**Mechanised cultivation for Economic and Sustainable Growth of Agriculture**

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**ABSTRACT**

The country's agricultural production has stagnated at a time when the broader elements of the economy have grown. In order to sustain an overall growth rate of 9 per cent in India, it is imperative for the agricultural sector to grow at 4 per cent. Though India has achieved self sufficiency in food grain production, the last couple of decades have seen the growth rate of food grain production (1.5 per cent) lag behind that of population (1.9 per cent). With the efforts such as introduction of high yielding varieties and expansion of irrigated area have played a crucial role in achieving the goal of food self sufficiency in the past, rapidly growing demand for food has brought the need for building efficiencies in agriculture to the forefront. Towards this objective, it is imperative to focus on improving the intensity of farm mechanisation in the country. Agricultural Mechanization “removes the drudgery associated with agricultural labour, overcomes time and labour bottlenecks to perform tasks within optimum time windows and can influence the environmental footprint of agriculture leading to sustainable outcomes.” Hence there is need to increase access to environmentally sound agricultural Mechanisation strategy that both sustains and enhances rural livelihoods and reduces pressure on natural recourses that are the lifeblood for producing food. The ultimate objective of Agricultural Mechanization Strategies is to help increase the welfare of farm households and create positive dynamics and opportunities for economic growth in rural areas. The linkage between the farmer and other stakeholders like manufacturers, retailers, wholesalers, and importers is of critical importance to the successful and sustainable development of agricultural mechanization. Sustainable Agricultural Mechanization (SAM) – a potentially beneficial, yet widely neglected element in agriculture-for-development agendas. A fundamental requirement is that stakeholder “businesses” are profitable. If farmers are not making money they will not be able to purchase inputs; if retailers cannot sell items at profit then they will not stock them and if manufacturers are not fabricating tools and machines at a price that is affordable by the farmer, then their business is unsustainable. Agricultural engineering and environmental sustainability must be perceived to be sufficiently important by the broader community, to justify strategy formulation. They should be able to participate in a full and open exchange of views at all stages of SAM strategy development. For the success of a SAMS, it is important to consider the pre-conditions that SAMS must emanate from a real need expressed by a political will which depends on the political, economic and sociological status of the state.

**KEYWORDS** Mechanization, Economic growth, Sustainable Agricultural Mechanization, Business, Agricultural engineering, environmental sustainability

In the fast changing world and increasing competition in a globalised economy, there is a need for exploiting the available resources to the maximum level and use of best technologies available world over, to cope up with domestic demand of food and also to target export market. This will be particularly relevant in India, where farmers grow a number of crops, but have technical constraints in enhancing production and productivity because of inadequate exposure to high technology & inputs coupled with advanced production practices, logistics and marketing.

The country's agricultural production has stagnated at a time when the broader elements of the economy have grown. In order to sustain an overall growth rate of 9 per cent in india, it is imperative for the agricultural sector to grow at 4 per cent. Though India has achieved self sufficiency in foodgrain production, the last couple of decades have seen the growth rate of food grain production (1.5 per cent) lag behind that of population (1.9 per cent). During 1980’s the land reforms measures along with agricultural extension programmes in the form of greater utilization of HYV seeds, technological improvement etc., have led to increase the yield growth rate and that have resulted in the higher growth of agricultural production in the state. However, the growth performance of India agriculture is found to experience a serious set-back in 1990’s. There is a sharp deceleration trend in the growth rates of agricultural output.While efforts such as introduction of high yielding varieties and expansion of irrigated area have played a crucial role in achieving the goal of food self sufficiency in the past, rapidly growing demand for food has brought the need for building efficiencies in agriculture to the forefront.

Towards this objective, it is imperative to focus on improving the intensity of farm mechanisation in the country. It facilitates timely, precise and scientific farm operations, increasing farm output and labor use efficiency. This would result in significant improvement of agricultural productivity.

 Farmers mechanise farm operations when the biological sources of energy, e.g., human and animal labour become more costly than the mechanical sources. There is a secular tendency everywhere for the biological sources to become costlier than the mechanical sources. This is due, in part, to the increasing ease with which capital can be substituted for labour (rise in the elasticity of substitution) in agriculture and partly to the rise in the cost of human and animal labour relative to that of machines and fuel ([Hanumantha Rao, 1972](http://scialert.net/fulltext/?doi=ijar.2010.1107.1115#552516_ja)).

 Further, as a result of globalization and liberalization, the mechanization of the farm becomes utmost necessary because to have a comparative cost advantage of the farming practices. With the implementation of the modern farming machinery, the cost of cultivation may be reduced to a substantial level. Mechanization of farm is expected to generate enormous development opportunities for the agricultural sector. It will increase the marginal productivity of labour substantially and have a higher return per unit of land and labour ([Roy, 2007](http://scialert.net/fulltext/?doi=ijar.2010.1107.1115#56969_b)).

The economic development and labour scarcity are the two major drivers for farm machinery and equipment demand. Presently, India is the largest manufacturer of tractors in the world accounting for about one third of the global production and more than 50 per cent of tractors in <60 hp category (Singh and Mani 2009). During 1981, the average farm power available was about 0.47 kW/ha which increased up 1.46kW/ha in 2005 comprising of about 84 percent from mechanical and electrical sources and 16 per cent from animal power and human labour. Now it is estimated that average farm power available India is 1.9 kW/ha by 2011-12. (Kulakarni 2011) as there is a strong linear relationship between power available and agricultural productivity. Improved agricultural tools and equipment are estimated to contribute to the food and agricultural production in India by savings in seeds (15-20%), fertilizers (15-20%), time (20-30%), and labour (20-30%); and also by increase in cropping intensity (5-20%), and productivity (10-15%). Agricultural Mechanization can contribute to reaching this objective by:

* Increasing the efficiency of agricultural production and thus productivity
* Reducing post-harvest losses
* Increasing value added to agricultural raw materials
* Maintaining the integrity and quality of farm products

**Farm Mechansiation in Andhra Pradesh**

Farm Mechanization in the Andhra Pradesh has played a significant role in the rapid transformation of agriculture; still there is a large scope for increasing agriculture production of per unit area and time by increasing cropping intensity through optimum resource use. Cropping intensity is further increased by speedy and timely operations. This increased cropping intensity calls for the extensive mechanization to ensure the variety of field operations to be performed at optimum time. This is possible only through the use of farm mechanization.

One of the major constraints of increasing agricultural production and productivity is the inadequacy of farm power and machinery with the farmers. The average farm power availability needs to be increased from the current 1.6 kW/ha in Andhra Pradesh to at least 3.5 kW/ha to assure timeliness and quality in heavy field operations. The heavy field operations are possible to be attended only when adequate agricultural mechanization infrastructure is created.

**Challenges for Agricultural mechanization in Andhra Pradesh:**

* Land holding is going down so requirement of efficient but less costly agril. tools and equipment suitable for small farmers will continue to exist – whether owned or on hire.
* Plant protection equipment: Precision applicators to minimize excess application of pesticide to plants for good environment and soil health.
* The area under upland rice is expected to increase where rainfall is decreasing. Thus there is a need for implement set-up.
* Commodity specific mechanization package development.
* Package of practices based on Crop for efficient mechanization has to be studied and developed for different locations of Andhra Pradesh.

To overcome these challenges/constraints of agricultural mechanization, there is a need to formulate mission with an aim to benefit small and marginal farmers, poorly mechanized areas and unemployed rural youth for creating ownership and Entrepreneurship with the following goals:

* Agricultural mechanization should lead to a sustainable increase in yields and cropping intensity with the objective of meeting the planned growth rate in agricultural production and maintaining it.
* The income of agricultural workers should rise at a satisfactory rate so that the disparity between urban and rural incomes is contained and they get opportunity to lead a dignified life.
* The benefits of agricultural mechanization should apply to all types of farmers including small and marginal ones in different regions of the state, particularly rain fed areas.
* Agricultural mechanization should create a worker friendly environment especially for women workers by lessening hard labour, health hazards and improve safety in production operations.

Agricultural mechanization should lead to a reduced cost of production thereby increase the income of farmers and impart a price advantage while competing for export contracts in the international market WTO regime.

**Case Study: Economics of Selective Mechanization in Paddy crop**

Rice is the Principal food crop cultivated throughout the coastal andhra pradesh providing food for its growing population, fodder to the cattle and employment to the rural masses. Any decline in its hectarage and production will have a perceivable impact on the state’s economy and food security. During the last few years the farmers in Guntur district are compelled to transplant the paddy crop late in the season with aged seedlings due to late onset of monsoons and late filling of the reservoirs and subsequently late release of canal water. To solve such problem during the recent years some farmers adopted a strategy i.e: dry seeding of rice directly in the filed with onset of monsoons and converting the dry field into wet condition as soon as canal water is released.

In the present scenario, paddy cultivation is not economical in the state due to high labour cost and shortage of labour. With the efforts of ANGRAU and Departmet of Agriculture, AP Considerable reduction in cost & labour requirement can be achieved through selective mechanization with appropriate farm machinery systems to change rice production as economically viable.With the introduction of farm mechanisation in labour intensive operations of paddy cultivation like sowing and harvesting, The economics of traditional method Vs Selective mechanisation of sowing and harvesting are as follows:

|  |  |
| --- | --- |
|  **Operations**  | **Cost of Operation/acre ( Rs.)** |
|  | **Traditional method** | **Mechanised Cultivation** |
| Land Preparation |  1000.00 | 1500.00 |
| Seed  |  600.00 (30kg) |  300.00 (15kg) |
| Nursery management |  1500.00 | Nil |
| Direct sowing  |  Nil |  600.00 |
| Puddling  |  2000.00 |  Nil |
| Transplantation  |  2500.00 |  Nil |
| **Sub Total** |  **7500.00** | **2400.00** |
| Harvesting | 2000.00 |  |
| Gathering and heap Forming | 3000.00 |  |
| Threshing | 2500.00 |  |
| Combine Harvesting | Nil | 2100.00 |
| Transportation | 600.00 | 600.00 |
| Straw Collection | 1000.00 | 1000.00 |
| income after selling paddy straw | -2000.00 | Nil. |
| Net Cost of Operation | 7100.00 | 3700.00 |
| Total Cost of Operation(Sowing & harvesting)  | 14600.00 | 5100.00 |
| **Net Savings** |  | **9500.00** |

**Benefits of Mechnanisation In Paddy Crop:**

* The operational cost has reduced to about Rs. 9500/- which help the farmers for getting profit and reducving drudgery in cultivation.
* Sowing with mechanical seed drill reducing the durgery involved in transplaning
* Early harvesting with Combine harvestor allowing Rabi Maize crop cultivation
* Saving of time and reduction in post harvest losses.

With the proven advantages of mechanization, the agricultural mechanization strategy in Andhra Pradesh for economic development of state is as follows:

* Increasing the reach of farm mechanization to the regions where availability of farm power is low and to small and marginal farmers
* Feasibility of co-operative / contract farming in different parts of Andhra Pradesh to get benefit of higher economic efficiency of scale of operation
* Development of Package of Practices of different operations and set of crop based machinery suitable to particular operation for different locations of Andhra Pradesh
* Promoting the Custom Hiring Centers for Agricultural machinery either on crop or location cluster approach to overcome shortfall like high cost of farm equipment and economics of operation
* Employment creation through creating farmers groups for purchasing and maintenance of hi-tech, high value and hi-productive agricultural machinery
* Promoting farm mechanization by creating awareness among stakeholders through demonstration and capacity building activities

Agricultural Mechanization is thus well placed to address many of the most fundamental farming challenges in a profound and comprehensive manner. Provided that suitable technology solutions are employed, Agricultural Mechanization “removes the drudgery associated with agricultural labour, overcomes time and labour bottlenecks to perform tasks within optimum time windows and can influence the environmental footprint of agriculture leading to sustainable outcomes.” Hence there is need to increase access to environmentally sound agricultural Mechanisation strategy that both sustains and enhances rural livelihoods and reduces pressure on natural recourses that are the lifeblood for producing food.

**Sustainable Agricultural Mechanization Strategy Concept**

Sustainable Agricultural Mechanization (SAM) – a potentially beneficial, yet widely neglected element in agriculture-for-development agendas. The ultimate objective of Agricultural Mechanization Strategies is to help increase the welfare of farm households and create positive dynamics and opportunities for economic growth in rural areas.

SAM should be considered as one element of sustainable development that integrates consideration for economic, social and environmental concerns (Fig.1).

From an economic perspective, farmers must invest in mechanization and generate income and profit from their production. Productive agricultural income is required to fund input suppliers, such as the suppliers of income. Consideration must be given to the link between farmers and other stakeholders, including retailers, wholesalers manufacturers and importers of equipment. A fundamental requirement for a sustainable sub-sector is a strong linkage between these different stakeholders. All of these stakeholders must be able to make a livelihood from their businesses.



Fig. 1: Schematic of sustainable development (Wikipedia 2006)

SAMS must also be seen in a social context. In fact, agricultural mechanization aims to provide additional benefits to the user, such as a reduction in the drudgery of farm work and increased opportunity for leisure. These are subjective benefits and are difficult to translate into economic terms. The impact of mechanisation on employment constitutes a very controversial issue in the social context. While on one hand, mechanization is considered to be a key in reducing employment and deskilling of labour, mechanization addresses rural labour shortages and conversely reduces unemployment through the development of new employment opportunities such as in manufacturing, and repair, mechanization services. Environmental concerns are critical in a SAMS strategy. Agricultural mechanization has been criticised for its negative impact in particular with regard to the degradation of natural resources through intensive tillage, overuse of inputs, and its role in reducing biodiversity and particularly agricultural biodiversity.

What is very important is that the technology adopted meets the real needs of the farmer and that it can be used efficiently and effectively, while contributing to environmental sustainability. In other words, mechanization doesn’t mean large investments in equipment such as tractors and combines but necessarily involves shifting to an alternative combination of land, capital and labour, which results in improved farm income without causing environmental degradation. This is achieved either through increasing output or through reducing costs, or through a combination of both. Agricultural mechanisation technology in developed countries has reached a very high level of sophistication and has resulted in increases in labour and land productivity while reducing production costs. Farm power and equipment have not, however, played as important a role as expected due to many constraints amongst which the institutional aspects are very crucial.

Sustainable agricultural mechanisation is considered as a system where each component is dependent on those both before and after it in the flow of goods and services from the manufacturer to the final end user. The strength of the whole system, which is dynamic, depends on the effective function of all components and the linkages between them.

The main groups of directly interested parties in the system are:

* Farmers
* Retailers and Wholesalers
* Manufacturers
* Importers

The farmer, the main stakeholder, is the first target in an agricultural mechanization strategy. In different parts of country, farmer capacity varies widely from subsistence farmers whose farm output is adequate only for meeting the food requirements of the family to commercial farmers whose farm output consists mainly of cash crops.

The linkage between the farmer and other stakeholders is of critical importance to the successful and sustainable development of agricultural mechanization. A fundamental requirement is that stakeholder “businesses” are profitable. If farmers are not making money they will not be able to purchase inputs; if retailers cannot sell items at profit then they will not stock them and if manufacturers are not fabricating tools and machines at a price that is affordable by the farmer, then their business is unsustainable.

The purpose of a sustainable agricultural mechanisation strategy is to create linkages among stakeholders and to address issues that affect environmental sustainability as well as the profitability of one or more of these stakeholders. This dictates how national governments should provide the basic conditions for the largely self-sustaining development of agricultural mechanization within a policy of minimum direct intervention.

Farming systems are central to the analysis of sustainable agricultural mechanization. The pattern of production, the ownership of resources, participation by household members in farming, gender division of labour, environmental concerns and the profitability of farm enterprises influence the range and scope of sustainable agricultural mechanization.

**Sustainable Agricultural mechanization supply Chain**

It is important to analyse supplies from manufacturers, retailers, wholesalers, and importers. It is also essential that the existing farm machinery and equipment supply chain be thoroughly investigated and clearly understood. This will mean an in-depth collection of data about manufacturers, importers, artisanal activity, and national, regional and local distribution and retail systems. Others factors that can have a great influence on sustainable agricultural mechanisation, include:

* Domestic and international markets for farm products
* National policies (trade, industry, fiscal, labour, environment..)
* International trade
* Infrastructure level
* Institutional support
* Raw material availability



Fig. 2: Agricultural Mechanisation Supply System

There must be broad consensus on the fact that bottlenecks and constraints exist within the agricultural engineering sector and that these hinder environmental sustainability and the development of the agricultural sector. This can guarantee the adherence of all partners and therefore enhance the opportunity for success of the strategy and its eventual implementation.

Agricultural engineering and environmental sustainability must be perceived to be sufficiently important by the broader community, to justify strategy formulation. They should be able to participate in a full and open exchange of views at all stages of strategy development. For the success of a SAMS, it is important to consider the pre-conditions that should be in place. First of all a SAMS must emanate from a real need expressed by a political will. This depends on the political, economic and sociological status of the country.

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