RESEARCH ARTICLE

# The Agrarian Question and Mechanisation of Agriculture in Kerala

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**Abstract:** Two features of agriculture in Kerala lend special significance to the phenomenon of low agricultural mechanisation. The first is the relative shortage of agricultural workers, and the second the comparatively high wage rate in agriculture. We argue that the failure to mechanise agricultural operations cannot be explained without examining the larger question of the stunted development of agriculture in the State. A revival of agriculture, therefore, cannot be based entirely on mechanisation, for it must address a range of problems including the growing dominance of the "asset" function of land at the expense of its "means of production" function, and the atomisation of farming. The social organisation of production needs to be reoriented such that the means of production function is reinstated and the limits imposed by the small size of farms are overcome. Possible remedies to this problem include collectivisation of agriculture, appropriate organisational structures for production, and State support.

**Keywords:** Farm mechanisation, agrarian question, means of production, atomisation of farming, labour shortage, micro experiments, paddy, Kerala, village, Green Army.

## *Introduction*

This article analyses the progress of mechanisation in agriculture in the State of Kerala. Two features of agriculture in Kerala lend special significance to the phenomenon of low agricultural mechanisation. The first is the relative shortage of agricultural workers, and the second the comparatively high wage rate in agriculture. These two factors have contributed to a persisting crisis in Kerala's agricultural sector, and mechanisation is perceived as a way out. Early efforts at mechanisation, such as the introduction of tractors in the early 1970s in Kuttanad, an important rice-growing region, were met with strong resistance from workers.

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Opposition from labour, however, does not account for the continuing failure to introduce mechanisation. The problem that farms face now is not workers competing with machines for work. Rather, it is the non-availability of workers even at comparatively high wages, particularly for manual work involving drudgery. There is evidence that workers and their unions have become more favourably disposed to the cause of mechanisation. This makes the issue of mechanisation a particularly challenging one. Why has mechanisation not occurred despite the presence of important facilitating factors, such as labour shortage, a high wage bill, and crucially, stakeholders' consent? The unavailability of technology or machines cannot be an answer, given the advance of farm mechanisation technology and the related industry in India and elsewhere in the world. We argue in this article that the failure of mechanisation cannot be explained without examining the larger question of the stunted development of agriculture in the State. Specifically, we argue that the social organisation of agriculture plays a dampening role on attempts at mechanisation.

Our argument is located in the perspective of Kerala's agrarian political economy. The lack of mechanisation in agricultural operations is part of a deeper problem affecting agricultural growth and the modernisation of agriculture. Two issues are relevant in this context. The first is the behaviour of capital in agriculture. In areas of production that face various types of uncertainty because of factors beyond human control, such as climatic and other natural factors, capital investment faces certain constraints. A case in point is agriculture, where the production process cannot be accurately determined and controlled in advance, as in industry, because of the influence of natural factors (Marx 1967). Crop husbandry is dependent upon soil and weather conditions, seasonality, and the nature of crops chosen for cultivation. The requirement of natural conditions restricts attempts to reduce the production time in agriculture, unlike in industry where the capitalist can more easily manipulate the conditions of production with the help of technology. The longer the production period, the more limited the turnover of capital and profit. A capitalist would prefer to maximise his turnover of capital by reducing the time involved in production. Therefore, it is not in the interest of capital to invest in sectors of the economy where the production time is long and turnover is limited.

Marx has observed as follows:

> Due to the difference between working time and production time, the time of the employment of the applied fixed capital is of course continually interrupted for a longer or shorter time, for instance in agriculture in the case of working cattle, implements, and machines. In so far as this fixed capital consists of draught animals, it requires continually the same, or nearly the same, expenditure for feed, etc., as it does during the time they work. In the case of dead stock, non-use also brings on a certain amount of depreciation. Hence the product is in general increasing in price, since the transfer of value to it is not calculated according to the time during which the fixed

> capital functions but according to the time during which it depreciates in value. (Marx 1967, Vol. II, pp. 245–46)

This observation is relevant not only for calculating the costs and returns from agriculture, but also in the economics of acquisition or use of constant capital items such as tractors or combine harvesters that require sizeable investment outlays. If constant capital frequently lies idle during excess production time, depreciation during this period will add to the cost of the product. Further, the possibility of idle capacity will be a burden on the farmer or capitalist, and hence influence the choice of investment. A small farmer cannot afford huge investments, while a large farmer or a capitalist farmer can be discouraged by the possibility of idle capacity. A capitalist who buys farm machines for hiring out in the rental market is also constrained by idle capacity, as he may not be able to utilise the machines throughout the year due to the excess production time and seasonality of crops. During a crop season, he might be able to maximise utilisation by selling the service to several farms by shifting the machine from farm to farm. This may also be constrained to the extent that in a season several farms simultaneously demand similar services, which necessitates the use of a greater number of machines. However, even in situations where the capitalist is able to maximise utilisation in a given season, the machinery will remain idle after the season. Thus, the continuous engagement of capital is obstructed in agriculture. This acts as a disincentive to invest in costly agricultural machinery.

A second set of problems in agriculture relates to the social aspects of production. Land ownership and distribution, the social organisation of production, the nature of agrarian classes, and the role of state policies in the development of agriculture are key elements of this framework. Two distinct features of capitalist agriculture, namely, the predominance of wage labour and production for the market, characterise agriculture in Kerala. However, the limited scale of production and size of farms (excluding the plantation sector), and the limited use of modern technology (particularly the use of machinery such as transplanters and combine harvesters) restrict agriculture to a largely petty production sector. In other words, agriculture in Kerala remains underdeveloped in terms of its technological base, and has a high dependence on wage labour and the market. As Lenin pointed out, "in agriculture, the process of development of capitalism is immeasurably more complex and assumes more diverse forms (than in industry)" (Lenin 1964, p. 111). Capitalist agriculture, whether developed or underdeveloped, places certain constraints on and limits the development of agriculture.

> Thus, even in advanced capitalist countries, we are confronted with a significant anomaly: the persistence and coexistence of rural petty commodity production alongside a predominantly capitalist mode of production. Capitalist development appears to stop, as it were, at the farm gate. (Mann and Dickinson 1978, p. 467)

It has been argued that in recent times, peasant or small-scale agriculture is expanding at an increasing rate even in the advanced capitalist countries of Europe and the US, in the context of an ongoing financial crisis and economic depression (van der Ploeg 2010). Constraints on the development of advanced capitalist agriculture can be of different degrees in different countries, depending on the historically developed specific features of agriculture in those countries. This article examines such constraints in the context of agriculture in Kerala, and their impact on mechanisation.

Our analysis is primarily based on trends in the mechanisation of rice cultivation, as this is the sector where agricultural mechanisation has received significant attention in the State. As secondary sources provide only limited data, such as the stock of agricultural assets (machinery, for example), we have used data from a primary survey conducted in nine villages in the State in 2012–13 (see Harilal and Eswaran 2015 for details of the survey villages). The second section of the article is a brief discussion of the agrarian question in Kerala, and serves as the background against which we analyse the issue of mechanisation. The third section discusses agricultural mechanisation at the all-India level. The comparative picture of the status of mechanisation in agriculture in Kerala is the main theme of the fourth section. Our major findings and conclusions comprise the fifth section.

## *Aspects of the Agrarian Question in Kerala*

Agriculture in Kerala in recent times has been characterised by general stagnation and a substantial decline in the area under and production of food crops. The share of agriculture and allied activities in State Domestic Product (SDP) fell from around 22 per cent in 1999–2000 to 8.8 per cent in 2013–14, and is currently hovering around the same level. The share of the primary sector as a whole went down from 29 per cent to 9.2 per cent during this period. Correspondingly, the share of the tertiary sector went up from about 51 per cent to nearly 71 per cent. There was marginal growth in the contribution of the secondary sector during this period. The status of agriculture as a major provider of employment has also declined at a rapid pace. Thus the economy of Kerala is in the middle of a major structural shift, characterised by a substantial decline in the percentage share of agriculture in terms of both income and employment, and the emergence of the services sector as the mainstay of the economy.

The total area under food crops in the State in the 1970s was around two million hectares, and at present it is around 1.3 million hectares (see Johnson 2018). There has been a steady decline in the area under paddy cultivation from the mid-1970s: after peaking at 0.88 million hectares in 1974–75, this area was just below 0.2 million hectares in 2015–16. The decline in the area under paddy cultivation at an annual rate of roughly 20,000 hectares over the last three decades is noteworthy. This decline has occurred across all regions of the State, including the Kuttanad and Kole areas, and Palakkad, with high levels of paddy productivity. Rice production has

also declined in the absence of any significant increase in productivity. The production of rice in 2013–14 was around 0.57 million tonnes, as against a peak of 1.4 million tonnes in 1972–73.

Crops such as coconut and tapioca, which are very important in the State, have also recorded a sharp decline in area and production in recent years. Some labour-intensive crops, such as pulses, sugarcane, sesamum, finger millet (*ragi*), and other millets, which were among the principal crops of Kerala, are no longer cultivated. The production trends in the case of crops such as pepper and ginger, which occasionally fetch attractive returns, have not been much different. There has also been a decline in the area and production of vegetables.

We now summarise some important dimensions of the crisis in agriculture in Kerala, which may help delineate the agrarian question. The crisis is not just one of a relative decline of agriculture, but extends to an absolute decline in the employment, production, and income generated by the sector, worsening food security, and growing indebtedness and misery of peasants and agricultural labourers (Harilal and Eswaran 2016). Large-scale conversion and filling up of wet lands, mainly paddy lands, that have been reported from almost everywhere in the State, is leading to a crisis in its ecosystem. The decline of agriculture tends to affect allied activities such as animal husbandry, poultry, village industries, and the rural economy in general. This crisis has affected almost every crop in the non-plantation sector. The State has lost much of its cropping diversity: across crops as well as within each crop. The generalised impact of the crisis, reaching every region as well as all crops, underlines the need to search for general factors for the crisis, rather than confining our answers to crop- or region-specific issues.

Attempts to conceptually link the crisis in agriculture to the overall transformation of the economy have thrown light on some important features of the economy of Kerala. The "Dutch disease" argument, for instance, attributes the crisis to the "resource movement" and "spending effect" caused by the boom in migration remittances that commenced in the 1970s. The "Dutch disease syndrome," it is argued, pushed up wages as well as the prices of non-tradeable inputs, including land (Balakrishnan 1999; Harilal and Joseph 2003). The movement of labour to non-agricultural activities and opportunities outside the State resulted in increases in real wages for agricultural work in Kerala as compared to other States in India. The boom in migration remittances is also said to have played a major role in boosting the "asset function" of land, at the expense of its "means of production" function (Harilal 2008). Migrants, or, for that matter, anybody with investible funds, view land as an attractive and fairly secure asset for investment. High and increasing land prices may be attractive to those who value its asset function, especially speculators, but not to those who choose to buy land for agricultural activities. The returns from agricultural activities may not be high enough to offset the interest cost on capital invested in buying land. In the context of Kerala, the

conversion of land into a speculative asset has assumed alarming proportions and has become a hindrance to industrial investment (Harilal 2008; Harilal 2009). The impact of high land prices is far greater on agriculture, for in agriculture, unlike industry, land is the most important means of production. An argument raised by Namboodiripad (1984) in the national context (see also Patnaik 1990) is relevant here. Namboodiripad argues that high land price (which is the capitalised form of capitalist ground rent that retains in it all earlier forms of pre-capitalist rent) is a hindrance to the development of agriculture. This ground rent argument, also raised by earlier Marxist writers including Kautsky and even Marx himself, assumes importance in the context of Kerala, where speculative investment in land has substantially increased along with what may be referred to as "financialisation" of the land market.

The physical characteristics of the region, such as those with respect to soil fertility, water availability, agro-climatic conditions, genetic resources, quality of labour, and traditional and modern knowledge of farming, all have much greater potential than is at present realised. In fact, the same mass of land and its resources were able to achieve much higher production decades ago. Further, the absolute decline in the State's agricultural production cannot be explained in terms of a shift in the land-use pattern, as large tracts of agricultural land remain unused or underused in their capacity as means of production. The problem of agriculture in Kerala is thus not the scarcity of land but the inability to use it.

An important limitation of the contemporary literature on this issue is the inability to connect the agrarian crisis to the social organisation of production in agriculture. This is surprising because agrarian relations were at the centre of the discourse on development and politics in the State for a long period up to the land reforms and in their immediate aftermath. It was the backwardness and the repressiveness of pre-capitalist agrarian relations in the region, known as "*jathi–janmi–naduvazhi medhavithvam*," (caste–landlord–chieftain supremacy), that blocked the development of productive forces in agriculture and the modernisation of Kerala society, and led to massive mobilisation of the people against it. The decline of the old system and the introduction of radical land reforms probably led scholars to take issues of change in production relations for granted. As a result, there have been few studies on the nature of agrarian relations in the post-land reforms period, and its influence on production and growth.

It is widely acknowledged that land reforms, which were fairly successfully implemented, resulted in significant changes in the agrarian structure and society of Kerala. An estimated 1.25 million tenants acquired land rights, of whom 1 million tenants became new landowners through the transfer of rights. These 1.25 million tenants received ownership rights over about 1.9 million hectares of land that had earlier been held under lease. About 1.75 million acres of land were leased in from large landholders, the upper strata of society, and from various temples, trusts, and

royal households. Thus, a significant portion of the State's land (only five million acres of land were under cultivation in Kerala at the time) was transferred to the people as a result of the land reforms. In addition, 0.35 million hutment dwellers received rights over their small plots, according to the Land Reforms Survey, 1966–67 (GoK n.d.). It is estimated that hutment dwellers gained ownership rights over 0.03 million acres of land. Surplus land of about 0.077 million acres (out of a total surplus of about 0.10 million acres taken over by the Government) was distributed to about 0.17 million landless families. Thus, there was a substantial decline in the concentration of land alongside corresponding distribution of land, as evident from the increased number of ownership holdings in Kerala in the post-land reforms period.

The decline of the traditional system of labour relations in the aftermath of land reforms contributed to the growth of trade unionism among agricultural workers. The period from the 1960s to the 1970s witnessed a rapid growth of trade unions among agricultural workers (Jose 1976). The enhanced collective bargaining strength that the unions promoted contributed significantly to the increases in real wages of agricultural labourers in Kerala in the post-land reform period. The land reforms conferred ownership rights on agricultural labourers over the plots of land on which their hutments stood (*kudikidappu* land) and thereby enhanced the reserve price of their labour, as ownership of these small holdings meant a permanent and settled habitation. Labour thus became free of feudal bonds, and labourers were free to sell their labour power to buyers of their choice. An important outcome of land reforms that has not sufficiently been acknowledged is freedom of mobility. Those who were forced to work on the land now used the freedom of mobility to exit agriculture. The period after land reforms witnessed a process of desertion of agriculture by workers and their migration to other occupations – within the village, to nearby urban areas in other States in the country, and abroad.

Although the process of land reforms continued for a number of years, its major component, namely tenancy reform, was effectively completed by 1970–71. The eviction of tenants was curbed during the regime of the Communist government of 1957–59. In the 1960s, in many parts of the State, tenants stopped paying rent and became the de facto owners of the leased-in land. From the 1960s up to the mid-1970s, the area under cultivation and agricultural production, particularly for rice and coconut, grew at a reasonably rapid rate. Gross income from land registered an increase of nearly 25 per cent (estimated at constant prices) between 1960–61 and 1970–71. The contribution of the primary sector to net SDP also registered an increase up till 1974–75. After the mid-1970s, however, there was a general decline in agriculture (excluding plantation crops, which showed varying trends), particularly for food crops.

Land relations and the social organisation of production in post-land reforms Kerala witnessed significant changes. According to surveys conducted by the National Sample Survey Organisation (NSSO), the average area of land owned by rural

households in 2003 at the all-India level was 0.81 hectare (ha). The average size of operational holdings in Kerala declined from 0.74 ha in 1967 to 0.33 ha in 1991, and further to 0.26 ha in 2003. In India as a whole, 80 per cent of rural households owned less than one ha of land. In Kerala, 95 per cent of rural households owned less than one ha of land. Further, 92 per cent of operational holdings in the State were less than one ha in size.

Our study of nine villages in the State identifies some important aspects of the present agrarian structure (see Harilal and Eswaran 2016). The pattern of land distribution in the villages highlights the preponderance of small holdings and the problem of parcellisation. Our primary survey data showed that a little over 88 per cent of all holdings were less than one acre in size. Thus, the problem of small holdings is far more serious in Kerala than in the rest of India, and has consequences for agricultural mechanisation in the State.

Land reforms, the division of families, and the rise in land prices, among other factors, have contributed to the preponderance of small holdings. The preponderance of small holdings is an important attribute of a phenomenon of atomisation of farming, which, in our opinion is central to an understanding of contemporary agrarian relations in the region. Atomistic units are unable to come together for collective action, especially in the context of hostile neoliberal policies. Atomisation puts farmers at a disadvantage vis-à-vis other more organised and large entities, such as traders, processors, retailers, and suppliers of inputs and credit, in the relevant commodity chains. Further, atomisation is a barrier to cooperative labour processes that can improve the efficiency of agriculture.

The distribution of land among farming and non-farming households brings out another critical dimension of land relations in Kerala: there is a disjuncture between ownership of land and actual cultivation (see Table 2 in Harilal and Eswaran 2016). Other than in two out of nine study villages, farming households owned less land than non-farming households. This is an indication of the growing tension between the means of production function and the asset function of land. People in Kerala invest in land not so much to use it as a means of production in agriculture but as an asset with an assured value of appreciation. The rise in land prices and the pressure of speculation in the land market offer further evidence of the growing contradiction between these two functions of land. In this context, what happens on the margins of the land market is important. Uncertainties such as crop failure and indebtedness may force cultivators to alienate their land, but high land prices make it difficult for them to buy land for cultivation. Therefore, land alienated by peasants is likely to be bought by those who value the asset function of land rather than its means of production function. Our village survey data showed that when the interest on land prices was accounted for in the cost of cultivation, paddy farming yielded a negative return. This constitutes another barrier to expanding investment in agriculture, such as for mechanisation.

Another aspect of production relations that shows up in an analysis of the costs and returns of farming is the predominance of wage labour. A characteristic feature of agriculture in Kerala is the near-complete orientation of production in favour of the market. In paddy production, retention for consumption is negligible. Even small holders sell their produce in the market and meet their consumption requirements from the market or from the public distribution system. Local producers do not have any control over product markets in the neighbourhood, which are closely integrated with national or even global markets. It is not surprising that the atomisation of farming and the globalisation of markets occur simultaneously. Neoliberal policy favours national, regional, and global integration of markets, but resists efforts to aggregate farm power. By farm power we mean the market power of farmers, which if aggregated would empower the farming community to influence market outcomes and political decisions.

Another important aspect of land relations is the resurgence of leasing of land. Our primary data included some respondents who had leased out land and others who had leased in land for cultivation. This is significant, for leasing, particularly small-scale leasing, discourages any form of long-term investment in agriculture, either by the lessor or the lessee.

## *Mechanisation of Agriculture in India*

The mechanisation of agriculture in the country has been uneven. In the early years of the Five Year Plans, technological issues in agriculture were not given serious consideration. During the first three Five Year Plans, expansion of the area under cultivation, supported by large-scale irrigation projects, was the major strategy of agricultural development. The subsequent New Agricultural Strategy (NAS) that led to the Green Revolution initially focused on biological innovations that consisted of high-yielding varieties of seeds, chemical fertilizers, and pesticides. Soon after, the policy encouraged the adoption of labour-saving mechanisation.

In 1951, only about 8,500 tractors were in use in India. By 1966, that is, over a period of 15 years, this number increased to 54,000. In subsequent years, coinciding with the early period of the Green Revolution, the growth in the number of tractors was higher; by 1969 it was over 90,000, and by 1971 it had risen to over 0.1 million. The Fourth Five Year Plan had envisaged a growth in installed capacity for the manufacture of 68,000 tractors per year by 1973–74. The policy of de-licensing in 1969 encouraged domestic production of tractors by the removal of restrictions (licensing) on private manufacture. Government support to privatisation of irrigation also resulted in the fast growth of mechanisation in lift irrigation. The number of diesel and electric pump sets, for example, doubled (from 8,86,000 to 17,75,000) during a span of three years (between 1966 and 1969) in the early years of the Green Revolution. Mechanical threshing also began to spread on a wide

scale in the wheat belt of Punjab, Haryana, and western Uttar Pradesh in the same period.

In the context of growing mechanisation in the early 1970s, there were differences among economists and planners about the technology suitable to agriculture. Several studies pointed out the consequences of adopting labour-displacing and capital-intensive technology in agriculture in countries such as India, where surplus labour was readily available (Sen 1975; Raj 1972; Rao 1979). Even earlier, planners (P. C. Mahalanobis, for example) had expressed concerns about the premature mechanisation of agriculture (Chakravarty 1987). Such concerns notwithstanding, mechanisation in agriculture has steadily progressed over the years. This can be attributed to two reasons. First, labour-using and land-augmenting technologies have not been given emphasis in the strategy for agricultural growth (Rao 1994). This was not a mere lapse in planning; rather, planning that tried to accommodate the interests of the market and the emerging agrarian capitalists had to allow such a trajectory. Secondly, the rich peasantry (and landlords), particularly in north-western India, became an influential class both economically and politically during the Green Revolution with the government unwilling to impose any control over their influence, and could adopt the new technology (Byres 1981). This was also the period when agriculture enjoyed favourable terms of trade due to the price support policy, which greatly benefited rich farmers who had a significant marketable surplus. Rich farmers could invest in machinery not only to enhance their income, but also as a means of reducing their dependence on wage labour to meet any seasonal shortage in labour supply. In short, rich farmers were the major users of the new technology owing to the high cost involved in investing in agricultural machinery in the initial stages (*ibid.*).

The growth of mechanisation in the initial stages was mainly concentrated in areas where the adoption of technologies introduced by the Green Revolution was high. In the late 1960s, one-half of all tractors in the country were concentrated in the north-western part of India (Punjab, Haryana, and western Uttar Pradesh). Diesel pump sets for irrigation were concentrated in parts of Gujarat and Rajasthan, while more than one-half of all electric pumps were in the prosperous agricultural regions of Tamil Nadu and Andhra Pradesh. Thus, not only was the process of mechanisation confined to a few States, but even the pattern of mechanisation was different among the States (Raj 1972). This unequal pattern of mechanisation still persists in the country.

Recent data confirm the concentration of machinery in north-western India (Punjab, Haryana, and western Uttar Pradesh). Nearly one-half of the total number of tractors in the country (24,00,000 according to the Livestock Census of 2003, the latest available statistic) are concentrated in these three States. Data from the Food and Agriculture Organisation (FAO) for 2007 reveal almost the same pattern of geographic concentration. The pattern of distribution of power tillers in the country

is similar: out of a total of nearly 2,80,000 power tillers, nearly 1,20,000 are in Punjab, Haryana, and western Uttar Pradesh. The combine harvester, a relatively recent arrival in the country, shows a similar distribution, with more than half (2,80,000 out of a total of 4,20,000) being concentrated in these three States. In Punjab there is a tractor for every 10 hectares of cultivated land (Singh 2009). Haryana and western Uttar Pradesh present a similar picture with regard to tractor use. Despite these numbers, tractors are used for tilling on only 23 per cent of the total cultivated area in the country (*ibid.*). States such as Andhra Pradesh, Tamil Nadu, and Gujarat have advanced in the mechanisation of irrigation (diesel and electric pump sets), but are far behind Punjab and Haryana in the use of tractors and power tillers. Interestingly, more than half of all combine harvesters in the country are in Haryana, while Punjab lags behind with only three per cent. It appears that in Punjab, farmers prefer less expensive, locally developed harvesters and threshers, as compared to more sophisticated combine harvesters that require bigger investment. The use of combine harvesters is absent in a majority of the States, and even where they are used, their coverage is very limited.

Human power and animal power are the mainstay of agricultural operations in the country. Animal-operated implements such as cultivators, puddlers, and levellers are widely used, including in agriculturally advanced States such as Andhra Pradesh. Manually operated implements such as seed drills, seed-cum-fertilizer drills, rice planters, and sprayers and dusters are widely used in Andhra Pradesh, Haryana, Tamil Nadu, Uttar Pradesh, West Bengal, and Maharashtra. Some of these States lay claim to a sizeable presence of power-operated and more modern types of agricultural machinery, as noted earlier. Despite the presence of agricultural machinery, manually operated and animal-operated implements are used on a substantial scale in these States, indicating the unequal pattern of mechanisation within and across States in the country.

This unequal pattern can be attributed to a number of factors. First, the increasing cost of capital investment is a deterrent factor in the acquisition of machinery, in both agriculturally advanced regions and backward regions of the country. In Punjab, the deceleration of agricultural growth, declining agricultural profitability, and increasing cost of capital replacement have become financial burdens on farmers (Singh 2009). Agricultural backwardness in the central and north-eastern regions of India has meant limited investment in capital-intensive technologies. Secondly, the predominance of smallholder farmers is a deterrent to investing in high-cost technologies, as small-scale farmers are unable to generate any significant surplus for such investment. Thirdly, capitalist agriculture has an inherent disinclination to adopt high-cost technologies, as discussed earlier. The seasonal nature and uncertainties of agriculture discourage even rich farmers from investing in costly machinery. In regions of the country where labour supply is abundant and wages are low, there is no immediate incentive for mechanisation.

Internationally, India's ranking in agricultural mechanisation is low. A recent United Nations Industrial Development Organisation (UNIDO) study identified 12 levels of agricultural mechanisation, in ascending order (Bottinger *et al.* 2013). On the basis of a survey conducted in 2010, India occupied the fourth level of mechanisation, below countries such as China (seventh), the United Kingdom and Italy (ninth), the United States and Japan (tenth), and Germany (eleventh). The UNIDO study predicts that India will improve its position and move to the fifth level of mechanisation in the next 10 years, whereas China will move to the ninth level.

## *The Kerala Experience of Mechanisation*

The use of machines for agricultural operations began in Kerala at the close of the nineteenth century, with the use of motorised pump sets to reclaim backwaters for paddy cultivation in the Kuttanad region. The use of pump sets (steam engines at first and kerosene engines later) grew slowly in the early years of the twentieth century. In those days pump sets were mainly used for large-scale de-watering of backwater areas. They were owned collectively by groups of farmers who were partners in the reclamation of land for agriculture.

Mechanisation as a desirable strategy for agricultural development and as an element of State policy found recognition in the early years of the Five Year Plans. The improvement of indigenous agricultural implements, and distribution of irrigation machinery and tractors were a part of the agricultural agenda of the Second Five Year Plan. The Second Plan set a modest target of distribution of 300 pump sets and five tractors (Government of Travancore-Cochin, Second Five Year Plan). An agricultural engineering division was also begun by the Agriculture Department in the first year of the Plan. However, attempts such as these were limited and there were no major efforts to expand mechanisation. This was also a period of labour abundance when there was no compulsion for the adoption of large-scale mechanisation.

The mechanisation of agriculture received greater attention with the launch of the New Agricultural Strategy (NAS) in the 1960s at the all-India level. In Kerala, this led to the establishment of the Kerala Agro-Industries Corporation in 1968, for the procurement and distribution of improved agricultural implements such as tractors, power tillers, pump sets, and power sprayers on a hire-purchase basis. The Fourth Five Year Plan (1969–74) gave due importance to the role of mechanisation in its Intensive Agricultural Development Programme. The Plan proposed to introduce mechanised implements through the Agro-Industries Corporation and financial provisions were made to strengthen the Corporation. The Department of Agriculture was entrusted with the task of imparting training for the use and demonstration of agricultural machinery.

In the initial years of the Agro-Industries Corporation, there was a modest but steady growth in the demand for tractors and tillers (GoK 1971). In 1969–70, the first year of its operation, the Corporation supplied 230 tractors, 63 power tillers, and 1,700 pump sets to farmers on a hire-purchase basis. In the next year, 1970–71, it was able to supply 366 tractors, 65 power tillers, and 2,700 pump sets. In subsequent years there was a steady decline in the sale of tractors and pump sets, but the sale of power tillers witnessed an upward trend till 1974. The significant drop in sales of tractors, tillers, and pump sets that followed the modest growth of sales in the initial years weakened the Agro-Industries Corporation. The Corporation diversified into custom-hiring services dealing in input services, and started a subsidiary (the Kerala Agro-Machinery Corporation) for the manufacture of power tillers and diesel engines in 1973.

Besides the cost of machinery, the resistance of agricultural workers also played a role in slowing down the growth of mechanisation in the 1970s. The use of tractors for tilling operations was resisted by ploughmen for fear that they, along with their draught animals, would be displaced from work. The opposition resulted in an arrangement whereby only one-half of all tilling operations could be carried out by tractors, and the other half was reserved for manual and animal labour. This arrangement continued up to the late 1980s, when the shortage of manual labour for ploughing and the high cost of maintenance of draught animals became evident. At present, tilling operations in the State are almost entirely carried out by tractors or tillers, and draught animals are rarely used. There has been a steady decline in the number of draught animals in Kerala from the 1970s, particularly male buffaloes, which are primarily used for tilling operations (George and Nair 1990). As per the Livestock Census, in 2012, only 2,638 male buffaloes were used for tilling operations in the State, an insignificant number. Maintenance of draught animals is also fast disappearing in the State.

It is noteworthy that mechanisation has remained slow in the State despite relatively high agricultural wages and shortage of labour for agricultural work. The growth of trade unionism and the collective bargaining strength of agricultural labourers contributed significantly to the increase in wages of agricultural labourers in Kerala from the 1960s onwards. The wage trends as analysed in various studies show an almost steady increase in the real wages of agricultural workers in the State from the 1960s up to the end of the 1990s (Jose 1974; Baby 1996; Government of Kerala 1999). Further, agricultural wages in Kerala are significantly higher than in other States of India. A comparison of wages in Kerala with the wage rates in the three neighbouring States of Tamil Nadu, Karnataka, and Andhra Pradesh, and the agriculturally advanced States of Punjab and Haryana, from 1999 to 2010, shows that wages in Kerala were substantially higher: nearly three times higher than in Karnataka, Tamil Nadu, and Andhra Pradesh, and about twice the wage rates prevailing in Punjab and Haryana (Table 1). This is reflected in the higher cost of production of paddy in Kerala (Table 2). Besides higher wages, shortages of

**Table 1** *Ratio of male agricultural workers' wages in Kerala to that in selected States, 1999–2000 to 2009–10*

| Year | Karnataka | Tamil Nadu | Andhra Pradesh | Punjab | Haryana |
|---|---|---|---|---|---|
| 1999—2000 | 3 | 2 | 2.9 | 1.7 | 1.3 |
| 2000—01 | 2.8 | 2.6 | 3.1 | 1.9 | 1.3 |
| 2001—02 | 3.4 | 3 | 3.5 | 2 | 1.6 |
| 2002—03 | 3.5 | 3 | 3.8 | 2.2 | 1.9 |
| 2003—04 | 3 | 2.9 | 3.5 | 2.1 | 1.8 |
| 2004—05 | 2.9 | 2.9 | 4 | 2.4 | 2 |
| 2005—06 | 3.2 | 2.9 | 3.5 | 2.3 | 1.9 |
| 2006—07 | 3.4 | 3.6 | 3.6 | 2.5 | 2.1 |
| 2007—08 | 3.6 | 3.4 | 3.3 | 2.7 | 2.1 |
| 2008—09 | 2.7 | 3.1 | 2.8 | 2.3 | 1.8 |
| 2009—10 | 3 | 2.4 | 2.7 | 1.8 | 1.7 |

*Source*: Calculated from data in *Agricultural Wages in India*, various years, Department of Agriculture and Cooperation, Ministry of Agriculture and Farmers' Welfare, Government of India.

agricultural workers have been widely reported, particularly for labour-intensive agricultural operations such as transplanting, weeding, and harvesting.

### *The Status of Mechanisation in Kerala at Present*

Data on agricultural machinery (Table 3) show that in 1966, there were 185 power tillers and 418 four wheel tractors in Kerala. This grew to 627 tillers and 1,511 tractors in 1972. More than 35 years later, in 2003, there were just 1,732 power tillers

**Table 2** *Cost A1 of production of paddy per quintal, Kerala and selected States, 1999–2000 to 2012–13* in Rupees

| Year | Kerala | Tamil Nadu | Karnataka | Andhra Pradesh | Haryana | Punjab | Assam |
|---|---|---|---|---|---|---|---|
| 1999—2000 | 443 | 333 | 279 | 274 | 273 | 184 | 186 |
| 2000—01 | 449 | 321 | 290 | 270 | 261 | 1825 | 192 |
| 2001—02 | 434 | 352 | 379 | 304 | 279 | 179 | 206 |
| 2002—03 | 456 | 372 | 377 | 285 | 346 | 265 | 195 |
| 2003—04 | 543 | 380 | 380 | 252 | 350 | 216 | 206 |
| 2004—05 | 504 | 388 | 376 | 261 | 368 | 210 | 256 |
| 2005—06 | 473 | 408 | 317 | 295 | 315 | 226 | 219 |
| 2007—08 | 507 | 432 | 344 | 339 | 304 | 207 | 256 |
| 2009—10 | 596 | 541 | 444 | 485 | 488 | 315 | 338 |
| 2010—11 | 700 | 582 | 532 | 504 | 594 | 341 | 347 |
| 2012—13 | 887 | 811 | 790 | 604 | 604 | 376 | 407 |

*Note*: Cost here includes all paid-out costs except rent on leased-in land, that is, Cost A1.
*Source*: *Cost of Cultivation of Principal Crops in India*, various years, Department of Agriculture and Cooperation, Ministry of Agriculture and Farmers' Welfare, Government of India.

**Table 3** *Tillers, tractors, threshers, and combine harvesters in Kerala, 1966–2003* in numbers

| Year | Power tillers | Tractors | Power-operated threshers | Combine harvesters |
|---|---|---|---|---|
| 1966 | 185 | 418 | — | — |
| 1972 | 627 | 1,511 | — | — |
| 2003 | 1,732 | 2,114 | 500 | 587 |

*Note*: Figures include machinery owned by State government agencies and private individuals. The latest available data are for 2003.
*Source*: Government of India (1966; 1972; 2003).

and 2,114 tractors in the State. Power threshers and combine harvesters were introduced to Kerala only recently and their numbers in 2003 were small, at only 500 threshers and 587 combine harvesters. Except for tractors, which have multiple uses including transportation, other machines are used mainly in paddy cultivation in the State.

The density of agricultural machinery in Kerala is very low in comparison with Punjab, Haryana, Uttar Pradesh, and Andhra Pradesh. In 2003, the number of tractors per 1,000 hectares of cropped area was 0.72 in Kerala, 30 in Haryana, 38 in Punjab, and nine in Tamil Nadu. According to the Livestock Census of 2003, the number of tractors in Punjab was 2,98,800 and in Haryana, 1,93,700. More recent estimates indicate that about 4,00,000 tractors operated 40 lakh hectares of cultivated area in Punjab, which is equivalent to one tractor for every 10 hectares of land (Singh 2009). Assuming that tractors are used only on paddy fields in Kerala, this implies that there was only one tractor for almost 142 hectares of land under paddy. Ownership or possession is not necessary if machinery is available on hire, and, in fact, machines are brought from the neighbouring State of Tamil Nadu on hire service to some of the major paddy-growing areas of Kerala; however, we do not have corroborating data on this.

In the absence of recent secondary data on the spread of mechanisation in agriculture in Kerala, we turn to the primary data collected from our nine study villages in 2012–13 (Table 4).

Data on agricultural assets (Table 5) indicate that out of a total of 269 sample households, only 34 households (12.6 per cent) owned draught animals in all nine panchayats that were surveyed. In only one panchayat (Muttil in Wayanad district), a majority of the cultivators kept draught animals; in six panchayats, not a single cultivator had draught animals. Muttil is a village located in a hilly region where machinery cannot reach all the fields, and hence animals were used for tilling operations in areas beyond the reach of tractors and tillers. In addition, draught animals were employed in this village for multiple uses, such as paddy threshing and transportation. A majority of the farmers in this village employed animal labour for paddy threshing.

**Table 4** *Profile of villages surveyed, 2012–13*

| Panchayat | District | Area (in sq. km) | Number of households | Number of persons | Literacy (in per cent) | Scheduled Caste (in per cent) | Scheduled Tribe (in per cent) |
|---|---|---|---|---|---|---|---|
| Ezhome | Kannur | 21 | 4,297 | 19,261 | 85 | 9 | 0.17 |
| Muttil | Wayanad | 47 | 7,998 | 35,281 | 78 | 3 | 15 |
| Nemmara | Palakkad | 37 | 8,810 | 36,549 | 79 | 13 | 0.7 |
| Erimayur | Palakkad | 34 | 7,079 | 30,645 | 77 | 21 | 0.09 |
| Wadakkanchery | Thrissur | 29 | 7,873 | 32,811 | 84 | 13 | 0.05 |
| Anthikad | Thrissur | 13 | 5,278 | 21,449 | 88 | 11 | 0.26 |
| Nedumudi | Alappuzha | 26 | 4,916 | 19,701 | 88 | 8 | 0.08 |
| Bharanikkavu | Alappuzha | 23 | 9,485 | 35,426 | 88 | 16 | 0.15 |
| Pulimath | Thiruvananthapuram | 27 | 8,570 | 32,293 | 84 | 17 | 0.5 |

*Note*: Ezhome is in Zone V (Northern midland), Muttil is in Zone XII (High ranges), Nemmara is in Zone VIII (Palakkad), Erimayur is in Zone VIII (Palakkad), Wadakkanchery is in Zone IV (Central midland), Anthikad is in Zone IV (Central midland–Kol land), Nedumudi is in Zone XI (Kuttanad), Bharanikkavu is in Zone I (Onattukara), and Pulimath is in Zone III (Southern midland).
*Source*: Harilal and Eswaran (2015).

**Table 5** *Households that owned agricultural assets in the nine study villages, by type, 2012–13* in numbers and per cent

| Panchayat | District | Draught animals | Pump sets | Tractors/ Tillers | Transplanters |
|---|---|---|---|---|---|
| Anthikad | Thrissur | — | 27 (87) | 2 | — |
| Bharanikkavu | Alappuzha | — | 3 (10) | — | — |
| Erimayur | Palakkad | 1 | 17 (61) | 1 | — |
| Ezhome | Kannur | — | 3 (10) | — | — |
| Muttil | Wayanad | 29 (97) | 11 (37) | — | — |
| Nedumudi | Alappuzha | — | 2 (7) | — | — |
| Nemmara | Palakkad | — | 8 (28) | 1 | — |
| Pulimath | Thiruvananthapuram | — | 2 (6) | — | — |
| Wadakkanchery | Thrissur | 4 (13) | 3 (10) | — | 1 |
| All | | 34 (12.6) | 76 (28) | 4 (1.5) | 1 |

*Notes*: 1. Figures in brackets indicate percentage shares of the total number of households.
2. No household owned a thresher, reaper/harvester, winnowing machine, or combine harvester.
*Source*: Survey data.

Among power-driven machines, 25 per cent of farmers owned pump sets. Only four cultivators owned tractors. It is noteworthy that not a single farmer in any study village owned a reaper, harvester, thresher, winnowing machine, or combine harvester.

At the same time, our survey showed that agricultural operations in paddy cultivation were mechanised in many regions of Kerala. Tractors and tillers were widely used for land preparation (Table 6). All farmers in five out of the nine study villages used machinery for tilling operations, and 85 per cent of farmers in aggregate used machinery for tilling. The use of pump sets for watering and de-watering fields was common in some of the villages. The lowland areas of Anthikad (Thrissur district) and Nedumudi (Alappuzha district) required large-scale de-watering, which was carried out collectively by paddy farmers' associations. These associations owned pump sets that were supplied by the government or the panchayat, and the electricity to operate the pump sets was subsidised. The farmers' associations, on average, had one pump set with a 50 HP motor for a field of 100 acres. Maintenance of the pumps and motors was carried out collectively, and the required manpower for maintenance was also provided by the associations. Three study villages (Erimayur in Palakkad district, Wadakkanchery in Thrissur district, and Nemmara in Palakkad district) received gravitational irrigation from major irrigation schemes, while in the other villages, artificial irrigation was minimal. In Anthikad, Wadakkanchery, Erimayur, Nemmara, and Nedumudi, which fall in the major paddy-growing regions of Thrissur, Palakkad, and Kuttanad, the use of machinery for harvesting, threshing, and winnowing operations was substantial. More than 80 per cent of farmers in these five villages employed machinery for these activities, but the use of machinery for these operations was absent or insignificant in the other four villages, that is, Bharanikkavu in Alappuzha district, Ezhome in Kannur

**Table 6** *Proportion of farmers who used machinery in paddy cultivation in the nine study villages, by operation, 2012–13* in per cent

| Village | District | Land preparation | Water control | Transplanting | Harvesting | Threshing | Winnowing |
|---|---|---|---|---|---|---|---|
| Anthikad | Thrissur | 100 | 100 | 3 | 100 | 100 | 100 |
| Bharanikkavu | Alappuzha | 100 | 30 | — | 0 | 0 | 0 |
| Erimayur | Palakkad | 93 | 14 | — | 86 | 86 | 86 |
| Ezhome | Kannur | 53 | 0 | — | 0 | 0 | 3 |
| Muttil | Wayanad | 40 | 0 | — | 0 | 33 | 3 |
| Nedumudi | Alappuzha | 90 | 87 | — | 83 | 100 | 100 |
| Nemmara | Palakkad | 100 | 21 | — | 52 | 52 | 52 |
| Pulimath | Thiruvananthapuram | 100 | 3 | — | 0 | 0 | 0 |
| Wadakkanchery | Thrissur | 100 | 7 | 80 | 90 | 90 | 90 |
| All | | 85 | 29 | 10 | 50 | 56 | 53 |

*Note*: Water control involves watering and de-watering.
*Source*: Survey data.

district, Muttil in Wayanad district, and Pulimath in Thiruvananthapuram district. In the latter villages, harvesting, threshing, and associated activities were carried out by human labour, with only one of them reporting use of a hand-operated thresher. Mechanised transplanting was significant in Wadakkanchery (Thrissur district). Overall, only 50 per cent of all farmers in the surveyed villages employed mechanised harvesting, and a slightly higher proportion of farmers used machinery for threshing and winnowing operations.

The progress of mechanisation was, of course, uneven across the villages and regions. There was a higher level of mechanisation, which included mechanised harvesting, threshing, and winnowing operations, in the major paddy-growing areas. Machinery for harvesting and related operations was not used in four out of the nine study villages, while in four villages only some farmers used machines for these operations (Table 6). Interestingly, even in a major paddy-growing area like Nemmara (Palakkad district), only 52 per cent of all farmers owned/used machines for harvesting activities. Similarly, mechanised transplantation was carried out only in Wadakkanchery in a significant way.

The overall share of machine labour in the total cost of paddy cultivation was 15 per cent in the surveyed villages. It went up to over 25 per cent in Anthikad (Thrissur district) and Wadakkanchery (Thrissur district) (Table 7). In Ezhome (Kannur district), Bharanikkavu (Alappuzha district), and Pulimath (Thiruvananthapuram district), which did not show a significant degree of mechanisation, the share of machine labour in total cost was in the range of 2 to 8 per cent.

The use of machinery can promote savings in the costs of agricultural operations. For example, a combine harvester can complete the tasks of harvesting, threshing,

**Table 7** *Share of machine labour in total cost of paddy cultivation in the nine study villages, 2012–13* in per cent

| Village | District | Share of machine labour in total cost |
|---|---|---|
| Anthikad | Thrissur | 26 |
| Bharanikkavu | Alappuzha | 8 |
| Erimayur | Palakkad | 17 |
| Ezhome | Kannur | 2 |
| Muttil | Wayanad | 10 |
| Nedumudi | Alappuzha | 10 |
| Nemmara | Palakkad | 15 |
| Pulimath | Thiruvananthapuram | 8 |
| Wadakkanchery | Thrissur | 27 |
| Aggregate | | 15 |

*Note*: Total cost includes all paid-out costs and the imputed value of family labour.
*Source*: Survey data.

and winnowing on one acre of paddy land in one-and-a-half hours at a cost of Rs 2,400. Manual labour for the same activities costs about Rs 7,000 to Rs 9,000 per acre. Thus, the use of a combine harvester can save nearly Rs 5,000 to Rs 6,000 per acre. However, despite the scope for lowering costs and shortage of labour, the process of mechanisation has not gathered pace. Our survey data show that manual labour accounted for the highest share in total costs of cultivation, amounting to as much as 62 per cent (including the imputed value of family labour) in some of the villages.

A comparison of the cost incurred for machine labour in paddy cultivation in Kerala with that in other States shows that in the last three years, the cost of machine labour in Kerala has been on the rise, and is comparable to the cost prevailing in more mechanised States such as Tamil Nadu and Punjab (Table 8). As can be seen from Table 8, until 2008, the share of machine labour in total costs was lower in other rice-growing States, except Assam. A sharp rise in the share of machine cost was observed in Kerala, from 11 per cent in 2008 to more than 20 per cent in 2009. This was probably on account of the substantial mechanisation that has taken place in the major paddy-growing areas.

Cultivators and workers in the villages surveyed by us were of the opinion that faster mechanisation was the only solution to the problem of shortage of labour in agriculture in Kerala. Unlike other States, Kerala can implement mechanisation of agricultural operations without fear of displacing labour. We argue that the main reason for the slow rate of mechanisation is the generally stunted nature of capitalist development in Kerala's agriculture. A low investment base has been a feature of capitalist agriculture in the State. The level of investment in machinery by both farmers and the State has been nominal, and there is an absence of local private capital ready to

**Table 8** *Share of cost of machine labour in total cost of paddy cultivation in Kerala and selected States, 2000 to 2012–13* in per cent

| Period | Kerala | Tamil Nadu | Karnataka | Andhra Pradesh | Assam | Punjab |
|---|---|---|---|---|---|---|
| 2000—01 | 9.2 | 9.8 | 10.5 | 8.9 | 2 | 20.3 |
| 2001—02 | 9.5 | 10.7 | 9.4 | 10 | 2.2 | 21.5 |
| 2002—03 | 8 | 13.4 | 7.4 | 8.3 | 1.4 | 19 |
| 2003—04 | 7.9 | 14.5 | 9 | 9.8 | 1.6 | 19.4 |
| 2004—05 | 7 | 15 | 10.5 | 10.3 | 1.7 | 21.6 |
| 2005—06 | 12.2 | 16 | 12.4 | 12.5 | 1.8 | 18.9 |
| 2007—08 | 11.3 | 18 | 14.6 | 13 | 1.6 | 22.4 |
| 2009—10 | 20.7 | 19.7 | 13.4 | 15.4 | 5.2 | 20.3 |
| 2010—11 | 25.2 | 18.5 | 15.9 | 16.9 | 6 | 18.9 |
| 2012—13 | 20.9 | 18.1 | 16 | 16.7 | 6.7 | 16.5 |

*Note*: Total cost includes all paid-out costs (excluding rent on leased-in land), the imputed value of family labour, and cost of owned machinery.
*Source*: *Cost of Cultivation of Principal Crops in India*, various years, Department of Agriculture and Cooperation, Government of India.

invest in agricultural machinery, particularly costly machinery such as combine harvesters, tractors, and transplanters. The existing combine harvesters are mostly owned by State government agencies or local government institutions, while a few combine harvesters are owned collectively by a labour cooperative in Wadakkanchery known as the Green Army, which has been supported by the State for the purchase of machinery. Private sector investment for procuring tractors has not been impressive, though there has been some investment on account of tractors being put to multiple uses, such as transportation in addition to tilling the soil. Restrictions due to seasonality have not affected tractors as much as other machinery. Investment in cheaper farm implements such as seed drills, planters, and bund formers shows a similar trend. Although a range of machines have been recommended for cultivation of garden land, they are rarely used in crop cultivation.

Secondly, natural factors such as differences in soil and terrain in different regions of the State make it difficult to adopt a uniform technology or machinery throughout Kerala. The machinery has to be improvised to suit the conditions of different regions. For example, in the inundated paddy fields of Kuttanad and Kole, tillage is carried out by means of tractors with cage wheels, whereas in the dry fields of Palakkad, tractors and cultivators are sufficient and cage wheels are not required. Similarly, the standard combine harvester cannot be used in all fields across the State; in moist soils, improvised reapers are used instead of combine harvesters. Further, the reapers that are available are not suitable for use in some areas. In the saline and inundated Kaippad paddy lands (in Ezhome village, Kannur district), a different type of machinery is required to prepare the soil. Attempts were made by the Kerala Agricultural University to devise machinery suitable for the region, but these have not been successful. Enquiries made at the Research Department of the university revealed that they are yet to identify the different requirements of various regions in the State, and current research lacks an organised approach. The low priority accorded to research and development of indigenous machinery and a dependence on machinery readily available in the international market pose a serious problem in the context of Kerala.

There have been some attempts to overcome the problem of small holdings and low investment through collective organisation of farming. Here, we briefly discuss two such experiments: one, a labour collective known as the Green Army in Wadakkanchery (Thrissur district); and the other, a farmers' collective, Kudappanakunnu Karshika Karma Sena, in Thiruvananthapuram district.

### *The Wadakkanchery Green Army*

The Wadakkanchery block panchayat, comprising nine village panchayats, was earlier an important agricultural region. The main crop here is paddy. As in the rest of Kerala, the steady decline of paddy cultivation is a major concern in this region as well. The gross area under paddy cultivation in the block was about 10,000 hectares, which

declined to 3,000 hectares by 2007–08. The block panchayat initiated several measures to arrest the decline of agriculture, which included the formation of a labour bank known as the Green Army to address the problem of acute shortage of agricultural labourers. This labour bank, registered as a non-profit organisation under the Charitable Societies Registration Act, 1955, is an association of trained agricultural labourers. The project was initiated by the block panchayat, and led by a committee that comprised the president and vice-president of the block, the assistant director of the Department of Agriculture, a representative from the cooperative bank, and two technical experts. Apart from agricultural labourers, marginal farmers who also worked as agricultural labourers could enrol as members of the association. In 2008–09, when the project was initiated, the Green Army had 220 members. This has now expanded to about 400 members, of which almost 40 per cent are women. A unit of the labour bank is located in each of the nine village panchayats that falls under the block panchayat, and these units are further sub-divided into labour teams at the ward level. There are more than 50 teams of five workers each in a team, and each team has a team leader. A group leader is assigned for a group of five teams.

The labour bank takes up work on farms from the Padasekhara Samitis (farmers' associations) on contract, and a labour team is allotted to a "*padasekharam*" (a contiguous unit of paddy fields) as per the requirement. The wage rates of labourers and charges for machinery are collectively decided through consultations between representatives of the labour bank, farmers representing the "*padasekharam*," and panchayat representatives. The labour bank receives an advance of 25 per cent of the total cost from the Padasekhara Samiti before starting work, and the remaining amount is disbursed as the work progresses. The workers receive wages on a monthly basis, and, in addition, the labour bank provides them with life insurance, medical insurance, pension, and assistance for children's education. The labour bank has been able to ensure a minimum of 150 days of work a year per worker. In the off-season, when there is no work, the labour bank provides food coupons to needy workers. This institutional arrangement of the Green Army has been able to provide agricultural workers with reliable employment and livelihood, as well as higher levels of skill and dignity. It has also given an organised character to the arrangement of labour supply in the region. Farmers in the region now have a dependable and assured labour force for carrying out farm operations in time and with higher levels of professionalism. Machine costs were also less for these farmers as compared to the market rates. The expansion, in 2006–07, of the gross cultivated area of paddy in Wadakkanchery block panchayat from nearly 3,000 hectares to about 4,850 hectares can be attributed to these collective efforts.

Given the shortage of labour, especially for labour-intensive operations, such as transplanting and harvesting, the labour bank embarked on a path of mechanisation. It purchased machinery in stages, as and when capital was mobilised. Presently, the labour bank has 67 transplanters (each unit costs about

Rs 4,00,000), three combine harvesters (costing about Rs 25,00,000 per unit), and two baling machines (costing Rs 2,50,000 per machine). The tractors owned by the labour bank are used on hire. Tractors were not bought as they were available for hire in the locality. The labour bank used available funds for buying machines that were in short supply in the region. The entire cost of machinery purchase was mobilised from public sources: grants from the plan budgets of the block panchayat and village panchayats, and funds from a centrally sponsored scheme, the Rashtriya Krishi Vikas Yojana (RKVY). The Green Army has a workshop facility and a team of six mechanics for the maintenance of machinery. Detailed discussions with representatives of the organisation indicated that its financial status is sustainable, although it may not have sufficient surplus for a significant expansion in machinery stocks or replacement requirements that may arise in the future.

### *The Kudappanakkunnu Agricultural Labour Group*

Another successful model of a collective experiment is the Kudappanakkunnu Karshika Karma Sena (Kudappanakkunnu Agricultural Labour Group). The Karshika Karma Sena (KKS), registered as a charitable society, is an organisation of 40 small and marginal farmers that offers a range of services. The project was started in 2007–08 at the initiative of the village panchayat of Kudappanakkunnu in Thiruvananthapuram district. The KKS is administered by an 11-member executive committee, of which nine are farmers, one is an agricultural officer, and one member an agricultural expert. It is supported by an advisory committee with the president of the panchayat as its chairman. The district agricultural officer, the chairman of the panchayat standing committee, members of the committee for agricultural development in the panchayat, and two external agricultural experts are members of the advisory committee.[1]

A major activity of the KKS is the supply of labour to farmers engaged in garden land cultivation of coconut and vegetables. The organisation has a group of 135 trained workers and machinery required for all agricultural operations. The services of the KKS extend even to tiny plots of one or two cents of land, and include all operations from the preparation of land to harvesting, including coconut plucking. Workers are given monthly wages (calculated on an hourly basis), and each worker receives work for about 300 days in a year. Workers receive up to Rs 20,000 per month, as well as reimbursement of expenses for travelling beyond a certain distance for work, medical insurance, and group life insurance. Thus the organisation has been able to ensure regularity of employment and income, along with some features of formal sector employment, in terms of making jobs remunerative for its members.

All KKS workers are trained in the use of different machinery. The KKS owns an array of agricultural machinery, including tractors, tillers, coconut climbers, bush cutters,

[1] The Kudappanakkunnu village panchayat area was recently merged with the Thiruvananthapuram Municipal Corporation, and so the organisation will henceforth be supported by officials from the Corporation.

and sprayers, worth nearly Rs 30,00,000. As paddy cultivation is very limited in the area, the KKS does not keep transplanters or combine harvesters. Funds for the purchase of machinery were mobilised from public sources, including plan funds of the village and block panchayats, and the Agriculture Department of the State government. The premises of the Krishi Bhavan of the village panchayat are used as the maintenance yard for the machinery. Interviews with functionaries of the KKS indicated that the financial status of the organisation is stable.

These two experiments, the Wadakkanchery labour bank and the Kudappanakkunnu Karshika Karma Sena, show that an institutional arrangement based on collective organisation can overcome the twin problems of labour shortage and lack of capital investment in machinery faced by small farmers. The village panchayat, the block panchayat, and the Department of Agriculture in the State played a vital role in the formation and development of both organisations. These collective ventures based on partnerships of farmers and labourers had the full support of the State government. The organisations were able to provide workers with a guarantee of minimum employment, income, and other benefits such as medical allowance and educational support for children, which helped in attracting labour to agricultural work. The reduction of drudgery through the use of machines was another incentive to work.

## *Conclusion*

The prevalence of relatively high wages and labour shortages in agricultural work, two important factors that normally encourage mechanisation, has not resulted in the rapid mechanisation of agriculture in Kerala. It is only in rice cultivation that we see some degree of mechanisation, but only in the major rice-growing regions of the State. Detailed data from our surveys of nine villages showed that the use of machinery for harvesting, threshing, and winnowing was substantial in some areas, but absent or insignificant in other areas. In aggregate, only 50 per cent of all farmers surveyed used machines for harvesting, and a slightly higher proportion used machines for threshing and winnowing. Mechanisation in transplanting was very limited and machines were rarely used on garden land.

We argue that the low level of mechanisation in Kerala's agriculture can be attributed to a number of factors, of which the stunted development of capitalism in agriculture is an important one. Most cultivators in the State cultivate small or tiny holdings, and have not been able to invest in costly machinery.

At the same time, the pattern of remittance-based development of the State's economy has led to an increase in the demand for non-agricultural use of land, and thus to a dominance of the "asset" function of land at the expense of its "means of production" function. Collectivisation of agriculture, appropriate organisational structures for production, and State support are possible remedies for these problems.

The case studies of two successful micro experiments discussed in this article, though varying in their characteristics, are noteworthy efforts to overcome constraints imposed by agrarian relations in the State. They also illustrate why, in the absence of private capital investment, financial support by the state is important in enhancing capital investment in agriculture. However, these initiatives are still at an early stage, and their development will depend on the prevailing policy environment. That, in turn, could affect the direction of investment in agriculture in Kerala.

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