking individual component (human/worker, tools/equipment, and

surrounding environment) into account. The aim behind having tools and equipment with ergonomic design or an ergonomic operator's workplace is to ensure that the human working over there is safe and comfortable. An effective ergonomics approach produces significant returns on investment by reducing injuries, absenteeism, systematic waste, errors, etc.

Assessment of anthropometric and biomechanical database is undoubtedly backbones of 'Ergonomics', or 'Human Factors', which study human characteristics for the appropriate design of tools, equipment, and workplace. Anthropometry deal with physical characteristics of the body and biomechanics deal with human capabilities and limitations. Therefore, understanding relations between anthropometry and biomechanics is apparently essential. Standardization of data collection process techniques and terminologies should be followed such as ISO standard [2] 7250-1 (Basic Human Body Measurements for Technological Design-Part 1: Body Measurement Definitions and Landmarks), recommendations of the conference on standardization of anthropometric techniques and terminologies [3], Anthropometric Source Book [4], etc. Anthropometric and biomechanical incompatibility may lead to discomfort, fatigue, pain, injury and illness of workers. Design of tools and equipment with the integration of ergonomics guidelines not only regarded as essential to reduce human drudgery but also enhance agricultural productivity [5]. Anthropometric database of Indian agricultural workers is available to a certain extent. However, availability of strength data of Indian agriculture workers are not only limited [6-10] but also rarely in use. Therefore, all agricultural tools and farm machinery engineers/manufacturers need to have a basic understanding of human factors principles. Humans are variables in their size, shape, characteristics, etc. Therefore, knowledge of variability in databases helps to provide a baseline, how much adjustability or what range of forces are to be considered to accommodate the intended population of agricultural workers [11].

Most of the agricultural tools/machinery used in India is based on body dimensions of western workers [10,12]. Thus, imported farm equipment and tools designed considering the anthropometry data of the Western country would not be suitable for Indian populations [13] as the Western nation has higher body dimensions as compared to Indian people [6]. The significant variation in agricultural workers body dimensions across the regions highlights the need to design regional/location-based tools and equipment. The specific body dimension which has substantial variation implies giving more attention to providing adjustable features/facilities into the design process of user-friendly tools and equipment to achieve safety, comfort, and productivity [14]. The following are some examples related to

adjustability mechanism such as adjustable handle height of Cono weeder to suit the operator's working height, multistage adjusting of cultivator handle for better maneuverability, adjustable tractor seat height to accommodate a smaller to a taller person, etc. Hence, require regular updating of old anthropometric data which has practical implications for human-centered product design.

Body scanning technologies such as 3D anthropometry are maturing but, in developing countries like India, we are still using traditional methods which are time-consuming, and reliability of data is questionable. There is a need to promote inexpensive 3D anthropometry system that would be readily accessible to researchers/engineers. Therefore, a database for anthropometry, strength and physical work capacity should streamline on a priority basis. Application of ergonomic knowledge from various sub-disciplines of ergonomics, e.g., agricultural ergonomics, occupational health and safety, environmental ergonomics and design-ergonomics, intervene comprehensive and logistic user-friendly solutions useful for developing sustainable farming practices with better productivity and farmer's wellbeing. Ergonomically designed need-based agricultural tools and equipment would have a direct multiplier effect on the socio-economic transformation of farmers for sustainable development.

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