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An Overview of Indian Vegetable: Production Trends and Related Health Hazards

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ABSTRACT

Agriculture has been regarded as one of the most drudgery-prone occupations in the unorganized sector. In vegetable production system both men and women play important role in the entire process from land preparation to harvesting of crops. Vegetable cultivators actively participate in various farm operations such as a ploughing, uprooting, sowing, transplanting, weeding, hoeing,harvesting. They are exposed to number of health hazards the most prevalent of which are musculoskeletal issued like a like strains, low back pain, lower and upper extremity discomfort and so on. It was observed that farmworker generally adopt awkward posture during various activity of vegetable production system. In order to minimize the adverse effect of these postural discomfort and hazard an ergonomic evaluation of farm activity need to be conducted. Ergonomic measures were accomplished by making modification on the task/tool used or by workers moreover training and extension activities will also improve their work productivity and efficiency.

HIGHLIGHTS

- Vegetable production system different activities leads to ergonomics health hazards.
- Ergonomics risk factors leads to musculoskeletal discomfort.
- Providing suitable ergonomics guidelines to improve work efficiency and productivity.

Keywords: Ergonomics, Farmworkers, Agriculture, Musculoskeletal, Postural Discomfort, Vegetable Cultivators

India is the second-largest producer of vegetables after China. Vegetables are important constituents of Indian agriculture and nutritional security due to their short duration, high yield, nutritional richness, economic viability and ability to generate on-farm and off-farm employment. Our country is blessed with diverse agro-climates with distinct seasons, making it possible to grow a wide array of vegetables. Agriculture plays a significant part in meeting people's basic requirements by supplying food and creating jobs on a huge scale in rural areas. In India, agriculture is the primary source of income for about half of the rural population. Agriculture is also regarded as a dangerous vocation for farm laborers. Vegetable cultivation plays an essential role in the country's agricultural development and economy. Vegetable farming is a significant source of income for many people. In the case of vegetable cultivation, women play an important role in the entire process, from land preparation to harvesting the crop except for ploughing, farm workers actively participate in various farm operations such as seedling uprooting, transplanting, weeding, hoeing, harvesting, picking, threshing, winnowing, sieving, cleaning, and storing grains. It was observed that

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farmworker generally adopt awkward posture during various activity of vegetable production systems some review related to topic are given below.

Gender Participation in Agriculture Activity

In the agricultural sector, from land preparation to commercialization, women play a key part in all farm-related activities. They provide a bigger proportion of labor than males. It emphasizes the need for a new agricultural research and extension strategy that includes gender analysis in the development and diffusion of technologies. It also proposes future methods to increase women's participation in key farm decisions, both at home and in the legislature. To achieve women's empowerment in agriculture, it is critical to strike a balance between agricultural research systems, extension education, and policy-making organizations (Satyavathi *et al.* 2010). Women's engagement in agricultural activity in most Indian states, except for Kerala, Punjab, and West Bengal, where women were heavily active in non-agricultural activities such as housework and other sectors (Zhu *et al.* 2020). Compared the role of women in the hilly and plain regions of Tripura and found that land preparation (84.00 percent in plain and 68.00 percent in hilly), product marketing (84.00 percent in plain and 96.00 percent in hilly), and other tasks were mostly performed by male family members. In the plain region, female members were found to be actively involved in various crop production operations such as weeding (82.00 percent), gap filling and thinning (42.00 percent), and harvesting (40.00 percent). Similarly, female engagement was critical in rice transplanting (62.00 percent), vegetable planting (70.00 percent), gap filling and thinning (72.00 percent), weeding (82.00 percent), and harvesting (82.00 percent) in the hilly terrain (80.00 percent).Result of the study revealed that the women contribute more to various farming activities than males(M. Kumar 2016).Moreover, women are important contributors to agricultural development resources. Winnowing, weeding, grading, threshing, and cleaning of field farm operations are all occupations in which more than 75 percent of women participate. Because of intensive work tasks and low VO2max, female farmers appear to be under too much physical strain in agricultural operations. Various activities performed by women in agriculture and related fields, such as manually handling loads/material, threshing, transplanting, land preparation, cleaning animal sheds, feeding animals, and dumping cow dung, require a variety of traditional postures, including sitting, squatting, stooping, standing cum banding, and sitting cum standing, erect standing etc. (D. Singh & Vinay 2013). Women's role in agriculture in Uttar Pradesh's Deoria district was recognized, with the majority of women regularly participating in activities such as grading and storage, animal husbandry, weeding, drying and cleaning of grains, cutting, sowing operations, and shifting production to threshing floor activities (Kumari 2018).

The foregoing discussion demonstrates how women's engagement in agricultural and allied industries differs by location. Women's participation in agricultural activities has been observed across the entire food production system, including field preparation, field cleaning or removal of stacks and stubbles, seed sowing, seedling transplantation, weeding, manure spreading, harvesting, and post-harvesting operations. Work intensity is determined by the necessities of the scenario. As a result, women employees are critical to agriculture's success.

Activity Profile of Farmworkers in Vegetable Production System

India is the world's second-largest producer of vegetables, after China. Vegetables are grown over 9.575 million hectares in India, with a yield of 17.7 mt/ha, accounting for 14.00 percent of total global vegetable production. Among India's numerous states. West Bengal, Uttar Pradesh, Bihar, Madhya Pradesh, and Odisha are all states in India. The largest vegetable-growing states are Gujarat and Karnataka. West Bengal, Uttar Pradesh, and Madhya Pradesh are the top producers of vegetables, accounting for almost 40.00 percent of total production in the country, with West Bengal accounting for roughly 16.00 percent and Uttar Pradesh accounting for 14.00 percent. Furthermore, Madhya Pradesh contributed 8.60 percent, Bihar 8.75 percent, Gujarat 7percent, Odisha 6 percent, Karnataka 5.00 percent, Tamil Nadu, and others 3.40 percent to total production (Sahni & Kumari 2017).

As per Census 2011, the number of the female workforce in agriculture has been increased from

54.2% to 63.1%. Out of every ten farmers, six happen to be women. It means a staggering 60% of the total farmers' population of India is women. 64% of the women in Uttarakhand work as cultivators and 84.4% of them are agriculture laborers. Rural women have enormous potential to contribute to the development of the economy and rising GDP and can significantly contribute to revitalizing the agriculture sector; therefore, the barrier of gender disparity should be efficiently addressed. According to the FAO, 2011, if women are given the same resources as provided to the men, the agriculture growth in the developing countries would have increased between 2.5% to 4%, and the number of undernourished people in the world would have decreased by approximately 12%-17% (Joshi and Chaudhary 2021). Moreover,the female cultivators were forced to assume bending posture (including forwarding bend and twist) for around 33.00 per cent of the work period when doing parboiling tasks and about 27.00 per cent when performing threshing tasks. In the threshing activity, workers were forced to spend the majority of their time (about 71.00 per cent) standing, but in parboiling, female workers were forced to spend the majority of their time (around 41.00 per cent) crouching. The data also revealed that women workers finish their household responsibilities before heading to work in the field, which makes them more stressed. However, research on spinal curvature revealed that while threshing, workers had to lean slightly forward while operating in a standing position (Goswami *et al.* 2012). Whereas in another study the work rest patterns of female potato growers in West Bengal, India, and found that work break schedules differed in different sub-operations of potato farming. In diverse potato farming activities, the work time varied from 63.81 per cent to 65.25 per cent of the overall working hour, and the break period varied from 34.75 per cent to 36.19 per cent. Furthermore, the findings revealed that potato harvesting took the most time (about 6 hours each day), followed by plantation and tunneling (Pal *et al.* (2015) wheat, etc.

The studies above highlight the necessity of taking breaks between tasks. Workers must take a short break or rest period to relieve stress. Workers' work-rest patterns can be an important factor in creating a comfortable environment for them. It is acknowledged that the time necessary to complete various activities varies, as does the level of discomfort experienced by workers, depending on their level of involvement. It is obvious from the activity profile analysis that the workers need to take care of their health by managing their work time efficiently with several short breaks in between the work for better performance.

Work-related health hazards of workers

Agriculture is seen as a dangerous business in most underdeveloped nations. Farmers have been demonstrated to suffer from the most prevalent occupational injury, musculoskeletal disorders (MSD). Identify the key risk factors linked with MSD by determining the prevalence of musculoskeletal complaints and assessing working postures and ergonomic working conditions. In fact, 83.1 percent of the farmers had a QEC score of high or very high (activity levels 3 and 4). To enhance working conditions, it was suggested that dangerous working postures be eliminated (Momeni 2020).

In India, the informal sector employs a vast number of people, including women. The bulk of them work in the agriculture industry. Agricultural employees are required to accomplish their duties through manual labour and are subjected to a variety of occupational pressures. The purpose of this study was to assess postural stress and the prevalence of musculoskeletal disorders (MSD) among women rice producers who were uprooting their crops. A Nordic questionnaire and a 10-point body part discomfort scale were used to assess the prevalence and severity of MSDs among the growers. The direct observation approach was used to investigate the work rest pattern and posture pattern. The OVAKO Working Postures Analysis System (OWAS), Rapid Entire Body Assessment (REBA), Rapid Upper Limb Assessment (RULA), and Quick Exposure Checklist (QEC). The lower back, hip, wrist, shoulder, and knee were all severely harmed. Longer working hours and uncomfortable postures may contribute to a higher prevalence of MSDs among growers. Women cultivators had to wake up early in the morning to accomplish domestic tasks like cooking, cleaning, washing clothing and dishes, and so on before heading out to the fields, putting them under added stress. It is possible that ergonomic treatments, such as changing work-rest schedules,

altering work postures, and introducing new design hand tools, could be investigated for enhancing the working conditions of women cultivators (Pal and Dhara, 2018). To assess musculoskeletal diseases (MSDs) and postural stress in male employees performing various potato farming tasks In the state of West Bengal, male potato growers may be found in several areas. MSDs in various body parts were identified using a modified Nordic Questionnaire and a Body Part Discomfort Scale. Direct observation was used to evaluate the postural pattern. OWAS, REBA, and QEC techniques were used to assess postural stress. The findings suggest that MSDs are highly common among employees, with the back and upper extremities being the most afflicted. According to postural analysis, the individuals were required to assume various stressed postures while completing various potato farming tasks. Workers were subjected to more postural stress during potato harvesting operations than during other jobs. Postural stress may have a role in the development of MSDs. Workers should avoid improper work postures as much as possible while employment to reduce job-related health dangers, according to the findings of this study (Pal *et al.* 2018). Where as in another study looks on the situation of work-life balance and psychological constraints that nurses encounter.

In Uttarakhand's four districts, a cross-sectional research was undertaken. 390 nurses were chosen for the research from 39 hospitals throughout Uttarakhand's districts. Nurses' demographic profile, work-life balance, and psychological characteristics (VAS and FSS) were all factored into the interview schedule. Nurses reported extremely severe neck pain (34.1 percent) on a psychological test (VAS), but 82 percent on the FSS Score. To help nurses deal with their problems, a training programme was created and delivered to them for the enhancement of their lives (Singh and Upasna, 2020).

Moreover, the effect of musculoskeletal disorders (MSDs) is extensive and prevalent across a wide range of vocations, as evidenced by various research undertaken throughout the world. to investigate the frequency of MSDs among women farmers who transplant vegetable seedlings found while using the previous approach, the women's working heart rate was 122 beats per minute, however, when using the novel sapling transplanter, it was 116 beats per minute. When using the conventional approach, the postural study revealed a significant amount of bending in the trunk and neck area, compared to a small bend when using the sapling transplanter (Vyas *et al.* 2020).

To achieve inclusive agricultural growth, women must be empowered by having a thorough understanding of work participation, gender issues, drudgery, and health and nutritional status. According to the study, six load factors affected women's work efficiency in maize production(Jain and Singh 2018). Workplace health dangers encompass a vast area that requires special care. The preceding section sheds light on the physical challenges faced by workers in various occupations. It covers a wide range of health risks, as well as musculoskeletal diseases and other physical and chemical dangers. It is acknowledged that if these hazards are not addressed, irreversible damage to the worker's health may result, limiting productivity and sustainability. Health risks can be decreased by employing ergonomic features and adding some ergonomic solutions at a low cost.

Postural Analysis during Vegetable Production System

In agriculture, the role of ergonomics in long-term development has become a hot topic. To increase agricultural productivity, it is necessary to research not only fundamental agricultural requirements but also human elements in design and working environments (Vijay Kamate 2018). The lack of ergonomically built equipment and workers' incorrect work postures, job-related musculoskeletal illnesses have become a big danger in the agriculture business. An investigation of various labor postures used in the hand transplanting of plants. The agriculture sector plays a significant role in the Indian economy, and it is also where work posture analysis is most commonly overlooked. Rapid Upper Limb Assessment final scores throughout diverse working tasks were found to be high. A sizable portion of the workforce is employed in high-risk positions. As a result, workers are at a moderate to high risk of developing musculoskeletal problems as a result of their jobs. To lower the incidence of WMSD, the research advised that an ergonomics intervention program be implemented properly, with worker awareness and training

(Tripathi *et al.* 2020). It is well known fact that India is the world's second-largest producer of vegetables in 2018. However, India's average vegetable output remains lower than that of several Asian countries. Transplanting plug seedlings is a time-consuming and labor-intensive task. Due to a lack of labor during peak season, timely transplantation is not possible. Because the cost of labor is rising every day, manual transplantation is becoming uneconomical. On a bare bed, seedlings of 4 weeks old had a maximum field efficiency of 86.80 percent (Thorat *et al.* 2018). Whereas in another study, Wedding is one of the most drudgery-inducing jobs in vegetable growing. Farmworkers frequently assume bad and static postures while weeding for long periods using traditional equipment, resulting in a variety of physical pressures on the spine or lumbosacral region, resulting in drudgery and work-related musculoskeletal discomfort. They also reported that Weed growth is a major problem in agriculture, resulting in lower crop yields. Weeding is one of the most important intercultural activities in the crop production system, and it is mostly done by women. 15 to 20 percent of total crop production man-hours are spent on weeding and inter-cultivation (Burman *et al.* 2020). Moreover, an ergonomics research was conducted on rice threshing by farm women using four methods: traditional technique, thresher cum winnower, VL paddy thresher, and motorized thresher. Although paddy threshing using wooden planks is popular among small and marginal farmers in the hill region, and roughly 9% of paddy is wasted as a result of utilizing this old technology, a time-saving motorized thresher was invented. The upgraded thresher was found to be the best of all threshing systems, since it lowers drudgery and produces maximum yield with little energy cost. New mechanized paddy threshing delivers maximal production, i.e. 16.69 kg with 9.6 kJ/min energy expenditure, 299 beats TCCW, 127 beats/min, heart rate 20.94 percent MSD and 20.86 percent RPE, and 299 beats TCCW, 127 beats/min, heart rate 20.94 percent MSD and 20.86 percent RPE (Singh and Vinay, 2014).

In harvesting vegetables, standing/walking rather than kneeling has been demonstrated to reduce lumbar compression. During hand harvesting in vegetable production, harmful labor postures emerge. Mechanized labor instruments and proper agricultural procedures can help lessen the risk. As a result, research methodologies that aid in the development and analysis of innovative manual harvesting solutions in the least developed and newly industrialized nations are required (Pinzke and Lavesson 2018). Agriculture is one of the most drudgery-prone jobs due to a lack of access to modern agricultural technology, as it is an unorganized industry. The lack of essential facilities forces the adoption of static and neo-neutral postures and unsupported positions, as well as a reliance on muscular force and strength, all of which make the work very taxing and energy-intensive. (Nishi Sharma *et al.* 2018).

Ergonomics Intervention Programme

The Application of ergonomic principles, biomechanical and engineering principles can be effective in reducing the risks and improvements in physiological markers and musculoskeletal concerns. As a result, improving tools to prevent fatigue is urgently required. By threshing paddy bundles using conventional and updated methods (Kwatra *et al.* 2010) examined the ergonomic data of farmworkers in the Tarai and Hill Regions of Uttarakhand. When compared to a local wooden platform, the pedal-driven paddy thresher showed a considerable drop-in heart rate (20.71 percent). The usage of a paddy thresher lowered the total cardiac cost of work (TCCW) and physiological cost of work (PCW) by 60.28 percent. Doubled application force and double operators increased the thresher's overall production capacity per hour per person (Kishtwaria and Rana 2012).

In another study, REBA (Rapid Entire Body Assessment) and RULA (Rapid Upper Limb Assessment) were used to assess agricultural laborer's work posture and discomforts. To examine their work postures, the current study was conducted in two locations: U.S. Nagar District's vegetable research facility and Doguda village in Uttarakhand's Nainital district. Standing, crouching, bending, reaching, lifting large loads, and working for extended periods of time all contribute to the physical demands of agricultural labour, which vary from moderate to heavy. Uttarakhand accounts for 1% of India's total land area and 1% of overall output. Manual transplanting is one of the most tiresome and tedious procedures among all the

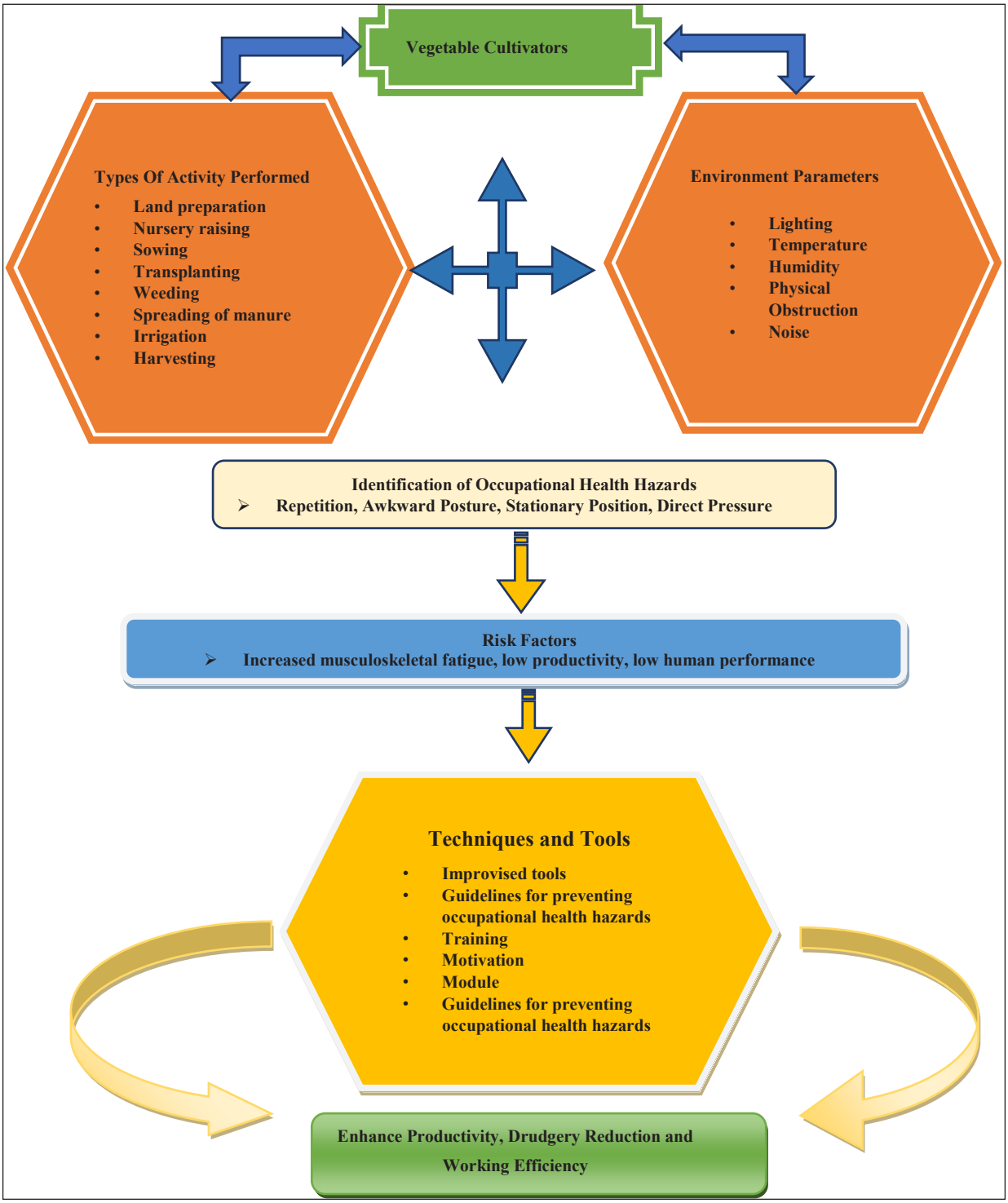

Fig. 1: Conceptual frame work of the study

vegetable production activities since employees must assume a demanding bending position. Farm laborer's experience a high incidence of postural discomforts as a result of extended working hours, unnatural body positions, repeated labour, and physical stress. The highest postural load factor was recorded during manual transplanting tasks in which workers sat in bending or semi-bending positions. In the study of Yadav *et al.* (2017) emphasized the designed a sapling transplanted to alleviate drudgery for women in the vegetable producing system. The conventional sapling transplantation technique was shown to cause significant discomfort in the lower back (66.70

percent), upper back (46.70 percent), fingers, and feet (43.00 percent), respectively. The severity of discomfort was much decreased in the majority of responders when they used a hand-operated sapling transplanter. Moreover, in another study the ergonomics of an improved and native sickle for harvesting paddy crop with 10 farmworkers ages 22 to 45 in Bhopal, Madhya Pradesh. The improved sickle was tested on farmworkers to increase job efficiency and minimize drudgery. The enhanced sickle resulted in a 5.3 percent increase in productivity. In comparison to the local sickle, upgraded sickles resulted in a 28percent reduction in drudgery (Khadatkar *et al.* 2018).

Ergonomic research on drudgery reduction in tomatoes in the Chittoor area of Andhra Pradesh utilizing a three-Tyne wheel hoe for weeding. It was discovered that the same amount of labor could be completed in nearly half the time and that job efficiency was raised by 93.80percent when compared to traditional weeding. In terms of reducing time, human effort, boosting work capacity, and production, the three Tyne wheel hoe is beneficial. The three Tyne wheel hoe's weeding effectiveness was judged to be good (Swarna *et al.* 2018). Whereas Paddy threshing using a manually driven paddy thresher is popular among farmers, as more than 60% of farmed land in India's hill areas belongs to small and marginal farmers. Manual beating required the operator to sit in a bowed position, which was not ergonomically suitable for long-term operation, as incorrect posture might result in significant harm. Drum speed increased as a result of the mechanical process, reducing the users' energy expenditure and threshing time (Singh and Vinay 2014).

When conducted manually by farm women for practically all crops farmed, vegetable transplanting is a tough, time-consuming, and drudgery-inducing field operation duty. This calls for technological improvements to relieve women of high energy needs, time spent, and related drudgery, particularly when it comes to transplanting. To address this issue, the Krishi Vigyan Kendra in Kalikiri performed an on-farm study using an easy transplanter to demonstrate the efficiency of better technology in decreasing drudgery among women involved in tomato seedling transplantation. The use of new technologies lowered postural tension and the intensity of discomfort in numerous body areas, according to the findings. Improved practice was found to have a significant impact (Devi *et al.* 2019).

Conceptual theoretical frame work

The conceptual framework of the study represents the relationship of variables with the respective objective of the study the following conceptual Framework depicts that vegetable is affected by the type of activity they have performed like (land preparation, nursery preparation sowing, transplant, irrigation, weeding, spread of manure and harvesting) and environmental parameters (lightning, temperature, noise, physical obstructions and humanity) it has been conceptualized that in vegetable production system the farmworker adopted different postures the natural or unnatural posture release two different occupational health hazards repetition exertion awkward postures stationary position and direct pressure and risks risk factors increased musculoskeletal fatigue you know if we will provide some basic Strategies for human eyes in their work by suggesting correct purchase and introduction of safety issues at their work place. We will improve their work efficiency moreover if they adopted various training-based ergonomics suitable guideline and motivation practices will lead to disease option as well as improve their productivity.

CONCLUSION AND RECOMMENDATION

The involvement of farm laborers in agriculture and related sectors varies by area. Field preparation, field cleaning or removal of stacks and stubbles, seed sowing, seedling transplantation, weeding, manure spreading, harvesting, and post-harvesting procedures have all been documented to include farm personnel. Tomato, broccoli, and brinjal were shown to be the most profitable crops for vegetable growers Workplace health hazards cover a broad spectrum that needs specific attention. the physical demands that workers in various jobs encounter. It includes a wide variety of health concerns, including musculoskeletal illnesses and other physical and chemical hazards. It is recognized that if these dangers are not handled, permanent health harm to workers may occur, reducing productivity and sustainability. Health hazards can be reduced by

including ergonomic elements and adopting certain low-cost ergonomic solutions. The primary purpose of an ergonomic solution is to improve employee health and well-being by eliminating risk factors in the workplace, which can be done by altering the activity or instruments utilized, or by altering the worker's physical position.

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