



## Farm mechanization: Ecological paradise or disaster?

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### ABSTRACT

The story of agricultural revolution in developed world is incomplete without farm mechanisation. The giant of the world – the United States agricultural success story is also incomplete without farm mechanisation. Feeding a hungry world will be incomplete without farm mechanisation. Nevertheless, farm mechanisation, just like farm pesticides have challenged sustainable agriculture; especially in fragile tropical ecosystem. No matter the level United States has attained in agriculture, it is very difficult for them to fend solely for a world of over 6 billion people, targeted to hit 10 billion by 2050. It calls for collective action of all nations of the world. Farm mechanisation that is tailored to local, regional and national requirements are very crucial to solving world food problems. Farm mechanisation: ecological paradise or disaster? Is a mind rubbing question that keeps us conscious of limitations and needs in our agricultural systems. An attempt have been made to answer the question in this review.

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### Introduction

From the beginning, all crops for the sustenance of mankind were produced and prepared by the power of human muscles. Many centuries passed before the power of animal muscle was used to relieve that of human being (Smith, 1965). With the discovery of iron, tools were fashioned that further relieved the labour of human muscle. The transition from hand farming to this modern power farming was at first slow, but with the development of the steel plough, the internal combustion engine, the farm tractor, and other modern farm machines, the movement has accelerated beyond the wildest dream of our forefathers. Smith (1965) was so amazed by the changes which occurred in the past two decades that he wonders what effect farm machines of the future will have on human welfare. According to Smith assessment in 1965, there has been more farming progress in the last hundred years (1865 – 1965) than in all the previous history of the world. Smith is right. That was the advent of agricultural revolution.

Smith (1965) defined a machine as a device that gives a mechanical advantage which facilitates the doing of work. The term is usually associated with such tools as threshing machines, mowing machines and grain binders. Others include mounted, semi mounted and self propelled machines which depends on its power transmission. The power may be delivered either to directly mounted tools or at the drawbar, at a belt pulley, or at a “power take-off”, many high powered tracklayers and small four-wheel, two-wheeled tracklaying machines. Culpin (1969) narrated of many tractors evolving which are specially designed for use with “tractor mounted” or “multi-principle” implements, mounted directly on the tractor itself which can be raised and lowered by means of a power-lift. The “row-crop” tractor which are specially designed for work between the rows of growing crops as gradually being merged into an “all purpose” outfit which retains the essential row-crop features. According to Culpin (1969), the modern tractor has, indeed become a kind of multipurpose machine tool on which all manner of attachments can be mounted. Other specialized self-propelled machines such

as the self propelled combine harvester and the self-propelled pick baler were also included.

Mechanization has been defined, viewed and interpreted in different ways, depending on the context. Stout *et al.* (1970) defined it as encompassing the use of hand and animal operated tools and implements as well as motorized equipment to reduce human efforts, improve timeliness and quality of various farm operations in an attempt to increase productivity and overall efficiency. Agu and Nwandikom (1984) defined mechanization as the use of machines, mechanisms and devices for the production, processing and storage of crops and animals for human and animal consumption.

The justification of farm mechanization, according to Barger *et al.* (1963) was based on man’s very inefficient and ineffective power unit; limited to about 0.1 hp continuous output. This is worth almost nothing as a primary source of power. According to the workers, for the farmer to receive an adequate return for his labour, he must be an efficient producer. This efficiency can only be achieved if there is proper use of materials and effective utilization of power through mechanization.

Irrespective of the gains in farm mechanization; there are still ecological challenges. Removal of vegetation cover and intensive cultivation expose the land to the devastating effects of erosion (both water and wind) – (Oparaugo, 1994) via run-off or overland flow or flood. Closely associated with run-off and preceding it, according to the author, is rain drop or splash erosion which detaches soil particles and places them in suspension to be carried away by run-off. For Fagbami (1994), the severity of heavy machinery on tropical soils is predicated on their fragility; thin erodible surface layer, underlain by stony/gravelly or easily laterized layer. Furthermore, Fagbami (1994), explains degradation effects, as the land is opened up to cultivation, not just as a result of the trauma of bush clearing, if done mechanically, but as a result of the shear vigour of the environmental factors of intense rainfall, high temperatures, accompanied by high evapotranspiration and high wind velocity in the Sudan and Sahelian zones. Pretty (2002) estimates 2

billion out of 13 billion (Baird, 2001) hectares of land that is degraded worldwide. According to Pretty, they suffer from a mix of physical degradation by water and wind erosion, crusting, sealing and waterlogging; chemical degradation by acidification, nutrient depletion, pollution from industrial wastes and excessive use of pesticides and fertilizers; and biological degradation by organic matter depletion, and loss of soil flora and fauna. The breakdown based on Pretty (2002) are: 490 million hectares in Africa, 750 million hectares in Asia, 240 million in Latin America; with Europe, North America and Australia sharing 100 million to 200 million of degraded land.

The essence of this review is to examine farm mechanization and to present it in the context of ecological paradise or disaster.

### **The Pros and Cons**

#### **Increased agriculture and food production**

Pellizzi (1984) summed up agricultural mechanization as one of the turning points for a harmonic development of a country where the manufacturing and the use of machines involve the contemporary development of all its economy with its three fundamental sectors: primary (agriculture); secondary (industry); tertiary (service and educational). The United States Agriculture is always a reference point. Igbeka (2000) rightly quotes American agriculture to have changed from mere subsistence farming to a large scale power-operated enterprises within a span of 70 years. He cites the Farm Equipment Institute, Chichago (1950) as listing efficient equipment in the hands of free farmers as the best insurance against hunger and want. For them, if farmers everywhere could be blessed with the know-how, the freedom and the machines so typical of America, the hunger and famine which have stalked mankind since time began might well become a memory. Unfortunately for 65 years (1950 – 2015) after that assertion, and even the next century (2015 – 2115) and beyond we still have a hungry world of 6 – 10 billion people.

Nevertheless, there is still an agreement that mechanization and technology have not only modernized the operations of America's farming but world farming. It is in agreement with Igbeka (2000) that the nation (US) have striking facts: a single hour of farm work produces more than twelve times as much as it did in 1940, when a single farm worker could provide for about ten people; American consumers, with a growing array of fine foods from which to choose, spend only about 11% of their take-home pay for food despite a general rise in the price of food during the last three decades; though the farm population has dwindled to about 7.6 million from more than 30 million in 1935, largely as a result of the general urbanization of American Society, the agricultural industry has been expanding. Four of every ten positions in private employment are related to agriculture in one way or another. Igbeka (2000) rightly gives agriculture as America's largest industry, with assets exceeding 198.8 billion dollars. Between 2000 – 2015 (15 years), Igbeka will not be surprised that America's agriculture is worth over US\$600 billion per annum (White, 1994). A rise of 401.2 billion within 15 years or 27 billion increase per year over that period. According to Igbeka (2000), what agricultural mechanization has done for the USA, can be done for any other country, especially the developing countries, and in fact in a shorter period of time. This is an over exaggeration, on the part of Igbeka, as he failed to take in economic, political, social and religious equations into context. Similarly, issues of fragmented land holdings, land tenure system, land use system/Act, weather and climate, land degradation. Many developing countries are fighting many wars: hunger and starvation, unstable democracy,

weak economy, terrorism, religious/civil unrests, climate change, desertification. Many have leaders without foresight, who fail to plan and invest wisely at their period of economic prosperity. The oil boom of 1960s to 1980s were not well utilized by many developing oil nations like Nigeria. Today, the oil glut is far worse than it was in the late eighties, with price of crude falling to nearly US\$20 per barrel. Yet, there is no lessons from the trend on the part of developing country like Nigeria, as developed countries like US and Europe have learnt, during the economic meltdown of the last decade. Many developed countries are now exporters of both agricultural products and oil; while the so called developing oil countries are now net importers of food and refined petroleum products from developed countries. Shame unto them.

#### **The principles versus the practices of farm mechanization**

Igbeka (2000) lists agricultural mechanization as assuring a technical and economical contributions to the qualitative and quantitative development of plant and animal production. For the worker, it allows the increase in yield and in multiple cropping every year; the reduction of production losses; greater timeliness in agricultural practices; reduction of workers fatigue. Igbeka (2000) expanded these principles to embrace: reduce hazards of farming or redeem farming from the inconsistencies and uncertainties of nature and its elements; reduce production costs and increase productivity, with better methods of farming, more efficient use of machine, better use of labour, better planning and design structures; improving and retaining the quality of farm products, through better storage, ventilation, refrigerator, pasteurization, grading and improved methods of handling. Others in Igbeka list are: utilization of profitable farm by-products and surpluses, removing drudgery from farm operations, with more incentives for young people to remain on the farm when menial chores such as manure handling, waste handling and others are improved by mechanization. Farm machines make farm life more enjoyable, thereby leading to more accomplishment in less time. Leisure time is ensured, such modern conveniences and amenities as running water, electricity, sewage disposal make farm life more comfortable and pleasant. Again, it enhances efficient conservation of our natural resources, including water conservation and control, efficient farm-stead planning and management.

All these are principles of agricultural mechanization listed by Igbeka (2000), but the practices in most scenarios, locality, region, countries are quite different. It is not only mechanization that increases yield and multiple cropping. Other inputs like fertilizers, pesticides, and resources such as capital, labour, land make it practicable. The reduction in production losses through silos and refrigerators, may not work in practice without 24 hours uninterrupted power supply. The timeliness in agricultural practices are dependent on weather and climate forecasting and reality. The reduction in worker's fatigue is dependent on conditions of service. If a worker can get good wage for hours worked, even at fatigue point, it will reduce his temptation of working above normal working hours to make both ends meet. In current industrial society, man is used more than machine, made to work 24 hours, 7 days a week, leaving him more fatigued and miserable at peanut per hour wage, which cannot feed him, not to talk of bills and rents. Talking of reduction of production costs in midst of high cost of gasoline, petrol and lubricants, high interest rates, quotas/barrier/tariffs on agricultural inputs, outputs and services. The utilization of profitable byproducts and surpluses does not always work, as farmers are paid subsidies and incentives in most developed world to destroy excess products, to maintain local and

international prices of commodities. Sometimes, cost of utilizing by products, may be more than the products themselves. Farm chores like manure handling, waste handling is not the main drudgery associated with young people in farm operations. Even if they are to do these operations manually, and they are well paid for them, they will do them conscientiously. How many countries in developing and underdeveloped world can afford modern conveniences like running water, electricity, sewage disposal in farm steads and thus make farm life more comfortable and pleasant. This is more of “wishes” in such countries. When Igbeka (2000) talks of conserving and using more efficiently our natural resources such as water conservation and control, efficient farm-stead planning and management, they are more of principles than practices. The extent farm mechanization is helping to achieve these, remain to be properly understood. Is it only water that is natural resource. What of soil, air, wildlife, biodiversity, trees/vegetations. How do farm mechanization contribute to their conservation?

#### **How mechanized is farm mechanization?**

Igbeka (2000) classifies agricultural operations by their use of power in relation to human judgment. The first operations to be mechanized are the ones that use a large amount of power and little or no human judgment (citing, Pingali *et al.*, 1987). In most cases, according to these workers, operations in which human judgment are important are only mechanized when wages begin to rise. In developing countries, the pattern of mechanization have been found to be the same for all countries during the early stages of mechanization but the sequence in which power-intensive operations are mechanized depends on the economy wide factor endowments. For example, mechanized pumping is mechanized before mechanical tillage in places where land-to-labour ratios are low.

Igbeka (2000) also grouped agricultural operations to the relative intensity with which they require power or energy in relation to the control functions of the human mind or judgment. Operations which are power intensive include land preparation, transport, while weeding, sifting, winnowing and fruit harvesting are control-intensive operations.

The shift of the source of power from human to mechanical power, according to Igbeka (2000) is dependent on the level of power intensity of the operation as cited by Pingali *et al.* (1987). To the workers, new power sources should always be used first for power-intensive operations, regardless of the stage of mechanization. It is only for these select operations that the use of the new power source can have the greatest comparative advantage. Furthermore, according to the authors, it is known that the mechanization of power-intensive operations depended less on the price of labour, that is, the mechanization of control-intensive ones. In other words, it often pays to move to a higher stage of mechanization in power-intensive operations, even at low wages, when mechanization of control-intensive operations is not profitable.

A comparison was done by Igbeka (2000) of agricultural operations according to their power-intensity and control-intensity and the sequence of their transfer to the new power source. The worker showed stationery operations, such as milling, grinding, threshing and water lifting which are of high power-intensive are among the first to be transferred to a new source of power. The transport and primary tillage operations are the only mobile operations in this category. Igbeka (2000) laments on the constraints imposed by low farming intensity on the adoption of the plough, which are not applicable in the case of milling, grinding and transport. For this worker, these operations are mechanized even under low farming intensities

because of the enormous savings in labour as a result of a switch away from human power and the ease of establishing rental markets for the use of this equipment, which does not suffer from the timeliness problem faced in the tillage operation. He mentioned some mechanical operations in Nigeria like cassava grating, pepper and cereal grinding. In his report, operations, such as harvesting, which are of intermediate power and control-intensities, are mechanized only after the mechanization of labour-intensive operations. The worker advocated selective appropriate mechanization for the developing countries, where adoption of a new source of power should be peculiar to each country.

#### **Agriculture mechanization/allied services and ecological niche**

Pretty (2002) reports African farmland losing nitrogen, phosphate and potassium nutrients at a rate of at least 30 kilogrammes per hectare per year; with land in 23 countries losing more than 60 kilogrammes per hectare. This is in addition to areas under degradation from various factors listed earlier. The author also list agricultural systems as contributor to carbon emissions through the direct use of fossil fuels in farm operations, the indirect use of embodied energy in inputs that are energy intensive to manufacture and transport (particularly fertilizers and pesticides), and the cultivation of soils resulting in the loss of soil organic matter. For Pretty, agriculture as an economic sector also contributes to carbon emissions through the consumption of direct and indirect fossil fuels. With the increased use of nitrogen fertilizers, pumped irrigation and mechanical power, accounting for more than 90% of the total energy inputs to farming, while industrialized agriculture has become progressively less energy efficient. The author mentioned soil as a major carbon sink, but regrets that once a soil under conservation tillage are ploughed, the gains in carbon and organic matter stock are also lost. This poses a big challenge for carbon trading systems, as there is no such thing as a permanent emissions reduction or a permanently sequestered tonne of carbon.

Pretty (2002) mentions one problem with the redesign of landscape for modern agriculture: the loss in natural features and functions. Wetlands have been drained, rivers straightened or hidden behind levees, aquifers mined, and rivers, lakes and seas polluted, mostly to ensure that production farmland is protected from harm or excessive costs. He laments the increased flooding to vulnerable areas in Europe as a result of conversion of meadow to arable fields. In Germany, Rienk van der Ploeg (cited by Pretty, 2002) have correlated the loss of meadows with an increased incidence of inland flows. The author gives the reduction of Japan wetland's under irrigated paddy to flooding of 1000 – 3000 houses every year. In China, the reclaiming of 500,000 hectares of wetlands for crop production for the past 63 years have also meant the loss of flood water capacity of some 50 billion cubic meters, a major reason for the US\$20 billion flood damage caused in 1998 (Pretty, 2002). According to the author, in many agricultural systems, over intensive use of the land has resulted in sharp declines in soil organic matter/or increases in soil erosion, some of which in turn, threatens the viability of agriculture itself. In his report, one quarter of farmland is affected by water erosion, one fifth by wind erosion, and one sixth by salinization and waterlogging in South Asia. Pretty's value on wetlands and watercourses, so as to calculate how much is lost when they are damaged or destroyed is not a trivial task. According to the worker, economists have no agreed value for wetlands, though various studies indicate that individual bodies can provide several million dollars of free

services to nearby communities for waste assimilation and treatment. Pretty (2002) records show that USDA put wetland monetary value at US\$300,000 per hectare per year. Another way Pretty assessed value was to investigate how much people pay to visit wetlands, whether to watch or photograph biodiversity, or indeed to shoot it. In the US, it is estimated that 50 million people each year spend US\$10 billion observing and photographing wetland flora and fauna, 31 million anglers spend US\$16 billion on fishing, and 3 million waterfowl hunters spend nearly US\$700 million dollars annually on shooting it. Pretty (2002) meta-analysis of economic studies of people's willingness to pay for recreational services of wetlands and watercourses puts the average value in Europe at UK£20 to UK£25 per person per hectare per year. Thus, each hectare of wetland converted to another purpose means the loss of at least UK£20 of value to the public. There are, of course, limitations in these exercises, as monetary values cannot be allocated to all uses. This was an incredible analysis by Pretty.

This genius (Pretty, 2002) puts most serious side effects of agriculture as the leaching of run-off nutrients, and their disruptions of water ecosystems. This, he referred as eutrophication. The nutrient enrichment of water that leads to excessive algal growth, disruption of whole food webs and, in the worst cases, complete eradication of all life through deoxygenation. The most notorious example is the Gulf of Mexico dead zone, an area of 5000 – 18,000 square kilometers of sea that has received so much nutrients in the Mississippi Basin borne by the fishing families of Louisiana. No one is yet to put a cost on these losses. However, according to Pretty, further internalization of the prices of fertilizers, or the activities of intensive livestock units, would give much greater concern about such polluting activities. In UK, he estimates nutrient enrichment to cost UK£130 – 170 million per year.

#### **Sustainable solutions to agricultural mechanization and practices**

Igbeka (2000) had earlier recommended selective appropriate mechanization for each country. This was collaborated by Sobulo (1999) who advised on poor adaptation of foreign technology to other countries. Such countries they copy, according to Sobulo, are able to sustain their high yields under intensive farming because they know how to manage their soil, which may be a non-renewable resource, when it is badly damaged. For the worker, differences in soil and climate, is responsible for differences in management of temperate and tropical soils. He recommended not less than 20 years baseline studies, as necessary for developing technologies in soil management. Igbeka (2000) advised that adoption of new and improved technologies, especially in the developing countries, must be appropriate and acceptable, both in terms of the rural people's socio-economic environment, resources and technical suitability.

Then comes to Pretty (2002). The worker is a strong advocate of sustainable practices or programmes. In his report, sustainable agriculture starts with the soil, by seeking to reduce soil erosion, and to make improvements to soil physical structure, organic matter, water holding capacity and nutrient balances. He recommended the use of legumes, green manures; the adoption of zero-tillage, and the use of inorganic fertilizers where needed. For the author, these are age old practices adapted for today's conditions. Some, though, according to Pretty seem to break one of the fundamental rules of agriculture. Which one Pretty?. The answer is in your next sentence in paragraph one, page 86 of your 2002 work, where you mentioned of current reversal to no-till as opposed to

conventional tillage practices, that have governed agriculture for over 12,000 years of civilization. Amazingly, for the past decade, as reported by Pretty, Latin American farmers have found that eliminating tillage can be highly beneficial, and many in Africa have adopted no-till or only shallow cultivation for rice production. For Pretty, at first sight, it seems a strange idea. Nevertheless, after harvest, the crop residues are left on the surface to protect against erosion. At planting, seed is slotted into a groove that is cut into the soil. Weeds are controlled with herbicide or cover crops. This means that the soil surface is always covered, and the soil itself no longer inverted.

The fastest uptake of these minimum till systems has been in Brazil where there are 15 million hectares under *plantio direto* (also called zero-tillage, even though there is some disturbance of the soil), mostly in three southern states of Santa Catarina, Rico Grande do Sul and Parana and in the central Cerrado. In neighboring Argentina, there are more than 11 million hectares under zero-tillage, up from less than 100,000 hectares in 1990, and in Paraguay there are another 3 million hectares of zero tillage. There are several million hectares of conservation or no-till farming in the US, Canada and Australia, but here, according to Pretty (2002) it mostly tends to be simplified modern agriculture systems, which save on soil erosion but do not necessarily make the best use of agroecological principles for nutrient, weed and pest management.

Pretty (2002) gave much details of role of adoption of zero tillage in sustainable agriculture. The author quotes John Landers who runs Brazilian network of clubs, including friends of the lands, as believing farmers zero-tillage adoption represents a total change in the values of how to plant crops, and manage soils. According to the workers, on adopting zero-tillage, farmers adopt a higher level of management and become environmentally responsible. Followed by many fundamental changes, including the adoption of biological controls, awareness that the new technology is eliminating erosion and building the soil so they have something to have for their children, and a willingness to participate in joint actions.

In Pretty's account, zero tillage has had an effect on social systems, as well as on soils. According to his narration, earlier adoption had the notion that zero-tillage was only for large farmers. This has now changed, and small farmers are benefiting from technology breakthroughs developed for mechanical farming. A core element of zero-tillage adopted in South America has been adaptive research; working with farmers at microcatchment level to ensure technologies are fitted well to local circumstances. According to Landers (cited by Pretty, 2002) zero-tillage has been a major factor in changing the top-down nature of agricultural services to farmers groups: from local (farmer microcatchment and credit groups) to municipal (soil commissions, friends of land clubs, commercial farmers and farm workers' unions) to multimunicipal (farmer foundations and cooperatives) to river basins (basin committees for all water users) and to state and national level (state zero-tillage associations and the national zero-tillage federation).

With the adoption, of new technologies by farmers, organic matter levels have improved so much that fertilizer use has been reduced and rainfall infiltration improved. In Pretty (2002) account, farmers are now getting rid of contour terraces at many locations, insisting that there are no erosion problems. As biological controls are enhanced with surface mulch and crop rotations, it has also become possible to reduce the amount of pesticides used, with some success in herbicide-free management. Pretty listed other advantages of zero tillage:

reduced siltation of reservoirs, less flooding, higher aquifer recharge, lowered costs of water treatment, cleaner rivers and more winter feed for wild biodiversity. According to Pretty (2002) a large public good is also being created when soil health is improved with increased organic matter, making soils good sites for carbon sequestration. Pretty (2002) laments on other controversies surrounding zero-tillage. Some feel that the use of herbicides to control weeds, or the use of genetically modified crops, means that we cannot call these systems sustainable. Pretty defends the substantial environmental benefits, particularly where farmers use cover crops for green manures in order to raise organic matter levels. For Pretty (2002) the critical message is improve the soil, and the whole agricultural system's health improves, too. Even if this is done on a very small scale, people can benefit substantially.

The proper management of water is also essential for agriculture. According to Pretty (2002) proper management of water makes landscapes productive. He gave one fifth of the world's cropland under irrigation, allowing food to be produced in dry seasons when rainfall is in short supply but sunlight is abundant. The author defended the role of water management citing topical examples, where farmers produce three crops each year, and altogether irrigated lands produce two-fifths of the world's food. Nevertheless, according to the worker, most farmers don't entirely depend on rainfall, an input that is becoming increasingly erratic and uncertain in the face of climate change. To address this limitations, water harvesting is encourages, especially in drylands. Water harvesting has increased grain yields of rice, wheat, pigeon peas and sorghum from 400 to 800 to 1000 kilogrammes per hectare, and the increased fodder grass production from the terrace bunds used for livestock in northern India uplands of Gujarat, Rajasthan and Madhya Pradesh; using the Indo-British Rainfed farming Project. The improved water retention has also resulted in water tables rising by 1 meter over three to four years, meaning that an extra crop is now possible for many farmers in those provinces.

Pretty (2002) account on water harvesting in sub-saharan Africa is also stunning. It is turning barren lands green. Again, the technologies are not complex and costly, and can be used in even the poorest of communities. In Burkina Faso, 1000,000 hectares of abandoned and degraded lands have been restored with the adoption of *tassas and zai*. These are 20 – 30 centimeter holes dug in soils that have been sealed by a surface layer hardened by wind and water erosion. The holes are filled with manure to promote termite activity and to enhance infiltration. When it rains, water is channeled by simple stone bunds to the holes, which fill with water, and into which are planted millet or sorghum seeds. Normally, cereal yields in these regions are precariously low, rarely exceeding 300 kilogrammes per hectare. Yet, these lands now produce 700 – 1000 kilogrammes per hectare.

Pretty (2002) gives a good panacea on improving irrigated agriculture: good organization. According to the author, despite great investment, many irrigation systems have become inefficient and subject to persistent conflict. He criticized irrigation engineers, who assume that they know best how to distribute water, yet can never know enough about the specific conditions and needs of large numbers of farmers. He mentioned of simple ideas like farmers' water user's groups and letting them manage the water distribution for themselves. The author refers us to Sri Lanka, Gal Oya region, where farmers group manage water for 26,000 hectares of rice fields, and produce more rice per year and per unit water. Moreover, when farmers took control, the number of complaints received by the irrigation

department about water distribution fell to nearly zero. The benefits were dramatically shown during the 1998 drought. According to the government, there was only enough water for the irrigation of 18% of the rice area. But farmers persuaded the irrigation department to let this water through on the grounds that they would carefully irrigate the whole area. Through cooperation and careful management, they achieved a better than average harvest, earning the country US\$20 million in foreign exchange. Throughout Sri Lanka, 33,000 water user's associations have been formed, a dramatic increase in local social organization that has improved farmers' own capacities for problem-solving and cooperation, and for using nature more efficiently and effectively in order to produce more food. Infact, Pretty is a prophet of sustainable agriculture. Read Pretty (2002) and other works online at [www.julespretty.com](http://www.julespretty.com)

#### **Farm mechanization – ecological paradise or disaster?**

Farm mechanization does not fall into any of these extremes. One cannot imagine agriculture without farm machines. It should have been like civilization without mobile phones and computer. The most civil thing is that mechanization should take into account the types of vegetation, soil, weather, climate, culture, traditions, economy, polity, socio-religious lives of a nation. They are all inclusive. What is good for Peter, may not be good for Paul. One man's meat is another man's poison. Indigenous engineers are challenged on these subject matters. From land clearing to processing/ preservation/ marketing calls for local touch. The design, fabrication and mass production of farm machines has been crop and process specific and all stakeholders: agricultural engineers, investors, farmers, agronomists, processors, marketers, cooperatives, policy makers, government, banks, insurance companies, NGOs, environmental managers and custodians have to be fully involved in every level to achieve agricultural sustainability. It will very difficult to feed a hungry world, without a well articulated, and coordinated farm mechanization programmes and policies in all nations on earth. Figures 1 to 7 depicts the many faces of farm mechanization.

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