Agricultural Machinery Safety – a Perpetual Theme of Human Society[1]

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1. Current Situation of Agricultural Machinery in Asia

Asia is an agricultural area where three fourths of the world's population total are concentrated. Recently the development of agricultural mechanization is changing the facet of the agricultural production and the life of the rural farmers in this area. Many developing countries in Asia are now in transition from labor intensive to control intensive agriculture. However, agricultural mechanization is still in its infancy in most countries compared with the industrialized nations.

The barriers that impede the growth and sustainability of farm mechanization in this area vary in different countries. In some Asian developing countries, local manufacturers are still in the "cut and weld" level of manufacturing technology. Low or substandard machines continue to be peddled in the market while some machines are not suitable to the farming conditions of the users. Farm machines are likewise beyond the reach of most farmers owing to high acquisition and maintenance costs. In Nepal, human power still remains at 36.4% and animal power 28.1%. In Bangladesh, the decrease of farm size has increased the occurrence of small and marginal farmers. Twelve million of small holders (80% ranging from 0.05 to 2.5 acres) primarily dominate the farming system. The serious scarcity of animal draft power necessitates the use of mechanical power for agricultural production activities. On the other hand, the use of machines is not often affordable by individual farmers. Small scaled agricultural machinery with low price is their urgent need. Similar situations have been recorded in many other developing countries in Asia.

For instance, the basic power source in south Asia is the Chinese 12 - 15 hp two-wheel tractor, which rural entrepreneurs and small farmers find much more affordable (see Photo 1). In addition, their attachments such as trailers, rotovators, reduced till-drills, strip till-drills, zero till-drills, and bed planters can be made in local workshops and factories.

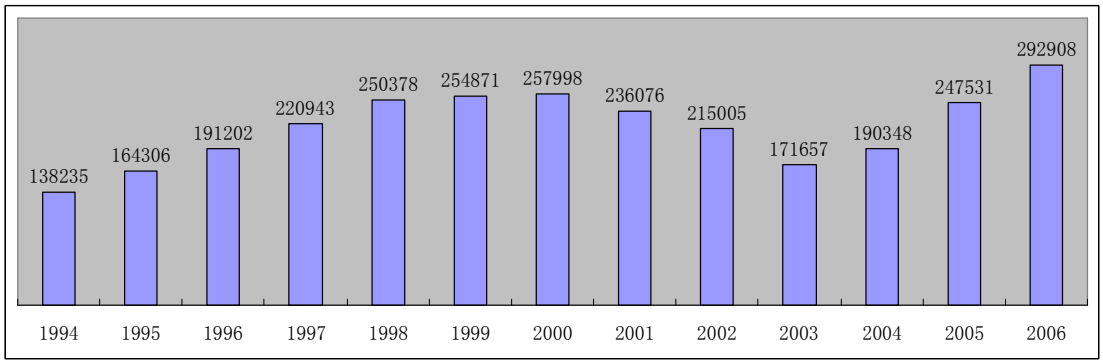
Photo 1: Belwa Agricultural Mechanization Committee of Nepal posing with their new Chinese two-wheel tractor and reduced till-drill

[1] This paper is prepared for the Global Agricultural Safety (GAS) Forum, Rome Italy, 25 September 2008.

Source: Justice S. and Biggs S.: Socially equitable mechanization in Nepal, 2004

The agricultural mechanization in India and China demonstrates quite a different picture. The global spotlight on tractor manufacturing in terms of unit volume seems to be swinging away from the USA, Europe towards India and China, where growth in the number of producers and the total volume of agricultural machinery production in recent years has been impressive. The Indian tractor industry is the largest in the world, accounting for one third of the global production. Volume growth in the tractor industry in the past four decades shows a compound annual growth rate (CAGR) of 10%. (see Figure 1) In the long term, the industry growth is expected to continue from a moderate CAGR of 5% to 7% largely due to the continued thrust by the government to increase agricultural GDP.

Figure 1 Tractor industry growth in India (units sold)



Source: Jian R. C.: Tractor Industry in India – Present and Future, 2006

In China, the total farm power reached 760m kw in 2007, 4.6% increase than in 2006. The aggregate mechanization level of planting, seeding and harvesting is 41.0%, of which the wheat harvesting level is over 81.0%, rice planting level is 11.2% and corn harvesting level is 6.8%. The annual growth rate of total output value of agricultural machinery and sales income exceeded 20% since 2002. Exports have been increasing rapidly (see Figures 2, 3 and 4). The estimated comprehensive mechanization level will surpass 42% and the total farm power will reach 780m kw by the end of 2008.

Figure 2 Status of Agricultural Machinery Industry in China

Unit: ten thousand sets

	2002	2003	2004	2005	2006	2007
Medium and large scaled tractor	4.5	4.8	9.8	16.2	20.73	20.31
Self- propelled combines	2.5	4.3	4.6	7.1	10.8	5.6

Source: China Association for Agricultural Machinery Manufacturers: Agricultural Machinery Industry in China, 2008

Figure 2 shows that the production volume of medium and large scaled tractors in 2006 was 207,300 sets, 4.6 times that in 2002. The output kept the same momentum in 2007. The production volume of self-propelled combines in 2006 was 108,000 sets, 4.32 times that in 2002.

Figure 3 Outputs of Major Agricultural Machines in China

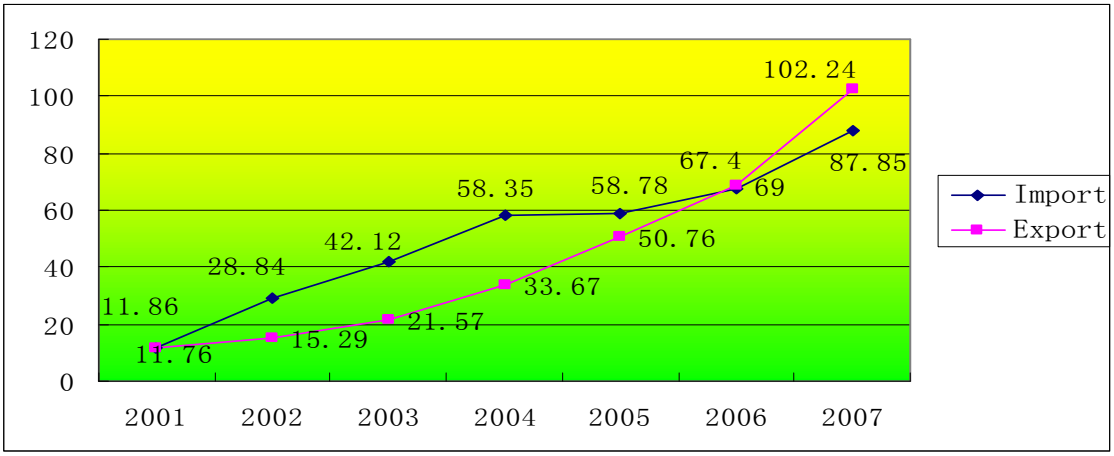
Name of Products	**Unit**	**2006**	**2007**
Medium and large scaled tractor	Set	207,328	203,128

Small-sized tractor	Set	1,915,079	2,138,094
Diesel engine	10,000Kw	45,217	56,529
Harvesting machinery	Set	355,837	250,523
Farm transportation vehicle	Set	1,844,993	1,893,407
Grain processing machinery	Set	1,685,025	1,400,258
Feed processing machinery	Set	169,804	251,846
Pump	set	37,524,727	59,469,301

Source: China Association for Agricultural Machinery Manufacturers: Agricultural Machinery Industry in China, 2008

Figure 4 Import and Export of Agricultural Machinery in China (including diesel engines and water pumps)

Unit: 100 million USD



Source: China Association for Agricultural Machinery Manufacturers: Agricultural Machinery Industry in China, 2008

Figure 4 demonstrates a fast development of the export and import of agricultural machinery in China. The export value in 2007 was 10.224 billion US dollars and the import value was 8.785 billion, 8.7 times and 7.4 times respectively compared with that in 2001.

2. Situation of agricultural machinery safety in Asia

2.1 General situation of agricultural machinery safety in the world

No farm or ranch can function without agricultural machines. They save valuable time and are essential to agricultural productivity. They also represent an ever-present danger to the people who operate them. Farm machinery uses power to do work. This creates a number of possible hazards for both operators and bystanders. Agriculture is one of the most hazardous occupations worldwide. In several countries the fatal accident rate in agriculture is double the average for all other industries. According to ILO estimates in 1999, from a total of 330,000 fatal workplace accidents worldwide, some 170,000 agricultural workers are killed each year. Contrary to mining, where fatal accidents have decreased in a number of countries, agriculture mortality rates remained consistently high in the past decade.

2.2 Situation of agricultural machinery safety in Asia

As mentioned in chapter 1, Asia has become a potential area in manufacturing agricultural machines with India and China as its lead. Agricultural machinery incidents also recorded a high rate in this area.

2.2.1 In India, a large number of studies have been conducted on agricultural accidents by different researchers, namely, Dr. S.R. Verma and Dr. V.K. Mittal, PAU, Ludhiana, Dr. S.K. Tandon, Indian Council on Agricultural Research (ICAR), New Delhi and by cooperating centres of All India Research Coordinated Research Project (AICRP), on Ergonomics and Safety in Agriculture (ESA). The dangerous machine causing accidents have been identified by these researchers as threshers, sugarcane thresher, chaff cutter, tractor, tractor trailer etc.

2.2.1.1 As per the estimate of WHO, collaborating Centre for Research and Training in Safety Technology, Indian Institute of Technology, New Delhi (IIT, 1992), the agricultural related activities cause 5,000 to 10,000 deaths, 15,000 to 20,000 amputations and 1,50,000 to 2,00,000 serious injuries every year in the states of Haryana, Punjab and Uttar Pradesh alone. According to them, threshers and chaff cutters were the two major machines involved in most of these accidents. They developed various safety gadgets for these machines which could be fitted to existing units. It is claimed that these gadgets are cost effective and can help in minimizing accidents. Tandon et al. (1988) reported data for 96 accidents happened during 1986-88 around Delhi. The maximum accidents were due to threshers (43%) followed by tractors 35%, sugarcane crushers (10%), Chaff cutters 8% and other machines (4%). Mittal et al. (1996) reported that 47% of the total agricultural accidents caused in Punjab State during 1994-95 were due to sprayers. Other important machines involved in the accidents were tractors (23%), electric motors (14%), and threshers (8%). Smith (2001) estimated that every year more than one lakh people are killed in agricultural accidents in India.

2.2.1.2 Gite & Kot (2003) compiled the data of the accident surveys carried out by four centres of All India Research Coordinated Research Project (AICRP) on Human Engineering and Safety in Agriculture, namely, CIAE, Bhopal, OUAT, Bhubaneswar, TNAU, Coimbatore and PAU, Ludhiana in Madhya Pradesh, Orissa, Tamil Nadu and Punjab respectively by adopting a common methodology and survey *proforma* Information on accidents occurred in agriculture during the five year period from 1995-1999 was collected under this programme. Here only the accidents causing loss of more than two days of working time were included in the survey, so as to maintain the similarity with the industrial accidents data. It was observed that out of the total accidents reported, the fatal accidents were 9.2%, 21 %, 4.3% and 22% respectively in Madhya Pradesh, Orissa, Tamil Nadu and Punjab. The overall accident incidence rates/1,000 workers/year were 1.25, 1.77, 2.81 and 1.40 respectively. The farm machinery related accidents were 79.0%, 39.7%, 89.5% and 72.0% whereas the hand tools related accidents were 11.8%, 21.0%, 9.7% and 1.0% in Madhya Pradesh, Orissa, Tamil Nadu and Punjab respectively. Other sources (like snake bites/animal bites, fall in wells, lightning, heat strokes etc.) contributed to 9.2%, 39.3%, 1.3% and 27.0% of accidents respectively in these states.

2.2.1.3 The accident surveys showed that the major farm machines involved in accidents were tractors, threshers, chaff cutters, sprayers, electric motors and cane crushers. In case of tractors, the accident incidence rate per 1,000 machines per year was the highest, i.e. 55.00 in Orissa followed by 25.83 in Madhya Pradesh, 14.33 in Tamil Nadu and 1.24 in Punjab. In case of threshers, the incidence rate was the highest, i.e. 41.85 in Tamil Nadu followed by 9.40 in Madhya Pradesh, 2.09 in Punjab and 2.02 in Orissa. In case of sprayers, also the incidence rate was the highest, i.e. 14.47 in Tamil Nadu followed by 1.73 in Punjab, 0.97 in Orissa and 0.45 in Madhya Pradesh. In case of cane crushers, the highest incidence rate of 61.30 was observed in Tamil Nadu, followed by Orissa (13.33) and Punjab (1.31). In case of electric motors and pump sets, the Orissa state had the highest incidence rate of 2.50, followed by Madhya Pradesh (1.27) and Punjab (0.54). In case of self-propelled machines, an incidence rate of 50.00 was observed in Madhya Pradesh as against 5.13 in Punjab. In Orissa, accidents on power tillers, animal drawn puddlers and winnowers were also reported, the incidence rates being 42.85, 5.10 and 1.60 respectively. Based on these data, the estimates for farm machinery and tools related accidents in the country worked out to be 2.67 lakh causing 0.19 lakh fatalities and 2.48 lakh injuries. The total loss to the country in monetary terms has been given as Rs. 1143 crore.

2.2.1.4 Periodical monitoring of agricultural accident data

Small sample survey of agricultural accidents occurred in four states namely Madhya Pradesh, Tamil Nadu, Orissa and Punjab during 1995-1999 was carried out. From the data obtained, mean values for source wise percentage of accidents and accident incidence rates per 1000 machines were calculated. The accidents due to tractors were highest i.e. 24.5% followed by threshers 10.1%, sprayers 8.3%, chaff cutters 7.2%, electric motors and pump sets 3.5%. The accident incidence rates per 1000 machines were 24.1 for tractors, 13.9 for threshers, 4.4 for sprayers, 3.8 for chaff cutters, 1.1 for electric motors/pump sets and 18.9 for cane crushers. Based on the data collected, the number of accidents per 100,000 workers was estimated to be 200.4 whereas the number of fatalities were 21.2.

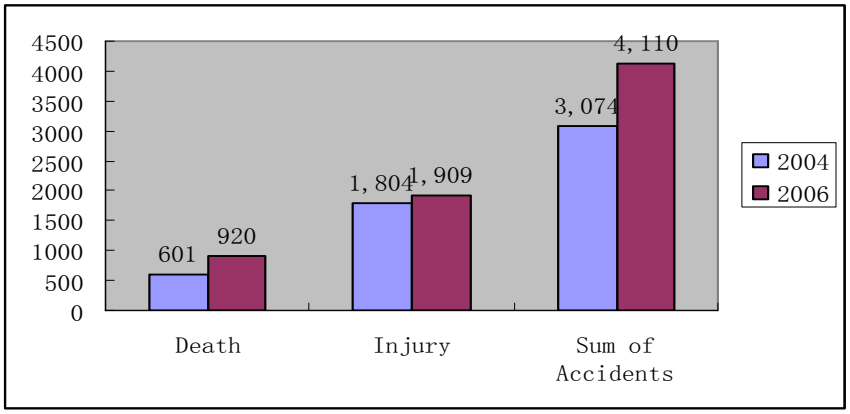
As the small sample survey showed the seriousness of the agricultural accident situation, a large sample size survey was carried out from 2004 - 2005 in Tamil Nadu, Madhya Pradesh and Orissa and from 2005 - 2006 in Punjab. The data were collected from 240 villages each in Tamil Nadu, Orissa and Punjab, and from 360 villages in Madhya Pradesh. The mean values for number of accidents per 100,000 workers were 1278 and the number of fatalities per 100,000 workers was 12.4. On the basis of the data collected through survey, each centre has worked out a survey, package of safety measures for their respective states. The package consists of recommendation related to engineering, education and enforcement aspects and efforts are being made to promote these packages of safety measures through the agencies of the State Government.

2.2.1.5 Safety Standards in Agriculture In consideration of the high accident record, the Indian Standard Institute has developed a large number of standards on safety of agricultural machines being used on the farm, such as power thresher, pedestrian control cylinder (power lawn mowers), crop protection equipment, tractors and power tillers, etc. A Dangerous Machine Act has been promulgated by the Government of India in which codes and guidelines on dangerous machines have been given. Due to large number of accidents occurring on the threshers in 1980s, the Government of India enacted the “Dangerous Machine Regulation Act, 1983" and made safe feeding chutes/feeding systems compulsory on power threshers. However, while formulating the various standards for various agricultural machines, the safety aspects should be kept in mind especially by operators.

2.2.2 China’s record also shows a serious situation in this regards.

2.2.2.1 According to the General Station for Monitoring of Agricultural Machinery Safety (GSMAMS) of China, there were 4110 incidents occurred in 2006 (exclusive of farm transportation vehicle induced incidents). The death toll was 920 and the injuries were 1909. The direct economic loss in monetary terms was 21.18 million RMB. Compared with 2004, the increase rates were 25.2%, 34.7% and 5.5% respectively. Figure 5 shows an astonishing incident increase trend in this country.

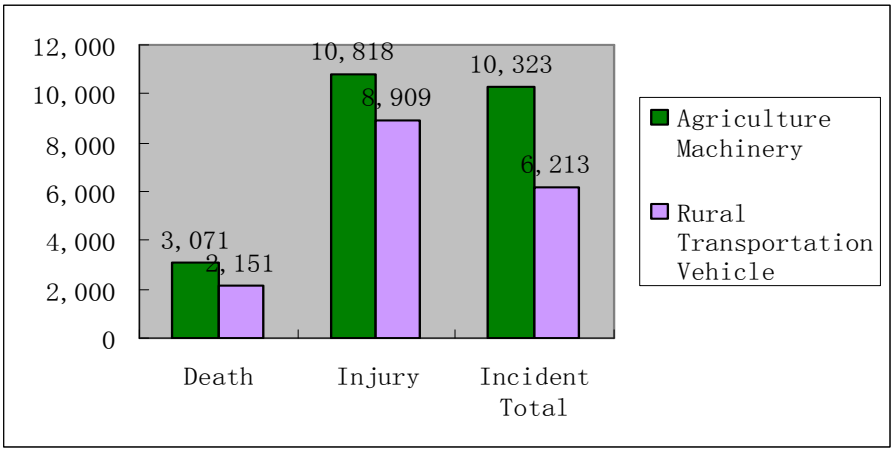
Figure 5 A rising trend of agricultural machinery incidents in China (exclusive of farm transportation vehicle induced incidents)



Source: Ministry of Agriculture of China, 2007

2.2.2.2 Taking farm transportation vehicle (FTV) into consideration, the total FTV-induced incidents was 6213 in 2006 with a death toll of 2151 and injuries of 8909. Figure 6 demonstrate a surprisingly huge portion of FTV-induced incidents in the total agricultural machinery incidents. In comparison with the total agri-machinery incidents in 2006, the FTV incidents and their induced deaths and injuries occupy 60%, 70% and 82%! **Obviously, FTV is the major source for agricultural machinery accidents in China.** According to GSMAMS, a FTV incident occurred on 15 May 2008 resulted in 29 deaths and 13 injuries. There are 22.5 million FTVs in the nation and there is still an increasing momentum. The production of FTV in 2006 was 1,844,993 and 1,893,407 in 2007.

Figure 6 FTV-induced Incidents in 2006 in China



Source: Ministry of Agriculture of China, 2007

2.2.2.3 Government policy and regulations The Ministry of Agriculture and the Ministry of Public Security are both responsible for agricultural machinery safety especially the FTVs. According to the strategic programme of the Central Government on safety production, the overall objective of agricultural machinery safety is to reduce the death toll by 10% by 2010. Regulations include the Law on Road Transportation Safety and regulations on its implementation, and the Law on Promoting Agricultural Mechanization issued by the Central Government in 2004. There are also regulations issued by related ministries and local governments. Although a national monitoring system has been established which includes 2900 monitoring organizations above the country level, their main responsibility is focused on solving incident other than preventing it.

2.2.3 In Pakistan, agriculture has been the mainstay to the national economy. The use of tractors and allied agricultural machinery is continuously on the rise. The increasing application of modern technology in man-machine environment system has caused serious accidents whenever safety has been overlooked.

2.2.3.1 Realizing the gravity and severity of accidents, a survey on farm accidents was conducted by Farm Machinery Institute, NARC, Islamabad in district Multan (the Punjab Province). Data was collected for three consecutive years i.e. 1982, 1983 and 1984. 130 farmers were interviewed at their premises. 65 farmers reported 104 accidents while 48 farmers did not report any accident. 83% injuries happened to farm workers while 17% injuries happened to non-farm workers. Agricultural sprayers, tractors, threshers, tube-wells and fodder choppers were the prominent machines involved in 104 accidents. The respective accident shares of these machines were 34, 31, 16, 6.5 and 6.5 percents. The sprayers' accidents took place due to physical contact and inhaling of chemicals. Majority of the farmers was unaware about the safety masks and gloves. The agro-chemical dealers did not provide any safety devices while selling the chemicals.

Tractors involved in accidents were of medium power range (25-45 kW). Around 18 percent of tractors involved in accidents were Massey Ferguson while Fiat and Ford involvement was 9% and

4% respectively. Majority of the threshers involved in accidents were driven by tractors and electric motors. Belt entanglements, electric shocks and feeding the crop into thresher without safety measures were the major causes of the accidents. Most of the tube-well accidents happened due to belt entanglement and electric shock. Similarly fodder cutting machines caused 6.5 percent injuries.

2.2.3.2 Agricultural Machinery Testing & Safety related Standardization
In general, UNAPCAEM (formerly Regional Network for Agricultural Machinery - RNAM) test codes for agricultural machinery are adopted in the country for testing of farm machinery incorporating their own test procedures for evaluation of the machinery not covered under the RNAM test codes.

Pakistan Standards and Quality Control Authority (PSQCA) is the apex national standards body in Pakistan. Recently, all ISO standards (about 14000) have been directly adopted as Pakistan standards. All Pakistan standards developed earlier are being reviewed and the standards which can be replaced by ISO standards would be re-designated and only those standards would be retained as Pakistan standards which are specific to local products, raising number of Pakistan standards to about 15000.

The implementation of farm machinery standards in Pakistan is on voluntary basis. Full benefits of standardization can not be reaped unless standards are adopted and practiced. In order to improve quality and safety of farm machinery there is a need for adoption of Pakistan Standards through the establishment of a centre of excellence in the country.

2.2.4 In Mongolia of Northeast Asia, about 80 percent of agricultural tasks are fully and semi fully mechanized at the present time. However, about 62 percent of the tractors and crop harvesters have been operating for more than 15 years. These outdated machines often fail to operate and result in accidents. The outdated parts of the agricultural machines as well as the incomplete and improper maintained machines and equipments leads to many serious accidents and failures. 85 percent of the incidents were caused by carelessness of tractor/machine operators. Severe weather conditions and unexpected disasters like strong dust storm, heavy rainfall, thunder hazard etc. are also apt to cause hazard cases and accidents. Most of the farm accidents happened in potato and wheat harvesting and fodder making operation. The rationalization and proper management of farm workload on the man-machine system is much indebted to farm machinery safety and human factor engineering and ergonomics for promoting safety work in agricultural mechanization.

2.3 The figures provided above only give an idea of the magnitude of the agricultural machinery-related incidents in these developing countries. Although official data are not available in many Asian countries, they are oftentimes imprecise and notoriously underestimated. Taking the Asian area as a whole, comprehensive data have yet to be available. However, the aforementioned cases in some Asian developing countries are enough to remind us not to neglect the hazards induced in agricultural machinery.

3. Major Factors Inducing Agricultural Machinery Incidents

An accident is an unplanned, unforeseen or uncontrolled event--generally one which has unhappy consequences. During the operation of various agricultural machines, accidents take place resulting either in loss of life or making people physically disabled or causing injuries. Verma et al. (1978) reported that about 73% of the thresher accidents were due to human factors like inattentiveness, unskillfulness, overwork, physical incapability, 13% due to machine factors like improper feeding system and 14% due to crop and other factors. Ghosh (1981) reported data for 192 cases of thresher injuries from the records of Safdarganj Hospital, New Delhi. In 72 percent of the cases, the left hand was involved the accident and amputation had to be done on 60 percent of the victims. Thyagraj and Shrivastava (1982) carried out studies on safety feeding chutes and recommended the minimum bottom length as 90 cm and top cover length as 45 cm. They also suggested a tilt angle up to 6º with horizontal for proper feeding of crop materials.

Based on the survey and the practice/experience in some Asian developing countries, major factors involved in agricultural machinery incidents can be summarized as follows:

(1) **The operator's attitude is a major factor with regard to safety.** Most accidents with agricultural machinery are the result of human error/negligence. Errors include: taking shortcuts to save time; failure to read the operator's manual; ignoring a warning; improper or lack of instruction; failure to follow safety rules including loose fitting clothing; and improper or lack of maintenance.
(2) **Outdated machinery lack of maintenance.** Outdated agricultural machinery often leads to incidents because of the malfunction of some parts or not repairing/maintenance periodically. Repairs and adjustments are frequently necessary to ensure optimum machinery performance and efficiency. The outdated machinery beyond expiration should be phased out in time.
(3) **Farm transportation vehicle, a major factor of incident.** FTV-induced incident has become a major factor of agricultural machinery incidents in some Asian developing countries. Such kind of incidents often occurred because of overloading or improper operation of the driver/operator. Infrastructure including road quality, sign, etc is also a factor to impose influence on normal operation of transportation vehicles.
(4) **More solving, less preventing.** The monitoring agencies on agricultural machinery safety prefer to solve the incidents which have already occurred. Incident aftermath education is neglected. Periodical training and warming are neglected. More focus on preventing than solving incidents is essential for monitoring agencies. Operators should be alerted through extension of knowledge that accidents are extremely expensive. Accident costs can include hospital bills, doctor bills, extra hired labor, machinery repair, tractor and machinery rental, pain and suffering, and loss of the use of limbs for the rest of one's life.
(5) **Technology research to reduce incident.** Technology research could not meet the requirements of agricultural machinery safety. Technology innovation should be encouraged and enhanced to modify the machines or the most hazard parts of agricultural machines.

4. Pesticide, a Deadly Workmate

In discussing agricultural machinery incident, the threat of pesticide application to the health of farmers should not be neglected. Pesticides are used widely to control insects, weeds and fungi, that might otherwise destroy a large part of the world's food crops. Exposure to pesticides and other agrochemicals constitutes one of the major occupational risks, accounting in some countries, for as much as 14 % of all occupational injuries in the agricultural sector and 10 % of all fatal injuries (ILO, 1996). In several countries the fatal accident rate in agriculture is double the average for all other industries, with agrochemicals accounting for a large number of the accidents. WHO places the total cases of pesticide poisoning at between 2 and 5 million each year of which 40,000 are fatal. CGIAR estimated that at least three million cases of pesticide poisoning occur worldwide each year, with 220,000 deaths. The majority of these poisonings occur in developing countries where less protection against exposure is applied, knowledge of health risks and safe use is limited and harmful pesticides are easily accessible. Despite the magnitude of the problem of pesticide poisoning, there have been very few analytical studies in developing countries to identify the risk factors.

Outdated technology and poorly manufactured and maintained pesticide equipment is also a major cause of excessive application rates in the Asian developing countries. The pesticide application equipment has a fast development in several Asian developed countries such as Japan and Republic of Korea. Truck-carried equipment could greatly reduce the exposure of workers to agrochemicals (see Photo 2). However, these improved equipment designs and better manufacturing quality are more expensive. Portable and manually operated pesticide application equipment, such as back-carried pesticide application equipment, is still prevailing in most of the Asian developing countries. In general, the farmers never wear any protection clothing including hand gloves and masks during operation (see Photo 3).

Photo 2 Truck-carried pesticide sprayer of Korea R.O.

Type: SS-ATOMIII – 1000 Size: 4180(l) x 1430 (w) x 1360 (h) mm

Weight: 1550kg Engine: Diesel 4 cylinder, 55ps, D4BB

Volume of tank: 1000 litre Pump for spraying: Super YH100A, 3-plunger

Max traveling speed: 18 km/h Max working speed: 6 km/h

Source: Chang P., UNAPCAEM

Photo 3 Back-carried pesticide sprayer, Sri Lanka

Source:cigar

5. Agricultural machinery safety, a perpetual theme of human society - Conclusions

5.1 Agriculture is a most heavily occupied sector in the world. Agriculture employs half of the world labour force and an estimated 1.3 billion workers are active in agricultural production world-wide. Although the proportion of the workforce engaged in agriculture is under 10% in the more developed regions, the proportion is 49% worldwide with almost 60% concentrated in developing countries. According to FAO, Asia dominates the regional distribution of the economically active population in agriculture with 80% of the world's total. Two countries alone, China and India, account for over 60% of the world's agricultural labour force and 78% of the total for Asia.

5.2 Agriculture is one of the most hazardous occupations worldwide. The three industry divisions with the highest fatality rates were agriculture (including forestry and fishing), mining and construction. Fatalities within agriculture and construction industries comprised nearly one half of all machinery-related fatalities. The highest industry-specific annual fatality rate was found in agriculture, forestry and fishing 7.47/100,000 which accounted for 30 % of the fatalities. Tractors had both the highest frequency and fatality rate of all machinery types and were associated with 2635 (38.2 %) of the 6904 cases that were coded to a specific machine or machinery group between 1980-89. Harvesting machinery and power takeoffs had the second and third highest machine specific fatality rates for the industry (ILO, 1999).

5.3 Agriculture is a neglected sector. Agriculture is also a sector traditionally neglected as a result of the emphasis placed on industrial development as well as the difficulties involved in dealing with its multiple problems. One of the distinguishing characteristics of agricultural work is that it is carried out in an essentially rural environment where working and living conditions are interwoven. Furthermore, for time immemorial, farm workers on the land have tilled the soil in pain. They have been the last to organize and, even when organized, their interests in promoting their own welfare in terms of safety have suffered through a general lack of attention to the needs of this group of workers (Velasco M.S., ILO).

For instance, it is generally very difficult in establishing the employment status of agricultural workers. According to ILO, agricultural workers are excluded from any employment injury benefit in many countries. Another example is that experts noted the impairments due to noise and vibration among tractor operators. Noise in agriculture is the result of high frequency vibrations produced by machines. At full power the motor produces far more than the 85dB(A) established as the limit for hearing loss prevention. The usual level is 95 and even 100 dB(A) for long periods, both in cabinless tractors and in those with cabins where there are additional resonance phenomena (Marquez Delgado, 1986). However, the farm workers are ignorant of the knowledge. When protection method is taken into consideration by researchers, the cost will increase accordingly.

Fortunately, PSQCA of Pakistan has publicized a standard on provision of safety on farm implements. Noise level tests have been included in the standards on test procedures for tractors and combine harvesters with a view to generating data for setting the safe limits. Some standards on safety of earth moving and other agricultural machines have also been developed.

5.4 In compensation aspect, farm workers fear of legal implications. Agriculture being a rural based activity, the farmer employers and workers live togther in a village in the same society. There is a social bond between these people. They prefer to a traditional pattern that any provision for compensation to the victims of agricultural accidents should be made in such a way that the social fabric of the village system is not disturbed or gets spoiled. As a result, there is a tendency to hide agricultural machinery-related accidents because they lead to litigations, court cases etc. and finally to bitterness and disharmony in the society (Tandon S. K. , 2008).

5.5 Policy, legislations and standards. Progress has been found in the aspects of legislations and standards in some Asian countries. Most of the country-level standards are on a voluntary basis other

than mandatory. They need to be fully implemented and improved towards regional ones. In terms of legislations, general labour laws or road transportation laws may not be applicable in full to the agricultural sector. Agricultural machinery safety needs to be addressed with a well defined strategy and must be integrated into a rural development policy. The progressive extension of agricultural machinery safety monitoring system requires the implementation of effective national policies, specific programmes and strategic plans of action with an emphasis on ***prevention***.

5.6 Extension system of knowledge and training Safe machinery operation primarily depends on how you operate the machine. Machines are inanimate objects. They cannot think, reason, or adapt to meet the needs of people. The responsibility for machinery safety rests with the operators. However, lack of information/knowledge and training for the operators has become one of the major factors resulting in a high incident record in many Asian developing countries. Furthermore, information dissemination activity through multi-media, fairs and exhibits, and similar modes remains weak in the chain of public awareness waiting for enhancement.

Agricultural machinery safety is a perpetual theme of human society, which is complicated and challenging. No single policy instrument is likely to be wholly effective other than a national/regional systematic strategy. According to the experience and lessons, education, training and information sharing play a crucial role in preventing incidents, so should positive incentives, and in extreme cases, prosecution.

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