Ergonomic Risk Factor in Poultry Farming and Prevalence in Musculoskeletal Disorder

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Abstract:
Poultry Industry is one of the fastest growing sectors of the Indian agriculture today. The production of eggs and chicken layer has increased by 15.2% and 10.14% from the 2019 growth rates to 2020, respectively. Though there is a tremendous growth in poultry industry and already providing employment to about 1, 50,000 farmhands in India, and the poultry industry ranked ninth among the different industries with high occupational injuries due to musculoskeletal disorders. The main objective of this study is to formulate an equation to predict the severity of musculoskeletal disorders that the poultry layer workers have been experiencing. This is done by analyzing the literature review, respondent survey and ergonomics assessment results and statistical study. Stepwise Regression Technique and Residual Analysis were done after analyzing the gathered data. Another output of this study is the design of the automatic feeder. The design is based from the analysis of the study and formulated predictive equation. To fully accomplish the design, Quality Function Deployment (QFD) matrix, and Product Costing were completed. The result of the final model was being tested in the poultry farm to validate the usability issues, safety measures and its function. Time and Motion Study was used to analyze the improvements in the standard time of the feeding task. It is concluded that feeding using the automatic feeder is more stress-free, time-saving and convenient when compared with the existing manual feeding of the poultry workers.

Keywords: Poultry Industry, Musculoskeletal disorders, Time and Motion, stress-free, time-saving and convenient.

1. INTRODUCTION

1.1 INTRODUCTION ABOUT POULTRY SECTOR

The world is heading towards 21st century with widespread mechanization and automation in every field but this advancement is seen more in the developed countries. In a country like India, because of its large population size and low general economic status, the use of manpower may likely persist on a larger scale in the coming decades. Most of the workforce is employed in organized as well as unorganized sectors and many other occupations comprise men as well as women. Poultry sector is also one of them in which the maximum number of laborers are working and performing most of the activities manually. Poultry work involves considerable degree of manual efforts which are associated with body movements. If such movements are minimized by adopting motion economy and proper working postures, it would reduce fatigue to a considerable extent. While attempting such motion economy, one can take resource to biomechanical approaches and identify the wasteful movement or awkward body postures.

1.2 THE INDUSTRY’S 25 YEAR EFFORT ON ERGONOMICS

“OSHA defines ergonomics as “the science of fitting the job to the worker, and when there is a mismatch between the physical requirements of the job and physical capacity of the worker, work related musculoskeletal disorders (WMSDs) can result. Workers who must repeat the same motion throughout their work day, who must do their work in an awkward position, who use a great deal of force to perform their jobs, who must repeatedly lift heavy objects or who feel a combination of these risks factors are most likely to develop work related musculoskeletal disorders (WMSDs)” In recent years, there has been a significant increase in the reporting of musculoskeletal disorders and other work related disorders due to ergonomic hazards. Much of the increase in musculoskeletal disorders is due to change in process and technology that exposes employees to increase repetitive motion and other ergonomic risk factors.

Figure 1.1 Poultry Farms

There are a number of factors which are responsible for occupational health hazards in poultry industry. The goal of any health and safety program is to prevent hazards and illnesses by removing their cause. For ergonomic hazards, this goal is achieved through taking steps to eliminate or materially reduce worker exposure to conditions related to musculoskeletal disorders, related injuries and illnesses. Because of the huge population of India, any slight ergonomic improvement at the individual level would yield very significant qualitative effect in total, especially in unorganized sectors such as agriculture and poultry where an application of ergonomics is much less common than in organized sectors. According to Bureau of Labor Statistics (BLS), 1982 nearly 20 percent of all injuries and illnesses in the work place and
1.1 LIMITATION

have direct effect on the physiological living condition of the worker and their effect on health status of the workers. Its main aim was to find out the activities performed by the workers which are responsible for back injuries. The study was limited to the poultry workers only.

The study was limited to the poultry workers only.

The study was limited to the sample size of 60.

Since ergonomics is very vast area of research, only selected activities were taken under study. Assumption:

The awareness level of the selected respondents was very poor regarding the ergonomic hazards.

2. PROBLEM DESCRIPTION

Farming is a physically arduous occupation and this places farm workers at potential risk of musculoskeletal disorders such as osteoarthritis (OA) of the hip and knee, low back pain (LBP), neck and upper limb complaints, and hand–arm vibration syndrome (HAVS). This review considers the epidemiological evidence concerning such risks. The strongest evidence relates to OA of the hip, for which the public health impact is likely to be considerable. There is also weaker, but suggestive evidence that farmers more often have knee OA and LBP than workers in occupations with fewer physical demands. Tractor drivers, in particular, seem to have more LBP. Relatively little information exists on the risks of soft tissue rheumatism in the limbs and neck. For some outcomes, the link with occupational risk factors (such as heavy loading of joints and whole-body vibration) is sufficient to suggest the course that future prevention should take, but for several outcomes more research is first needed.

3. POULTRY FARMERS

3.1 POULTRY FARMING IN INDIA

India is the third-largest egg producer in the world after China and the USA and the fourth-largest chicken producer in the world after China, Brazil and the USA. In India, the per capita consumption of eggs has gone up from 30 eggs per annum to 69 eggs per annum, and that of chicken from 400 gms per annum, to 2.8 kg per annum in the last 25 years. Human nutritionists recommend a minimum of 180 eggs & 10 kg chicken per annum for a healthy adult human, which means that the Indian poultry market is laden with opportunities. Adult population in most developed countries consume over 240 eggs and 20 kg of chicken per annum.
million tons, which includes corn and soya bean and pearl millet. Eggs and chicken were “agriculture produce” few years ago but are considered as “food items” today. Safe food has become a priority. Besides maintaining his production efficiency, the producer has to concentrate on the nutritive values, the adulterants and contaminants of his produce. The ministry of food processing industries at the central govt. level and food inspection authorities at the local levels has started keeping track of eggs and chicken production in India for quality and nutrients. Poultry Production has three segments:

1. Layers,
2. Broilers,

Some 70% of the layer birds are being raised in the states of Andhra Pradesh, Telangana, Tamil Nadu, Karnataka and Maharashtra in south and Haryana in the north of India. Boiler Feed (65%) and chicks (25%) account for 90% of the broiler inputs and consolidation is being observed in the market. Improved varieties of ‘Low technology input birds’, which are dual purpose, i.e., producing eggs and meat, are new being bred in India for the purpose of backyard/family production. The final food products, i.e., eggs and chicken are not exported in huge quantities as there is a huge gap in supply and demand within India.

3.2 EXPORT TRENDS
As per Agriculture and Processed Foods Products Export Development Authority (APEDA), India has exported 659,304 MT of poultry products for the worth of INR 7,680 million during 2015-16. Majority of the exports are destined for the Middle East. Each year, India exports around 5000 MT of poultry products into Europe, the largest chunk of which is destined for Germany, although the share of the Netherlands has grown significantly over the last few years.

3.3 MAIN MARKET
A large group of poultry companies are based in and around Hyderabad. Andhra Pradesh and Telangana (erstwhile Andhra Pradesh) account for majority of the birds and eggs produced in India. Hyderabad in Telangana is the epicentre for the poultry industry in India owing to the presence of large producers as well as the existence of organisations such as the Directorate of Poultry Research (DPR), a Indian Council Agriculture Research (ICAR) institute and Indian Poultry Equipment Manufacturers Association (IPEMA).

a) Sneha Foods Limited, Telangana
b) Srinivasa Hatcheries (SH Group), Telangana
c) Balaji Hatcheries, Andhra Pradesh
d) V S N Hatcheries, Andhra Pradesh
e) Mulpuri Group, Andhra Pradesh
f) Venky’s (V H Group), Maharashtra
g) Suguna Foods, Tamil Nadu
h) R M Group, Haryana.
i) Skylark Foods, Haryana
j) Komarla Group, Karnataka
k) I B Group, Chattisgarh
l) Bharati Poultry, West Bengal.

3.4 CHALLENGES AND OPPORTUNITIES
Currently, the poultry sector in India faces the following challenges, which in turn could open up opportunities for the Dutch entrepreneurs.

a) Low productivity
The production facilities and methodologies followed by the poultry farmers in India are not in line with international standards. A good majority of the poultry farms in India are open buildings with no climate control or quarantine mechanisms in place, which exposes the birds to various climate variation as well as potential diseases and epidemics. In order to mitigate the risks posed by that, the density of birds in farms have to be kept low, which in turn negatively affects productivity per farm. Latest farming technologies such as climate controlled farm houses, automated feed lines etc. can help improve the productivity in Indian poultry farms.

b) Lack of storage, cold chain and transport
More than 60% of broiler birds produced in India are produced in 6 states (Andhra Pradesh, Telangana Karnataka, Maharashtra, Punjab and), similarly more than 60% of eggs produced in India are produced in 6 states (Andhra Pradesh, Telangana Haryana, Maharashtra, Punjab and Tamil Nadu). Birds are currently transported alive between the states, which causes them to be transported in inhumane and sometimes unhygienic conditions. Many birds are killed during transport. Lack of dry processing and cold chain facilities make it a logistical nightmare to be transporting good quality poultry produce within India. Poultry produce neither are transported using refrigerated trucks nor are specialized equipment used for packing or transporting poultry produce. Latest expertise in the field of cold chain can be of immense benefit to the Indian poultry farmer.

c) Supply of quality feed
Soya bean and maize are widely utilized by poultry farmers in India as the main feed. These help only in fulfilling minimum nutritional requirements, and do not help in raising high quality, healthy birds. There is shortage of quality feed in the market and lack of knowledge about the benefits of using quality feeds. The problem is confounded by the fact that there is no alternative protein source.
available either. This opens up immense opportunities for poultry feed manufacturers and dietary supplement producers.

d) Quality standards for farm management

There are no quality standards in farm management in India, prescribed either by the Government or by self-regulating industry bodies. For export market, APEDA has imposed strict quality standards and regular audits to ensure quality is maintained up to international standards. However, in the domestic market, there is a lack of comprehensive regulating authority to maintain hygiene in farms, processing and transportation. Licensing of farms is done on municipality level, who often lack the knowledge, expertise and human resources to strictly enforce quality standards. Europeans and USA poultry industry has a lot to contribute to the Indian poultry industry in the form of trainings, best practices, skill development etc.

e) Lack of processing facilities

There is a lack of dry processing capabilities in the Indian domestic poultry market. For lack of knowledge and awareness, Indian consumers prefer to go for freshly culled birds which are not processed in clean and hygienic conditions. Wet processing machineries pose serious environmental concerns owing to poorly managed waste disposals. There exist limited storage facilities which can conserve the products without loss in quality. Processing machineries that are clean and hygienic, coupled with waste treatment plants are the need of the hour in Indian poultry market.

F) Feed Resources

Success on poultry production rests primarily on the quality of the bird employed, comforting environment and provision for good feed, the last being most expensive of all other inputs, deserves befitting attention. Feed accounts for 65-70% of broiler and 75-80% of layer production cost. Maize is the popular cereal used in combination with protein meal like soybean meal which generally determines the cost of compounded feed. Production of maize increased from 9.65 million tons in 1989-90 to only 24.4 million tons in 2015. Similarly, soybean meal production increased to 11.35 million ton in 2015 from 3.52 million tons in 1999-2000. Average increase in maize availability has been 3.8% per annum which is far below the growth rate of egg or meat production. Thus, there is a need to increase the production of maize and soybean or explores the usefulness of other alternate energy and protein rich feedstuffs to maize and soybean meal, respectively, in poultry diets. In view of the large gap between the demand and availability of feedstuffs for poultry production, a holistic approach is needed to meet the demand of ever growing poultry industry. Some of the approaches in these respects are

i). Identification of newer feed resources

Since the production of cereals and oil seeds may not increase significantly, the availability of grain and oil seed meal to feed industry is expected to decrease. This would lead to escalation in the cost of feed ingredients and consequently the cost of eggs and meat. To some extent such a situation can be corrected by developing strains that need less feed input. However, alternate feed ingredients that are not related to human consumption and available in plenty should be identified and their suitability should be tested including the economic aspects.

ii) Utilization of structural

With the advancement of technology, the reduction in dependency of poultry on the storage plant carbohydrate, protein or other nutrient and to allow them to make greater use of structural carbohydrates and other nutrients. Hence the dimension from research should change from as such providing feed than technologies that utilize feed better. There are many components of feed such as β-glycans, pentosans, mannans, cellulose, lignin and phytic acid which cannot be digested by poultry under normally. These non-digestible feed ingredients frequently generate digestive stress in poultry with a consequent reduction in nutrient utilization and wet litter problems. These problems could be largely alleviated by use of feed enzymes.

iii). Overcoming limitations of Agro industrial

Byproducts and unconventional feed stuff. The nutritive value of a variety of maize and soybean meal replacers has been examined and despite their potential, the utilization in practical formulations is negligible due to constraints imposed by several antinutritional, technical and socioeconomic factors. These constraints need to be resolved by the feed industry utilizing the services of scientists, planners and policy makers.

G) Food safety

Reduction of antibiotics use in animal feed demands substantial improvement of herd health issues, but also sensible and professional management of the antimicrobial drugs is necessary to prevent the threats of antibiotic resistance in human being. Antimicrobial drugs may be used for effective therapeutic and prophylaxis purposes, but the pulsing or continuous use of antibiotics in-feed has been severely questioned, besides public health issues, because of the consequences in intestinal microbiota and the gastrointestinal barrier harmonic function.

There is a worldwide concern to minimize the use of antibiotics in poultry because of disease resistance and antibiotics residues in food chain. In such case suitable alternatives need to be explored, which could be beneficial and cost effective. Many products of such nature like probiotics, gut acidifiers, immuno modulators, eubiotics, organic acids etc. are available in the market, but need further research. Ensuring safe food is paramount for the protection of human health and for enhancement of the quality of life. Safe food plays an important role, whether domestically produced and consumed, imported or exported. In addition, the production of safe food represents an opportunity for income generation and market access. Over the last decades, the food chain approach has been recognized as an important step forward to ensure food safety from production up to consumption. This approach requires the commitment of all players in the food chain, involving producers, traders, processors, distributors, competent authorities as well as consumers. The role of animal feed in the production of safe food is also recognized worldwide, and several events have underlined its impacts on public health, feed and food trade, and food security.
Concerns prompted by the outbreak of bovine spongiform encephalopathy (BSE), and other more common food problems associated with Salmonella, enterohaemorrhagic Escherichia coli and other contaminants, have encouraged professionals and the feed industry to scrutinize more closely the causes of these diseases and methods for their control.

H) Marketing

Though, commercial production of eggs and chicken meat on scientific principles has been well standardized, marketing of eggs and broiler meat are not fully organized except few in urban sectors. Eggs are still transported in open condition and in un-refrigerated vehicles. Eggs are sold as commodity in India and purchased by consumers mostly from shop next door for daily needs. Eggs are channeled through wholesale dealers, sub-dealers, retailers etc. in two to three stages, which raises the cost of eggs by 10-15% over the actual sale price at producer’s place.

Broilers are sold live or slaughtered at the place of sale. Sometimes the birds are dressed and displayed for sale in the open air without any concern for hygiene. Similarly, eggs are sold in open without consideration for preservation of their quality. Seasonal variations in consumption and demand of eggs and meat pose greatest challenge to the stabilization of prices. The fluctuations at times go to the extent of up to 25-30% in a short period of 3-4 weeks. Thus, there is a need to strengthen the marketing system. Some of the approaches in this direction are Development of reliable and stable

• Market chain round the year for marketing of poultry products.
• Facilities for hygienic slaughter and
• Preservation of eggs should be made available at market places in both urban and rural areas. Formation of producer co-operatives/
• Associations and rural market yards will help in proper marketing. National Egg Coordination
• Committee, a farmers’ cooperative agency has been contributing to the improvement in marketing of eggs. However, more systematized marketing strategy and the state’s involvement in minimizing the channels are required for making poultry farming remunerative and cost effective in the years to come. Because of the location of farms in

• urban and peri-urban areas that too concentrated in few states, availability of eggs and chicken meat are high in these areas only, but in rural areas and rest of the country the availability is low. Thus, there is a vast scope to tap the rural markets and remote areas of the country where availability is low.

I) Processing and exports

However, these are not the only factors that will influence the evolution of the poultry industry in this coming decade. Technical factors and the evolution of science and technology, the availability of natural resources and water (which are becoming increasingly limited), and the maintenance of trade barriers must also be considered. The price of raw materials for feed production will also influence poultry production in the next few years. According to OECD-FAO (2010) estimates, feedstuff prices will be higher than the historical average between 2010 and 2019, but lower than the

Finally, consumer demands will have a strong influence as these demands are becoming increasingly concerned with animal welfare issues, food safety, and environmental impact relative to poultry production. New methods to assess the economic and environmental impact of poultry production have been developed. An example is the LCA (Life Cycle Assessment), an ISO-standardised procedure that proposes to evaluate the impact of poultry production during the entire flock life cycle, from raw material purchase, waste production and treatment, to production surplus recycling and disposal on the environment (van der Werf and Prudêncio da Silva, 2010).

J) Value addition in Poultry

Value addition in poultry plays an important role in increasing the profits. The value addition may be through nutritional manipulations, processing and transgenesis. Omega-3 enriched eggs and meats are available in the market for premium price developed by nutritional approaches. Feeding the chicks with rich sources of omega-3 fatty acids will aid in increasing the levels of omega-3 fatty acids in eggs and meat of the birds. Experiments on fortification of Zinc and Vitamin B12 in chicken egg and meat through dietary manipulation for enhanced value addition and shelf life are going on and need commercialization. The second one is through biotechnological approaches, where in the gene (inter species) responsible for specific trait can be made through transgenesis. However, this approach is still in primitive stage where in research is being carried out. The commonly utilized method for value addition is processing of the poultry products. By value addition low valued meats and by products can processed in to a highly nutritious finished products adding to the returns.

K) Welfare concerns in Poultry

Welfare of poultry has become an important issue in recent days since EU banned cage rearing of birds. Animal welfare activists increasingly argue that rearing of these high producing and rapid growing birds in intensive system of rearing resulted in some of the welfare and health issues which were not apparent in slow growing extensively reared birds. Animal welfare activists allege that the welfare of birds reared particularly in conventional cages (CC) is compromised. The space provided in CC is not sufficient for birds to do normal activities such as to stand, lie down, and turn around without touching each other and sides of the enclosure (Chatterjee and Haunshi, 2015). The birds kept in CC do not have sufficient space to express their natural or highly motivated and comfort behaviours.

Highly motivated or internally driven and comfort behaviours in laying hens are nestling behaviour, preening, dust bathing, wing flapping, wing stretching, foraging, pecking, etc. Wing flapping is often referred to as “comfort” (stretching) behaviour. Wing flapping requires more space than wing stretching (one wing stretched downward) and wing raising (slight elevation of both wings). All these
behaviours are not seen in birds kept in conventional cages. Broilers are reared mostly on floor in open sided houses for a short period of time i.e. up to 6 weeks of age. Hence, welfare issues in broiler production are entirely different. Genetic selection for higher body weight over the last 50 years resulted in increase in growth rate by over 300% from 25 g per day to 100 g per day (Nicol, 2013).

This phenomenal increase in growth rate of broilers resulted in emergence of metabolic disorders such as ascites and sudden death syndrome (Bessei, 2006). Other welfare problems are leg disorders and lameness in the fast growing broilers and hunger in the broiler breeders (Weeks and Butterworth, 2004). Extreme hunger in broiler breeders due to feed restriction to prevent accumulation of fat and in-turn affecting the egg production is considered to be one of the welfare concerns in broiler breeders. Incidence of contact dermatitis (Pododermititis) that includes hook burns, breast blisters and foot pad lesions is considered to be another welfare issue. Policy makers should consider both positive and negative aspects of the problem before making a decision on the issue related to cages. A layer bird producing 330 eggs annually in a conventional cage and a broiler growing at rapid rate (2.5 kg in 42 days) in itself is very good example that the birds are quite comfortable. One cannot imagine a spectacular productivity from birds if the birds are under stress or uncomfortable.

3.5 MAJOR CHALLENGES FACED BY THE INDIAN POULTRY INDUSTRY

Global compound feed production is estimated at a bit less than 900 million tonnes, out of which more than 30% are in Asia. Poultry feed represents 44% of the total volume (Source: IFIF). Top 5 meat chicken producers in 2012 were USA, China, Brazil, India and Mexico, whereas for egg production the ranking was China, USA, India, Japan and Mexico (Source: UNA Mexico). According to various sources, broiler meat production in India was less than 1 million tonnes in 2000 and has reached 3.4 million tonnes 2014. This is an increase of 350% over the last 10 years. Different estimations have been given for the future. Assocham has stated that broiler meat production in India will reach 6 million tonnes in 2015, but a more realistic figure would be 4.1 million by 2020 (Source: ICRA). Today, per capita broiler meat consumption in India is around 3 kilo per year, a very low figure compared to, for instance, 66 kg for Kuwait, 47 kg for Hong Kong or 41 kg for Brazil. Indian table egg production is around 66 billion per year, and is forecasted to almost double by 2020. The average Indian person consumes 55 eggs per year (around 3.3 kg), far less than for instance in Mexico (almost 21 kg), Singapore (18.8 kg) or Japan (16.3 kg).

However, Indian feed and meat businesses have to face serious challenges if they want to continue expanding, starting with land availability. India counts about 1.22 billion citizens, meaning 17.5% of total world’s population. But, India occupies only 2% of world’s total land, and a bit more than 7% of the arable land available. This land shortage means that Indian agriculture must be more efficient in the future. According to Cassidy et al. (2013) who studied crop allocations in terms of calories, protein and weights of 41 major crops combined, India directs 89% of produced crop calories to food, leaving little room for feed production, but also indicating that more food can only be produced if agriculture is more efficient.

According to FAIDA (2013), India has the potential to double the yield of most of its crops. However, there are several prerequisites to achieve this. Indian agriculture must improve the quality of seeds used, work on farming techniques and education, put in place proper water irrigation, adequate mechanization and encourage research. It is also essential to ensure a proper management of resources such as land and water. Partnership between private industry and farmers is also needed to develop successful interactions. Through an appropriate policy regime, India should improve the marketing of agricultural goods.

Last but not least, the creation of a new segment of branded foods will help to generate demand and ensure consumers of traceability and quality. The challenges for Indian poultry industry are multiple. Raw material availability and prices are already an issue. Considering that about 1 kg of corn is required to produce 1 kg of broiler (based on FCR = 1.65 and 60% corn in feed), it means that, for broiler production only, and depending on the different forecasts, an additional 1 to 3 million tonnes of corn will be needed in the next years.

Another challenge or issue is the fact that production is not evenly distributed in the country. More than 60% of broilers are produced in 5 states (Andhra Pradesh with 20%, Karnataka, Maharashtra, Punjab &West Bengal) while more than 60% of eggs are produced in 5 states (Andhra Pradesh, Haryana, Maharashtra, Punjab and Tamil Nadu). This creates logistic and quality issues related to transport. The third challenge that India needs to overcome if it wants to continue expanding its poultry production is a lack in education and access to technology. For instance, most of poultry farms use open buildings, which means no control of climate and high risks related to potential poor biosecurity.

On the positive side, this means production costs are reduced. India poultry producers also have to deal with a lack of genetic diversity. Two breeds, namely Vencobb and Babcock, represent respectively more than 70% of birds in broilers and 80% in layers. This means a potential rapid spread of diseases across the country. However, these breeds are well adapted to Indian conditions and ensure optimum performance.

Last but not least, India currently lacks skilled manpower. There are not enough managers, veterinarians, nutritionists, or researchers, to ensure a top quality. To allow expansion, efforts are needed to change the way poultry products are offered in India. Less than 5% of eggs are processed, and about 90% of poultry meat in India is consumed in fresh form, as many consumers prefer to buy live poultry and get it dressed in their presence. This has several consequences: it is difficult to transport non-processed products from one region to another one, and high mortality and shrinkage rates due to transport of live birds are observed. Also, prices are determined by daily local supply and demand, which encourages volatility.

More efforts are needed to improve supply and distribution of poultry meat in India. Indeed, poultry dressing facilities are usually manual and lack sanitary measures. This does not ensure a hygienic and scientific slaughter, and proper utilization of by-products. There is also a shortage of adequate and cost effective infrastructure, leading to poor distribution and risks on quality. Cold storage facilities are
lacking, which is a serious issue because meat and egg demand vary a lot over the year, due to different religious rituals.

Last but not least, adequate quality control standards need to be implemented. For instance, large eggs are sold at same price as small ones, which do not encourage producers to deliver quality. In summary, investments in infrastructures (slaughter houses, processing plants, transportation, warehousing and cold storage), as well as quality certification systems, are necessary to ensure growth of the Indian poultry industry. One should, however, keep in mind that same needs are required for imported products.

In spite of rapid growth, the poultry industry suffered many setbacks in recent times due to rising cost of feed, emergence of new or reemerging of existing diseases, fluctuating market price of egg and broilers, etc. which need to be addressed to make the poultry sector as a sustainable enterprise.

Issues relating to animal welfare and environmental pollution by poultry units

A major constraint affecting

• The growth of the poultry industry in India is the lack of basic infrastructure such as storage and transportation, including cold chain. As a result, there are wide price fluctuations in the prices of poultry products, i.e., eggs and broilers. An inefficient marketing system-
The

• The presence of so many market intermediaries harms both the producer and the consumer. The price and availability of feed resources- Maize or corn plays a major role in broiler production, as it constitutes 50 to 55 percent of broiler feed. As the broiler industry is growing at the rate of 8-10 percent per annum, the demand for maize and soya is thus likely to increase. Emerging and re-emerging diseases of poultry- Mutations in viral genomes leading to new variants in viruses and developing resistance to vaccines and antibiotics. Avian Influenza outbreaks occurring in parts of India, is a very good example.

The policy measures that are required to improve the poultry industry must involve:

(a) improving infrastructure facilities, which will help not only to stabilize the price of poultry products in the domestic market, but will also make them available in remote areas;

(b) creating an efficient marketing channel that will help provide remunerative prices to producers (in other words, India’s marketing set-up should also grow along professional lines).

4. MUSCULOSKELETAL DISORDERS IN POULTRY FARMING

4.1 MUSCULOSKELETAL DISORDERS

There are numerous types of work-related musculoskeletal disorders that are reported in agriculture. These include disorders of the back and neck, nerve entrapment syndromes, musculoskeletal disorders such as tendosynovitis, tendinitis, peritendinitis, epicondylitis and nonspecific muscle and forearm tenderness (National Institute for Occupational Safety and Health 1997).

The majority of the farm women reported musculoskeletal problems is non-specific and lacks a well-defined clinical diagnosis (National Research Council and Institute of Medicine 2001). The prevalence of specific disorders and syndromes are not precisely known since many of these disorders have been difficult to classify in epidemiologic studies (NIOSH 1997). This may be due to inconsistence case definitions and that many musculoskeletal disorders are difficult to ascertain using conventional medical diagnostic tools. Although quantitative laboratory tests such as nerve conduction studies are available for nerve entrapment syndromes, it is difficult to objectively measure the presence or severity of disease and functional deficits in muscular or tendon disorders. Work-related musculoskeletal disorders develop slowly over months and years of repeated stresses. The risk factors themselves are ubiquitous, found in most jobs, during the preceding 12 months. As compared to women, men reported more back and knee problems. Women reported more symptoms in the neck, upper back and upper extremities than me.

The review of literature highlights some musculoskeletal disorders in poultry farms as given below

4.1.1 Back Pain

Any pain in the back is usually characterized by dull, continuous pain and tenderness in the muscles of the lower regions of the back. Some causes for back pain include poor posture, bad lifting, pushing and pulling techniques.

4.1.2 Neck Pain

Neck pain is usually caused by bad habits including poor posture, poor lifting techniques and overexertion on the job. Another major cause is stress. Some common symptoms of neck pain are persistence aching and stiffness and sharp pain. Scutter et al. (1997) reported that one-third of agricultural workers surveyed reported neck pain at least once a week. Tractor driving was reported most frequently as the activity that contributed to neck pain
Tendon: Tendon disorders can be classified based on the anatomy of the tendon and its surrounding tissues: tenosynovitis, stenosing tenosynovitis, peritendinitis and tendinosis (Viikari-Juntura 1994). The term tendonitis is often used to refer to chronic tendinitis which is associated with repeated loading and is believed to be due to microtears in the tendon. Tendinitis is the deterioration of a tendon from repetitive motion. Animal studies on overuse of tendons have demonstrated an increase in cellularity and collagen disorganization, and an increase in tendon cross-sectional area and a decrease in tissue stiffness (Carpenter et al. 1998).

4.1.3 Shoulder Disorders:
NIOSH (1997) identified over twenty epidemiologic studies investigating shoulder musculoskeletal disorders. Evidence of association between repetition and shoulder disorders was identified. Few studies investigated actual repetitive neck movements.

4.1.4 Cumulative Trauma Disorder:
Cumulative Trauma Disorders (CTD) is a collective term for syndromes characterized by discomfort, impairment, disability or persistent pain in joints, muscles, tendons and other soft tissues, with or without physical manifestations. It is caused or aggravated by repetitive motions including vibrations, sustained or constrained postures, and forceful movements at work or leisure. Many different terms have been used to describe the observed events. For example, the syndrome has also been called over-use injury, cervicobrachial disorder, cumulative trauma injury, repetition strain injury, repetitive motion injury, rheumatic disease, osteoarthrosis (Putz-Anderson 1988). Cumulative

4.1.5 Repetitive Motion Disorder:
Tissue damage caused by repeated trauma usually associated with use of hand tools or vibrating tools is identified as repetitive motion disorder. Almost any form of activity that produces repeated trauma to a particular area of soft tissue, including tendons may cause this type of injury. Repetitive and forceful work activities, awkward or static postures and mechanical pressure associated with work tasks have been cited as important etiological factors for WMSDs (Bernard et al. 1993).

4.1.6 Carpal Tunnel Syndrome:
Pain, numbness or weakness that affects some part of the median nerve in the hand, thumb or ring finger is called carpal tunnel syndrome. Pain may radiate into the arm. Forceful work and repetitive hand work can cause CTS. According to Donne (1984), Carpal Tunnel Syndrome is a disorder by injury of the median nerve where it passes through the wrist on its way from the forearm to the hand. Injury to this nerve can cause impaired function.

4.1.7 Low Back Disorders:
Low back pain is one of the most common health problems in agriculture occupation. Low back pain is a non-specific condition in or near the lumbosacral spine that can be caused by inflammatory, degenerative, neoplastic, gynecologic, traumatic, metabolic, or other disorders. NIOSH (1997) identified the relationship between low back disorders and occupational risk factors.

The five risk factors included for this review are:
- heavy physical work which is defined as work that has high energy demands or requires some measure of physical strength,
- lifting and forceful movements,
Heavy physical work and awkward postures are the main causes of low back pain. Low-back disorders are associated with work-related lifting and forceful movements. Manual materials handling and lifting are the major causes of work-related low back pain and impairments (Waters et al. 1993) with other factors such as bent and/or twisted position (Riihimaki 1991; Hagberg 1992).

Manual material handling is the most frequent (36% of all the claims) and costly (35% of total cost) category of compensable low back disability (Snook et al. 1978). The prevalence of low back pain (LBP) in farmers has been related to LBP and more severe cases reported to be around 50%, which is higher than other manual laborers (about 37%) (Walker-Bone and Palmer 2002). Crop cultivation has been related to LBP and more severe cases (e.g. sciatica) with about 20% of farmers working in this area developing pain (Manninen et al. 1995). Chronic back pain (lasting longer than 3 months) prevalence has been reported to be around 10% (Brackbill et al. 1994).

Nursery workers are exposed to awkward postures and poor lifting conditions in several of their activities:

1) handling of plants in 1-gallon containers,
2) pruning of plants,
3) weeding,
4) plant labeling, and
5) loading/unloading trucks.

Weeding in plant nurseries produces severe stooped postures for extended times that may lead to LBP (NIOSH 2001). Pruning, weeding and labeling are particularly stressful due to prolonged extreme flexion of the trunk (>60°) (Meyers et al. 1997, 2000). Harvesting crops (fruit and vegetables) often requires farm workers to bend over into a stooped trunk posture, oftentimes for significant periods of time (NIOSH 2001). Cellulitis: It is infection of the palm of the hand followed repeated bruising called “beat hand”. Use of hand tools, like hoe and sickle coupled with abrasion from dust and dirt can cause cellulitis. Epicondylitis: It is inflammation of the area where bone and tendon are joined. It is called “tennis elbow” when it occurs at the elbow. Repetitive work, often from strenuous jobs like harvesting can cause it. MSDs are a major concern for farm workers, farmers and health care professionals due to the negative impact on the health and productivity of workers.

5. SURVEY METHODOLOGY

5.1 CONCEPTUAL FRAMEWORK

At the beginning, all data of the variables obtained from the data gathering were used in the entire methodology. Independent variables are the working posture, task design, physiological, demographical profile and physical working condition factors. The dependent variable is the severity of MSDs experienced by the caretakers. NMQ was used to determine the common types of MSDs among the caretakers. Upon obtaining all the data, frequency count and percentage distribution were utilized and results were standardized using the rubrics rating scale.

5.2 RESEARCH DESIGN

The study describes what exists, which may help to uncover new facts, about the working conditions of the caretakers. They were described factually based from the observations, surveys, interviews, and tests made. It is a descriptive research wherein the results obtained were recorded, interpreted, and analyzed.

5.3. RESPONDENTS OF THE STUDY

The participants of the study were the caretakers working in M.M Anupol Poultry Farm. The total number of caretakers employed in the poultry farm is forty (40) caretakers.

5.4. RESEARCH LOCALE

The study was conducted in Manuel Anupol Poultry Farm which generates the highest amount of gross sales among the poultry farms in Nueva Ecija.

5.5. INSTRUMENTATION SURVEY FORM

This was used to obtain the data for the demographical profile factors.

- Nordic Musculoskeletal Questionnaire. This was used in determining the discomfort location and knowing the common types of MSDs among the poultry caretakers. Cornell Musculoskeletal Discomfort. It was used to assess the frequency and extent of pain felt in each
- Body segment. NIOSH Lifting Equation. This was used to determine if task redesign is needed to reduce the risk of
- Lifting-related low back pain. Rapid Upper Limb Assessment (RULA). This tool was used in the study to investigate the exposure of
- The caretakers to risk factors associated with work-related upper limb disorders.

5.6. DATA GATHERING PROCEDURE

All the data were gathered using the apparatuses, devices and instrumentation. First, the caretakers were asked to answer the survey and questionnaires provided by the researcher. While answering, their blood pressures were taken and recorded. Then they were taken videos while working for RULA scoring purposes and data for other variables. Each one of them was carefully observed while working. Then, the equipment and building were measured for the size of the prototype. Lastly, the devices were used to record the data for the working condition factors.

6. RESULT AND DISCUSSION

The results of the Nordic survey questionnaire are presented in the table below. On average, lower back pain is the most frequent MSD the caretakers are experiencing. This is followed by wrists/hands, upper back, shoulders, neck and elbow pain.

<table>
<thead>
<tr>
<th>Body</th>
<th>Before</th>
<th>During</th>
<th>After</th>
<th>Consulted a Doctor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>17</td>
<td>31</td>
<td>37</td>
<td>24</td>
</tr>
<tr>
<td>Shoulders</td>
<td>23</td>
<td>34</td>
<td>37</td>
<td>12</td>
</tr>
<tr>
<td>Upper Back</td>
<td>16</td>
<td>33</td>
<td>38</td>
<td>22</td>
</tr>
<tr>
<td>Elbows</td>
<td>12</td>
<td>28</td>
<td>31</td>
<td>7</td>
</tr>
<tr>
<td>Wrists/Hands</td>
<td>23</td>
<td>36</td>
<td>35</td>
<td>6</td>
</tr>
<tr>
<td>Lower Back</td>
<td>30</td>
<td>35</td>
<td>39</td>
<td>30</td>
</tr>
<tr>
<td>Hips/Thighs</td>
<td>12</td>
<td>16</td>
<td>22</td>
<td>6</td>
</tr>
<tr>
<td>Knees</td>
<td>8</td>
<td>23</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>Ankles/Feet</td>
<td>8</td>
<td>24</td>
<td>17</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 6.1 Nordic Musculoskeletal Questionnaire Results
The table below shows the average computed risk for each part of the body of the caretakers. The percentage of each risk was also computed in order to get the body part which has the highest risk.

<table>
<thead>
<tr>
<th>Part</th>
<th>Risk</th>
<th>% Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>15.2875</td>
<td>14.0%</td>
</tr>
<tr>
<td>Shoulder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>16.9875</td>
<td>15.5%</td>
</tr>
<tr>
<td>Left</td>
<td>10.8</td>
<td>9.9%</td>
</tr>
<tr>
<td>Upper Back</td>
<td>11.2625</td>
<td>10.3%</td>
</tr>
<tr>
<td>Upper Arm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>8.45</td>
<td>7.7%</td>
</tr>
<tr>
<td>Left</td>
<td>3.9375</td>
<td>3.6%</td>
</tr>
<tr>
<td>Forearm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>4.3375</td>
<td>4.0%</td>
</tr>
<tr>
<td>Left</td>
<td>3.7125</td>
<td>3.4%</td>
</tr>
<tr>
<td>Wrist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>19.8</td>
<td>18.1%</td>
</tr>
<tr>
<td>Left</td>
<td>14.85</td>
<td>13.6%</td>
</tr>
<tr>
<td>Lower Back</td>
<td>20.15</td>
<td>18.4%</td>
</tr>
<tr>
<td>Hips/Buttocks</td>
<td>4.5875</td>
<td>4.2%</td>
</tr>
<tr>
<td>Thigh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>4.0625</td>
<td>3.7%</td>
</tr>
<tr>
<td>Left</td>
<td>1.5875</td>
<td>1.5%</td>
</tr>
<tr>
<td>Knee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>6.05</td>
<td>5.5%</td>
</tr>
<tr>
<td>Left</td>
<td>1.9125</td>
<td>1.7%</td>
</tr>
<tr>
<td>Lower Leg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>2.475</td>
<td>2.3%</td>
</tr>
<tr>
<td>Left</td>
<td>1.45</td>
<td>1.3%</td>
</tr>
<tr>
<td>Foot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>8.4</td>
<td>7.7%</td>
</tr>
<tr>
<td>Left</td>
<td>6.3875</td>
<td>5.8%</td>
</tr>
</tbody>
</table>

Table 6.2: Cornell Musculoskeletal Disorder Questionnaire Results

Objective 2: Determination of Significant Factors
All factors being examined were proven to be good predictors of MSDs for having p-values less than 5%, using 95% confidence level. The computations only show the proof of what the authors of the related literatures have been saying: that the factors examined are causes of MSDs. This means that all of these variables are significant factors of MSDs.

Objective 3: Determination of the Effects of Significant Variables to the Severity of MSDs
After re-examining each factor, the results show that only the variables height, working experience and light show a negative correlation to the MSD severity. This implies that as these variables increase, the MSD severity will decrease. The rest are positively correlated with the severity of MSDs which basically relates that as these variables increase, the severity of MSDs also increases. Moreover, since all the values of $R^2$, coefficient of determination, ranged between 0.25 and 0.80, this indicates that the variables are moderate predictors of the severity of musculoskeletal disorders.

7. CONCLUSION
According to the results, it has been known that the common types of MSDs are low back pain, hands/wrists pain, upper back pain and upper limb disorders. It can be concluded that the current working conditions of the poultry caretakers are at risks since all the values assessed exceed the acceptable standard values provided by the OSHA and NIOSH. All factors examined have p-values less than 0.05, thus all of them are considered to be good predictors of MSDs. After re-examining, the results show that only the variables height, working experience and light show a negative correlation to the MSD severity. The rest are positively correlated with the severity of MSDs. Since all the values of $R^2$, coefficient of determination, ranged between 0.25 and 0.80, this indicates that the variables are moderate predictors of the severity of MSDs.

8. REFERENCES


