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An analytical study on the drudgery prone paddy cultivation practices

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ABSTRACT

Drudgery is termed for hard work, monotony, time-consuming, and use of traditional tools with inappropriate working posture in the field [1]. The drudgery of farmers is a crucial aspect that has attracted wide attention from researchers. Paddy is cultivated and consumed as the major food grain crop all over the world. Almost all the practices are performed manually by the farmers. Many of such activities are drudgery susceptible to varying degrees which results in the various health hazards and reduced work efficiency of the farmers. The present study aims to showcase the areas of discomfort while doing the various cultivation practices in paddy, the causes for the reduced efficiency and production, health hazards that farmers are facing at the field level, and strategies to overcome them. The study collected various literature reviews by the experts which pooled together for a better understanding of the existing situations in which work-related health hazards, body part discomfort, Energy expenditure, Human Physical Drudgery Index (HPDI), and Extent of postural discomfort using Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA) were included. However, it is very challenging to the researcher to take the body part measurements from the respondents in the data collection process. Various improved tools are available for the paddy cultivation practices should be made aware of by the farmers for effective and efficient participation in farming which results in reduced drudgery.

Keywords: *Drudgery, Efficiency, Hazards, Productivity, Health.*

Introduction

Rice feeds more than half of the world's population [2]. More than 90% of rice production is coming from Asia [3]. China and India have the largest rice cultivating areas, the highest grain production, and the highest share of rice consumption in the world. Paddy cultivation in these two countries plays a pivotal role in both national and global food security. In addition to food security, paddy is related to several human health issues. Almost all the cultivation practices in paddy were done manually by the farmers because of various reasons such as the small size of land holding, lack of awareness on the improved tools, reduced access to the credit, etc. As a result, farmers are facing various occupational health hazards, discomfort in various body parts, energy loss, etc. These all factors resulted in reduced work efficiency and reduced production in the paddy production system.

Occupational health hazards and body part discomfort in paddy cultivation practices

Health hazards are predominant in the paddy production system such as pain in the body, fatigue, tingling/ numbness in hand, blurred vision, heat stress, tripping, falling, etc. These hazards are sometimes activity-specific, suppose a farmer sprays the pesticide in the field with a sprayer without any precautions and safety measures such as mask, gloves, and eyeglasses there is a more chance of blurred vision. Likewise, body part discomfort is also predominant in the paddy production system where farmers face discomfort in various regions of the body such as the neck, shoulder, arms, legs, knees, trunk, lower back, and upper back, etc. body part discomfort can also be activity-specific sometimes such as pain in the lower back while doing a transplanting activity because of the longtime bending posture.[4] used a diagram of the body to identify the location of an individual's work-related body part discomfort. The diagram showed a back view of the human body marked with twelve regions (e.g., neck, shoulders, upper arms, lower arms, back). The regions differentiated between the right and the left legs, but not between the right and the left arms, and they did not include any joints (e.g., elbows, wrists). [5] recommends the use of a rating scale to assess the intensity of discomfort experienced in various body parts, and he suggests the use of a 5-point scale which is anchored at the 1 point with 'very mild pain', and at the 5 points with 'extreme pain'.[6] Workers in the agricultural sector face several work-related health and safety challenges, similar to what workers in other high-risk sectors experience. The prevalence of MSDs among the farmers was greater than in the nonfarmer populations [7]. Awkward and static postures cause musculoskeletal stress on different body regions and are a major factor in the development of Work-Related musculoskeletal disorders [8]. Threshing of paddy using a manual operating paddy thresher is the most popular among farmers, this is because more than 60 percent of India's farming land is in hill areas which belongs to marginal and small farmers. The bending position has to be adopted by the farmer for the manual beating of the bundles, which is ergonomically highly not suitable for long-term operations, this is because incorrect postures result in considerable harm [9]. Musculoskeletal problems are one of the most prevailing occupational ailments and one of the leading causes of absenteeism and productivity loss. One of the major drawbacks that farmers face is a lack of awareness about how to keep their bodies in normal and proper working conditions [10].

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Rice cultivation is associated with Gender disparities and the occurrence of musculoskeletal disorders among rice farmers by recognizing the wide range of ergonomic risk factors. As per the study, most of the respondents that are 99 percent faced problems of pain in different regions of the body, including the lower back (93.8 percent), shoulder (60.9 percent), hand (53.6 percent), and knee (80.9 percent), as a result of abnormal posture (99 percent) and excessive repetitive job (95 percent) over the period. twin groups of rice farmers had experienced the most difficulty during operations such as excavating (87.7 percent), planting seeds (82.7 percent), hauling crops (99 percent), and harvesting (90.9 percent). Farmers were also exposed to extreme physiological and temperature stress, which ceased their capability to carry out their other daily activities. The rate of oxygen consumption and the relative cost of the workload were found to be highest in 4-row transplanters, then lowest in local practices, 3-row transplanters, 2-row transplanters, and row transplanters [11]. The use of chemical agents in crop management such as fertilizers, herbicides, and pesticides also various hazards to farmworkers [12]. Occupational exposure of humans to pesticides is a significant cause of death worldwide [13]. Contact with pesticides has contributed to serious long-term and chronic health hazards among farmers [13]. Lower back disorder was common among the rice farmers. The farmers reported having consistent and persistent body pains and extreme fatigue because of long and tedious working hours [14]. Farming activities pose a lot of problems to farmers due to the tedious and muscular nature of the occupational work [15]. Traditional tools used by farmers operating in bending or squatting posture which induces drudgery and leads to serious health problems such as back pain, and knee pain and also causes injury to women who operate it [16].

Energy Expenditure in Paddy cultivation practices

As discussed earlier, manual cultivation practices in paddy were more drudgery involved which resulted in various health problems among farmers. These health problems are a result of more energy-demanding practices in paddy production systems. Heartbeat was the main indicator for calculating energy expenditure, energy expenditure rate, cardiac cost of work, cardiac cost of recovery, total cardiac cost of work, and physiological cost of work. The more the value indicates the more severe the health problem is.

The physiological workload of a worker in weeding activity in wetland paddy crop was found to be 10.36 beats/min and 7.50 KJ/min for physiological cost of work and energy expenditure respectively which is more strenuous for the workers and this drudgery can be majorly reduced by the use of a conoweeder for wetland paddy cultivation [17]. human energy consumption of various cultivation practices involved in lowland rice cultivation was done in Malaysia. based on recorded average heart rates, fertilizer application was found to be the most strenuous operation, with an average heart rate of 138 beats/min. There were no significant differences in the average heart rates of the farmers among the individual tasks within the very first plowing, second plowing, and harvesting operations, with the average heart rates for these three tasks being 116, 106, and 106 beats/min, respectively. The energy expenditures were 3.90, 3.43, and 3.35 kcal/min. filling the seed into the blower tank and broadcasting the seed were regarded as the most difficult tasks for the broadcasting operation, with average heart rates of 124 and 136 beats/min, respectively.

The highest energy expenditure of 418.38 kcal/ha was reported for broadcasting, and the lowest energy expenditure of 127.96 kcal/ ha was reported for second ploughing. The total seasonal human energy expenditure for rice cultivation was estimated to be 5810.71 kcal/ha, 55.7 percent of which has been spent on pesticidal spray. Thus, mechanization of some tasks can decrease worker physical effort and fatigue and thereby increase production and efficiency of work [18]. Among the conventional agricultural activities, a maximum average heart rate of 107.8 beats/min was reported while farmers doing weeding with the traditionally available primitive tool, among the tasks with improved implements, the use of long handle weeder recorded the maximum average heart rate of 101.8 beats/ min [19]. Three male and three female agricultural workers were randomly selected for the ergonomic evaluation of a manually operated six-row paddy transplanter. The average heart rate of the male subjects was 139.68 beats /min while for female subjects was 144.19 beats/min during transplanting operation by paddy transplanter. The heart rate of the male subjects increased steeply from the beginning of the operation and stabilized in the range of 141.0 beats/min after the 6^{th} minute of the operation while for female subjects it was 145.0 beats/min. The mean value of heart rate of the male and female subjects was found 119.90 and 115.09 beats/min respectively while doing transplanting by hand. The heart rate of the male and female subjects was stabilized in the range of 121.0 and 116.0 beats/min after the 6^{th}minute of the operation. It has been reported that the heart rate of the operator is almost stabilized after 5 min of the start of the operation [20]. Threshing paddy bundles using traditional and updated methods, in comparison to the local wooden platform, the pedal-operated paddy thresher reported a considerable drop-in heart rate (20.71 percent). Usage of a pedal-operated paddy thresher lowered TCCW (total cardiac cost of work) and PCW (physiological cost of work) by 60.28 percent [21]. A study on Paddy Cultivation Practices was done by [22]in which physiological evaluations done for different activities by women farmers with three replications of fifteen-minute cycles without rest pause. Ergonomic parameters such as Heart Rate, EER, TCCW, PCW, and VO_2 Max were measured during the experiment. Observations were taken on women farmer with normal health, regularly involved in farm operations, and in the age group of 25 to 45 years. For transplanting activity by a conventional method, the resting heart rate of 81.52 beats/min hiked up to 128.78 beats/min with an Energy Expenditure Rate of 11.75 (kJ/min), TCCW 728.68 beats and PCW of 48.53 beats. Harvesting and threshing of paddy also have been evaluated. The values of TCCW were 682 beats and 829.4 beats and PCW were 45.46 beats and 55.29 beats respectively in those activities. The physiological cost of work in weeding was seen to be 14.67 beats/min, and the overall cardiac cost of work was 6165.87 beats. Weeding was revealed to have an average working heart rate of 94.36 beats per minute and an average energy expenditure of 6.28kJ/min. Many women thought weeding was a light to moderately heavy job, though it was done in a squatting position for the majority of the days in the year.[23]. A hand-cranking type manual paddy transplanter was designed and the average working heart rate, work pulse, and energy output per minute were 118.06 beats per minute (2.18), 35.8 beats per minute (3.96), and 10.03 (0.36) kJ/min, respectively [24].

Conceptual framework of the study

The conceptual framework of the study depicts the relationship of variables with the objectives of the study and it states that

farmers' health is affected by personal factors (Age, BMI, Skin fold parameters, number of family members, etc.) and risk factor associated with the work (posture adopted, working hours, repetition of work, and frequency of work, etc.).

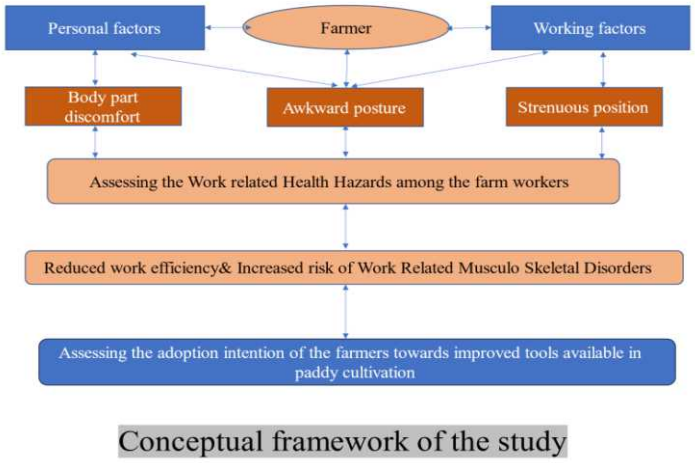

Figure 1. Conceptual framework of the study

Personal factors (Age, education, family size, income, etc.) and working factors (Duration of work, frequency of postural change, repetition of work, etc..) help in the identification of occupational health hazards/work-related health hazards and body part discomfort among farmers. Interview schedule and observation from the researcher could help in assessing the Human Physical Drudgery Index (HPDI) which identifies the most drudgery-prone activity in the paddy cultivation practices, awkward posture and strenuous position reducing working efficiency of the farmers and increasing work-related musculoskeletal discomfort (WMSD) during their work. Rapid Upper Limb Assessment (RULA) can assess the extent of drudgery faced by the farmers in the paddy cultivation practices where the upper limb is involved in carrying out the activity [25]. Similarly, Rapid Entire Body Assessment (REBA) can assess the extent of drudgery faced by the farmers in the paddy cultivation practices where the entire body was involved in carrying out the activity [26]. Simultaneously we can assess the farmer's intention towards the adoption of the improved tools. We can suggest they choose ergonomically improved tools for paddy cultivation.

Postural Stress in farmers in paddy cultivation practices

There is a higher chance that farmers will feel postural stress while doing the paddy cultivation practices manually. Evaluate the postural stress among the farmers there are different techniques like the Human Physical Drudgery Index (HPDI), Rapid Upper limb Assessment (RULA), Rapid Entire Body Assessment (REBA), etc... RULA was used to evaluate the postural stress where the upper limb is involved in that activity, REBA was used to evaluate the postural stress where in addition to the upper limb, all the other body parts were also involved. HPDI was popularly used to assess the most drudgery-prone activity by evaluating the parameters like frequency of postural change, repetition of work, duration of activity, load in kg, etc...

Evaluation of the status of musculoskeletal disorders done with the help of RULA revealed that with an increase in RULA score, the incidence of musculoskeletal disorders increases [27]. Majority of workers were at high-risk levels and required immediate change in the work posture [28]. Monotonous and sustained work was a strong risk factor for musculoskeletal problems.

The farmers involved in cultivation practices constantly 6 to 8 hours in a squatting posture during the weeding operation. These postures have led to pain in different parts of the body such as the neck, lower back, trunk, wrist, shoulders, etc, and also unusual working postures may lead to MSDs [29]. Assessment of RULA revealed that the most female activities need further investigation and change is required. Participation of females the majority in the weeding activity they had to adopt a squatting posture continuously and us traditional hand weeding tools which resulted in the risk of the activity. REBA assessment showcased that farmers working in unacceptable postures can increase the possibilities of postural MSDs; therefore, activity needs further investigation, and change is required [30]. Manual workers in agricultural activities are frequently exposed to work-related discomfort and pain while performing their work tasks which ultimately leads to health problems such as Work-related Musculoskeletal Disorders (WMSDs) which occur because of the feeling of discomfort while doing daily tasks, which ultimately affect their work performance. a video camera was used to record the postures and movements of the farmers while performing their tasks. The Digital Human Modelling Software (DHMS) has been used to analyse the postures by using Rapid Upper Limb Assessment (RULA) analysis. The findings revealed that the harvesters experienced body part discomfort mainly on the upper body limbs. Based on the RULA analysis, all recorded postures in the video reported that they were unsafe hence immediate actions should be implemented to ensure safe and comfortable working conditions. The main problems observed were their repetitive movements, awkward postures, and heavy tools used when performing the work tasks. Necessary actions should be taken to minimize work risk was concluded by[31].REBA method is mainly used for the analysis of forced postures. It is not useful for the evaluation of repetitive movements. Though this method was primarily intended to be applied to the analysis of forced postures in individuals related to the human health and social work activities field, as well as various activities in the service sector, it can best apply to any sector or labour activity. In fact, it is observed that the application number is greater in other knowledge categories than in the original field. The REBA method was mainly applied to three areas: “manufacturing,” “agriculture, forestry, and fishing” and “other activities.” It is often widely used in combination with other methods and has been greatly by the digitization of scientific content over the last decade. In addition, unlike other methods that are combined with REBA, this one focuses on the upper limbs (arm, forearm, and wrist), lower extremities, trunk, and neck. In the Americas, its application is highly diversified over the different fields of knowledge. Conversely, in Asia, it is applied more specifically in two sectors: “manufacturing” and “agriculture, forestry and fishing” [32]. Results of postural assessment by RULA and REBA methods reported that the bending posture has been categorized as very high risk and needed investigation and change immediately and the squatting posture has been categorized as high risk and needed investigation further and change soon [6]. Forward bending and squatting postures in the workplace are significant contributors to MSD at the knee and thigh [33].

Performance evaluation of drudgery-reducing technologies and adoption intention of farmers towards improved tools

It is necessary to evaluate the performance of drudgery-reducing improved tools in the drudgery intervention program

to make aware the farmers of the benefits of using them because they can witness the results with the naked eye in the field conditions in the presence of a researcher or they could read the reports written by the researcher later.

Improved sickle resulted in higher harvesting efficiency than the traditional sickle. The rate of perceived opinion for improved sickle falls in the category of highly acceptable tool as compared to traditional sickle. The results of the study showed that improved sickle was very helpful in reducing the level of drudgery in which physical tiredness was medium to low, time-saving was from 12 to 20 percent and cost-saving from10 from14 percent compared to traditional sickle [34]. A weeder was tested at a paddy field having an inter-row spacing of 20 cm. Various parameters such as moisture content, field capacity, weeding efficiency, Percentage of breakage, and cost operation of the weeder were taken into account during the test. The developed weeder was worked up to 3.5 cm depth of operation with a field capacity of 0.0126 ha/hr at operation speed of 1.2 km/hr, weeding efficiency was obtained 63.41 percent, moisture content was found 19.33 percent and the field efficiency of the developed weeder was obtained 70 percent [35]. Weeding is one of the main drudgery-prone activities performed by farm women. To overcome this problem Krishi Vigyan Kendra conducted an OFT program in adopted villages of two districts of Bihar viz Vaishali and Muzaffarpur during 2014-17 to assess the impact of three different weeding tools Khurpi, RAU Wheel Hoe, and Improved Grabar refined by KVK Sheohar for weeding. A total of 225 respondents were chosen for the study. The main objective of the study was to assess women-friendly weeding tools to alleviate drudgery, pains, and ill health and enhance efficiency and productivity in the weeding operations. The women carried out weeding operations traditionally by using tools like Khurpi in squatting and bending positions which reduced the work efficiency. Results revealed that Improved Grabar was the best in terms of area covered (0.15 ha/day), weed mortality (90 percent), and low cost of weeding (Rs 6000 /- per ha for two times weeding). The work output of Improved Grabar was about four times as compared to the traditional weeding tool is Khurpi in terms of area covered, and the performance of the RAU wheel was at par. Farm women adopted the Improved Grabar as it increased the efficiency of work, reduced the drudgery, and helped in avoiding bending or squatting posture. It reduced the exertion and fatigue and women felt comfortable was revealed by [36]. The farm women felt that serrated sickle is portable, durable, cost-effective, and very handy to use. majority of the farm women accepted farm technologies and opined that these are -neutral, drudgery-reducing, convenient, and comfortable to use [37]. The improved sickle resulted in higher field capacity than the simple sickle because of less pushing force required to operate the sickle, which resulted in higher cutting speed and also found increased output with better harvesting efficiency and reduced drudgery by using a serrated sickle [38]. 22.2 percent of farmers have a high level of perception about the drudgery-reducing technologies where whereas 73.1 percent have a moderate and 4.7 percent have a low level of perception regarding the drudgery-reducing technologies [39]. Prolonged work activity, high repetitiveness, and remaining constantly in an awkward posture for a prolonged period of time, etc. were the major factors of drudgery, acute pain, and discomfort among farm workers [40].

Conclusion

The majority of the paddy cultivation practices are done by farmers due to various reasons such as the small size of land holding, lack of awareness on improved tools, reduced access to credit, fear of using new technologies, low operational cost of manual tools, etc. this ultimately resulting in a lot of physical strain among the farmers which reducing the productivity, efficiency of work. In addition to the reduced production and efficiency incidence of work-related health hazards, postural stress, and discomfort were also hampering the health of the farmers.

Future scope of the study

A similar kind of research can be done on various commercial crops, food crops, and horticultural crops to know about the problems faced by the farmers in manual practices. The outcomes of the study may help the scientists of various institutions to identify the problem area and to act accordingly.

Conflict of interest

There exists no conflict of interest

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