AGRICULTURAL SERVICE HUBS

enhanced mechanization and beyond

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FOREWORD

Technology is widely recognized as a non-negotiable in development, agriculture not being an exception. There is also a tendency to view technology as a panacea for all ills. Science will find a way, we are trained to believe. If it's about science, then it is about considering all relevant factors; and for this reason the tech-option, if you will, has to be assessed in terms of the social, economic, environmental, cultural and even political context in which it is to be operationalized.

The above can be applied to farm mechanization. Machines, we've had and they've certainly helped. On the other hand, there have been issues of availability and affordability. As this report observes, it is disconcerting that Sri Lanka, after so many decades' worth of efforts at enhanced mechanization, still lags behind neighbouring countries. In this sense it is indeed timely to consider strategic options to mitigate climate vulnerability even as higher productivity is pursued. The idea of 'Service Hubs' certainly deserves the attention of policy makers in the agricultural sector.

The research team has proposed an ambitious and yet pragmatic approach derived from a survey that yielded the social and economic realities that have challenged numerous development initiatives over the years. They conclude that Agriculture Services Providing Hubs (ASPH) are capable of delivering a range and combination of mechanized services.

In fact, it goes beyond simple mechanization; this team contends that such hubs could be used to provide a range of other inputs such as seeds, planting material, fertilizer etc., a one-stop shop that can serve a larger community of farmers from the beginning to the end of the crop production cycle. I commend the authors for detailing the institutional arrangements that could support such approaches. Their work is timely and what they propose is pragmatic, especially given challenges exacerbated by the uncertainties of these times.

Malinda Seneviratne
Director/Chief Executive Officer

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EXECUTIVE SUMMARY

Sustainable mechanization considers all technological, economic, social, environmental and cultural aspects that contribute to the sustainable development of the food and agriculture sector. Despite being a country with a higher level of climate vulnerability and far lower levels of agricultural productivity in comparison to neighbouring countries in the region, Sri Lanka's farm mechanization is still at a very inadequate level in both paddy as well as the subsidiary food crop sector.

As for popularizing machinery use, there is a need for introducing new approaches to set up Agriculture Services Providing Hubs (ASPH) that could deliver a range and combination of mechanization services, without being confined to traditional types of operations. Not only machinery services, but machinery hubs also can be utilized to provide other production inputs such as seeds, planting material and fertilizer where a variety of services can be obtained by farmers under one roof without having to travel great distances.

This study attempted to derive a viable and practical model to initiate agricultural mechanization through ASPHs delivering diverse services along the value chain of key agricultural products. The study selected Anuradhapura as its laboratory to understand the state of its farming with the use of mechanization in various steps of agricultural crop production. Within the district, Agrarian Service Centres in Anuradhapura, Muriyakadawala, Thirappane, Kashyapagama, Siwalakulama, Yakalla, and Palugaswea were selected for farmer interviews.

The study initially planned to collect more data on field operation activities, but the scope of the study had to be restricted due to the Covid-19 pandemic situation prevailing in the country at the time of the survey. The survey has generated important insights with regard to establishing ASPHs to meet farmers' needs in terms of machinery and other inputs.

The cultivable land extent in a particular location is a key factor to be considered in this regard. Most of the sample farmers do not own land-preparation and harvesting machinery such as tractors, harvesters and threshing machines in any of the study locations. In such circumstances there is a serious shortage of machinery essential for timely cultivation and harvesting. In addition, farmer responses highlight the main issues pertaining to current machinery rental services provided by local suppliers such as high rentals, obtaining machinery service on time, unsuitable road networks or difficult access to farmlands. Findings clearly emphasize the need for developing agriculture road networks as a prior requirement for facilitating the movement of machinery to rural farmlands. The study also revealed that farmers struggle to pay the rent/payment immediately after they obtain the services or goods. This is one of the prominent phenomena that constrains marginal rural farmers. The inclusions of protocols to address such issues in the development of the ASPH concept could therefore be very useful. The costing of each item could also provide greater insight into running the centre sustainably and as a business.

The supply of agricultural machinery in the country through state intervention has been widely criticized for ineffectiveness, corruption and other adverse factors. These projects have proven to be unsustainable due to the inherent inefficiencies of businesses run by the government. However, there are many successful examples of mechanization that contribute to the improvement of food production, productivity and the rural economy.

In an ASPH, two different models are suggested. In the private model, three main actors are proposed: Entrepreneur (persons or a team who will establish the ASPH), Farmers (end user) and Farmer Organization (monitoring, evaluation and regulation in partnership with Department of Agrarian Development officials). The second model proposed is a system that is operated through a Public-Private Partnership (PPP). The machinery may be obtained through a donor agency or by the government under a subsidy programme. The Department of Agriculture (DOA) or the relevant Provincial Department of Agriculture (PDA) would provide the premises and own the equipment. Thereafter, both the departments will be listed here as ADOPAD (Agriculture Department or Provincial Agriculture Department). ADOPAD will appoint a Hub Manager who will liaise with the farming community. The private entrepreneur, selected by the ADOPAD, will run the day-to-day affairs of the Centre as a business entity. In addition to serving as a service provider of agriculture equipment, the hub will also act as a technology dissemination centre, selling publications and displaying videos. The hub will provide the service within the district.

In addition, these hubs could facilitate total solutions from the beginning to the end of the crop production cycle until it achieves a marketable product. Examples of providing services to encompass all activity in the paddy production cycle until it reaches the market may involve parachute trays including two weeks old seedlings, and providing services of labourers skilled in parachuting, facilitating chemical applicators with chemicals and sprayers, advisory services, and finally facilitating harvesting and drying facilities.

The sustainability of the hubs would depend on the money generated by providing services against the investments made. Therefore, it is mandatory to carry out an economic analysis before setting up the hub. This analysis should take into account the number of farmers to be served, the extent of lands to be covered, etc. Agricultural Service Provider Hubs should be established in agricultural service areas to provide complete solutions under an umbrella location, providing all services for agricultural production.

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LIST OF ABBREVIATIONS

2WT	_	Two Wheel Tractor
4WT	_	Four Wheel Tractor
ADB	–	Asian Development Bank
ADOPAD	_	Agriculture Department or Provincial Agriculture Department
ADZAP	–	Anuradhapura Dry Zone Agricultural Project
AOs	–	Agriculture Officials
ARPA	–	Agricultural Research and Production Assistant
ASCs	–	Agrarian Service Centres
ASPHs	_	Agriculture Service Providing Hubs
CBO	–	Community-Based Organization
CMC	–	Cascade Management Committee
CUMA	–	Farmer Machinery Cooperatives
DAD	–	Department of Agrarian Development
DCS	–	Department of Census and Statistics
DOs	–	Divisional Officers
DSD	–	Divisional Secretariat Division
DZADP	–	Dry Zone Agricultural Development Project
DZLiSPP	–	Dry Zone Livelihood Support and Partnership Programme
FFHC	–	Freedom from Hunger Campaign
FGDs	–	Focus Group Discussions
FMRC	_	Farm Mechanization Research Cantre
FMTC	_	Farm Mechanization Training Cantre
FOs	–	Farmer Organizations
ICT	–	Information and Communication Technology
IFAD	–	International Fund for Agricultural Development
IPHT	_	Institute of Post Harvest Technology
IRDP	–	Integrated Rural Development Project
IWMI	–	International Water Management Institute
KIIs	–	Key Informant Interviews
MASL	–	Mahaweli Authority of Sri Lanka
MDP	–	Mahaweli Development Programme

MIR	–	Minor Irrigation Rehabilitation/Reconstruction
MISs	–	Minor Irrigation Systems
MNPEA	–	Ministry of National Policies and Economic Affairs
MR	_	Machinery Rings
NGOs	–	Non-Governmental Organizations
O&M	–	Operation and Maintenance
OFCs	_	Other Field Crops
PEACE	–	Pro-Poor Economic Advancement and Community Empowerment
TOR	_	Terms of Reference
TOs	–	Technical Officers
VCRP	–	Village Community Rehabilitation Programme
VIRP	–	Village Irrigation Rehabilitation Project
WFP	–	World Food Programme
WUG	–	Water User Group

CHAPTER ONE

Introduction

1.1 Overview of Agricultural Mechanization

Technologies introduced with the agricultural revolution that began in the 1940s led to the transformation of the practice of agriculture by reducing the number of people on farms and significantly increasing the productivity of those who remained on the land. One such practice is the use of machinery.

With the expansion of the industrial sector at the dawn of the industrial revolution in Europe and North America, excess labour engaged in the agriculture sector was attracted to the more lucrative industrial sector, creating labour shortages in the agriculture sector. It also created the necessity of developing more efficient and effective farming options, including mechanical aids to increase labour productivity. It was the key catalyst for Western countries to enable a highly mechanized agriculture sector that laid the foundation for subsequent industrial development.

Using basic and simple hand tools to ease farm operations in the early stages of history led to the evolution of farm mechanization over the centuries to its present level, and it was not a process of simple and straight forward progress (Gifford, 1981). However, with the advantages of improved, readily available, and inexpensive machinery, farming was made more efficient by the replacement of human and animal power with machines.

However, in the majority of developing countries, including Sri Lanka, which were untouched by the industrial revolution until the latter part of the 20th century, only human labour and draught power were available for farm operations.

1.2 The Necessity of Agricultural Mechanization

Mechanization covers all levels of farming and processing technologies, from simple and basic hand tools to more sophisticated and motorized equipment. It eases and reduces hard labour, relieves labour shortages, improves productivity and timeliness of agricultural operations, improves the efficient use of resources, enhances market access and contributes to mitigating climate-related hazards. Sustainable mechanization considers all technological, economic, social, environmental, and cultural aspects that contribute to the sustainable development of the food and agriculture sector (Sims and Kienzle, 2017, FAO, 2016).

Despite being a country with a higher level of climate vulnerability and far lower levels of agricultural productivity in comparison to neighbouring countries in the region, Sri Lanka's farm mechanization is still at a very inadequate level in both paddy and other field crops (OFC) production systems. This has been attributed to a range of factors viewed through the supply-demand aspect (Bandara et al., 2021).

1.3 Research Problems and the Significance of the Study

The shortage of labour for agricultural activities due to various reasons, including the disinclination of youth for agriculture and an ageing population, has led to high wage rates, making agriculture an unprofitable venture (Karunagoda, 2004). Hence, it is of utmost importance to adopt improved and sustainable farm mechanization, leading towards increased crop production and productivity (Karunagoda, 2004; Pathirana et al., 2010; Abeyratne, 2017). Furthermore, the gradual development of export-oriented food crop production should also be considered as one of the positive demand-side drivers of agricultural mechanization.

Concerning the demand side constraints, poor farmer awareness of available machinery, incompatibility of machinery to suit the local farm environment coupled with farming community attitudes toward using new technology, as well as smaller land plots leading to low economies of scale in machinery use, issues of affordability due to high costs and poor farmer income have emerged in the context of farm mechanization.

A variety of reasons can be highlighted from the supply side, such as the unavailability of farm machinery for a variety of operations, while the available machines have technical defects, with low-quality imports and low taxes on imports discouraging local manufacturers, a lack of skilled workers, spatial concentration, a relatively small market for machinery, ownership skewed towards large landowners, resulting in an uncompetitive machinery-hiring market, and a lack of aftersales services and maintenance in remote locations (Ulluwishewa, Tsuchiya, & Sakai, 1985; Tilakaratne, 2003; Bandara, 2013; Kumara, Weerakkody and Epasinghe, 2016; Abeyratne, 2017; Balasuriya, 2019). These constraints lead to field-level issues in the lack of timely availability of appropriate machinery, equipment, and services, resulting in productivity issues that lead to heavy yield penalties on resource-poor farmers.

The Concept of Hubs Providing Agriculture Service

Sustainable Development Goal (SDG) Number 12 which mention the responsible consumption and production, provides a strong case for sustainable crop production intensification that will protect natural resources while producing food for a growing global population (Le Blanc, 2015; UN, 2015). This goal has to be achieved with restricted resources of land and labour, therefore, by improving labour and land productivity in the smallholder farming sector, which produces up to 80% of the food in developing countries (Kirui and Von Braun, 2018) like Sri Lanka, which is of utmost importance. This would not only require improved access to essential crop production inputs including quality seed, fertilizer and irrigation water, but would also necessarily increase access to appropriate machinery.

The government policy of ‘Vistas of Prosperity and Splendour’ clearly highlights the need, and the initiatives to be taken, to convert traditional and subsistence

agricultural systems to a new commercialized and modern technological food production system, leading to agro-industrialization (Presidential Secretariat, 2020).

Further, achieving increased agricultural production through promoting agricultural mechanization and the strengthening of value chains have been mentioned as special priorities of the State Ministry of Agriculture (SMoA, 2020). As smallholder agriculture becomes more commercial and modern, and agricultural value chains more intricate, there is a need for strategies to promote diverse types of mechanization technologies along these value chains (Kormawa, 2018; Mrema, Kienzle, and Mpagalile, 2018). For decades, low levels of farm mechanization have been linked to labour drudgery (Diao et al., 2012) which makes farming unattractive to youth and disproportionally affect youth, who opt for alternate livelihoods, favouring non-farm over on-farm activities (Damayanthi and Rambodagedara, 2013; Withanage and Damayanthi, 2019). Thus, improved agriculture mechanization can be utilized as a driver to attract youth into agriculture.

Contrary to the conditions of developed countries, small farm size and seasonality have often been seen as major limitations to the use and ownership of agricultural machines in underdeveloped nations (Pingali et al., 1987; FAO, 2006; Pingali, 2007; Ji et al., 2017). In such contexts, for underdeveloped countries (IFPRI, 2016) like Sri Lanka, characterized by smallholder farmers with lower purchasing power, where owning machinery by itself is not economical (Balsuriya, 2019), custom hiring through hubs providing agriculture services is considered as one of the viable solutions for popularizing farm mechanization. Houssou et al. (2015) emphasize that obtaining machinery services through hiring could reduce machinery costs sufficiently while enabling most farmers to adopt mechanized technologies. This would also encourage many entrepreneurs to invest in private machinery service provision. Sri Lanka has experience in implementing a variety of machinery hiring (service providing) programmes, such as government tractor pools, individual farmer lending, farmer-group operated, cooperative-managed, individual-entrepreneur run, NGO-supported, government-owned hiring centres (Agrarian Service Centres, or ASCs) over the past several decades. However, the majority of such attempts have proved to be ineffective and become inactive while the individual entrepreneur/farmer-operated type has long been practiced (Shaw, 2004). The machinery available for hire is mostly limited to land preparation (paddy and OFCs) and harvesting (only paddy), with most service providers being medium or large-scale farmers who could invest in tractors for their own use as well as to provide hiring services.

As for popularizing machinery use in the agriculture sector of the country, there is a need for introducing new approaches for custom hiring services that provide systems that deliver a range and combination of mechanization services without being confined to traditional types of operations such as land preparation and harvesting using tractors and combine harvesters, admittedly, not only for paddy.

Furthermore, the sustainability of such new approaches should be ensured through profitability for farmers, private-sector actors, and other service providers in the supply chain. The lessons and experiences of other countries like India and China, which have gained massive improvements in agricultural production and productivity in recent decades through strengthening farm mechanization via custom hiring services (Bhattarai et al., 2020) can be applied by adapting them to our context. Not only machinery services, but machinery hubs can also be utilized to provide other production inputs like seed and planting materials, fertilizer, etc., where a variety of services can be obtained by farmers under one roof in nearby places. Each service hub must be designed in a way to ensure the profitability of the business, including the need to also boost its clients' income.

The type and degree of mechanization should be decided by the producer to best suit their business and their own particular circumstances, and the choice of suitable methods will therefore be just one bundle of choices that the farmer has to choose from. The decision on if and how to mechanize is often a complex mix of reasons, with economics paramount. Therefore, a strategy of developing hubs providing agricultural services should consider the interests and aspects of the main interest and target groups, such as farmers, retailers and wholesalers, manufacturers, and importers etc. The fundamental requirement for a sustainable subsector is strong linkage between these different parties, and that all of them must be able to make a livelihood from their businesses. The role of the government in this exercise would be to create a conducive policy environment.

1.4 Research Objectives

General Objective

The primary objective of this study was to derive a viable and practical model to initiate agricultural mechanization through Agricultural Service Providing Hubs delivering diverse services along the value chain of key agricultural products.

Specific Objectives of the Study are:

1. to ascertain the level of mechanization in different farming practices, starting from land preparation to post-harvest and processing, in selected major crops;
2. to review previous strategies and models implemented in promoting mechanization in the paddy and OFC sector; and
3. to propose a model for sustainable agricultural mechanization through Agricultural Service Providing Hubs.

CHAPTER TWO

Strategies and Models towards Promoting Mechanization in Agriculture Sector

Farm mechanization refers to the application of mechanical technology to a variety of farming tasks such as land preparation, planting, levelling, watering, spraying, weeding, harvesting, threshing, and other related tasks. Mechanization can ensure timely field operations, enhanced productivity, lower crop losses, and better grain or product quality. All of the steps involved in the agriculture sector value chain, from land preparation to harvesting and post-harvest processing, could be mechanized. Farm mechanization may not only reduce labour use and post-harvest losses, but also help to lower long-term production costs. Multiple possibilities for accessing current technologies have emerged as a result of advancements in science and technology (ICFA, 2017).

2.1 Agricultural Mechanization Experiences in Other Countries

Large-scale agricultural mechanization began in North America and Europe, and more recently in Japan, and is now rapidly spreading over the world. Despite this development, there is still a substantial amount of human and animal-power utilized, particularly in the world's poorer countries. It is now widely understood that improving and upgrading such mechanization procedures prior to the transition to engine-driven equipment is critical (McNulty, 2009).

The stage of agricultural change, which reflects the usage of complementary inputs (better seeds, fertilizer), the intensity of farming, land holdings, and rural labour availability and hence wages, determines the desire for mechanization. Countries in the developing world have mechanized at varying rates depending on their level of agricultural transformation, but government initiatives have had a significant impact (Kennedy, 2019).

Pumps, tractors, power tillers, and threshers are usually owned by highly mechanized farms, whereas low-mechanized farms tend to hire out their farm activity. The crop output in the South-Asian region i.e. Bangladesh has been protected by the development of high-yielding varieties, fertilizer subsidies, good irrigation management, and the adoption farm mechanization like using two and four- wheel tractors. Paddy production has become more expensive for Bangladesh farmers in comparison to paddy prices due to labour shortages and high labour costs, particularly during planting, transplanting, and harvesting, as other paddy production operations are generally mechanized (Hasan et al., 2019).

The degree of mechanization in India varies substantially from one region to the other. Due to the region's extremely productive terrain and a shrinking work force, northern states such as Punjab, Haryana, and Uttar Pradesh have a high level of

mechanization. Owing to the smaller and more scattered landholdings prevalent, regions in the Western and Southern states of the country have a lower level of mechanization. As a result, mechanization has proved uneconomical in many circumstances, resulting in lower adoption. The level of mechanization in the North Eastern states of India is extremely low due to a various factors including hilly topography, high transportation costs, a lack of state financing and other financial restraints resulting from socio-economic conditions, as well as a scarcity of agricultural-machinery manufacturing businesses (ICFA, 2017). The level of mechanization is identified as being influenced by a region's agro-ecological conditions, landholding size, access to irrigation, and access to institutional credit (Sarkar, 2020).

The poor adoption of tractors in some of the African countries like Nigeria is largely due to supply-side constraints. However, countries where the demand for tractors is managed by the private sector are emerging as relatively well mechanized nations. Further, the private sector is considered to be more efficient provider of hiring services (especially farmer-to-farmer services) over time, than the governmental sector (Takeshima, 2017). Since 2007, the Government of Ghana has provided subsidized agricultural machines to individual farmers and private enterprises that have established themselves as specialized Agricultural Mechanization Services Enterprise Centres (AMSECs) to provide tractor- hire services to small-scale farmers across the country. Land preparation services, particularly ploughing, are currently in high demand across the country (Van Loon et al., 2020).

The most significant limitation to the profitability of investments in specialist agricultural mechanization service supply is low operational scale (Diao et al., 2014). With such a small operational size, it is critical to consider several options for introducing low-cost small tractors that are appropriate for a current farming scale. Tractor-hire services can play a critical role in modernizing smallholder agriculture, but substantial subsidies on large, expensive tractors can skew supply chain growth. As a result, many more suitable and less-expensive equipment are unlikely to enter local markets (Houssou, 2015).

Takeshima (2017) says future research areas are of policy importance, such as accessibility limits for tractor custom rental services, the establishment of appropriate regulatory policies for mechanization, and the provision of additional assistance to smallholders who do not fully benefit from the use of tractors alone.

2.2 Evolution of Agricultural Mechanization in Sri Lanka

Abeyratne and Takeshima (2020) have split the historical evolution of mechanization in Sri Lanka into two periods by looking at the trends, pre - and post-1970. In pre-colonial and colonial times, agriculture in the dry zone areas of the country was relatively neglected, and mechanization was limited to the processing of plantation crops in the wet zone. With the initiatives of the successive governments in the rehabilitation of irrigation systems and resettlement schemes in the drier parts of

the country, crop production and the related agriculture sector saw a significant development in those areas during 1935-1970. Furthermore, four-wheel tractors (4WTs) – characterized as those with engine greater than 25 hp – were in the early 1950s, introduced through government-run pools, and later promoted as private ownership, with incentive schemes for importation. This led to considerable growth in tractor use, especially in paddy fields, resulting in increased land extent and production. Basically, the key purposes for the importation of tractors were to avoid the drudgery experienced in operations of land preparation in paddy cultivation, and as a hauling vehicle in the construction industry (Tilakaratna, 2003: Abeyratne & Takeshima, 2020). Burchfield and Gilligan (2016) highlights that even by 1960s, draught power was widely used in agriculture operations, however, by the early 1970s, 4WTs have gained significant popularity in land preparation and threshing operations in paddy cultivation (Tilakaratna, 2003).

Primarily, the popularization of tractors in land preparation operations of paddy cultivation were carried out through the state-run tractor pools from 1949 to 1957 (Ulluwishewa, 1987), where the service (land preparation) was provided for farmers who sought such services. In addition, the establishment of hire services by cooperative societies, executing preferential import duties and providing low-interest credits were some other initiatives taken towards promoting tractor- based farm mechanization in the initial stage (Abeyratne, 2017). Even at the initial stage in the 1950s and 1960s, large-scale imports had occurred (Abeyratne & Takeshima, 2020) and tractor-use promotion and practice had spread to areas with a higher proportion of larger holdings. Farrington (1984), as cited by Abeyratne and Takeshima (2020), has highlighted that at the start of gaining popularity in 1950s, large-scale paddy farmers, mostly from the Eastern province, had made several requests for the importation of tractors reflecting the usefulness of this particular machinery in large-scale paddy farming. In the 1960s, approximately 15 percent of a paddy cultivation area was likely to have been ploughed by tractors (Abeyratne & Takeshima, 2020). Though 4WTs were first introduced in the early 1950s, the introduction of 2WTs (or power tillers with 5 hp) was promoted in Sri Lanka in the second half of the 1960s. As far as the 2WTs are concerned the Sri-Lankan designed, English-made Landmaster model became the first popular model. Japanese models such as Kubota gained prominence later on in the Sri Lankan agriculture sector (Abeyratne & Takeshima, 2020). While 4WTs are limited to activities such as land preparation, and the threshing of paddy and hauling, 2WTs (singe axle tractors) had begun to gain much popularity in land preparation (coupled with 14 blade rotavators/cultivators) especially where the small-scale farm holding size was less than one ha. The ability of rotavators to be used for both primary and secondary tillage was an added advantage of the 2WTs. In addition to a low initial investment and less maintenance cost, 2WTs had an attractive fuel economy too (Tilakaratna, 2003). Furthermore, the versatility of the 2WTs in land preparation, threshing, winnowing and hauling increased its appeal for agriculture in many parts of the country.

Though mechanization in the paddy sector saw gradual development over time, until the latter part of the 1970s, machinery use was not observed in other field crops (OFC) sector as the system was mostly of the slash and burn (*chena*) type. With OFCs allowed in the lowlands in the minor season (*Yala*) and the chena system characterized by mixed-cropping with farmers being compelled to carry out crop cultivation in established or semi-established land lots, machinery used in the OFC sector also began to slowly expand (Abeyratne, 2017). Owing to the import restriction policies of the government, during the 1970-1977 period, imports of tractors and other equipment were restricted (Abeyratne & Takeshima, 2020). With the adoption of liberal economic policies, since 1977, Sri Lanka has shown a rapid increase in tractor imports and use in agricultural and related sectors (Shanmugaratnam, 1984). By the mid-1970s, around 5,000 2WTs had been registered in the country. In 1977, 13,300 4WTs and 6,150 2WTs were registered, and by 1980 the numbers of 4WTs and 2WTs had increased to more than 21,000 and 13,000, respectively (Abeyratne, 1984).

The disintegration of the traditional system of exchange labour (*attam*) in agriculture, with the establishment of market economy, the transition of exchange labour to costly hired labour, also paved the way for mechanization particularly in land preparation (Ulluwishewa & Tsuchiya, 1984). From 2000 onward, mechanization spread further among certain OFCs, especially maize and groundnut. Furthermore, in the first decade of this century, especially the eastern part of the country began to experience a further expansion of mechanization in paddy harvesting and threshing using combine harvesters.

Whilst agricultural mechanization in Sri Lanka initially evolved with tractors used for land preparation and threshing in paddy farming, other forms of technology involved in agricultural mechanization in paddy as well as other field crop production sectors saw gradual development over the past several decades. Though machinery like bund makers, seeders, transplanters (both manual and tractor-driven types), weeders, power sprayers, and threshers including combine harvesters in the paddy sector received a prominent place in popularization campaigns, the majority of such machinery has not shown the envisaged level of adoption among the targeted farming communities, except for combine harvesters. Gamlath, Gunathilake & Chamara (2018) have shown that except for tillage and threshing operations, there were considerable differences in the mechanization level, mechanization capacity, and power per unit area of other practices in paddy cultivation.

In the OFC sector, in spite of a large range of machinery for seeding to postharvest handling having been introduced and promoted, the level of adoption is still insignificant. The mechanization of OFCs is limited and mostly confined to land preparation, while activities such as weeding, planting and harvesting are mostly carried out manually (Kumara, Weerakkody & Epasinghe, 2016).

Table 2.1: Level of Mechanization in Selected Countries

Country	4W Tractors (000's)		2W Tractors (000's)		Irrigation pumps (000's)		Combine harvesters (Units)		Power kW/ha	
	1990	2013	1990	2013	1990	2013	1990	2013	1990	2013
Bangladesh	5	60	10	700	220	1729	N/A	130	0.3	1.83
Cambodia	0.3	9.5	0.5	152	1.0	256	N/A	4580	N/A	1.32
China	814	5270	6981	17523	7255	22068	39588	1421000	2.0	5.7
India	1200	5430	31	440	12900	28000	4500	38000	0.75	2.02
Indonesia	4	2.8	17	71	N/A	N/A	N/A	N/A	0.3	N/A
Rep. Korea	31	278	739	640	326	350	32900	78854	N/A	10.6
Malaysia	2.5	8	2.1	35	70	N/A	44	1700	0.24	0.2
Nepal	6	30	1	12	23	550	N/A	N/A	0.22	N/A
Pakistan	231	573	5	2	288	1050	1300	9000	0.75	1.1
Philippines	6	N/A	32	N/A	107	N/A	N/A	N/A	0.39	N/A
Russia	1366	260	N/A	N/A	79.4	5.2	407800	67900	2.67	1.48
Sri Lanka	15	1.5	24	2.8	52	N/A	N/A	1099	0.43	N/A
Thailand	45	334	583	1750	851	2320	2250	15000	0.89	2.5
Vietnam	5.2	170	20	380	168	2170	0	20000	0.61	1.7

*N/A: Not Available

Source: Adopted from Agricultural Mechanization and Testing of Agricultural Machinery in the Asia-Pacific Region (RNAM reports); Data provided by national participants to CSAM meetings during 2014.

Increased agricultural output has become a necessary component for progressing toward sustainability because of the tendency of younger generations to move away from agriculture, leading to severe labour shortages. Mechanization is critical in encouraging young people to pursue careers in agriculture. Furthermore, transition from an agrarian to an industrial society, with the majority of people living in cities, has reduced the availability of agricultural labour and increased the agricultural mechanization.

Paddy farmers' tendency to use tractors for tillage operation can hardly be explained in rational terms in Sri Lanka, where paddy farmers' income is low and tractor hire rates are relatively high. Some selected socio-economic and physical factors are considered to be effective in generating compulsion to use tractors for tillage operations in paddy fields (Ulluwishewa., 1987).

2.3 Farm Mechanization Challengers and Opportunities

2.3.1 Issues and Problems in Mechanization at Farm Level

Farmers in Sri Lanka confront numerous challenges in obtaining a good yield from paddy agriculture, and the revenue generated after spending a significant amount of money on inputs is simply inadequate. Agricultural wages remained low during the early stages of mechanization, and the sector continued to employ a considerable percentage of the workforce. These early expenditures may have paved the way for

a later expansion of mechanization, which is fuelled by agricultural household income growth and rising labour costs (Takeshima and Joshi, 2019).

Agricultural mechanization spread in Sri Lanka despite a number of obstacles, including the poor quality of imported machines, the persistence of smallholders, lower prices, low crop productivity, hilly terrain, and lack of awareness of available mechanical technologies (Takeshima et al, 2020). Innovative farmers have adjusted the evolution of agricultural mechanization in Sri Lanka to fit their own demands. Imported machinery has typically accounted for the majority of their needs. In general, however, imported machinery has been unsuitable for the various land classes, operations, and crop types cultivated in Sri Lanka.

Provisioning services for combine harvesters are also on the rise. There is excess supply of harvesters in some locations (in some cases, more than 500 concentrated in one area), resulting in lower hiring rates; estimates imply that prices have dropped from Rs. 15,000/= per hectare to just Rs. 7,500/= per hectare. In other cases, rising operator labour wages, rising fuel and repair and maintenance expenses, a heavy reliance on brokers, and climatic issues such as floods and droughts can all put a damper on the use of combine harvesters (Bawatharani, 2014). Grain loss remains significant in combine harvester operations, at 20–30 percent. As a solution to these issues, some innovative farmers have modified existing machinery to match their specific needs. The Farm Mechanization Research Centre (FMRC) has the responsibility to test and certify these modified models before they could be commercially built. Such inventions have never reached large-scale commercial production levels due to considerable delays in these procedures (Kumara, 2016).

2.3.2 Machinery Hiring Services

Smallholder-appropriate mechanization encompasses a wide range of human, draft animal, and motorized power sources. Financial, social, and environmental issues all play a role in mechanization's long-term viability. Local manufacturers should be encouraged to produce implements and equipment that are tailored to local requirements, as well as greater technical assistance and replacement parts. With minimal direct government support, a variety of specialized hire firms for tractors and combine harvesters have evolved to cater to demand in some specific areas (Sims and Kienzle., 2016). The commercial sector has also stepped into help connect service providers and farmers by providing facilitation services. Many theories concerning the farm-level impact of mechanization in India are confirmed by empirical investigations of tractor ownership and tractor/combine harvester use. Despite India's traditionally limited landholdings, the desire to grow agricultural-holding size drives tractor purchase. Tractors are better at saving bullocks than they are at saving labour, whereas combine harvesters are better at saving labour. Combine harvesters raise yields more than tractors, however tractors' soil preparation may increase yields indirectly by increasing the usage of chemical fertilizer (Bhattarai et al, 2018).

Farmers' awareness of new land preparation technologies is imprecise, according to studies, and the spatial concentration of machinery continues to make hiring fees inconsistent among areas (Kumara, 2016). Larger machines such as combine harvesters and 4WD tractors, are usually held by large farmers and firms, whose distribution, and hence machine availability, do not always match the need for farmers in the local region. Ulluwishewa (1987) emphasized that redesigning machinery centres through cooperatives or government-owned companies could not be a good solution based on their failed experience in the past. In addition, this reiterates that it is critical to investigate how much more efficiency can be added to machinery hubs through a combination of individual and group ownership, public–private partnerships, and effective use of current technology such as information and communication technologies.

Punjab state in India has initiated similar interventions like mechanization facilities to the paddy field to prevent burning of paddy residue, and the decrease in youth taking part in agricultural activity, as attractive options to retain youth in the field. In that intervention, the Commission on Agricultural Mechanization has introduced bespoke hiring centres to counteract the negative economies of scale that result from small landholdings and high individual ownership costs. Paddy residue has arisen as a key difficulty for modern agriculture in Punjab, with farmers' frequently burning paddy straw in the field due to a lack of time. As a result, an effort was undertaken to establish a machine bank in order to train rural youngsters in machine operation and maintenance and to help them become entrepreneurs. Farmers were given various machines to demonstrate agricultural residue management techniques at crucial sites. It was discovered that the Machine Bank model has proven to be an effective approach for drawing rural youngsters to mechanized business growth (Singh and Basu, 2020).

Further, Catherine (2016) has stated that intermediary institutions should receive enhanced cooperation in order to make value chains in shifting agri-food systems in Sub-Saharan Africa more inclusive. As an intermediary institution, the hub concept has been used to coordinate advisory services, input supply, and smallholder access to markets. This study has investigated hub coordination in Kenyan smallholder dairy, conceptualizing the hub as a hybrid of a relationship broker. A one-stop shop is for services and as a place designated for a cluster of producers and service-providers. The hub enables horizontal (between smallholders) and vertical (between producers and service providers) coordination in between smallholders and value-chain actors and service providers. According to the findings, synergies arose as the hub blended several types of horizontal and vertical coordination to resolve issues that hinder smallholders' integration in value chains. This have had accomplished by organizing clusters of farmers, input and service providers (clustering role) while also actively facilitating delivery (broker and one-stop-shop function) with the hub structure stimulating demand (better articulation) to supply. Catherine (2016) further points out that complementary intermediate structures will be needed to carry out certain coordination tasks, taking into account the stresses and capacity issues faced by farmers' organizations.

It's critical to comprehend the kind of farmers who are willing to obtain the services of mechanization hubs. This will be required since the agriculture sector has a diverse range of farmers, from smallholder farmers who are not connected to well-defined and appropriate value chains to large-scale commercial farmers. They either have machinery or they may have a chance to use the facilities of the ASPHs because they have been part of the production value chain. The use of the "boda-boda" motorcycle system for transportation in nations like Uganda is an illustration of this. The need has been met in a major way, and it is worth emphasizing that most “boda-boda” drivers aren't the proprietors (Sims, Hilmi, and Kienzle, 2016).

Farm Machinery Cooperatives (CUMA) are agricultural service cooperatives founded by farmers for the benefit of farmers in Benin. CUMA was one of the most prominent measures utilized in Benin to enhance farmers' living conditions. The CUMA were created to facilitate access to agricultural mechanization; overcome financial difficulties felt by farmers, and increase profitability while increasing accessibility of suitable machinery to farming activity and other facilities, are its main function. CUMA is a type of collective model, investment and management conducted by farmers in independent groups in the same territory (Herbel, Nouwogou, and Bagan., 2018). Benin has 115 CUMAs that serve 1,250 farmers and are equipped with 57 tractors and other farm equipment. As a result, the cultivated area has increased by 350 percent, and the quality of food has improved, resulting in increased revenue and a higher standard of living (Ibid).

Machinery Rings (MRs) are a concept that was developed in Germany and were a response to a shrinking labour force and inefficient machinery use on small farms (Sims and Kienzle, 2017). MRs have 192,000 members, with about 230 local machinery rings (MRs) around the country. MRs are self-organized by farmers, and serve as a modern hub for a variety of services and technological expertise. This is governed by a board of farmers, with a professional manager on staff. A standard price list, cashless payments, and practical testing of new procedures are all available. Sugar beet, biogas for heat and power, cereals, potatoes, milk, and industrial and municipal services with agricultural equipment are all instances of MRs in value chains. Farmers are the driving force, but strong management and well-trained office workers are also required. The rules are clear and straightforward, and the prices are fair. Farmers appreciate the opportunity to collaborate in order to obtain contemporary mechanization at a reasonable cost by MRs (ibid).

Sims and Kienzle (2017) have further illustrated some protocols that are needed for the success of such MRs. Farmers have to be convinced it is a good idea, farming must be a business, farmers need continuous awareness and training on the vital components for the success of such mechanical centres. In addition, a good regulatory framework, infrastructure facilities, access to markets for all essential inputs and after-sales services and a reliable financial system are needed for success and to keep the stakeholders intact.

CHAPTER THREE

Materials and Methods

3.1 Study Sites

Agricultural Service Providing Hubs (ASPHs) have to be site specific, thus, designing ASPHs needs some site-specific characteristics and information. The Anuradhapura district was selected in this study as its laboratory to understand the level of mechanization in various steps of agricultural crop production. Anuradhapura is a district characterized by numerous crop cultivation systems, predominantly paddy, with other field crops (OFCs) and vegetable having a considerable share for each crop category. Further, it is easy to find cultivation under all three irrigation systems – minor, major and rainfed – in Anuradhapura. Within the district, Anuradhapura, Muriyakadawala, Thirappane, Kashyapagama, Siwalakulama, Yakalla, and Palugaswewa Agrarian Service Centre areas (ASCs) were selected for farmer interviews.

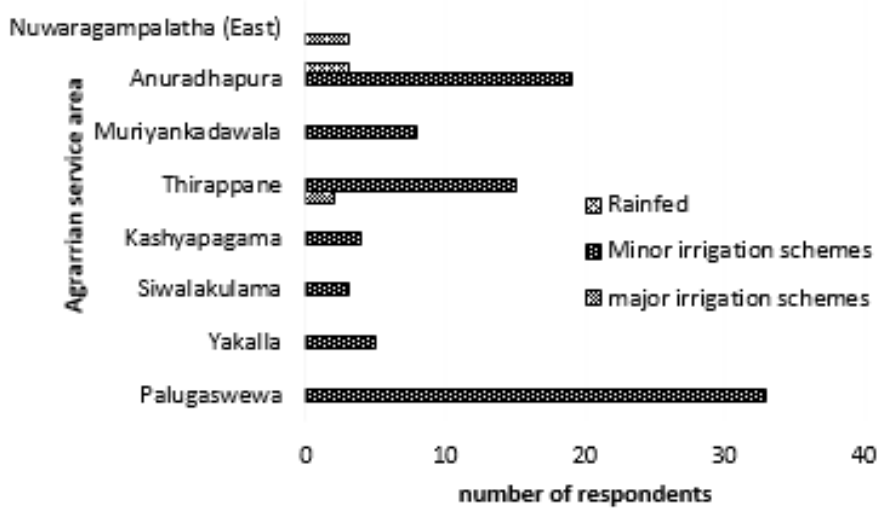


Figure 3.1: Number of Farmers Interviewed under Different Irrigation Systems

The initial design of the study was to collect every possible detail related to machinery use in selected crops like paddy, maize, groundnut and so forth. However, farmer interviews were restricted due to the Covid-19 prevention regulations enforced by the government at the time of survey.

3.2 Data Collection and Data Analysis

Both primary and secondary data were collected. The primary data was obtained through structured interviews from the farmers and farmer leaders. Some of the farmer interviews were conducted through telephone when there were difficulties in reaching them physically. The information on machinery rates, cultivating practices, rent, and machinery availability so on were collected as a primary data from farmers

and service providers in the study locations. In addition to the farmer interviews, key informant interviews were also conducted while the professional views and opinions were obtained through guided interviews. When developing the model for sustainable agricultural mechanization run by local agri-entrepreneurs, information on machinery types and market prices of machinery used for different agronomic practices, machine-hiring rates, number of machinery available in selected study locations were also collected from the primary sources.

Secondary data like, machinery imports, capital costs of machinery and other related information were collected through published reports and databases available at various government departments and private entities. The national level data on available agricultural machinery was collected from secondary data sources maintained by Sri Lanka Customs for the period of 2014-2020. The comprehension of previous strategies and models used to promote mechanization in the field of agriculture production and processing, were assessed by collecting and analysing information from previous study reports, published articles, and projects.

The structure of hiring centres or hubs, and other agricultural services, the mechanism/s of service provision, level of subsidy or interest rates for soft-loan schemes, the minimum land area to be covered to exceed the threshold level of profitability, etc., were included in the data analysis part to ascertain the sustainability of farm machinery custom hiring centres.

3.3 Limitations of the Study

The study was initially planned to collect primary data from the field level to analyze field situations and more data on field operation activities. However, the scope of the study had to be restricted due to the Covid-19 pandemic situation prevailing in the country at the time of the survey**.**

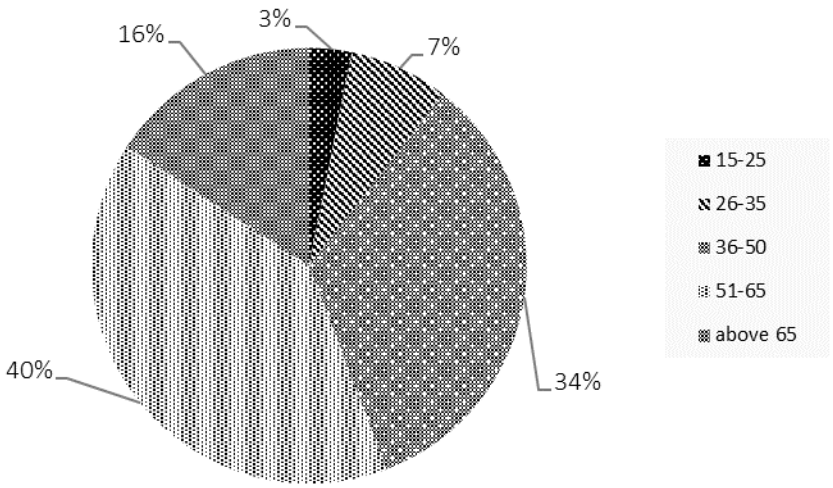
CHAPTER FOUR

Level of Agro-Mechanization at Selected Locations in Anuradhapura District

This chapter discusses the background related to mechanization of agricultural practices in selected Agrarian Service Centres (ASCs) in the Anuradhapura district. Anuradhapura has accounted for a considerable representation of the national quart of food production. It also demonstrates three major irrigation systems relating to paddy cultivation. In addition, the district significantly contributes to vegetable production and OFC production sectors. A shortage of labour is a common factor due to the intensive nature of agriculture, as in other districts. Mechanization is one of the options that can compensate for labour and also optimum use of resources.

4.1 Demographic Features of the Respondent Farmers

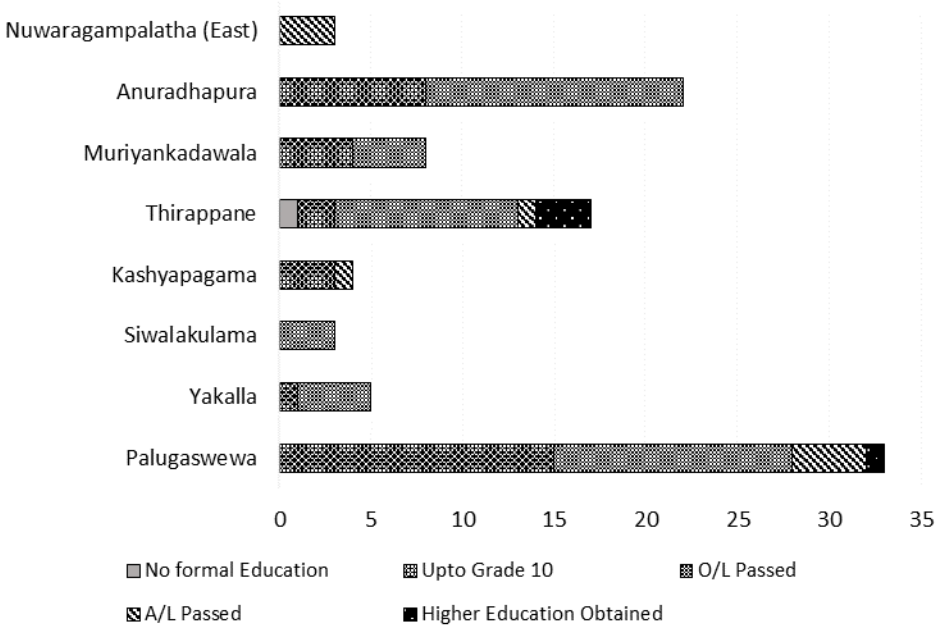
The demographic characteristics of the farmers interviewed illustrate the contextual nature of the sector, specific to the study locations. Thus the study attempted to gather demographic information from randomly selected farmers under different irrigation systems. Figure 4.1 illustrates the age distribution of the farmers interviewed, and this indicates that the majority of the farmers are in the age category 50-60 years. This is a representative cross-section of the farming community currently involved in crop production in many parts of the country (Udari, Perera and Wickramasinghe, 2019).



Source: HARTI Survey Data, 2021

Figure 4.1: Age Distribution of the Sample of Farmers

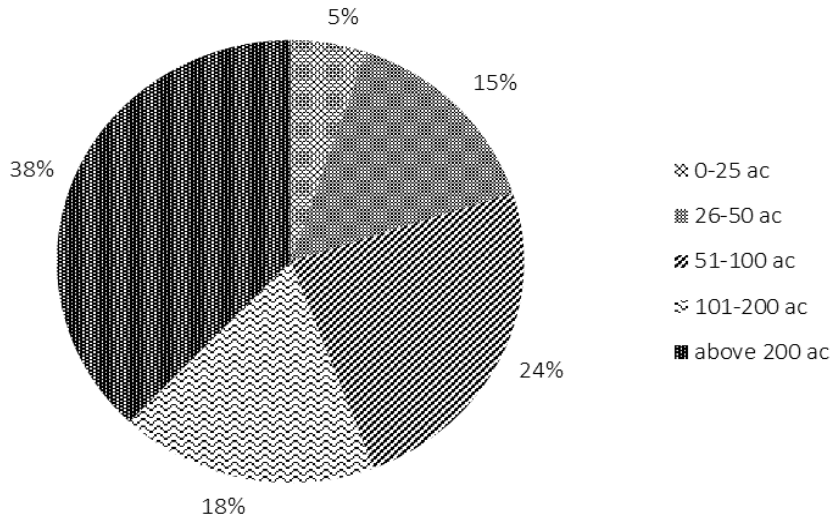
As illustrated in Figure 4.2, present-day farming communities are more schooled than earlier communities, and the majority of the respondents have minimum General Certificate of Education (GCE) Ordinary Level qualifications. A significant number of farmer leaders have GCE Advanced Level qualifications while a few have educational qualifications above the Advanced Level.



Source: HARTI Survey Data, 2021

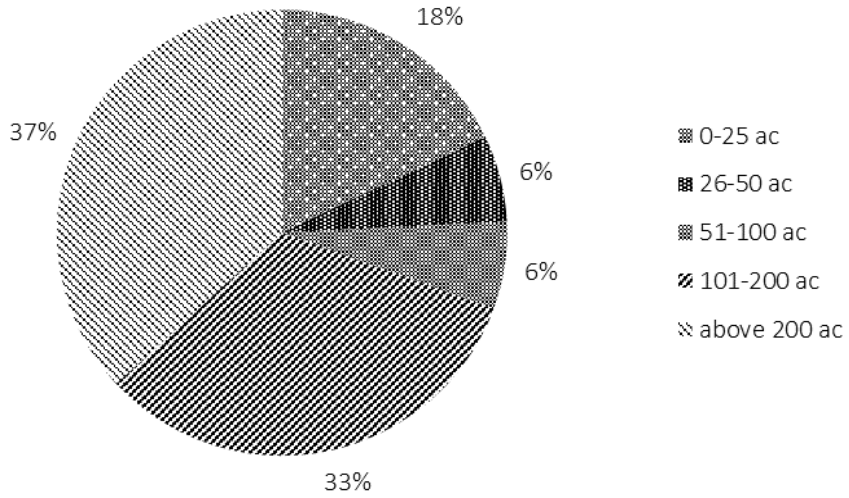
Figure 4.2: Education Status of Respondent Farmers

The extent of cultivation of upland and lowland by the respective farmer organizations whose information was collected, are graphically illustrated in Figures 4.3a and 4.3b. According to the data, the command area is higher than 100 ac in more than 50 percent of the FOs studied. In case of lowlands, more than 70 percent of the FOs have been cultivating extents higher than the 100 ac. The financial viability of the intervention as one of the key parameters that define their sustainability and, as highlighted in the literature, as there should be a reasonable land extent in a locality in order to keep machine-hiring services sustainable, these localities fulfil that requirement. Generally, in the Sri Lankan agriculture sector, there are two distinct cultivating seasons, and those are the busiest periods of time for machinery and labour. Financial viability depends on the number of working days and the amount of earning gained through the rent of the services offered, are directly correlated to the economics of scale. Therefore, the cultivable land extent in a particular location is one of the factors to be considered where implementing any type of ASPH.



Source: HARTI Survey Data, 2021

Figure 4.3a: Upland Land Extent under Respective FOs

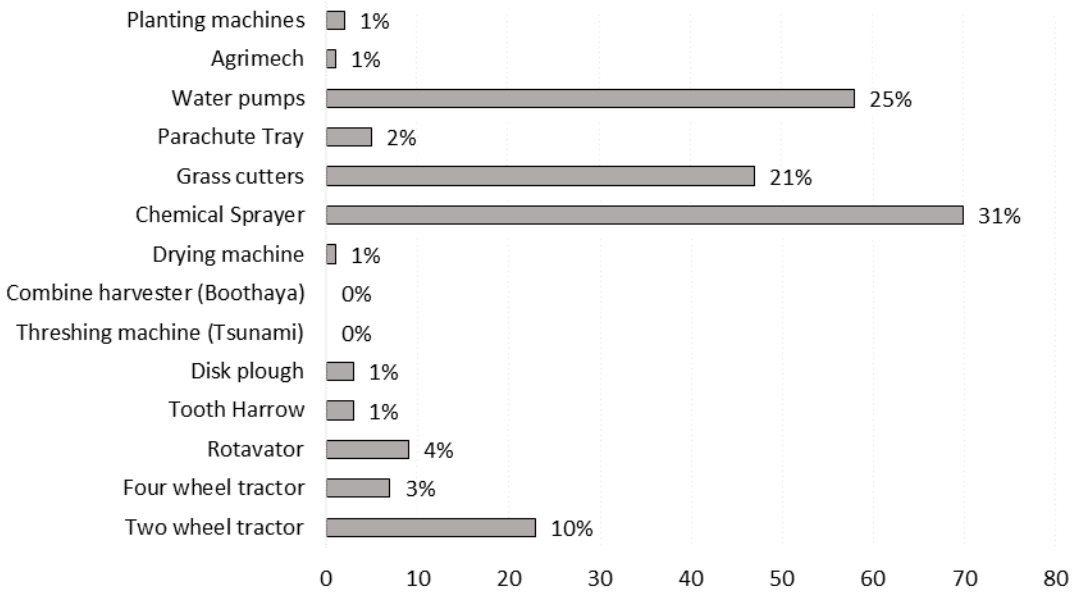


Source: HARTI Survey Data, 2021

Figure 4.3b: Lowland Land Extent under Respective FOs

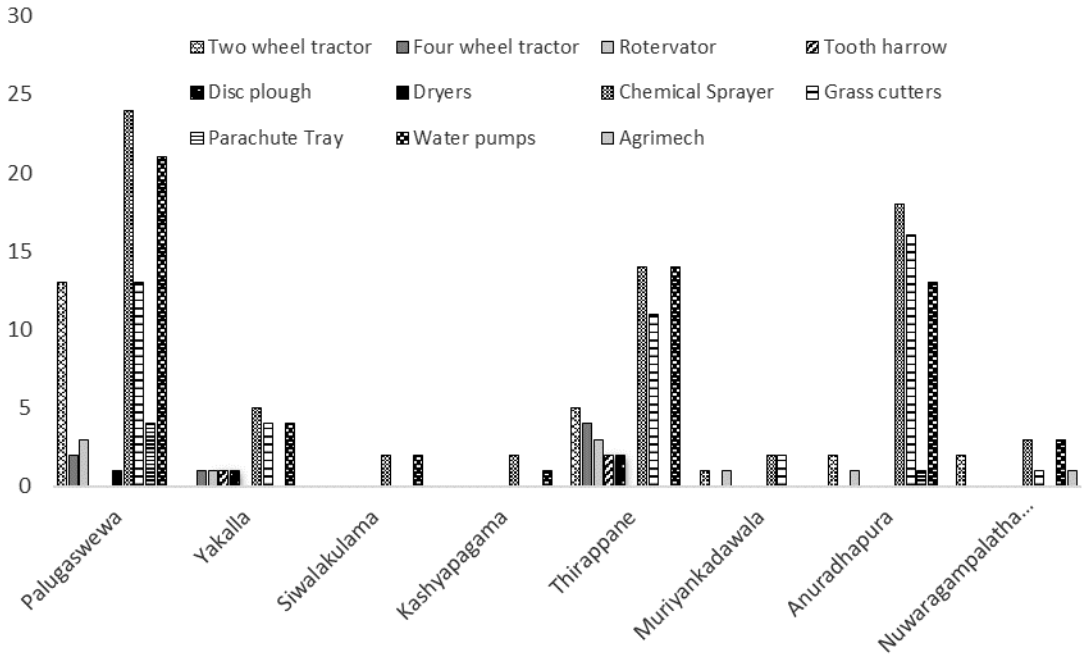
4.2 Type of Machinery Used and Issues Encountered

There are a few common types of machinery currently used by farmers in their respective areas as illustrated in Figure 4.4. Water pumps, sprayers and grass cutters are the more prominent equipment they use. Most of the farmers do not own machinery for the activities like land-preparation and harvesting such as tractors, harvesters and threshing machines in all study locations. In such circumstances, there is a serious shortage of most of the machinery that essential for timely cultivation and harvesting.



Source: HARTI Survey Data, 2021

Figure 4.4: Machinery Owned by Respondent Farmers



Source: HARTI Survey Data, 2021

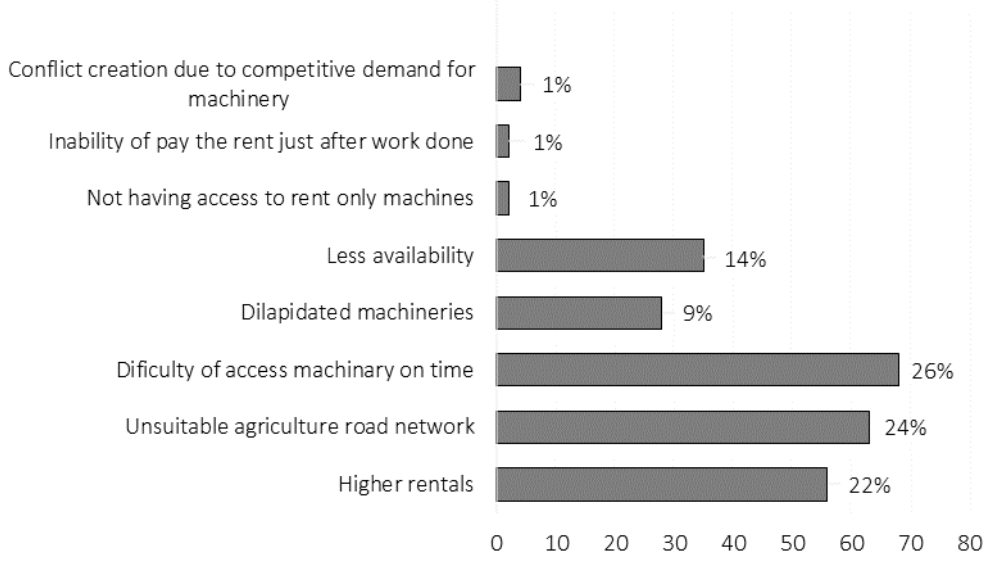
Figure 4.5: Type of Machinery Currently Available in the Respective ASCs

4.3 Problems in Procuring Machinery for Agriculture Activity

According to the farmer responses, Figure 4.6 highlights the main issues pertaining to current machinery rental services by local suppliers, such as high rentals, obtaining machinery service on time, unsuitable road networks or difficult access to farmlands. In addition, dilapidated machinery and less availability of machines are

prominent. The interesting finding is that an unsuitable road network or inaccessible agriculture road network to farmland prevent use of proper machinery for the respective purposes. It clearly emphasizes the need for developing agricultural road networks as a prior requirement for facilitating machinery to rural farmlands, so as to access such facilities freely.

Further, Kodithuwakku and Rosa (2002) pointed out that farmers struggle to pay the rent/payment immediately after they obtain the services or goods. This is one of the prominent phenomena for rural marginal farmers. The inclusions of protocols to address such issues in the development of the ASPH concepts also contribute to the success of such concepts.



Source: HARTI Survey Data, 2021

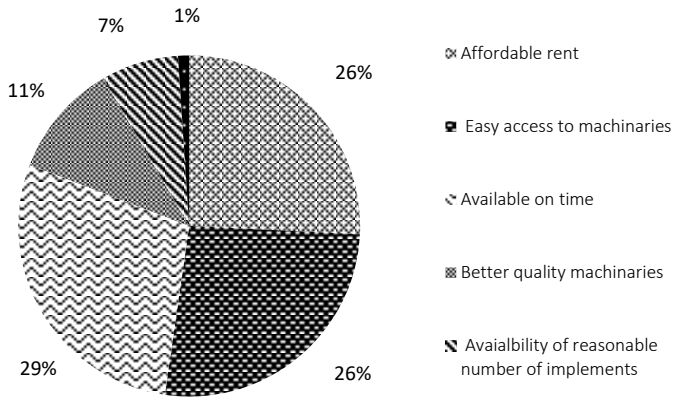
Figure 4.6: Main Issues Pertaining to Current Machinery Rental Services

4.4 User Anticipation for Machinery Rental Services

As discussed above, there are issues of lack of availability of suitable machinery at the required time, high rents charged by the service providers, and incapacity of resource poor farmers to acquire their own machines, which highlight the strong need to make available suitable machinery at fair prices in order to promote mechanization in Sri Lanka's agriculture sector through service-providing hubs.

Figure 4.7 shows the expectations of farmers regarding machinery services related to agriculture. The main concern of the majority of the farmers was that they should be able to access a service when they need it. Further, they highlight the importance of the availability and fair prices for the service. In addition, farmers emphasize that they do not get the machinery they need, and have to be satisfied with the machinery provided by the service provider, especially when it comes to ploughing. In most of the occasions, farmers are willing to get their lands ploughed with disc plough or similar equipment that can plough deep and turn the soil, however, due to

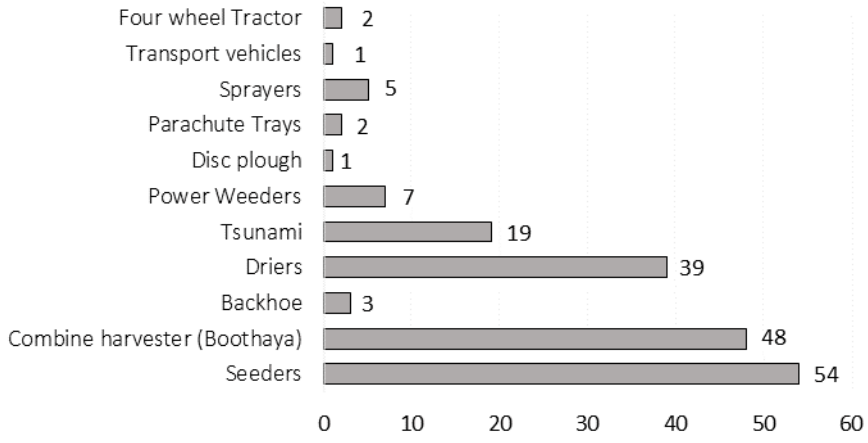
unavailability of such kinds off plough with most of the service providers the lands are simply prepared with rotervators/cultivators.



Source: HARTI Survey Data, 2021

Figure 4.7: User Expectations of Machinery Rental Services

During the interviews, farmers were asked about machinery that essential for their regular agricultural activity, and whether they are easily accessible. As indicated in Figure 4.8, seeders, combine harvesters, and driers are the more common type of machinery which many farmers cannot access easily in the neighbouring areas. Such machineries are comparatively expensive and it is not economical for the majority of smallholder farmers to retain those for individual usage. The capital costs invested for purchasing such machinery might not be covered by providing service in a limited area. Hence, those machines are required to be pooled in the ASPHs for use and to facilitate many people's usage and facilitate quick access, and also to recover the costs spent on such machinery in a reasonable time.

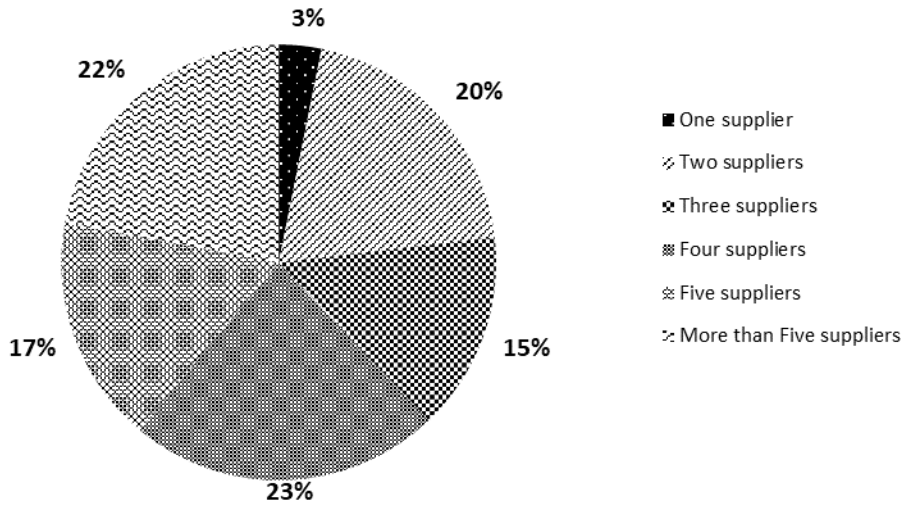


Source: HARTI Survey Data, 2021

Figure 4.8: Machinery that Not Easily Available

4.5 Number of Machinery Service Providers in Surrounding Areas

According to the survey data, a considerable number of machinery service providers are available in almost all the study locations, and 39 percent of respondents have access to five or more service suppliers are available in the respective locations (Figure 4.9). Nevertheless, as also mentioned earlier, farmers face different issues when it comes obtaining such services.



Source: HARTI Survey Data, 2021

Figure 4.9: Number of Service Providers in Surrounding Areas

CHAPTER FIVE

Level of Mechanization and Its Implications

5.1 Current Machinery Rental Prices in the Field

Due to the lack of properly established machinery rental market and regulations related to rental of the machinery, significant variations in rents could be observed even within the district. Prices varied mainly based on the type of the land (upland or lowland), topography of a particular land and accessibility to the land etc. Table 5.1 and Table 5.2 show the rental prices of selected machinery in the study locations for lowlands and uplands respectively.

Table 5.1: Machine Hiring Rates (Lowlands)

Machineries	Unit of measurement	Minimum (LKR)	Maximum (LKR)	Mean (LKR)	Mode (LKR)
Two-wheel tractor + rotavator	Per Acre	4,000.00	12,500.00	10,017.54	10,000.00
Two-wheel tractor + tooth harrow	Per Acre	4,000.00	12,000.00	8,550.00	10,000.00
Two-wheel tractor + disk plough	Per Acre	5,000.00	12,000.00	7,020.83	6,000.00
Four-wheel tractor + rotavator	Per Acre	7,000.00	13,000.00	10,655.91	10,000.00
Four-wheel tractor + tooth harrow	Per Acre	6,000.00	12,000.00	8,343.75	6,000.00
Four-wheel tractor + disk plough	Per Acre	6,000.00	12,000.00	7,651.52	6,000.00
Sprayers (Manual)	Per Hour	100.00	100.00	100.00	100.00
Sprayers (Manual)	Per Tank	100.00	500.00	197.50	200.00
Sprayers (Manual)	Per Day	500.00	2,000.00	1,390.00	500.00
Sprayers (Power)	Per Tank	100.00	500.00	265.00	250.00
Grass-cutting Machine (Power)	Per Acre	4,000.00	4,000.00	4,000.00	4,000.00
Grass-cutting Machine (Power)	Per Tank	700.00	750.00	725.00	700.00
Water Motors (Diesel)	Per Hour	200.00	250.00	225.00	200.00
Water Motors (Electrics)	Per Hour	1,000.00	1,000.00	1,000.00	1,000.00
Leaf-Crusher Machine	Per Acre	6,000.00	12,500.00	10,350.57	10,000.00
Tsunami (Threshing machine)	Per Acre	6,000.00	10,000.00	9,214.29	10,000.00
Tsunami (Threshing machine)	Per Hour	2,000.00	6,600.00	3,600.00	3,000.00
Seeders (Manual)	Per Acre	5,000.00	5,000.00	5,000.00	5,000.00

Source: HARTI Survey Data, 2021

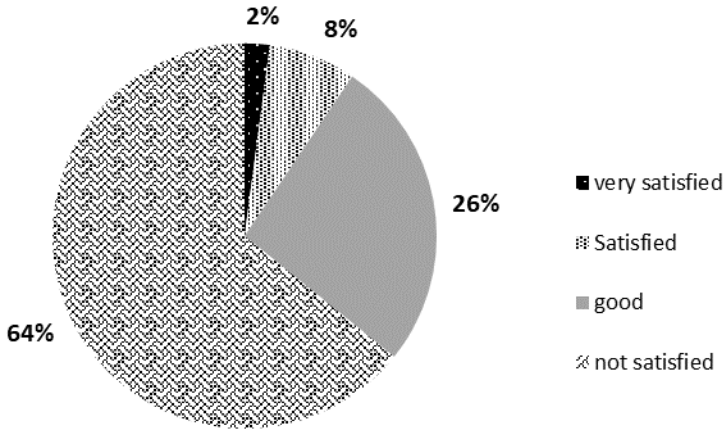
Table 5.2: Machine Hiring Rates (Uplands)

Machineries	Unit of measurement	Mean (LKR)	Minimum (LKR)	Maximum (LKR)	Mode (LKR)
Two-wheel tractor + rotarvator	Per Acre	10,538.46	5,000.00	100,000.00	10,000.00
Two-wheel tractor + tooth harrow	Per Acre	7,818.18	4,500.00	12,000.00	6,000.00
Two-wheel tractor + disk plough	Per Acre	7,162.16	5,000.00	12,000.00	6,000.00
Four-wheel tractor + rotarvator	Per Acre	9,129.21	4,500.00	12,000.00	10,000.00
Four-wheel tractor + tooth harrow	Per Acre	7,534.88	4,000.00	12,000.00	6,000.00
Four-wheel tractor + disk plough	Per Acre	7,427.54	5,000.00	12,000.00	6,000.00
Sprayers (Manual)	Per Hour	100.00	100.00	100.00	100.00
Sprayers (Manual)	Per Tank	199.32	100.00	500.00	200.00
Sprayers (Manual)	Per Day	1,390.00	500.00	2,000.00	500.00
Sprayers (Power)	Per Tank	255.00	100.00	500.00	200.00
Grass-cutting Machine (Power)	Per Tank	725.00	700.00	750.00	700.00
Water Motors (Diesel)	per Hour	500.00	200.00	1,000.00	200.00
Water Motors (Diesel)	Per Day	2,000.00	2,000.00	2,000.00	2,000.00
Leaf-Crusher Machine	Per Acre	9,250.00	6,000.00	10,000.00	10,000.00
Tsunami (Threshing machine)	Per Acre	9,571.43	7,000.00	12,000.00	10,000.00
Tsunami (Threshing machine)	Per Hour	3,682.22	2,000.00	6,000.00	3,000.00
Seeders (Manual)	Per Acre	3,500.00	3,500.00	3,500.00	3,500.00

Source: HARTI Survey Data, 2021

5.2 Necessity of Agricultural Service Providing Hubs

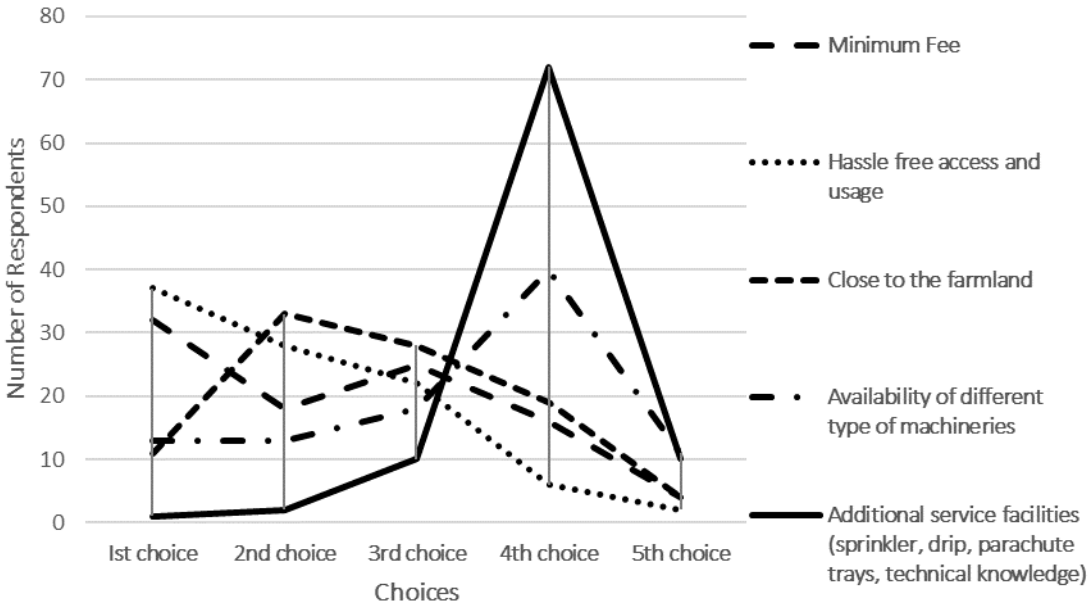
The study has made an attempt to understand whether the services that farmers obtained through the existing service providers are at a satisfactory level, or if there is a need for a new intervention. As illustrated in Figure 5.1, 64 percent of the respondents emphasized that the machinery services received are not up to the expectations. This provides some evidence that there is room for development of the facility centres (ASPHs) to fulfil this void. Nevertheless, the existing service providers' opportunities and engagements should not be challenged due to the new interventions.



Source: HARTI Survey Data, 2021

Figure 5.1: Farmer Satisfaction on Existing Machinery Services

Farmers were presented a list of features and asked to prioritize or rank them in accordance with the expectations from any service-providing centre if they happen to be established in future. Features highlighted by the farmers are displayed in Figure 5.2. Accordingly, their first priority is to be given to hassle-free access and usage of machinery, and this arose based on their present experiences. The second priority is a minimum fee, and the third priority is availability of different types of machinery in the hub to use for both upland and lowland cultivation practices. The respondents' priorities make clear that existing machinery services are not fulfilling their requirements, and this fully correlates with the answers they gave for the main issues pertaining to current machinery rental services.



Source: HARTI Survey Data, 2021

Figure 5.2: Prioritized Features to be Included in ASPHs

5.3 Existing Machinery and Its Investment

As mentioned, when developing service providing hubs to promote agricultural mechanization, the costing of each item provides a greater insight into running the centre sustainably, and as a business. Table 5.3 depicts the capital and maintenance cost associated with more commonly used agricultural machineries in Sri Lanka. Further, Table 5.4 shows the calculated running costs of machinery, including fuel and wear-and-tear costs under recommended conditions. In addition, the possible work done through their lifespan, and the space required for storage in a warehouse, is given in Table 5.5. Such information is of utmost important to design and develop ASPHs to provide mechanization support for farmland. These figures are drawn from the calculations made by Eng. G.A.M.A. Wijethunga and Eng. H.M.A.P. Herath, the mechanical engineers attached to the Farm Mechanization Research Centre (FMRC) at Mahailluppallama, Anuradhapura in 2018.

Table 5.3: Machine/Implement Capital Cost and Maintenance

Machine/Implement	Machine cost (Rs.)	Repair cost in lifetime (Rs.)	Machine lifetime (h)	Machine Depreciation (Rs/h)
4W Mould Board Plough	100,000.00	20,000.00	600	200.00
Rotovator with 4W-Drive Tractor	3,000,000.00	1,200,000.00	4000	1050.00
Seed Paddy Cleaner	180,000.00	40,000.00	2000	110.00
Power Weeder	100,000.00	10,000.00	300	366.67
Highland Inter-cultivator	40,000.00	10,000.00	300	166.67
Drum Seeder	30,000.00	5,000.00	500	70.00
Box Seeder	30,000.00	5,000.00	500	70.00
Mushroom Media Filling Machine	250,000.00	10,000.00	2000	130.00
4W Tractor Coupled Seeder OFC	400,000.00	20,000.00	500	840.00
Paddy Trans-Planter	700,000.00	150,000.00	600	1416.67
2W Axial Flow Water Pump	100,000.00	20,000.00	200	600.00
Combine Harvester (Paddy)	7,000,000.00	12,250,000.00	7000	2750.00
High-Capacity Maize Thresher (4W)	600,000.00	50,000.00	600	1083.33
Cowpea Thresher	500,000.00	40,000.00	600	900.00
Finger Millet Thresher (2W Trailer)	500,000.00	40,000.00	600	900.00
B Onion Seed Extractor	350,000.00	30,000.00	600	633.33
Groundnut Harvester (4W)	600,000.00	75,000.00	600	1125.00
Groundnut Pod Remover (4W)	900,000.00	50,000.00	600	1583.33
Groundnut Decorticator (450kg/h)	400,000.00	40,000.00	600	733.33
Pulse-Processing Machine	150,000.00	15,000.00	600	275.00
Grass Mover (4W)	200,000.00	20,000.00	600	366.67

Source: Prepared by Eng. G.A.M.A. Wijethunga and Eng. H.M.A.P. Herath (2018), FMRC

Table 5.4: Machine/Implement Running Cost

Machine/Implement	Fuel Consumption (l/h)	Fuel Cost		Other Running Costs (Rs.)	Total Cost (Rs.)
		(Rs. / l)	(Rs. / h)		
4W Mould Board Plough	8.8	111	976.8	195.36	1372.16
Rotovator with 4W-Drive Tractor	7.1	111	788.1	157.62	1995.72
Seed Paddy Cleaner	1.5	32	48	9.6	167.60
Power Weeder	0.675	125	84.375	16.875	467.92
Highland Inter-cultivator	1.5	125	187.5	37.5	391.67
Drum Seeder	0	0	0	0	70.00
Box Seeder	0	0	0	0	70.00
Mushroom Media Filling Machine	3	32	96	19.2	245.20
4W Tractor Coupled Seeder OFC	1	111	111	22.2	973.20
Paddy Trans-Planter	0.72	125	90	18	1524.67
2W Axial Flow Water Pump	1.5	111	166.5	33.3	799.80
Combine Harvester (Paddy)	8.45	111	937.95	187.59	3875.54
High-Capacity Maize Thresher (4W)	3	111	333	66.6	1482.93
Cowpea Thresher	1.5	111	166.5	33.3	1099.80
Finger Millet Thresher (2W Trailer)	1.5	111	166.5	33.3	1099.80
B Onion Seed Extractor	4	32	128	25.6	786.93
Groundnut Harvester (4W)					
Groundnut Pod Remover (4W)	1	111	111	22.2	1716.53
Groundnut Decorticator (450kg/h)	5	32	160	32	925.33
Pulse Processing Machine	2	32	64	12.8	351.80
Grass Mover (4W)	3	111	333	66.6	766.27

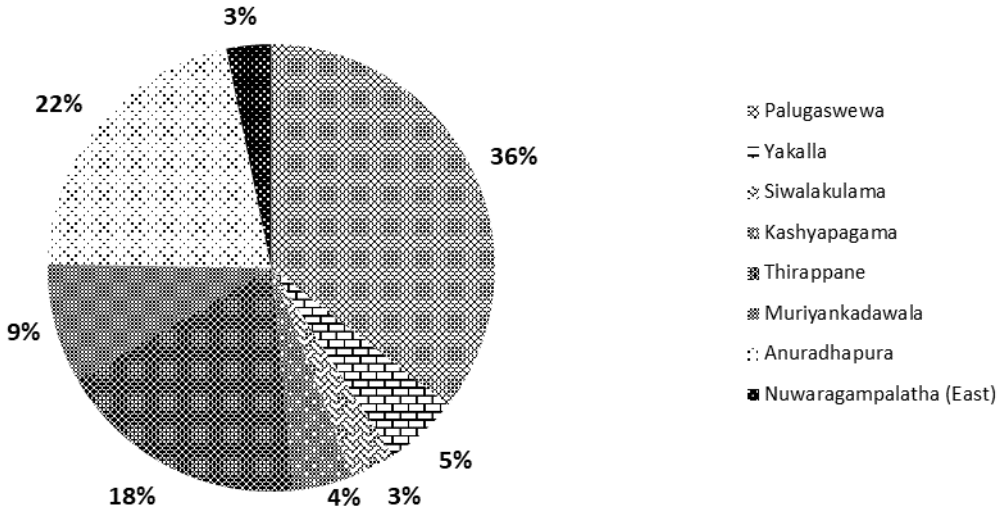
Source: Prepared by Eng. G.A.M.A. Wijethunga and Eng. H.M.A.P. Herath (2018), FMRC

Table 5.5: Machine/Implement Working Capacities and Floor Space Required

Machine/Implement	Field Capacity per Hour	Unit	Total Work Done over Lifetime	Floor Space per machine (ft x ft)
4W Mould Board Plough	0.6	Acre	360	4.5 x 3.5
Rotovator with 4W-Drive Tractor	0.5	Acre	2000	13.5 x 6.0
Seed Paddy Cleaner	120	kg	240000	5.0 x 2.5
Power Weeder	0.075	Acre	22.5	4.5 x 2.0
Highland Inter- cultivator	0.075	Acre	22.5	3.0 x 2.0
Drum Seeder	0.2	Acre	100	4.5 x 3.5
Box Seeder	0.2	Acre	100	3.0 x 3.0
Mushroom Media Filling Machine	150	Bags	300000	7.0 x 3.0
4W Tractor Coupled Seeder OFC	0.5	Acre	250	7.5 x 5.0
Paddy Trans-Planter	0.35	Acre	210	7.0 x 6.0
2W Axial Flow Water Pump	300000	liters	60000000	11.0 x 1.5
Combine Harvester (Paddy)	0.8	Acre	5600	18.0 x 8.0
High Capacity Maize Thresher (4W)	5000	kg	3000000	12.0 x 7.0
Cowpea Thresher	500	kg	300000	9.0 x 5.0
Finger Millet Thresher (2W Trailer)	350	kg	210000	11.0 x 5.0
B Onion Seed Extractor	60	kg	36000	5.5 x 4.0
Groundnut Harvester (4W)				
Groundnut Pod Remover (4W)	1	Acre	600	17.0 x 8.0
Groundnut Decorticator (450kg/h)	450	kg	270000	9.0 x 4.0
Pulse Processing machine	50	kg	30000	4.0 x 2.0
Grass Mover (4W)	1.5	Acre	900	5.5 x 3.5

Source: Prepared by Eng. G.A.M.A. Wijethunga and Eng. H.M.A.P. Herath (2018), FMRC

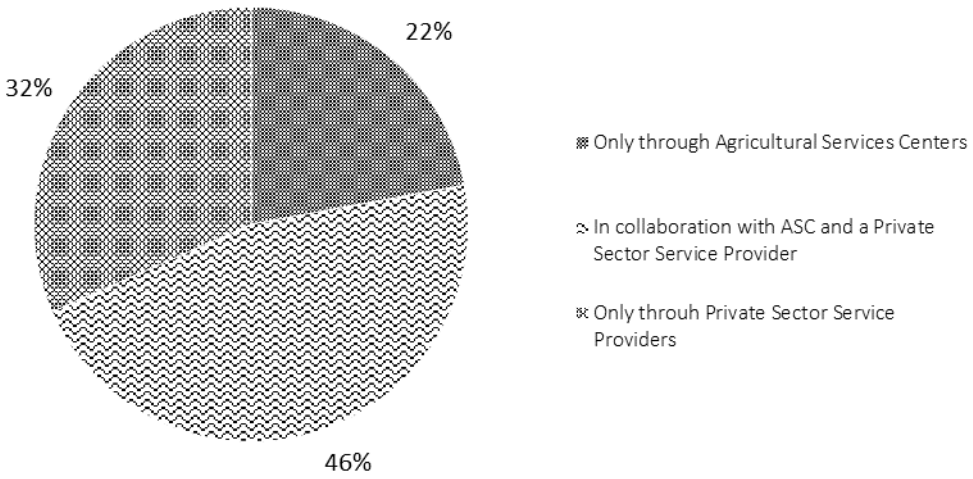
Study findings reveal that there are discrepancies in labour availability for agricultural activity among different ASCs even within the same district (Figure 5.3). As an example, Palugaswewa and Anuradhapura ASCs show a higher number of responses concerning the issues pertaining to labour. Therefore, a pilot-project initiation like an ASPH have to be introduced to those locations at the first instance. It is also important to restate that most of localities that have issues related to machinery use are minor irrigation or rainfed schemes. As many researches have already pointed out, most of the time those minor-irrigation farmers are resource-poor farmers having inherent less-investment capabilities, compared to major-irrigation farmers who have assured water sources and relatively rich infrastructure facilities (Bandara *et al*., 2021, Shantha, Ali, & Bandara, 2012).



Source: HARTI Survey Data, 2021

Figure 5.3: Labour Shortage as an Issue in Different ASCs

Willingness to maintain ASPHs at the Agrarian Service Centre itself, or through another private-service provider, was examined with respondent farmers, and the results are illustrated in Figure 5.4. About 46 percent of the respondents are happy to establish the ASPH as a public-private partnership together with the Agrarian Service Centre they belong to. This option sounds viable since there are many facilities already available in those ASCs along with the technological information to be shared. Further, an ASC is one of the unavoidable institutions familiar to many farmers for agriculture-related information and services.



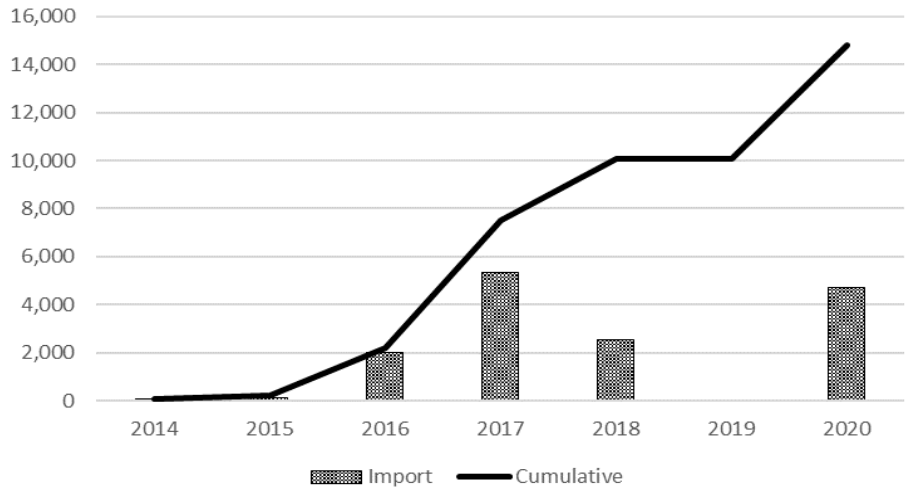
Source: HARTI Survey Data, 2021

Figure 5.4: The Model that Farmers Suggest for an ASPH

5.4 Prevalence of Agricultural Machinery in Sri Lanka

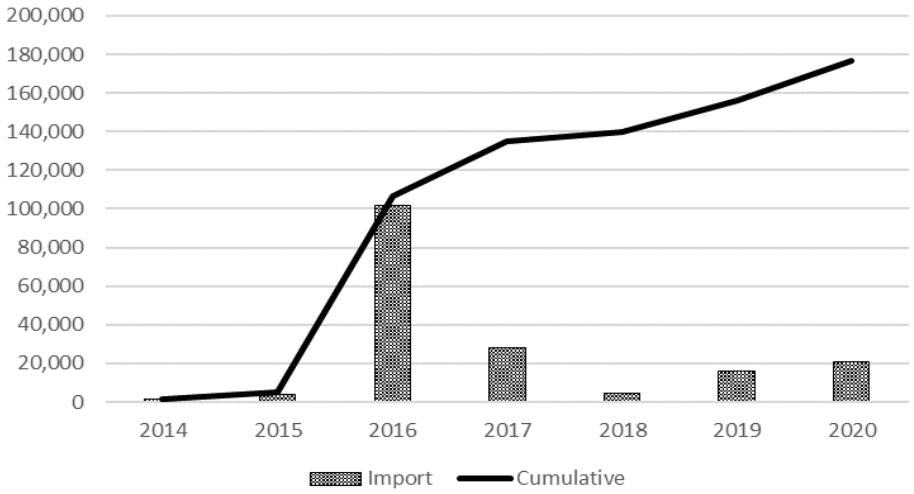
Since the agro-machinery manufacturing sector in Sri Lanka is not well developed, availability of most of the machinery within the country is ensured through imports.

Figure, 5.5 illustrates the number of seeders, planters and transplanters imported between 2014-2020 to the country from various countries, and it exhibits a significant increase from 2017.



Source: Data obtained from Sri Lanka Customs, 2021

Figure 5.5: Importation of Seeders, Planters and Transplanters in 2014-2020



Source: Data obtained from Sri Lanka Customs, 2021

Figure 5.6: Importation of Combine Harvester/Threshers in 2014-2020

Combine harvesters have made a considerable change in the paddy harvesting in the recent past by providing a sustainable solution to the prevalent labour shortage. Many of the combine harvesters are owned by private suppliers. It was very popular in large fields initially, and later became a common implement in many parts of the island for paddy harvesting. The numbers of harvesters imported during the period of 2014-2020 are illustrated in Figure 5.6.

Tractors and other implements like harrows, scarifies and cultivators, weeders and hoes are listed in Table 5.6. It also shows the number of dryers imported to the

country from 2014 to 2020, along with manure spreaders and fertilizer distributors. They are very much important implements for organic agriculture practices. Since last year, the Sri Lankan government has taken policy decision to shift from inorganic fertilizer-based agriculture to organic agriculture these types of equipment are very important for promoting organic agriculture.

Table 5.6: Tractors and Other Implements Like Harrows, Hoes, Scarifies, and etc.

Description	2014	2015	2016	2017	2018	2019	2020
Dryers	0	20812.5	43	178	1454.4	35	130
Ploughs, Harrows, Scarifiers, Cultivators, Weeders and Hoes	30220	62527.72	35393	51183.46	97663	24671	18301
Disc Harrows	1640	692	3295	199	2668	1909	281
Seeders, Planters and Transplanters	74	120	1983	5339	2560	16	4720.2
Manure Spreaders and Fertilizer Distributors	0	0	0	0	4	5	2
Combine Harvester/ Threshers	1282	3821.3	101709	28397	4385.06	16267.13	20816
Machines for Cleaning, Sorting or Grading *Eggs, Fruit or Other Agricultural Produce	1209	130	162	19	1061	72	151
Machines for Cleaning, Sorting or grading *Seed, Grain or Dried Leguminous Vegetables	51075	7940	8668	78938.54	6817.08	14535.5	7935
Tractors	4241.09	8429	6944	5087	6973	5131	6556

Source: Sri Lanka Customs, 2021

CHAPTER SIX

Strategy for Developing Agricultural Service Providing Hubs

6.1 Introduction

Agricultural mechanization embraces a comprehensive process, and consists of the use of tools, implements, and machinery for agricultural land preparation, crop production, harvesting, preparing storage for the harvest, different storage, and on-farm processing. Mechanization includes three main sources of power, such as human, animal, and mechanical. When considering an ASPH, it should involve repair, maintenance, management, and utilization of agricultural tools, inputs, implements. It also should be empowered with the ability to supply machinery and other inputs to the farmers in an efficient and effective manner.

The purpose of establishing an ASPH is to create an institutional strategy, and a market environment in which farmers and other end-users have a choice of farm power and equipment suited to their needs within a sustainable delivery and support system with minimum rental costs. An ASPH has to cater to the needs of all end-users of farm power, tools, and equipment, such as small family-operated farms, commercial farm businesses, farmer organizations, irrigation groups, contractors, government operators, and primary agricultural producers.

The supply of agricultural machinery in the country through state intervention has been widely criticized for its often ineffectiveness, being blamed for corruption and other adverse social and bureaucratic influences. This is largely an outcome of the experience of the country providing a large number of tractors from 1960s to early 1980s, as gifts from donors or on concessionary loan terms. In particular, projects designed to provide tractor services through government agencies have a negative record. These projects have proven to be unsustainable due to the inherent inefficiencies of businesses run by the government. However, there are many successful examples of mechanization that contribute to the improvement of food production, productivity and the rural economy.

6.2 Farm Productivity Enhancement through Mechanization

In many agricultural systems, agricultural production and food security are adversely affected because of insufficient use of farm power, low labour productivity, or labour scarcity and other low inputs. Finding solutions to environmental problems associated with agriculture requires improved agricultural tools and machinery, including tools for soil tillage and chemical application. Similarly, machines are required to assist with postharvest loss reduction and on-farm processing.

To avoid a recurrence of past drawbacks, such as those described in the above sections, efficient machinery providing systems/strategies are required. In fact, an

ASPH ought to be a part of an agricultural-technology strategy, within an overall agricultural-development strategy. In this context, three key achievements needing to be fulfilled through this ASPH strategy may be summarized as follows:

Labour productivity enhancement through replacing labour with machinery and releasing free labour to be employed in other higher productivity sectors. Further this will facilitate the expansion of the workload while releasing additional labour to other sectors within the locality or outside with higher returns. Simultaneously land productivity could also increase by using proper machinery to cultivate more land or expand the capacities of the service areas; for example, introducing micro-irrigation facilities coupled with solar powered pumps could enhance water productivity as well as land productivity. The important facts of introducing mechanization in rural farmlands are to reduce the costs of production. This will create an opportunity to increase the efficiency of the inputs used, while minimizing the losses during harvesting and storage.

As discussed above, benefits could create synergistic effects to users, and since they are subjective benefits, it is difficult to translate them into the financial terms. The additional benefits that are gained through machinery use are reduction in the drudgery of farm work, greater leisure, or reduction of risk, and so on.

6.3 Broad Guidelines to Selecting Localities to Initiate ASPH

Broad guidelines for the formulation of an agricultural technology strategy may be summarized as follows:

- Where the located land is abundant, but labour is a limiting production factor, an ASPH can increase production per worker, and the area under cultivation.
- Where the labour is limited, and machinery is not available to cater to demand during peak cultivation times, ASPH could be successfully implemented in such places.
- In most areas of the country, the rising cost of cultivation has led to the realization that one of the best methods to deal with this is the mechanization of farm operations, as mechanical solutions are more efficient and cost-effective than human labour-based activities in most cases. However, given the preponderance of small farms in minor-irrigation agriculture, it is neither practical nor viable for small farmers to own and operate agricultural machinery and equipment. As a result, they only require access to machinery rather than ownership. This could result in a new phenomenon of cooperatives, private entrepreneurs, organized sector actors, and even producer businesses providing specialized rental services of farm machinery and equipment (ASPH) in many parts of the country where such situations exist.

- Where the cost of traditional power sources such as human labour and draft animals has become high, an ASPH is a better solution to reduce the costs of agricultural production.
- Further, with the impact of climate change, there is a tendency to increases in high-temperature days during a season. This might reduce working conditions in a field even where there is plenty of labour available. In such instances, an ASPH can easily provide services to minimize the time spent in such activity in the field.

The cost of most of agriculture machinery is comparatively high even excluding import tariffs. For most resource-poor smallholder farmers, it is hard to purchase a machine on their own to use for agriculture activity. In many parts of the country, farmers cultivate only a small piece of land, and the net profit from a small plot of land only covers their cost of living, which sometimes may not be enough. In such areas, the ASPH concept could make positive changes in people's livelihoods through increased land productivity, decreased cost of cultivation and net income.

6.4 Proceeding with an ASPH Strategy

When formulating an ASPH strategy, the first step to be carried out is a review of the agriculture sector in a given locality, and the demand and supply of farm power. Typical farming/cropping systems, farm-power supply and demand profiles need to be examined and understood. Collection of farmland data, retail and farmgate prices, costs of inputs (in particular of labour, draft animals, and existing rental rates for mechanical-power technology) and their projection into the future, is crucial to assess the viability of different types/levels of mechanization technology. This has to be further analysed with regard to short-term, medium-term and long-term demand, and supply by the machinery industry, in different scenarios.

Initial field data collection is crucial to identify technical and financial constraints, and policy issues, that impinge on farm mechanization, to diagnose problems specific to the areas, and bottlenecks, so as to take comprehensive action when implementing an ASPH that addresses these problems and constraints. In addition, key informant discussions and informal discussions would lead to obtaining reliable and relevant information that might not be gathered through formal approaches. Multidisciplinary expertise knowledge is a must to develop these ASPH protocols, and the team should at least usually consist of a farm management/agricultural economist, an agricultural-mechanization engineer, an agronomist and a business analyst. Further, this team must consult a diverse group of persons, and in particular farmers and private entrepreneurs, because, they have a better understanding of farmer needs and beliefs, that can affect the success of this intervention.

6.5 Outline of an ASPH Strategy

In an ASPH, three key groups participate in the process of implementing the ASPH for its success. Namely,

1. The Demand-Side Actors: this is the end user (usually the farmer), who is concerned about getting the needed farm power on a timely basis, without hassle and at the lowest possible cost. In principle, the end-user's requirements and concerns have to be met satisfactorily by this ASPH.
2. The Supply-Side Actors: this involves contractors (entrepreneurs), importers, distributors, dealers, local manufactures and repair services. All these actors are conducting a business of providing goods and services to make a profit. In previous attempts, governments had taken over the role of supplier rather than analysing why the suppliers were not attractive to the market and what ways and means there are to entice suppliers to the market by creating favourable policy environment.
3. The Government: In its broadest sense, the government must be involved in the process only as a facilitator, to eliminate market failure and to ensure that supply meets demand in an efficient and satisfactory manner. For this purpose, the government can provide institutional support (for example, extension, training, and credit) and incentives. It can stimulate hub concepts by implementing a favourable policy environment, for example, related to import duties, taxes, subsidies, financing terms and conditions, and so forth.

The ASPH concept will not proceed in a sustainable manner if any one of these actors do not completely fulfil their roles and responsibilities.

There is overwhelming evidence that an efficient mechanization system could be more successful through private ownership. The record of government-run machinery rental services is very poor, with much evidence within the country where a number of attempts have failed to serve its primary objectives. Government-run machinery rental services are often subsidized directly or indirectly by the taxpayer, this might happen to be preventing the emergence and sustenance of lucrative private-sector contract businesses.

Private entrepreneurs are best suited to provide mechanical technology to small farmers/subsistence farmers. The business of existing machinery service providers should not be hindered when introducing such innovations and the arrangements should be made to keep them going.

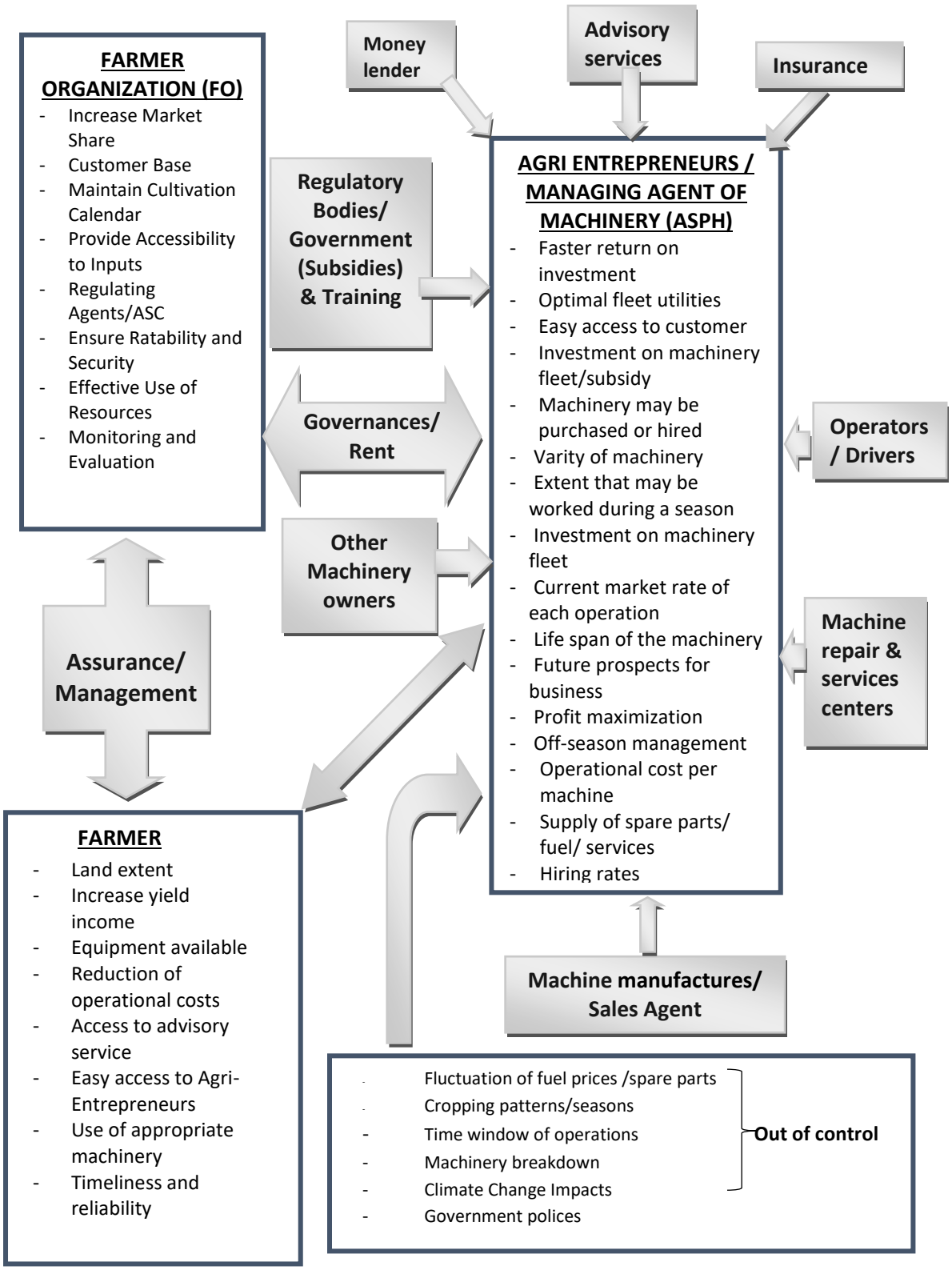
6.6 ASPH Model Frameworks

ASPH Operated through a Private Mode

The model shown in Chart 6.1 is a private ASPH model. In this model, three main actors are proposed. Entrepreneur (persons or a team who will establish the ASPH), Farmers (end user) and Farmer Organization (monitoring, evaluation and regulation in partnership with Department of Agrarian Development officials) are the main three actors actively involved in this framework.

Entrepreneurs provide the environment to deliver required machinery at a reasonable price and could enhance the increased availability of suitable machinery to fulfil the required work, as well as replace a lack of human labour. In this model, machinery is owned by the private entrepreneur. An ASPH has to maintain machinery in a ready-to-work mode by obtaining the services of the maintenance and repair agents.

Chart 6.1: ASPH Private Model Framework



The required machinery, and the number of replications of such machinery, other tasks that should performed by the ASPH actors, should be identified. An inventory has to be made available for other suppliers providing services nearby. In this way

they would have a better understanding by updating information on other service providers where necessary.

An off-season management plan has to be developed to engage machinery during the period where there is no cultivation activity, so as to make use of machinery to earn something, to compensate for the running of the centre, by balancing overhead costs.

In addition, these hubs could facilitate total solutions from the beginning to the end of the crop production cycle until it achieves a marketable product. Examples of providing services to encompass all activity in the paddy production cycle until it reaches the market by providing total service package may involve: parachute trays including two weeks old seedlings, and providing services of labourers skilled in parachuting, facilitating chemical applicators with chemicals and sprayers, advisory services, and finally facilitating harvesting and drying facilities.

Farmers are the end users of the ASPH services. The services will depend on land availability and the crops to be cultivated. Upland crops and lowland crops renting/hiring charges are different because the effort and the workload have slight variations due to the differences in conditions of the soil structures of two types of lands. Farmers' expectations are to reduce the operation costs while increasing the yield income. Other than this, they depend on convenience, timeliness and reliable services from the supplier/s. Some of the respondent farmers, as elaborated in the Chapter Four, stated that having credit facilities at the centres would be a great relief to them in getting other inputs without any additional hassle and they do not wish to go after informal credit lines.

A farmer organization (FO) is the governing body in collaboration with the Department of Agrarian Development. The main customer base will be managed by the FO while being the authorized body to design the cultivation calendar in line with seasonal water availability. In this model, the FO is proposed as the monitoring and evaluation body for the ASPH. The FO decides the rent/hire charges for each machine and the services in agreement with ASPH management. Department of Agrarian Development agents oversee the issues that arise and are not directly involved in the decision-making processes associated with the ASPH model. Again, the FO can also link farmer production to the market with the help of the ASPH. There is room for small profit sharing with the ASPH to strengthen the FO fund, as it is necessary to keep the both institutions alive with mutual benefits for their operations. In this way, an FO is bound to work with the ASPH, and the success in providing good services to the farming community belongs to the FO.

This model of ASPH is run by private entrepreneur or a team of people for the betterment of the farming community at the location where it is established. An FO is only a regulatory agent but does not earn a profit other than a small profit share to maintain links with the ASPH.

There are some factors that cannot be controlled or manipulated by each party who engage in the ASPH processes. Fluctuations of fuel and spare-parts prices, the time window of the cultivation and operations, the impacts of climate change, and changes in government policies, and so on can be recognized as such factors. Machinery breakdowns and cropping patterns also can be categorized under realities beyond the control of the ASPH, but it can be managed at certain levels by ensuring regular maintenance, and close coordination with the FOs.

ASPH Operated through a Public-Private Partnership Mode[1]

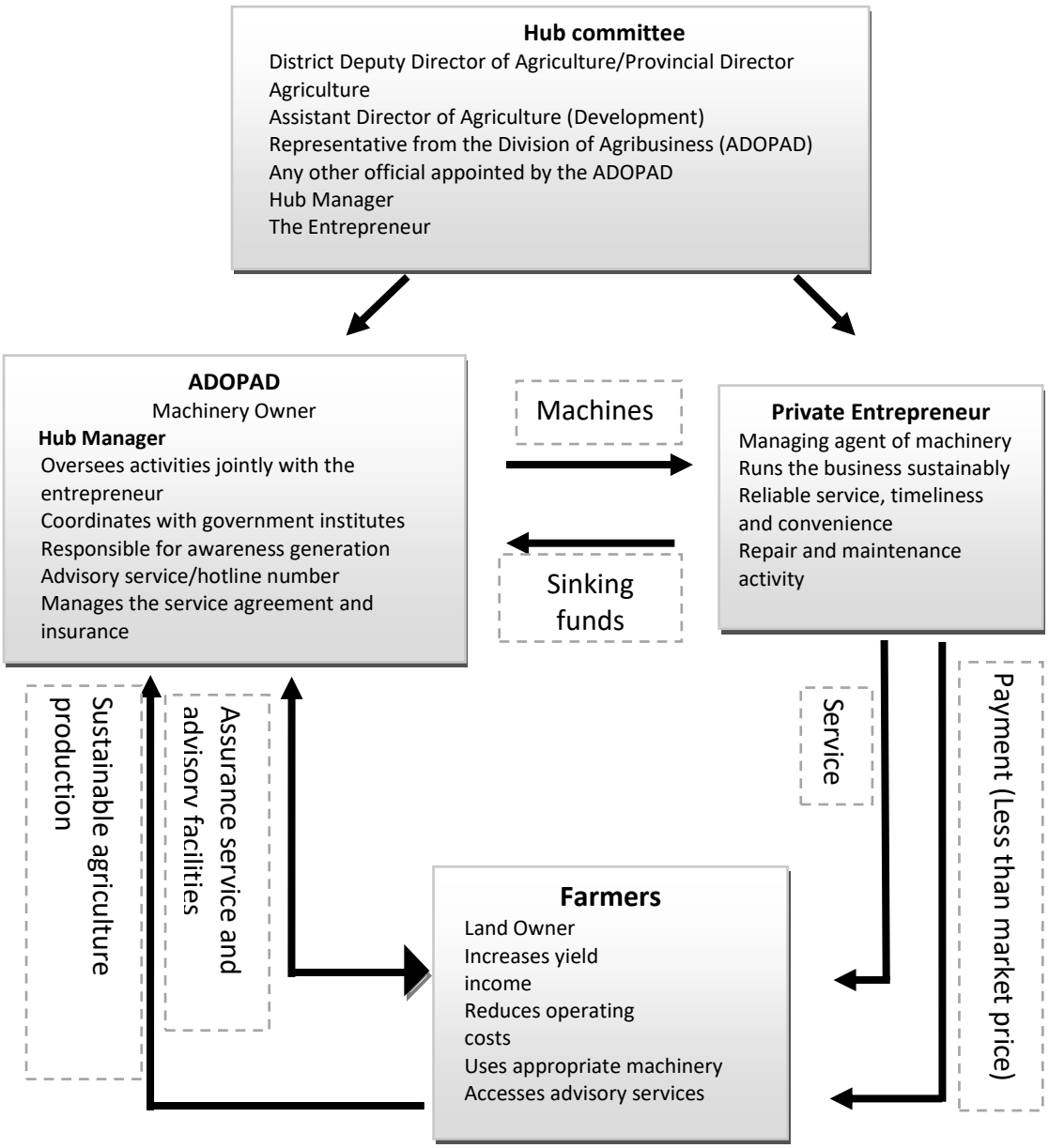
This model is planned to operate through a Public-Private Partnership (PPP) mode. The machinery may be obtained through a donor agency or by the government under a subsidy programme. The Department of Agriculture (DOA) or Provincial Department of Agriculture (PDA) would provide the premises, and own the equipment provided through this model. Hereafter, both the departments will be listed here as ADOPAD (Agriculture Department or Provincial Agriculture Department). ADOPAD will appoint, among its staff, a Hub Manager who will liaise with the ADOPAD and the farming community. The private entrepreneur, selected by the ADOPAD, will run the day-to-day affairs of the Centre as a business entity. In addition to serving as a service provider of agriculture equipment, the hub will also act as a technology dissemination centre, selling publications and displaying videos. The hub will provide the service within the division/district.

Manager of the Hub

Qualifications of the Hub Manager: Senior Agriculture Instructor/Graduate of the ADOPAD. The salary of the hub manager will be decided by the ADOPAD. In addition to salary and other allowances, the hub manager will receive incentives if targets are exceeded (This should be on par with the administrative and financial regulations of the country).

[1] This public-private partnership model was initially designed at the international workshop on Set-up and Operate Mechanization Hire Services Models and Agri-Business Hubs collaboratively organized by the Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI), Food and Agriculture Organization of the United Nations (UNFAO), and Rice Research and Development Institute (RRDI) held on 27 and 28 June 2019 at the Rice Research and Development Institute, Batalagoda, Sri Lanka. The authors coordinated this particular workshop under the activities of the project on *Building the Basis for Implementing the Save and Grow Approach: Regional Strategies on Sustainable and Climate-Resilient Intensification of Cropping Systems,* funded by the UNFAO.

Chart 6.2: ASPH through Public-Private Partnership Mode



TOR for Hub Managers

- Owns the machinery and other equipment on behalf of the ADOPAD while maintaining an inventory.
- Manages the centre by overseeing activity jointly with the entrepreneur
- Holds responsibility of coordination with government institutes
- Responsible for awareness generation
- Maintains advisory service/hotline number
- Links farmer products with suitable markets
- Manages the service agreement and insurance
- Undertakes and delivers machinery hiring requests to the entrepreneur, while preparing a schedule and maintaining a registry
- Links with institutes/private service providers

Selection of Entrepreneur/Entrepreneurs

The entrepreneur is selected through a formal interview and selection process. The members of the selection committee and selection criteria will be selected by the ADOPAD.

Operation of the Hub

An entrepreneur must be selected to operate the hub. The number of entrepreneurs for a hub is decided by the following Committee:

A Committee for Monitoring the Hub (Hub Committee)

- District Deputy Director of Agriculture/Provincial Director of Agriculture
- Assistant Director of Agriculture (Development)
- Representative from the Division of Agribusiness (ADOPAD)
- Any other Official appointed by the ADOPAD
- Hub Manager
- The Entrepreneur

This committee will have the following responsibilities.

- Decide rates for hiring equipment.
- Maintain a revolving fund.
- Random monitoring of hub activity
- Resolving major issues in the operation of the hub.

The Committee will use novel technology (GPS-enabled machinery) to monitor the operation of the hub.

Additional Suggestions for the Operations of the Hubs

Agreements

Since the ADOPAD owns the premises and equipment, the Entrepreneur shall sign an agreement for the business. It is suggested this agreement would initially cover a period of 2 years with a possible extension up to 5 years. The extension of the agreement up to 5 years shall be decided by an evaluation conducted every 2 years.

Recovery of Investment

The initial fund shall be provided by a donor agency or by the government under a subsidy programme. It is proposed that a revolving fund be set up. Ten percent of the income generated through services, and five percent of profits from the materials sold, should go to the revolving fund. Any investments made shall be recovered from the revolving fund. The maintenance cost for machineries shall also be borne by the fund.

The Committee in consultation with the Hub Manager and Entrepreneur shall decide rates and the schedule of payments. It is proposed that payments should preferably be made soon after the service is provided by the hub.

Sustainability of Hubs

The sustainability of the hub shall depend on the money generated by providing services against the investments made. Therefore, it is mandatory to carry out an economic analysis before setting up the hub. This analysis should take into account, the number of farmers to be served, the extent of lands to be covered, etc. The preparation of a sustainability plan (e.g., meeting operational costs, replacement costs due to depreciation of equipment, etc.) should be based on:

- The targets
- Mutual Understanding
- Making Agreements,
- Making Insurance compulsory
- Monitoring and continuous evaluation

Committees for the Establishment and Operation of Hubs

Based on the previous experiences, the importance of monitoring the establishment and operation of proposed hubs should be at the highest priority. It is to be noted that these committees would not interfere with the day-to-day running of the business of the hub. However, the committees will ensure that the services expected from the hubs by the funders and implementers are carried out through this mechanism.

Activities of the Proposed Project

The details of activities with respect to the implementing organizations of proposed hubs to achieve the objectives of the project are given in Table 6.1. The lead organization shall take the overall responsibility to initiate and implement the identified activity with the implementing partners.

Table 6.1: Activities and Respective Responsible Institutes/Partners

Activity	Description	Implementing Partners	Lead Organization
ACTIVITY 1.1:	Identify suitable private entrepreneurs, and work out the modalities of engagement	The Appointed Hub Committee	ADOPAD
ACTIVITY 1.2:	Identify the most suitable crop systems	Centre Manager	ADOPAD
ACTIVITY 1.3:	Identify local Agro-Dealers, Buyers, and develops a Business Model	Hub Committee, ADOPAD, Private Sector	ADOPAD
ACTIVITY 1.4:	Develops Modalities to engage with Mechanization Service Providers	FMRC, FMTC, Suppliers, IPHT, Extension, Farm Leaders	ADOPAD
ACTIVITY 1.5:	Organizes the members of the Hub, the Extension Advisors, the Agro-Dealers and the Service Providers around the business model developed from Crop Production (Agronomic and Market-related Information) to Post-Harvest (organization of transportation from farmers' fields to Hub for Bulking, and Facilities and Competencies for Grading, Sorting, Storing). This also includes: Informing the ADOPAD of the items and quantities to be procured for implementation of the Crop Systems by Members. Informing Extension Advisors of the needs of the Members, organizing with Service Providers with regard to timely planting operations and transportation from farmers' fields to the hub for bulking; and organizing the collection of the produce from the hub with the buyers	Hub Committee FMRC, FMTC, Extension, Hub committee	ADOPAD ADOPAD

6.7 Policy Implications

The challenges and prospects of popularizing agricultural mechanization as a necessary input is highlighted and discussed in previous chapters. Creating an enabling environment for mechanization, using precision farming, reductions of operating cost and analysing investment prospects are only a few of these requirements. Several priority action areas for the promotion of sustainable agricultural mechanization, have been discussed. This includes: Improved private-public sector collaborations; increased access to mechanization services for a variety

of end-user groups; institutional capacity building; fiscal strategies and policy environment; and services required to encourage mechanization investment. While the commercial sector should be promoted and supported, small-scale farmers should be encouraged to become more commercial. Training and capacity building are critical development instruments. Agricultural Service Provider Centres should be established in agricultural service areas to provide complete solutions under an umbrella location, providing all services for agricultural production.

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