



2nd Regional Forum on Sustainable Agricultural Mechanization in Asia and the Pacific

- Enabling Environment for Custom Hiring of Agricultural Machinery

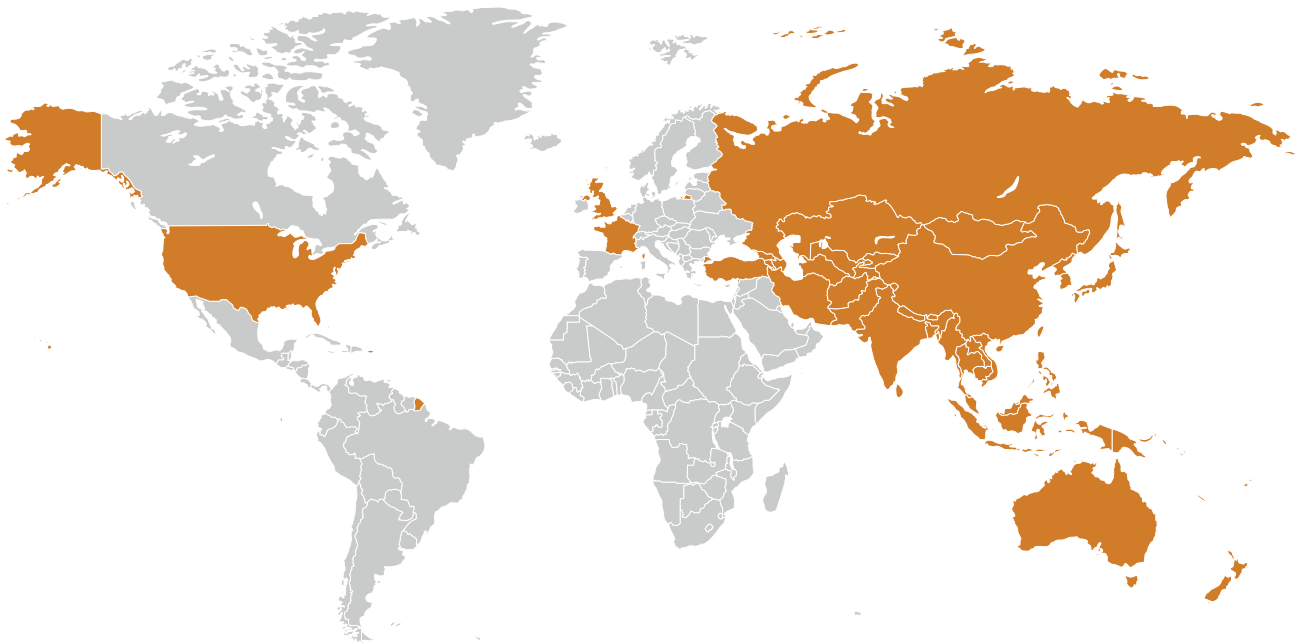
9-11 September 2014
Serpong, Indonesia



CSAM



The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) is the regional development arm of the United Nations for the Asia-Pacific region. Made up of 53 Member States and 9 Associate Members, with a geographical scope that stretches from Turkey in the west to the Pacific island nation of Kiribati in the east, and from the Russian Federation in the North to New Zealand in the South, the region is home of 4.3 billion people, or two thirds of the world's population.



The darker area of the map represents the members and associate members of ESCAP

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A man in a light-colored long-sleeved shirt and dark pants is operating a blue tractor in a field. The scene is set during sunset, with a warm, golden glow over the landscape. The tractor is a small, walk-behind model with a blue body and a single front wheel. The man is sitting on the tractor, looking forward. The background shows a field of tall grass or crops, with some buildings and hills visible in the distance under a hazy sky.

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Photoed by Zhou Kaiqiang

Acknowledgement

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Special thanks go to Camilla Stelitano and Feng Yuee for summarizing the country reports and compiling the proceedings. We are also grateful to Zhang Zhijuan for her lay-out and design.

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Executive Summary

The Regional Forum on Sustainable Agricultural Mechanization is designed to be an annual flagship event of the Centre for Sustainable Agricultural Mechanization (CSAM) in line with its renewed mandate and strategic functions. Building upon the success of the 1st Regional Forum, held in October 2013 in Qingdao, China, the 2nd Regional Forum on Sustainable Agricultural Mechanization in Asia and the Pacific was held on 9-11 September 2014 in Serpong, Indonesia, in collaboration with Indonesian Agency for Agricultural Research and Development (IAARD) of Ministry of Agriculture of Indonesia and the Regional Office for Asia and the Pacific of the Food and Agriculture Organization of the United Nations (FAO-RAP), and with the funding of the China-ESCAP Cooperation Program.

The theme of the 2nd Regional Forum was “Enabling Environment for Custom Hiring of Agricultural Machinery”. Small land holding and diversified social-economic realities are the two distinct features of the farmers in most parts of Asia and the Pacific. Custom hiring, as well as other modalities and practices of sharing farm machines, is increasingly seen as one of the most cost-effective approaches to enabling farmers, particularly small-holders, to benefit from agricultural mechanization and other adaptable technologies. Member countries in the region have started to apply context-specific forms of custom hiring for decades, with mixed degrees of success. A large body of experiences and lessons has been accumulated, both at the policy and grass-root levels. As many governments are including custom hiring as a major component in their national strategies to promote agricultural

mechanization, there is a need for in-depth knowledge and information sharing and policy dialogue to synthesize best practices and better inform their decision-making.

As a first meeting convened by a United Nations (UN) agency on this topic in many years, the Forum attracted the attendance of over 50 participants from 15 countries and 4 international organizations and NGOs. Country representatives from Bangladesh, Cambodia, China, India, Indonesia, Iran, Lao, Malaysia, Mongolia, Nepal, Pakistan, Sri Lanka, Thailand, the Philippines and Vietnam, briefed of the supporting policies and featured practices of custom hiring in their respective countries, and put forward suggestions and potential actions for encouraging and extending the practice across the region. Five service providers of custom hiring from Bangladesh, China, India, Indonesia and Sri Lanka shared their cases and stories, cited factors of constraints and challenges faced in their operations, and called for a more enabling environment for this value-added business. Colleagues from regional and international organizations shared their ongoing initiatives and insights on nurturing sound development of custom hiring of agricultural machinery.

The Proceedings synthesizes the country papers of member countries and presentations of peer organizations, and proposes recommendations and way forward for creating an enabling environment for custom hiring of agricultural machinery in member countries in support of sustainable agriculture, food security and poverty alleviation in the region.





Welcome Remarks

Dr. Agung Hendriadi
 Secretary General
 Indonesian Agency for Agricultural Research and
 Development (IAARD)
 Ministry of Agriculture of Indonesia



Assalamu'alaikum Warahmatullahi Wabarakatuh

It is my great pleasure to welcome all of you to the Second Regional Forum of Sustainable Agricultural Mechanization. On this special opportunity, I would like to express my gratitude to the officers of ESCAP, FAO and the officers of CSAM in China for their constant support to the organization of the Second Regional Forum of Sustainable Agricultural Mechanization. This year we will focus on “Custom Hiring of Agricultural Machinery: Policies and Practices in Asia-Pacific member countries”. As one of APCAEM former General Council members, I greatly support all efforts taken to promote the implementation of agricultural mechanization in this region.

The topic of the second regional forum of CSAM is very relevant to the Indonesian agricultural mechanization developmental policies. Our government has extensively supported agricultural development, and strongly pursued its developmental targets. Specifically, great emphasis has been given to the achievement of subsistence in food production. In 2013, Indonesia has produced 71.8 million ton of dried paddy, with a surplus of more than 5% of the average Indonesian rice consumption. This was the highest rice production since 1984, when Indonesia first achieved self-sufficiency in rice production. Beside irrigation, seed, fertilizer and pest control,

the role of agricultural machinery in national rice production is significant, which contributed about 10-15%.

Even if, the use of agricultural machinery has increased productivity, working efficiency and quality and reduced costs of production, the adoption of agricultural machinery on-farm in Asia-Pacific countries especially in ASEAN region is still low.

Realizing the very important role of agricultural machinery, the Indonesian government formulated and implemented several programs to promote the development of agricultural mechanization. The programs include facilitation of agricultural machinery procurement, developing demo areas, developing and improving rental and leasing system of agricultural machineries, capacity building on research and development, and reformation of regulations. Facilitation of agricultural machinery procurement is carried out by providing financial credit from government banks and providing assistance for purchasing of agricultural machineries.

During the past 10 years, the MOA (Minister of Agriculture) has implemented a policy on custom hiring of agricultural machinery, known as Institution for Rental Services of Agricultural Machineries (IRSAM or UPJA in Bahasa), which

can be operated by farmer's group or private sector. Today, more than 12, 000 UPJA have been operated to support rice production. The government of Indonesia has also allocated credit and grant for agricultural machinery to UPJAs. In 2011, UPJAs operated 179, 000 hand tractors, 206, 000 water pumps, 72, 500 power threshers and 3, 500 unit of dryer. However, more than 80% of UPJAs are still under-utilized.

Indonesia has large and diverse agro ecological zones, which require specific agricultural machinery. The IAARD has designated, developed and disseminated various agricultural machines for specific Indonesian conditions. Also, IAARD has strengthened research capability through capacity building of researcher, engineer and technician, and restructured research

facilities and collaboration with research institutes and universities. Besides, to optimize agricultural mechanization development, the MOA has conducted some efforts related to testing, patent and intellectual property right, mass production and marketing of agricultural machineries.

In this special occasion, I would like to deliver my appreciation to the delegates of CSAM's members' states, and invite them to share their experiences on practices of custom hiring.

Last but not least, I also would like to welcome your active participation in 2nd Regional Forum of CSAM. I believe that your participation would address and produce innovative solutions on those issues.

Opening Remarks

Mr. Marc Proksch

Chief

Business and Development Section

Trade and Investment Division

ESCAP



I am pleased to be here, today, to attend and address the 2nd Regional Forum of Sustainable Agricultural Mechanization in Asia and the Pacific. Inaugurated only in last year, this annual regional forum is intended to share knowledge, and provide recommendations on good practices for sustainable agricultural mechanization.

The focus of this year’s forum is on Custom Hiring of Agricultural Machinery is timely. As agricultural markets are becoming increasingly globalized, and competition is increasing, farmers across the world are trying ways to increase productivity and profits by increasing yields, moving to higher-value products, and / or keeping down costs. Just like other actors in the private sector, they are also trying to find ways to tie less money into capital assets, such as machinery, while also getting more hours out of capital invested by finding ways to increase the number of hours of usage of the equipments over the year.

Custom hiring, of course, fits into this picture. Modern agricultural equipment can help provide dramatic increases in yield. However, it is generally very expensive, especially for small farmers in our region. Given the high costs involved, it is often not economical for small farmers to own and operate such equipments, leaving them to choose between continually

dependence on more labor-intensive working methods, swapping services with others, hiring equipments, or simply moving out of farming, which is of course easier said than done as farming is often passed on from one generation to another.

Custom hiring addresses this dilemma as it enables farmers to rent farming equipments, such as tractors, tillage equipment, and combined harvesters and so on from custom hiring centres instead of owning it. Often, the operator of the equipment would also be included in the rental price. The services would be charged by the hour, or in some cases, by the acre harvested, and the owners of the equipments would be responsible for maintenance and major repairs, with farmers only potentially responsible for minor repairs related to their usage of the machinery.

The advantages of custom hiring is thus that it enables farmers to rent the appropriate equipment, often along with someone to operate it, for a defined period of time only, thus only paying for the services of the machine without having to own it. This would make cost estimates more predictable by reducing risks for unexpected costs of e.g. repairs. It also means that the cost of the machinery can come from operating capital, as there is no long-term investment involved. Finally, it increases

the chances that machinery is modern and in good operating condition requiring fewer stops due to breakdown.

The potential downside is that – due to competing demands (as harvests normally happen at the same time in one place) – the machinery and its operator may not be available at the exact time that farmer would like it, with potentially reduced harvests as a result. The farmer would also not have full control over the job performed.

Due to these reasons, custom hiring would generally be more popular among small farms, whereas large farms often prefer to own their equipment. This has also been shown for example in a study of Custom Hiring services in the Punjab¹.

Given the impact on yield, custom hiring can increase agricultural productivity, and this increase the income of small farmers, while at the same time improving food security. While it can be arranged jointly by farmers through farmers' cooperatives, or by private companies, in some countries public authorities have stepped in to facilitate the establishment of custom hiring centres. For example, the Indian Ministry of Agriculture in its 12th Five Year Plan (2012-17) proposed a dedicated "Sub-Mission on Agricultural Mechanization", which includes custom hiring facilities for agricultural machinery as one of its major components². This raises the issue of financing, subsidies and competition. As for any private sector

intervention, in the case of Government subsidization of such services, care need to balance the needs of farmers to access equipment with the need not to unduly undermine existing cooperative arrangements or existing private operators already providing such services.

The purpose of the discussion in this meeting is to learn how custom hiring is organized and financed in the countries present in this meeting, what are the lessons learned, and what role can and should public authorities play facilitating increased availability of agricultural machinery to farmers through custom hiring. We're looking forward to hearing all the experiences from the countries present at this meeting, and in particular the lessons learned. The recommendations from this meeting will feed into the future work of ESCAP's Centre for Sustainable Agricultural Mechanization (CSAM), including its work on sustainable agricultural mechanization strategies conducted in collaboration with FAO.

Finally, on behalf of ESCAP, I'd like to express our appreciation to the partners in the organization of this Forum, namely FAO, as well as the Indonesian Agency for Agricultural Research and Development (IAARD) of the Ministry of Agriculture of Indonesia, for their excellent collaboration and our sponsors, the Ministry of Agriculture of Indonesia, and the ministries of Agriculture and Foreign Affairs of the Government of China.

¹ "Custom Hiring Services of Farm Machinery in Punjab: Impact and Policies", by Singh, Kingra and Singeet (May 2013), found that it is better for small farms to hire tractor services than to have their own tractor. Among its surveyed 120 farms in four villages, about 40% of the served farms owned a tractor, whereas all farms used one. All farms above 10 ha owned their own tractors, whereas among those with less than 1 ha all did custom-hiring of tractors. The productivity was higher on tractor-owning farms than on those that do custom-hire. See: <http://www.seea.org.in/vol13-2-2013/09.pdf>

² The Economic Times of India, "Agriculture Ministry proposes custom hiring of farm machinery in 12th plan", 4 February 2013. http://articles.economictimes.indiatimes.com/2013-02-04/news/36742786_1_farm-machinery-farm-mechanisation-equipments

Opening Remarks

Mr. Li Hong

Permanent Representative of China to ESCAP
Permanent Mission of the People's Republic of
China to the ESCAP

I am very glad to attend the 2nd Regional Forum on Sustainable Agricultural Mechanization in the beautiful island city of Serpong. I'd like to thank CSAM and its partners for their considerate arrangement and kind hospitality.

The three-day Regional Forum provides us with a unique platform for discussing the important issues with regard to agricultural machinery and bio-energy. They are closely linked to the bigger issues like food security, poverty elimination and the inclusive development in our region. I am quite impressed that the forum achieves an extensive engagement with many stakeholders including both public and private sectors. Such broad involvement of participation would greatly expand the attention and bring joint efforts for our region to the challenging issues in relation to agriculture. We have already had a productive review on Agricultural and Bio-System Engineering this morning. The good start paved the way for our further discussion on a more concrete issue of Agricultural Machinery.

Dear friends,

Agricultural Machinery is the prerequisite and basis for agricultural modernization. It could reduce the labour intensity and raise the productivity of agriculture. It is vital to improving the quality of life of farmers, and reducing the vulnerability of agriculture. CSAM, as a unique institute for

Agricultural Machinery, is providing a platform for regional policy coordination, for exchange of good practices, for knowledge sharing and technology transfer. We are happy to see that, under the leadership of Mr. Zhao Bing, CSAM is actively working with a variety of international institutions like FAO and others to promote the objective of agriculture modernization, and sustainable agriculture and food security at large. This time, CSAM and its partners are choosing a very specific issue with general characteristics, the custom hiring of agricultural machinery, as a theme for this forum. The strategy of addressing a complicated issue by starting from a concrete point is an appropriate and practical approach.

The latest 70th Commission session of UNESCAP adopted a resolution titled "Promoting sustainable agricultural development in Asia and the Pacific through technology transfer". The resolution was proposed by China and co-sponsored by Indonesia, Cambodia and other member states of ESCAP. It calls upon member states to make greater efforts to introduce, adapt, develop and disseminate sustainable agricultural technologies, including technology for Agricultural Machinery. It requests the ESCAP secretariat and its subsidiaries to continue to support and assist member states for capacity building and knowledge sharing. It is my conviction that the productive discussion of this forum would contribute to the effective and full implementation of the above mentioned resolution.

Dear colleagues,

As a developing country with the biggest population in the world, China attaches great attention on agriculture, countryside and peasants. China has managed to feed nearly 21% of the world's population with less than 9% of the world's farmland and achieved the MDG on poverty alleviation ahead of schedule. Although the achievement is great, China still faces daunting challenges in agriculture. We hold the view that the integration of urban and rural area development is the way for addressing the challenges with regard to the agriculture, countryside and peasants. We strongly believe that, the Mechanization is the must-route to agricultural modernization. China has set up a series of laws and regulations for advancing the agricultural Machinery, such as the Law on the Popularization of Agricultural Technology

and the law on Agricultural Mechanization Promotion. China has been implementing a Construction Plan for Agricultural Machinery 2010-2015. Chinese achievements and experience in this field could contribute a lot for the regional agricultural sustainable development and agricultural Machinery. We have a big Chinese delegation at the forum. I am confident that our Chinese experts would have a lot to share with our regional colleagues. We would also learn from our regional partners with open minds.

On behalf of our Chinese colleagues here, I'd like to assure you all of our constructive spirit and cooperation for the success of the forum.

Thank you!

Abbreviations

ACEF	Agricultural Competitiveness Enhancement Fund
ANTAM	Asian and Pacific Network for Testing Agricultural Machinery
ASC	Agro Service Centers
BARI	Bangladesh Agricultural Research Institute
BSAM	Beneficiary Systems of Agricultural Machinery
CHRSAM	Custom Hiring for Rental Service of Agricultural Machineries
CSAM	Center for Sustainable Agricultural Mechanization
CSEs	China Combine Service Enterprises
CSF	Crop Supporting Fund
DA	Department of Agriculture
ENAMA	Italian Body for Agricultural Mechanization and Engineering
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FAO-RAP	Regional Office for Asia and the Pacific of FAO
GDP	Gross Domestic Product
ICAERD	Indonesian Centre for Agricultural Engineering Research and Development
ICT	Information and Communication technology
IRRI	International Rice Research Institute
IRSAM	Institution for Rental Services of Agricultural Machineries
LLP	Low Lift Pumps (LLP)
MARDI	Malaysia Agricultural Research and Development Institute
MoA	Ministry of Agriculture
NARC	Nepal Agricultural Research Council
OECD	Organization for Economic Co-operation and Development
PARC	Pakistan Agricultural Research Council
PT	Power Tiller
R&D	Research and Development
SAMS	Sustainable Agricultural Mechanization Strategies
SMS	Short Message Service
STW	Shallow Tube Wells
UN	United Nations
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UPJA	(Bahasa) Please refer to IRSAM
UPLB	University of the Philippines Los Baños
VIAEP	Vietnam Institute of Agricultural Engineering and Post-Harvest Technology



I. Regional and Global Perspectives



Efforts of FAO on Custom Hiring of Agricultural Machines

Dr. Rosa S. Rolle

Senior Agro-Industries and Post-harvest Officer
Food and Agriculture Organization of the United Nations
Regional Office for Asia and the Pacific



Dr. Rosa Rolle is an Agricultural Industries Officer in the Rural Infrastructure and Agro-Industries Division of the Food and Agriculture Organization. Since joining FAO in 1995, she has worked internationally in the areas of food processing, coconut water preservation, post-harvest systems development and food packaging. Dr. Rolle is currently actively involved with the development, design and implementation of training programs on horticultural chain management in Asia and Africa. Prior to joining FAO, Dr. Rosa Rolle conducted post-doctoral work at the University of Florida, Gainesville, Florida, USA and worked as a consultant to the Government of the Commonwealth of Dominica. Dr. Rosa Rolle holds MSc and Ph.D degrees in food science and a Higher National Diploma in Applied Chemistry. In 2003, she was recognized as an outstanding international alumnus of the Ohio State University's College of Food, Agriculture and Environmental Sciences.

From the analysis of the current regional agricultural scenario, it is characterized by growing scarcity of labor in agri-food systems, and increasing labor costs. Given this scenario, small holders are under continuous pressure to increase production and overall returns from their production output. New technologies, while available are out of reach of small holders, who cannot afford to purchase of these machinery. In this sense, custom hiring represents an important mechanism through which most small holders can access services of agricultural machinery. It is one option that can ensure the use of improved farm machinery, even to small and marginal farmers. Custom hiring offers prospects for facilitating rapid mechanization of agricultural systems in the region. Custom hire services enhance technical and economic efficiency across the whole spectrum of agri-food value chains covering input supply, growing, post-harvest, distribution, and retailing. The benefits of custom hire services include:

- reduce drudgery;
- expand and intensify production;
- reduce production, post-harvest and marketing costs; and
- increase smallholder incomes.

The suppliers of custom hiring services include cooperatives,

producer organizations, private sector, and poor landless farmers through public-private partnership.

The success factors to sustain the enterprises of custom hiring suppliers include a supportive enabling environment, a good business plan, skilled labor, and support services so that they could provide quality and competitive service delivery to meet market demand. Support services are essential for sustainability of operational continuity and integrity of custom hire services, which include equipment supply outlets, spare parts, skilled field staff, inputs, extension, technical and business skills training, finance and credit, and repair and maintenance services.

An enabling environment is critical for the custom hiring suppliers, which requires the following aspects:

- government commitment with a clear sustainable agricultural mechanization strategy (SAMS);
- a suitable regulatory framework and support policies to attract private sector investment for providing custom services;
- financial mechanisms and incentives to facilitate the procurement of machinery and equipment by smallholders;
- policies including those for land tenure and technology that

- support small farmers to access mechanization services; and
- infrastructural support base to facilitate use of machinery

FAO's work that addresses custom hiring of agricultural machinery covers development of inclusive financial models to support smallholders and the landless to take part in providing custom hire services.

In the context of SAMS, FAO supports custom hiring via facilitating the development of producer organizations/

cooperatives that allow small holders to benefit from capacity building and access to institutional credit to procure mechanization inputs, and the development of inclusive business models for smallholders engaged in custom hire based on analyses of successes achieved.

FAO Diversification Booklet 19 – Hire Services by Farmers for Farmers is available at <http://www.fao.org/docrep/015/i2475e/i2475e00.pdf> for further reference.

Essentials of an Enabling Environment for Custom Hiring

Mr. Zhao Bing

Head

Centre for Sustainable Agricultural Mechanization (CSAM)

United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)



Mr. Zhao Bing has been the head of the Center of Sustainable Agricultural Mechanization (CSAM), a regional institution of ESCAP, since December 2012. Previously he worked for five years as Deputy Director of the Center of international Cooperation and Service of the Chinese Ministry of Agriculture, coordinating and leading the design and implementation of bilateral and multilateral international projects, including the South-to-South Cooperation program under China-FAO Trust Fund, the science and technology exchange program with US and Australia. During the same period, he also co-directed the preparation for the establishment of the Asian-Pacific Center of the International Potato Center (CIP). During 1999-2007, as an Alternate Representative, he worked in the Chinese Permanent Representation to the UN agencies in Rome, a diplomatic mission to FAO, WFP and IFAD. Before that, he was a program officer in the Department of International Cooperation in the Chinese Ministry of Agriculture, primarily dealing with Asian and African affairs. Mr. Zhao has a BA degree in International Studies and a Master degree in International Business Law from the University of Rome, "La Sapienza" in Italy. He is now a doctorate candidate of the Third University of Rome in the area of food safety laws.

In essence, custom hiring is about sharing, helping farmers to achieve lower cost, higher returns and greater efficiency. Custom hiring is about specialized management and operations, with multiple advantages ranging from more skilled and higher quality operations, better access to repair and maintenance service, greater rural entrepreneurship development and income, faster uptake of new technologies and machines, and facilitating the organization and implementation of subsidies and other incentive policies. And custom hiring is, in particular, beneficial for small and marginalized farmers, especially women, in terms of better access to machinery service otherwise economically and technically out of reach, and more timely planting and harvesting to avoid waste and loss, and it is also conducive to food security and resilience to disasters and risks.

Custom hiring is an important approach to achieving sustainable agricultural mechanization. In order to further develop and promote this practice in the region, it is crucial for member governments to create an enabling environment for custom hiring. In the first section I will highlight a series of fundamental policies for the development of custom hiring. While, in the second section I will suggest some practical steps that member countries could follow to further expand renting activities.

I. Policy Design

Effective policies to facilitate the development of custom hiring include: subsidy regimes to trigger greater investment in custom hiring, especially the purchase of quality machines and implements; the reduction or exemption of related fees, including road toll fees and taxes. On these lines, it would be beneficial considering concessional loans schemes and preferential credits lines. Moreover, it would be helpful if governments and international organization could sponsor funding for research, training, extension and information sharing activities among farmers.

In order to encourage innovations in custom hiring, each government should formulate country-specific strategies and plans, with practical goals, priorities and actions. Moreover, competent authorities should implement effective communication and advocacy of good practices and successful models. For example, this could include organizing demonstrations of different types of custom hiring service at different levels.

Many countries in the region have yet to put in place specific laws and codes to regulate the conduct related to rental practices. In this sense, it is important to formulate laws and regulations to promote agricultural mechanization, including provisions to monitor and regulate market activities to promote fair competition, to put in place standards for quality control, to promote compliance with laws and voluntary codes of conducts by custom hiring practitioners, and specifically, to develop regulations in regards to the repair service and supply of spare parts.

Looking at the status of custom hiring in the region, it is evident that the need for capacity building and training activities to improve the skills and capacity of machinery operators and enlarge the pool of qualified operators, to develop entrepreneurial capacities, to build capacities in the access to, and the analysis and use of information in relation to custom hiring.

Besides, information service to farmers and custom hiring entities should be improved, for example, by setting up information networks to share and exchange information, and introducing innovative ways to communicate real-time information on supply and demand, price, weather, fuel and repair, for instance, through SMS (Short Message Service) and social media tools using mobile phones.

II. Practical Steps to be Undertaken by Government Agencies at All Levels

Commitment of government agencies at all levels is crucial for the development of custom hiring. The practical steps for government agencies shall:

- conduct survey on new trends of development. Results from the surveys should be used to design supportive measures to ensure the sustainable development of custom hiring sector;
- reinforce the testing and certification of machines focusing on adaptability, safety and reliability;
- put in place surveillance system to address complaints and disputes;
- safeguard the rights of custom hiring entities as well as those of farmers; and
- coordinate among themselves to ensure the consistency and synergy of their measures.

Gathering the stakeholders, from international agencies, national governments, academia and the private sector, the 2nd Regional Forum is aimed to take inventory of the experience and lessons, both at a political and at a practical level, to assess and highlight the importance of custom hiring in sustainable agricultural mechanization, and brainstorm innovative ideas on future practices and tap the potential of regional information-sharing and cooperation on custom hiring of agricultural machinery among Asian and Pacific countries.

I look forward to your presentations and discussions!

ENAMA and Custom Hiring of Agricultural Machinery in Italy

Dr. Sandro Liberatori

General Director

ENAMA (Italian National Agency for Agricultural Mechanisation)



Dr. Sandro Liberatori is the General Director of ENAMA (Italian National Agency for Agricultural Mechanisation). ENAMA is acting for the Ministry of Agriculture and its Members as a certification body in the field of agricultural engineering. Dr. Liberatori is actively involved in international co-operation with OECD (Organization for Economic Co-operation and Development) as past Chair of the Tractor Codes and National Designated Authority of Italy, ENTAM (European Network for Testing Agricultural Machines), and ESCAP/CSAM offering his experiences in the development of ANTAM Network. He has more than 140 publications at national and international level and more than 90 presentations at national and international conferences. In 2004, he received the Banhazi commemorative medal, the highest Hungarian tribute of respect awarded for foreign scientists acting in agricultural engineering by the Scientific Council of MGI (Hungarian Institute of Agricultural Engineering). He is Member of many Governing Bodies and Committees at national and international level. Dr. Liberatori is also involved in voluntary work for non profit associations.

Agriculture is the primary sector of economy; and the growth of globalisation requires more rules in order to regulate the flow of trade and the quality assurance of products. Technical standardisation and harmonisation may be considered a first step in the right direction. This step can be completed by a system providing testing and certification in order to assure all stakeholders a fair competition and trade. Even the WTO – World Trade Organisation provides the “Development and trade for a sustainable agriculture, avoiding unnecessary obstacles”. Furthermore, the roles of farmers and other stakeholders as well as custom hires, dealers etc. became essential, as the drivers of the primary sector, in order to achieve the multifunctionality of agriculture³.

ENAMA - Italian National Agency for Agricultural Mechanisation is an association created to improve competitiveness, develop technology and assess the performance and safety of machinery, bioenergy in the agricultural sector in Italy and overseas. It’s an Association, recognised in accordance with the Italian Presidential Decree 361/2000, whose composition is the guarantee of impartiality and consultation for the entire agricultural machinery world.

It has several Members, among which Farmers Organizations (CIA - Coldiretti - Confagricultura), Farm Contractors / Custom Hiring (Unima), Manufacturers (Federunacoma - Confartigianato), Dealers (Unacma, Assocap) and the Public Sector (Italian Regions and Italian Ministry of Agriculture and the CRA representing research. In this frame, ENAMA is a meeting point of all stakeholders that participate at the same level in the decision making processes.

In order to establish and implement a good working system, it’s necessary to assure all stakeholders with common rules, which may contribute to focus, evolve and stabilise the agricultural sector in a sustainable manner. As examples we may take the optimised use of chemicals, the efficient water management and the efficient use of agricultural machines in order to minimize the impact on the soil and the landscape.

³. WTO Glossary - Idea that agriculture has many functions in addition to producing food and fibre, bioenergy, bioproducts, e.g. environmental protection, landscape preservation, rural employment, food security, etc. – in addition: bioenergy, bioproducts etc.

All above described examples and others might be implemented through the harmonization of standards, test procedures and certification systems gained through the development of international cooperation that will optimize all investment in the primary sector.

In this context, promoting the development of harmonization of standards, testing and certification will offer a high level system to evaluate products and to guarantee all stakeholders. Furthermore the certification system offers an assurance service with a regulatory function importing and enforcing standards too.

Actually standards are defined by ISO as a “document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, processes and services are fit for their purpose” and are also defined by CEN as “created by bringing together all interested parties such as manufacturers, consumers and regulators of a particular material, product, process or service”. This explanation clarifies better the importance and the role of standards.

Test procedures containing the requirements for critical evaluation, play a key role in the process, because they are based on methodologies that verify the standard’s requirement on a product or process. They are usually performed by the producer or independent third party body.

The third part of this process is represented by the certification that is “the provision by an independent body of written assurance (a certificate) that the product, service or system in question meets specific requirements”(Definition of ISO) , assessing that everything contained in the standard has been checked, according to international rules.

The certification is the final act of a process that states officially the positive results of the testing activity based on standards, made by an accredited certification body.

All phases of the process above described might facilitate effective and cheap costs for all stakeholders as well as expense savings. A system based on those three pillars is the frame for a fair development of trade offering benefits to all stakeholders. In the case of agricultural machinery it will benefit farmers because of a higher quality of production and less injuries. For

Governments, it implies less social cost, less environmental cost and a better quality and security of food production. For manufacturers, it provides for higher quality and more exports, less responsibilities and fair competition.

In the frame of international cooperation development, it’s fundamental to follow examples as ENTAM and OECD that provide for a well established and functioning networks. Besides these networks are good examples and offer a strong support for the implementation of the ANTAM network.

ENTAM (European Network for Testing of Agricultural Machines), promoted by ENAMA, is an international effort to guarantee independent and harmonised testing systems in the European Union. Actually it has 11 Members, 1 honorary witness (FAO) and 4 observer members (INTA, AFMSPTC, CEA, VIM) respectively from Argentina, Bulgaria, Brazil, and Russia. ENTAM provides for a common testing activity and a mutual recognition of test reports and certifications in the field of agricultural and forestry engineering.

Regarding the voluntary or compulsory testing in the field of agricultural engineering ENTAM testing stations assess:

- performances
- safety
- environmental protection
- animal welfare requirements in animal husbandry.

OECD (Organization for Economic Cooperation and Development) Tractor Codes Certification, wherein are involved 34 member countries and 32 Testing Stations, exemplify the standardisation, testing and certification system under the umbrella of an intergovernmental organization. The system is based on common methodologies defined ad Codes that are used by accredited testing station in different countries operating on the basis of free market. The procedure in OECD is based on the requests made by the manufacturer to the chosen accredited testing station. After having performed the test, the testing station sends the test report to the OECD Coordinating Centre. The Coordinating Centre ensures that all procedures have been properly followed and then gives the approval number on behalf of the OECD. The approval number allows the manufacturer to use it for official purposes as the road homologation released by Governments. The Coordinating Centre operates as a third party and has no economic interest in

the process of testing. Actually the OECD Coordinating Centre task is performed by ENAMA.

ENAMA has among its Members the Association of custom hires and many activities are dedicated to them. In many countries with the investment of custom hiring of farm machinery even small and medium farmers have been able to get the benefit of agricultural mechanization. It's a better way in order to provide affordable farm machinery to small and marginal farmers and in areas where farm labour is scarce and it has potential greater contribution to sustainable agriculture. Besides it optimizes the investment for machinery.

The custom hiring aims to the implementation of agricultural machinery development among Asia-Pacific countries in addressing food security and climate change. For this reason, it must be enhanced and enforced as a facilitator of new technologies and product of agricultural machinery and equipment in order to support bio-system agriculture.

ENAMA has shared policies and practices of custom hiring of agricultural machinery in Italy and Europe, especially in the context of small and medium farming.

As an example in the following Tables, the fees for custom hires are displayed as well as some average prices in order to have a comparison with actual prices.

Table 1&2: Fees of Custom Hiring Services in Italy

Table: 1

Agricultural mechanization Fees	(€ / ha)
Ploughing	124,60 / 379,10
Mowing	43,30
Milling	124,60
Irrigation	29,05
Seeding	45,40 / 116,80
Herbicide treatment	33,35 / 45,40

Table: 2

Feeds	Prices*
Milk	42,50 (€ / hl)
Soft wheat	191,22 (€ / ton)
Healing Herb	227,50 (€ / ton)
Grain corn	189,04 (€ / ton)

* Medium prices - August 2014 - ISMEA

Custom hire can be seen as a good solution in many areas of the world offering farmers an opportunity to make a lower investment in machinery and being able to have the latest technologies at their disposal when needed. On the other side, custom hire can be a good system for Governments to spend better public money as a subsidy to farmers because every machine will be used by more farmers and renewed earlier.

In other words, the principal outcome of this solution is to reduce the unit cost of production, and improve quality of agricultural production and to meet the international requirements. It is well known that the cost of production can be reduced only if the cost of every single factor contributing towards the total cost is minimized and resource productivity maximized. Besides, it might play a key role in modernization due to its benefits of improved labour efficiency and productivity, efficient use of expensive farm inputs, reduction of human hard-work.

However, custom hiring through private companies or co-operatives will help to increase the use of modern agricultural machines and can facilitate diversification of agriculture's production.

Custom Hiring Services in the Region for Sustainable Agricultural Mechanization

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Dr. Gajendra Singh graduated in 1966 from the U. P. Agricultural University (now G. B. Pant University of Agriculture & Technology), Pantnagar in India. He received his Master's degree from the State University of New Jersey, USA in 1968 and Ph.D. from the University of California, Davis in 1973. Prof. Singh served as the first Vice Chancellor of Doon University, Dehradun during 2005-08. Dr. Singh served on the faculty of the G. B. Pant University of Agriculture & Technology, Pantnagar, India from 1973 to 1975. During August 1977 to June 1984, he served as Chairman of the Agricultural & Food Engineering Division of Asian Institute of Technology (AIT). Prof. Singh served the Indian Council of Agricultural Research (ICAR), New Delhi as Deputy Director General (Engineering) from December 1994 to December 1997. At present he is serving as an Adjunct Professor at the Indian Agricultural Research Institute (IARI) in New Delhi. He also serves on many committees of Government of India organizations including University Grants Commission (UGC) and Indian Council of Agricultural Research (ICAR).

The agriculture sector in developing countries in Asia and the Pacific region employs more people than any other sector. However, the contribution of agriculture to GDP is much smaller and thus average annual earnings of farm workers are much lower compared to workers in other sectors. For example, in India, agriculture employs about 50% labor force and its contribution to GDP is about 14% only. Thus the average annual earnings of non-agricultural workers are about 6 times that of agricultural workers. For example: China: 5; Philippines: 4; Thailand: 6. Moreover, the use of labor in agriculture is not uniform through out the year, so that the use of equipment is also seasonal. This situation not only causes unreliability of available labor shortage, but also causes labor shortages during peak periods, and inability of animate power sources to complete operations within optimum period resulting in losses in yield or produce. In this sense, custom hiring can be one of the most powerful tools to enable mechanization.

In India, initially, large farmers owned the equipment; and

they provided very limited custom hire services. With labor shortages many medium farmers that owned machines started to rent them to other farmers. Now, in most countries, entrepreneurs, both farmers and non-farmers, provide custom hire services. The size of machines owned by service providers is relatively larger compared to those owned by farmers for their own work. Many enterprises providing custom hire services own multiple sets of various machines. For example, in 2001, China Combine Service Enterprises (CSEs) were operating in 12 provinces. They shifted from Chinese Futian combines to more reliable Japanese Kubota combines.

CSEs have evolved in small co-operatives of 5-10 CSEs for maintenance and coordination. Combines are up to eight months away from home. In India, combine service providers travel up to 600 km over a period of 2 months to harvest mainly wheat crop.

Table 1 provides a list of the most common custom hire services provided in the region.

Table 1: Common Custom Hire Services

Transportation:	4WT and 2WT trailer: all countries; Animal carts: Nepal, Cambodia, Laos
Milling:	Engine and motor: all countries
Water pumping:	Engine, motor, 2WT pump: most countries
Threshing (Wheat):	4WT thresher: India, China, Pakistan Nepal
Threshing (Rice):	4WT and 2WT thresher: most countries; Diesel engines: Thailand
Harvesting (Wheat):	Combine Harvester: China, India, Pakistan
Harvesting (Rice):	Combine harvester: China, Malaysia, India, Thailand, Sri Lanka
Tillage (Dry):	4WT: most countries
Tillage (Wet):	2WT: most countries
Land leveling:	4WT laser leveler: India, Pakistan, Cambodia
Seeding:	4WT seed drill: China, India, Pakistan
Transplanting (Rice):	China, India
Maize shelling:	India, Bangladesh
Harvesting (Sugarcane):	Thailand, India

In Asia and the Pacific region, availability of competitive custom hire services is essential for mechanization of small farms to be productive and profitable. For sustainable agricultural mechanization, the governments should develop policies to strengthen custom hire services provided by individuals and enterprises.



II. Country Perspectives



Bangladesh

Status of Custom Hiring in Bangladesh

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Dr. Sultan Ahmmed holds a BS in Agricultural Engineering from Bangladesh Agricultural University, Mymensingh. He obtained his ME from Asian Institute of Technology (AIT), Bangkok, Thailand in 1990 and his PhD. in Mechanical Engineering from Bangladesh University of Engineering and Technology (BUET) in 2002. His research specializes in agricultural engineering and specifically in the fields of agricultural research management, farm machinery research management, and irrigation water management. He has been involved in strengthening the national research capacity through research planning, coordination, interaction and research resource allocation in the field of agriculture mechanization, soil science and forestry sectors. He has collaborated with several national and international institutions and acted as technical committee advisor for the Committee of Ministry of Agriculture, BARC, BARI, WARPO. Furthermore, he evaluated the projects for SPGR, PIU-BARC, NATP and KGF in the field of Agricultural Engineering. He also collaborates with several universities and journals including the Journal of Agricultural Engineering Division, the Institution of Engineers, Bangladesh. Dr. Sultan Ahmmed has more than 30 scientific research papers reviewed for scientific journals like Institute of Engineer's, Bangladesh, Bangladesh Journal of Agricultural Research (BJAR), Bangladesh Journal of Agricultural (BJA), etc.

I. General Information on Agricultural Mechanization

Bangladesh has 8.52 million hectares of cultivable land to feed its 150.00 million population (BBS 2013). Every year almost 0.20 million people are being added to the total population, whereas the estimated annual shrinkage of agricultural land is about 0.08 million hectares. The contribution to GDP by agriculture is about 18.70 % with a growth rate of 2.17 % in 2012-13. Agricultural sector generated 43.6% of total national employment. The country's food production has increased from 11.0 million tons in 1971 to about 38.30 million tons in 2014. Among many agricultural inputs, agricultural machinery plays an important role in promoting crop production to a targeted level to sustain self-sufficiency in cereal production in the country.

Recently, significant improvements have been made in the production and marketing of locally made agricultural machinery in the country. Agri-machinery is emerged as a potential agribusiness sub-sector. The annual total estimated market size is around US \$ 907.5 million of which local production and repair & maintenance market accounts for US \$ 402.7 million.

Eventually, almost all centrifugal pumps used, Shallow Tube

Wells (STW), Low Lift Pumps (LLP) are manufactured in the country. Similarly, paddy and wheat thresher, maize sheller, hand and foot-pump sprayer, weeder, engine and machine spare parts are also being manufactured locally. However, this sub-sector is still recognized as a non-formal sector and very limited effort has been made so far to assess the sub-sector market demand and supply, domestic demand and potential for export of agricultural machineries.

II. Custom Hiring in Bangladesh

Custom hiring system in Bangladesh started in the early seventies and it is now gaining momentum. Power tiller (PT / 2WT) and tractor (4WT) were the first machines involved in custom hiring. Below there is a brief description of the machines used in the country and specifically in custom hiring activities:

- Power tiller (PT / 2WT): The supply of PTs solely depends on import, power ranges from 12 hp to 16 hp. At the present, there are about 700,000 PTs operating in the country. Farmer's are using PT for their land preparation as well as for custom hiring for other farmers.
- Tractor (4WT): The supply of tractors in the country totally

depends on import, power ranges from 30 hp to 60 hp. At the present, there are about 150,000 tractors operating in agricultural sector, mainly in tilling and transportation purposes. Farmers are using for land preparation for their own as well as for custom hiring for other farmers.

- **Irrigation pumps:** The supply of centrifugal pumps for Shallow Tube Well (STW) and Low Lift Pump (LLP) depends on local production. At present, there are about 35,322 DTWs, 1,523,609 STWs and 170,569 LLPs operating in Bangladesh (BADC, 2013) with an annual demand of 850,000 centrifugal pumps. Farmers are using for irrigation for their own land as well as for custom hiring for other farmers.
- **Sprayer:** All types of hand and foot sprayers are produced locally. Only knapsack sprayers are imported from China, Korea, Brazil and India. The local manufacturers collect raw materials from Dhaka market and sell their product 30% to district market and 70% to other districts. Farmers are using for pesticide application for their own land as well as for custom hiring for other farmers.
- **Thresher:** The supply of paddy and wheat threshers depends on local manufacture. The manufacturers collect raw materials mostly from local market and sell on an average 30% at local market and 70% to other districts and upazilas. The numbers of open and closed drum threshers in the country already exceeded 150,000 and 280,000 respectively. The demand of thresher is increasing and the production does not face any competition from import market. Farmers are threshing crops for their own as well as for custom hiring for other farmers.
- **Maize sheller:** Almost 100% maize shelling is done by BARI developed maize sheller. There are two types of maize shellers small and large, their capacity are 1.50 ton per hour and 3.00 ton per hour, respectively. The supply of maize sheller also depends on local manufacture. The manufacturers collect raw materials mostly from local market and sell on an average 25% at local market and 75% to northern districts of Bangladesh. Farmers are shelling maize / corn for their own maize as well as for custom hiring for other farmers.
- **Rice milling:** Rice milling in the country is overwhelmingly mechanical and there are about 15,239 husking mills, 650

semi-automatic and 350 automatic rice mills in the country (Rice miller association, 2013). In addition there are about 100,000 traditional Engleberg type rice hullers in the country. Recent studies identified that the number of husking rice mills are shrinking and the businesses are being shifted either to semi-automatic or to automatic rice mills. These modern rice mills are using mechanical technologies, like pre-cleaning, parboiling, drying, milling, paddy separating, polishing, de-stoning, silking, colour sorting aerating, bagging, weighing & sewing. Farmers are milling for their own paddy as well as for custom hiring for others.

- **High Speed Rotary Tillers (HSRT) and Power Tiller Operated Seeders (PTOS):** In Bangladesh, many areas like Rajbari, Faridpur, Magura, Rajshahi and Dinajpur districts, the farmers are using tilling and seeding machinery extensively. Some large farmers have purchased HSRT / PTOS and using them commercially among other farmers. The farmers who have purchased agricultural machinery have shifted from subsistence agriculture to commercial agriculture using the machines. This enhances quick land preparation as well as smooth land preparation by reducing the number of ploughing from 4-5 to only 2-3 times. Farmers are using HSRT / PTOS for land preparation and seeding for their own as well as for custom hiring for other farmers.
- **Power Tiller Operated Bed Maker Cum Seeder:** BARI has also developed bed maker cum seeder. The machine is set behind a power tiller. It can form bed both in ploughed and unploughed soils. In normal and conservation tillage, this machine can be used to form beds and sowing seeds. For planting maize, wheat, vegetable seeds in beds, the machine can fairly be used. In some areas of Rajshahi and Dinajpur districts, this machine is being used for planting wheat, paddy, pulses and oilseed crops. Farmers are using for land preparation and seeding for their own as well as custom hiring for other farmers in the selected districts.
- **Urea Super Granule (USG) Applicator:** Another success is the recent development of a Urea Super Granule (USG) Applicator by BARI. This machine is only used to apply USG in transplanted rice fields. It can place the granules at a depth of 6-7 cm into the muddy soil. The present government strongly emphasized on the development of a USG applicator for saving application time and cost of labour for USG application in rice cultivation. More than 16,000 units are

used by the farmers for applying USG for their own land as well as custom hiring for other farmers in rice growing areas.

- Combine harvester and reaper: In order to overcome scarcity of labour in harvesting and planting seasons of paddy and wheat due migration of labour to the higher paid non-agricultural sectors, rice transplanter, self-propelled reaper and medium size combine harvester have high demand among farmers. More than 500 units are used by farmers for their own field as well as for custom hiring for other farmers in rice and wheat growing areas.

III. Supporting Policies

In 2013 the Ministry of Agriculture published the National Agricultural Policy. However, there is no custom hiring policy in Bangladesh.

IV. Social and Economic Benefits

Below is an account of hiring costs divided by machines:

Tilling cost (PT / 2WT & 4WT): land preparation hiring charge ranges from Tk. 3,000.00 to 3,500.00 per hectare for one pass. Complete land preparation hiring charge ranges from Tk. 6,000.00 to 7,500.00 per hectare 3-4 pass.

Irrigation pumps: Irrigation charge ranges from Tk. 8,000.00 to 12,000.00 per hectare 3-4 times in Boro season. In Aman and Rabi crops charge ranges from Tk. 70.00 to 100.00 per hour in case of 2 Cusec pump.

Cost and benefit of PTOS / HSRT operations: The service providers opined that renting out of PTOS / HSRT service to other farms was a highly profitable business in the study areas. The area under land preparation and seed sowing by PTOS / HSRT per year ranged from 6.72 to 71.26 hectare with an average of 28.37 ha. Again, the custom hiring charge of PTOS / HSRT ranged from Tk. 4,491 to Tk. 5,614 per hectare. The average gross income received by a sample service provider was Tk. 130,510 per year. The annual net returns over total cost and variable cost were Tk. 99,042 and Tk. 81,003, respectively. The average rate of return on investment was 2.64 implying that PTOS / HSRT operations at farm level were highly profitable.

Maize Sheller: The average net profit from an engine operated maize sheller is of Tk. 10,227 and return on investment is of 47%. The highest net profit is of Tk. 24,411 and the lowest is of Tk. 3,123. Each service provider's profit is at all satisfactory level. The profit range depends on the volume of work and service providers affordability and management of equipment. Hiring charge ranges from Tk. 30.00 to 50.00 per ton of shelling.

Thresher: The average net profit from a close drum thresher is of Tk. 15,823 and the return on investment is of 54%. The highest net income is of Tk. 25,020 and the lowest is of Tk. 7,516. The lowest earner is at fringe level but not a loser. The profit varied on the capital cost and the volume of work.

The average return on investment from per unit open drum thresher is of 71%. The capital investment of open drum is less than the close drum thresher but the working volume is more or less the same. The average net profit from a unit is of Tk. 11,074. The net return varied from Tk. 1,112 to Tk. 25,212. The small amounts of earners are a less afforded businessman. Hiring charge ranges from 100.00 to 140.00 per ton of threshing in the rice and wheat. The average return on investment is of 62% which is very much attractive and encouraging for the landless and marginal farmers to become service provider.

Combine Harvester: Data on the economic performance of combine harvesters were collected from the owners. In this research, the economic lives of new and refresh combine harvesters were assumed to be ten and five years. Moreover, it was calculated that during the harvesting season, combine harvester was effectively operated for ten hours in a day. The highest gross return was obtained from CLASS combine harvesters followed by Daedong and Kukje combine harvesters. The highest net return was found Tk. 3,720,000 per year from CLASS combine harvesters followed by Anower combine harvester. The net return from Daedong and Kukje combine harvesters were similar. The highest benefit cost ratio (BCR) was obtained from Anower combine harvester followed by CLASS, Kukje and Daedong combine harvesters. The reason was that the fixed and variable costs of Anower combine harvester were the lowest due to its lowest price, lowest fuel consumption and low cost with local spare parts (mostly). But the harvesting charge was the same for all types of combine harvesters. BCR of CLASS, Daedong, Kukje and Anower combine harvesters were found to be 2.68, 2.11, 2.29

and 2.70, respectively. The payback periods of refresh combine harvesters were lower than the new ones due to lower price of refresh combine harvesters. So, new and refresh combine harvester may be introduced. Because, a good demand of use of combine harvester has been created in the study areas.

For example, in 2009 Mr. Al Amin owned a CLASS combine. He harvested his own crops, 23 ha and used it for other farmers' field as custom hire basis. Corona Tractor Limited and The Metal (Pvt) Limited harvested rice and wheat in Rangpur and Thakurgaon, respectively. The machine was rent under custom hiring mechanism and was used for harvesting of rice and wheat.

According to this research, harvesting charge varies from location to location. The highest harvesting charge of rice was Tk. 10,500 per hectare in Bogra and the lowest was Tk. 9,000 per hectare in Rangpur. The reason for that difference might be that in Bogra the owner operated the harvesting, but in Rangpur harvesting was done under a demonstration program promoted by a private company. In manual method average harvesting, threshing and winnowing cost Tk. 16,131 per hectare, which was 35% higher than average cost of harvesting by combine harvester.

The average time saved for harvesting, threshing and winnowing of rice and wheat by combine harvester over manual method was 97.5%. Moreover, mechanization reduced grain loss by 2.75% in average. Time and grains savings attracted the farmers for using combine harvester.

V. Impact on Overall Livelihood Status

The overall standard of living and social status of the service providers have remarkably improved. According to the survey presented to service providers, more than 94% of respondents used safe drinking water from hand tube-well and use sanitary toilet, and about 50% extra households got connection of electricity at their residences.

Awareness development was another positive impact of the service providers during post-ownership period. It was reported that the awareness of service providers regarding contraceptive use, sending children to school, and consultation with MBBS doctor was increased (6.3-27%).

Furthermore, better economic standing enabled them to buy more costly new clothes for several social and religious events. It revealed that the members of service providers with local level cooperative society increased in the study areas. This employment opportunity has positively assisted to improve the social livelihood of service provider.

VI. Suggestions

The Asia Pacific region still has numerous acute mechanization problems, for example the absence of a mechanization strategy, the lack of appropriate machinery united with insufficient equipment support services, and inadequate farm credit. Bangladesh should first establish of a Central Institute of Agricultural Engineering (CIAE) and then formulate a National Agricultural Mechanization Policy.

Nowadays, the local market is trying to coordinate with the service providers to supply machines, spare parts, oil and fuel. Moreover, given the lack of technical skills, service providers should promote capacity building activities to train farmers to use the machines properly.

Nonetheless, service providers need financial support, for example micro-credit could be very important for supporting the purchase of agri-machinery. This could include policy options for removal of multiple VAT on imported raw materials and strengthening rules and regulations against illegal hoarding of raw materials for the growth and development of agri-machinery sub-sector. Also, policy options for zero tariff / nominal tariff on modern capital machinery import shall be developed for agri-machinery sub-sector.

Cambodia

Common Practices of Custom Hiring in Cambodia

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I. General Information on Agriculture Mechanization in Cambodia

Cambodia has a land area of 181,035 square kilometers of which nearly 20% is allocated to agriculture. The agriculture sector contributed 27.5% to the national GDP in 2012, while industrial sector accounted for 31.1% and services sector about 41.4%.

The number of farm machineries and equipment has been increased in the last few years because the economy grows; young people immigrate to urban areas; and the increasing food price. This is an opportunity for farmers to expand their food production by intensification (2 to 3 times a year).

The statistical data of agricultural machineries in Cambodia from 2004 to 2013 is shown in the table 1 below:

Table 1: Agricultural Machines in Cambodia (2004-2013)

Year	Harvester	Thresher	Rice milling	Tractor	Power Tiller	Water pump	Others
2004	-	6,220	36,531	3,857	20,279	106,569	
2005	-	7,338	38,606	4,166	26,504	120,968	
2006	325	7,795	38,618	4,247	29,706	127,610	
2007	395	8,036	38,680	4,475	34,639	131,702	
2008	430	8,237	39,429	4,611	38,912	136,061	
2009	836	13,798	47,620	5,495	53,220	164,974	
2010	947	14,390	48,217	6,200	66,548	166,633	
2011	1,548	15,210	48,753	6,786	77,421	183,502	
2012	4,820	16,146	54,328	8,961	128,806	231,942	
2013	4,580	17,542	55,270	9,467	151,701	255,954	

II. Status of Custom Hiring

Custom hiring on farm machinery in Cambodia varies from one region to another. Most farmers prefer to hire tractor for land preparation such as land leveling, plowing, harrowing and rotavating, and combine harvester for harvesting.

Normally, custom hiring services are offered directly from a farmer to the individual service provider. Otherwise, services are offered through a broker who deals with requests made by farmers. The relationship between a service provider and the end user and list of custom hiring farm machinery in Cambodia are shown in Figure 1 below:

Figure 1: Relation between Service Providers, Brokers and Farmers

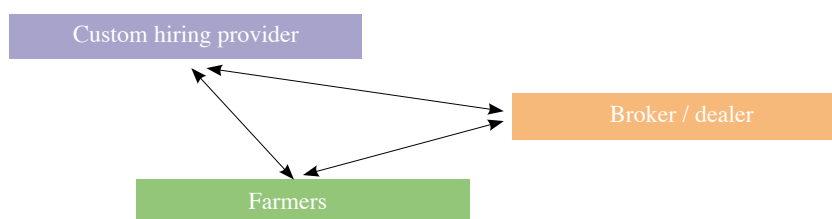


Table 2 provides a list of custom hiring farm machinery in Cambodia. Table 2-A shows the machines employed in paddy production, while Table 2-B enlists machines used for maize, soy bean and cassava production.

Table 2-A: Farm Machinery for Paddy Production:

No	Operations	Agricultural Machinery used	others
1	Land leveling	- For tractor: 20-25 US \$ / hr (front shield equipped with tractor) - For power tiller: 15-20 US \$ / hr (front shield equipped with power tiller)	The price is varied from one region to another region
2	Plowing	- For tractor: 35-70 US \$ / (depend on distance and field condition) - For power tiller: 5-45 (depend on distance and field condition)	The price is varied from one region to another region
3	Harrowing	- For tractor: 20-40 US \$ (depend on distance and field condition) - For power tiller: 15-20 US \$ (depend on distance and field condition)	The price is varied from one region to another region
	Rotavating	- For tractor: 50-70 US \$ (depend on distance and field condition)	The price is varied from one region to another region
4	Harvesting	70-90 US \$ / ha (by combine harvester and the cost is depended on distance and field condition)	The price is varied from one region to another region
5	Threshing	8-10% of total paddy after threshing	The price is varied from one region to another region
6	Transportation	075-1.25 / 100kg (1 sack) It depends on distance and road condition	The price is varied from one region to another region
7	Drying	20-25 US \$ / ton of paddy (it depends on paddy varieties and moisture content)	The price is varied from one region to another region

Table 2-B: Farm Machinery for Maize, Soy Bean And Cassava Production

No	Operations	Agricultural Machinery used	others
1	Land leveling	- For tractor: 35-40 US \$ / ha (depend on distance and field condition) - For power tiller: 25-30 US \$ / ha(depend on distance and field condition)	The price is varied from one region to another region
2	Plowing	- For tractor: 18-20 US \$ / ha (depend on distance and field condition) - For power tiller: 12-15 US \$ / ha	The price is varied from one region to another region

III. Supporting Policies

In 2011, the Department of Agricultural Engineering developed the first strategic plan on agricultural mechanization. The plan aims to enable access to mechanization, skill development, strengthening of commodity chains, and improving the legal and regulatory framework.

There are four key drivers in promoting agricultural mechanization, which respectively are enabling access to mechanization, promotion of self-help group (saving group) among farmers to mobilize local financial resource to invest in mechanization, commercialization of agricultural technologies, and formulation of a legal and regulatory framework. The plan, however, is not functioning properly and the lack of funding restrains its implementation.

The Royal Government of Cambodia offers zero tariffs for import of farm machines and equipment. In addition, 10% of VAT is also exempted. Usually, dealers ask for loans because there are demands of such loans to buy expensive machines such as tractor and combine harvester. Some dealers operate their own microfinance scheme to provide loan for buying their machines; and in some provincial branches, larger dealers, also have their own scheme of loans. Beside, there are several banks and micro-finance institutions that offer concessional loans.

IV. Social and Economic Benefits.

As the Cambodian economy grows, young people move out of rural areas to work in urban areas leaving only elder people and children in the rural areas. With the use of agricultural machinery in agricultural production, younger and more innovative people are encouraged to remain in rural areas and work on the land. In addition, because there is more demand for food for the growing population, it is an opportunity for farmers to expand their food production by intensification. For example, in some regions that used to product one crop per year, now grow 2 or 3 crops per years. The agricultural work using manpower and draft animal became less effective. Farmers, are currently shifting to use agricultural machinery because it can help reduce drudgery, workloads and increase safety in their working conditions.

Some Cambodian farmers have reduced their labor requirements in order to reduce costs, increase the cultivated area, and improve the quality of cultivation by using machines and other techniques. More developments in mechanization are occurring in the labor-intensive operation associated with land preparation and crop threshing in the rain fed areas of the northwestern provinces, the floating rice areas along the Tonle Sap and Mekong rivers, and the dry season irrigated areas in the south.

The number of tractors increased repeatedly at the rate of 145% during the last 10 years (from 3,857 units in 2004 to 9,467 units in 2013). The provinces around Tonle Sap Lake and dry season rice areas in the south have higher growing rates. The number of power tiller significantly increased at the rate of 648% during the last 10 years (20,279 units in 2004 and 151,701 units in 2013). Today, farmers use more agricultural machinery for land preparation, transportation, harvesting, threshing and milling because of labor shortage and agricultural production demands.

V. Challenges and Constraints Faced

There are several issues and obstacles related to the promotion of farm machinery in Cambodia that consequently effect the development of custom hiring activities. Namely, the lack of an appropriate governmental strategy on agricultural mechanization, united with budget constrains, lack of skilled personnel and financial supports, limitations of local infrastructure and manufactures, and insufficient repair and maintenance services.

In Cambodia, in response to rising labor scarcity, more and more women work in agriculture. However, women, comparatively, have less access to public services, training, extension and credit than men. Rural youth represents the future of rural development and innovation, yet, more and more rural youth migrates to urban areas and neighboring countries. Moreover, young generation is not interested in studying agricultural mechanization. Enrollment at university of agricultural mechanization programme is lower than other programs. This may due to the less significant role of agricultural mechanization in the past.

Furthermore, some farmers owned un-necessary machine which did not match with their farm size or they did offer for custom service work, therefore low utilization rate of machines has resulted in high fixed cost of machine and production.

VI. Solutions and Suggestions

There are some key driving factors that should be considered as below:

- Develop a national policy to enhance agricultural mechanization sub-sector in Cambodia, ensure the import of high quality agricultural machineries that are suitable for

Cambodian conditions and at an affordable price;

- Establish laws, guidelines, and other related regulations to improve the efficiency of the management of agricultural mechanization and protect the benefits of all stakeholders;
- Strengthen agricultural machinery and equipment supply networks and promote the manufacturing base on agricultural operations and processing technologies;
- Credit scheme should be available for all sizes and types of agricultural machinery and equipment;
- Support and encourage local manufacturers to produce local products with reasonable price, safety, quality and suitable for local geographical conditions;
- Improve farm infrastructure and land leveling;
- Provide in-service training for extension officers and manufacturers to improve their knowledge and skills;
- Establish Agricultural Machinery and Equipment Testing Center;
- Focus more on the development of small-scale and family-owned manufactures;
- Promote environmentally friendly mechanization practices that will result in sustainable economic growth;
- Support agricultural mechanization strategy (AMS) to be fully functioning;
- Establish adequate repair, maintenance and parts supply lines, as well as local stocks;
- Enhance research and development of new agricultural machineries and equipment which are needed at the present or in the future appropriate for different geographical conditions;
- Improve collaboration both inside and outside the region as well as build good relationships between public institutions, private sector, development partners, farmers and other stakeholders to enhance efficient management of agricultural mechanization in Cambodia; and
- Improve data collection and management systems for agricultural machineries and equipment to be comprehensive and compatible, which can be shared with and used by other countries.

China

Status and Measures of China's Custom Hiring Practices

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Born in 1970, Mr. Li Sihua graduated from China Agricultural University in 1992 with a Master Degree of Agricultural Extension. Between 1992 and 1996, Mr. Li worked at the grass-roots on socialized agricultural machinery services covering agricultural machinery hiring, engineering construction, and machinery maintenance. From 1996 to present, Mr. Li has been working at China Ministry of Agriculture. Currently, Mr. Li is the Division Chief of the Production Management Division, Department of Farm Mechanization of China Ministry of Agriculture majorly in charge of the research, formulation and implementation of the related agricultural mechanization supporting policies and regulations, establishment of the socialized agricultural machinery service system, management of the cross regional operation of agricultural machinery cooperatives, quality supervision of the agricultural machinery, and management of the agricultural mechanization projects in China. Mr. Li has been involved into the drafting of the Law of the People's Republic of China on Promotion of Agricultural Mechanization and other related ministerial regulations, and published several research articles on cross regional operation of agricultural machinery cooperatives.

I. A General Picture of China's Agriculture and Farm Mechanization

China is a large agriculture-based country, with 121.7 million hectares of farmland, accounting for around 9% of the world's total. At the same time, China is a populous nation, with 1.35 billion people, taking up about 21% of the world's population. In recent years, China has maintained a stable growth of its agricultural production, with the total production of crops, vegetables, fruits, meat and aquatic products all topping the globe. A total crop production of 60.2 million metric tons in 2013 has contributed to a remarkable achievement, that is, a grain output increase for 10 consecutive years. China has also made significant contribution to global food security by feeding over 20% of the world's population with less than one tenth of the world's farmland.

As is commonly quoted, science and technology are principal productive forces. Without the support from advanced agricultural technologies and equipment, it would have been impossible to be where we are in food production. A sign of modern agriculture, farm machines are important approaches to extend advanced agricultural technologies, and to raise labor efficiency, land productivity, and resource utilization rates. Agricultural mechanization is what made modern agriculture possible. Motivated by a series of agriculture-enabling policies from the central government, China's agricultural mechanization, as a highlight in China's agricultural development, has sustained rapid growth, and thus has promoted the transformation from traditional to modern agriculture.

According to 2013 statistics, the total power ownership of agricultural machinery in Chinese mainland reached 1.04 billion kilowatts, of which 22.79 million units are tractors, 1.42 million

units are combine harvesters, 0.6 million units are rice planters. With the share of integrated mechanization in plowing, sowing and harvesting crops standing at 59.5%, agricultural production has witnessed a historic change from reliance on manpower and animal power to mechanization; to be specific, the shares of mechanical plowing, mechanical sowing, and mechanical harvesting are respectively 76%, 48.8% and 48.2%. Regarding the three major food crops-wheat, rice and corn / maize, we have already realized whole-process mechanization of wheat production; apart from low mechanical sowing (planting) rate of rice and low mechanical harvesting rate of corn / maize, the mechanization rates of all other major links have exceeded 80%. Therefore, it is fair to say that, agricultural machinery has taken on a major role in boosting Chinese food production.

II. Current Status of Custom Hiring of Farm Machinery

Nowadays, many rural households purchase farm machines not only for their own fields, but also for custom hiring. Our definition for custom hiring is: a collection of services that farm machinery-owning households (or organizations) provide to other agricultural producers through hiring, leasing, etc. This includes mechanical plowing, mechanical sowing, mechanical harvesting, irrigation and drainage, plant protection and other services. When the function of an agricultural machine is intended for such use, the machine (e.g. a combine harvester) is not only a working tool to raise productivity, but also a way to obtain economic benefits. According to 2013 statistics, among the 268 million rural households, 42.387 million are farm machine owners, accounting for 15.8% of the total; the total operating income of farm machinery-owning households reached 430 billion RMB, with an operating income per household around 10,000 RMB. Households that make over 60% of their total income out of custom hiring services are called machinery service-providing households. In 2013, the number of such households reached 5.24 million, 12.3% of the total number of farm machinery-owning households.

The custom hiring service in China came into existence along with the reform of its rural operating system in 1979, and it has been growing along with the development of modern agriculture. Before 1979, China's rural farmland was collectively owned, and the government was charged with establishing state-run farm machinery factories and stations, and arranging the operation of farm machines in a centralized manner. At that time, farmers were not allowed to purchase tractors, let alone hiring and leasing farm machines. After 1979, China began the reform of household contract responsibility system, which granted farmers the right to independently farm and operate their contracted land. Tractors and agricultural tools that used to be owned by farm machinery stations were also given to individuals. This reform laid the foundation for the custom hiring of farm machinery in China. In 1984, the State Council issued a document, allowing farmers to purchase tractors and run custom hiring services. Since then, the custom hiring of farm machinery began to prosper with market incentives and custom hiring organizations and households also began flourishing.

Statistics show that, in 2013, China had 5.243 million machinery service-providing households, 168,000 machinery service-providing organizations, 201,000 machinery maintenance plants and stops, 96,000 machinery sales enterprises and outlets, and 7,000 intermediary service organizations. In particular, machinery cooperatives specialized in cooperative use of machinery were mushrooming, increasing by 22.7% year on year to 42,000 in 2013, and are still gaining momentum. Custom hiring of farm machinery including leasing, cross-region operation, order placement and contract management, has met the diversified needs of farmers.

Since the 1990s, some machinery-owning households in the North spotted opportunities of profit from the different time period of wheat ripening between North China and South China. They then drove their combine harvesters from the South to the North, harvesting wheat all the way for local farmers and gained quite impressive profits. The Ministry of Agriculture, together with other related ministries, released supportive policies of cross-region machinery operation in 1996, and since then more regions nationwide began cross-region machinery operation. Now the use of farm machines is extending from wheat harvesting to rice and corn harvesting, and from harvesting to plowing and sowing. During wheat-harvesting seasons, over 500,000 combine harvesters join the work, among which 300,000 are operated in a cross-region manner. In 2013, 36.719 million hectares of farmland were supported by cross-region operation of farm machines, accounting for 15.7% of the national total land of mechanized plowing, sowing and harvesting. Cross-region cooperation has become a major form of custom hiring of agricultural machinery.

Table 1: Farmland Supported by Cross-Region Machinery Operation from 2012 to 2013 (million hectares)

Item	2013	2012	Growth
national land area of cross-region machinery operation	36.71921	34.29588	7.1%
1.Cross-region machinery plowed land	6.76709	5.7537	17.6%
2.cross-region machinery sowed land	3.08471	2.57977	19.6%
3.Cross-region machinery harvested land	26.0054	24.9523	4.2%
Among which, wheat harvested by cross-region machines	14.42566	14.1618	1.9%
Rice harvested by cross-region machines	7.69569	7.42543	3.6%
Corn harvested by cross-region machines	3.25078	2.74414	18.5%

III. China's Policies on Custom Hiring of Agricultural Machinery

In order to bring benefits to machinery owners, the development of custom hiring should be guided by market forces and oriented toward the needs of the market. However, agriculture is a vulnerable industry that warrants policy support from the government. Therefore, the guiding role of the market and the pushing role of the government are both needed. The market and the government are like the two rows of wheels on a tractor--only when the front wheels are pulling and the rear ones pushing at the same time can the tractor proceed safe and fast.

The Chinese government gives great attention to agricultural mechanization; it launched supportive policies to promote custom hiring of agricultural machinery.

In 2004, the Standing Committee of the 12th National People's Congress adopted the *Law on Promoting Agricultural Mechanization of the People's Republic of China*; in 2010 the State Council released the *Opinion on Promoting Sound and Fast Development of Agricultural Mechanization and Agricultural Machinery Industry*, in which the responsibilities of all levels of governments and agricultural authorities were identified promoting agricultural mechanization in their respective administrative regions, and measures and requirements of promoting custom hiring were introduced. More than 30 provincial governments introduced local regulations on promoting agricultural mechanization. Custom hiring of agricultural machinery thus ushered in a new era of being legally-endorsed.

Since 2004, the central government has been earmarking a special fund for subsidizing eligible farmers who purchase agricultural machinery. The subsidies for one unit of machinery are from 15% to 30% of the sales price, and the subsidized machine models constitute major models used in all the links of agriculture production. Annual subsidies rose from 70 million RMB in 2004 to 23.75 billion RMB in 2014, maintaining high-speed increase for ten years. The cumulative subsidies reached nearly 120 billion RMB. The subsidy policy has significantly promoted farmers' willingness to purchase machinery; the increased ownership of machinery has laid a solid foundation for custom hiring.

In the spirit of encouraging machinery service-providing organizations and households to conduct cross-region operations, six ministries including the Ministry of Agriculture, Ministry of Public Security and Ministry of Transport jointly issued a notice in 1997 demanding relevant government agencies to ensure good organization, management and service concerning cross-region mechanized wheat harvesting; and the toll-free policy for combine harvesters working cross-regionally was introduced. In 2004, the State Council issued the Regulations on Toll Road Administration, adding transplinters and vehicles that transport combine harvesters and transplinters working cross-regionally into the toll-free list. This toll-free policy has effectively brought down the cost of machinery for custom hiring, and has saved the machinery service-providing households tolls worth over 100 million RMB annually. In addition, since 2008, the tax authorities exempted mechanized plowing and other service items from business tax, and agricultural machinery operation and maintenance, etc., from corporate income tax.

IV. Significance of Custom Hiring of Agricultural Machinery to China

Rural China has a huge population living on small patches of farmland and gaining limited income. Machinery ownership by every single farmer is neither affordable nor economically viable.

Custom hiring of machinery reduces unnecessary purchase and promotes shared use. On one hand it could increase the utilization rate of machinery and farmers' income. On the other hand, custom hiring meets farmers' strong desire for mechanized operation.

Custom hiring of agricultural machinery allows increasing the scale, standardized level and intensification of agricultural production while maintaining the rural household contract responsibility system. It could eliminate the conflict between small-scale household operation and large-scale mechanized production, exploring a way of China-specific agricultural mechanization.

V. Challenges that China Faces in Promoting Custom Hiring of Agricultural Machinery

The challenges China faces in promoting custom hiring of agricultural machinery in the course of agricultural modernization are as follow:

- Custom hiring is yet to be applied in more fields of agricultural production, being limited to farmland operation in the plain areas, it is unable to meet the accelerated development of agricultural modernization;
- Machinery service-providing organizations, including many machinery cooperatives, lack general capacity including solid operational mechanisms and sufficient management talent. A lot of mechanized operation services are segmented;
- The building of infrastructures, such as machinery tracks, garages and shelters, maintenance networks are strikingly lagging behind and resulting obstacles are quite prominent; and
- Increasing in the utilization efficiency of farm machinery is encumbered by the fact that farmland is highly segmented resulting from separate operation and consistently high international fuel prices.

VI. Objectives of Custom Hiring of Agricultural Machinery in the Future

In the Opinion on Forcefully Promoting Custom Hiring of Agricultural Machinery circulated by the Ministry of Agriculture, P. R. China, in October, 2013, main objectives till 2020 are laid out as: (1) increasing the number of service providers. The number of machinery service-providing households and organizations that own machinery with a worth of over 500,000 RMB exceeds 110,000; this number should be doubled by 2010. (2) Raising the profits earned from machinery service. The total revenue generated from

machinery service exceeds 800 billion RMB, that should be doubled 2010. (3) Enhancing service quality. The allocation of different kinds of machinery should be science-based; operational and maintenance services provided by the organizations should reach industrial standards. (4) Expanding the service scope. Custom hiring will cover all the major links of all major crops, and will be gradually expanded to forestry and fruit, animal husbandry, fishing, facility agriculture and preliminary processing of farm produce.

To this end, augmented efforts will be made in the following five areas:

- Soliciting more policy support. Active efforts will be made to introduce machinery operation subsidy policy, supportive policy of land use for machinery garage, interest subsidy for machinery financing loans and construction fund for machinery tracks. Machinery service-providing organizations will also be prioritized in enjoying the favorable policies.
- Fostering more market players. Machinery service-providing households and farmers will be guided and encouraged to form new service organizations such as machinery cooperatives, and the establishment of machinery share-holding companies and machinery lease companies will be actively promoted. Well-established machinery cooperatives will be encouraged to rent transferred rural land, hence playing a part in both machinery service provision and agricultural production. Human resource development in the field of machinery custom hiring will be strengthened, aiming at bringing more competent machinery operators and professional managers.
- Identifying role models. Based on the progressive successes of custom hiring, role models that have complete machinery models, diversified functions, salient features and good profits will be identified. (As of 2013, 1,022 machinery cooperatives nationwide are identified by the Ministry of Agriculture as model cooperatives) Continued efforts will be put to brand establishment, including promoting the use of “China Agricultural Machinery Cooperative” logo.
- Enhancing information service. Modern information technologies can serve for the collection, statistics and analysis of the supply and demand dynamics and operation pricing of custom hiring. The information will be timely offered to the public so that the service provided will be more effective. To this end, the Ministry of Agriculture has set up an on-line “information express of farm machinery cross-region operation”, and its next step, will create a mobile application of “dynamic monitoring and service platform of national agricultural machinery operation”. In addition, the use of satellite navigation and positioning technologies in agricultural machinery will be promoted.
- Improving the market environment. To establish a “unified, open and benignly competitive” custom hiring market, codes of conduct and technology standards on custom hiring of agricultural machinery will be established. Also, a custom hiring credit system, credit grading and service capability assessment will be encouraged.

India

Enabling Environment for Custom Hiring of Agricultural Machinery

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Dr. Kanchan Kumar Singh obtained his ME in Agricultural Mechanization & Management from the Asian Institute of Technology of Bangkok in 1988 and his Ph. D. in Farm Machinery & Power from Iowa State University in 1991. With more than 29 years of experience in the field of agricultural mechanization, he has served as senior scientist for the Directorate for Farming Systems Research, Modipuram (1998 – 2006); principal scientist for Farm Machinery & Power PDFSR, Modipuram (2006 – 2010); program facilitator for Cropping Systems & Resource management (2010 – 2013). Since September 16, 2013, he serves as the Assistant Director General at ICAR (Indian Council of Agricultural Research). Dr. Kanchan Kumar Singh coordinates and manages two research institutes, six research platforms under the umbrella of All India Coordinated Research / Network Projects (including one on Farm Implements & Machinery), and two Consortia Research Platforms (including one on Precision Farming & Farm Mechanization). Furthermore, he has cooperating centres in State Agricultural Universities located in different parts of India. Throughout his career, he has been received numerous prestigious awards including the American Society of Agricultural Engineers Paper Award.

I. General Information on Agriculture and Mechanization

By 2050, the world's population will reach 9.1 billion, 34% higher than today and India will be the most populous country (1.6 billion) on earth. In order to feed this larger population, food production must increase by 48.5%. India ranks second worldwide in farm output, but the economic contribution of agriculture to India's GDP is steadily reaching 14.6% now.

In India, 63% holdings are below 1 ha accounting for 19% of the operated area, while over 86% of holdings are less than 2 ha account for nearly 40% of the area. Fragmentation of operational farm holdings is yet another major concern in this respect and the average size of holdings has shrunk from 2.82 ha in 1970-71 to 1.1 ha in 2010-11. The average holding size is estimated to be 0.32 and 0.24 ha in 2030 and 2050 respectively. A large number of smallholders have to move to non-farm activities to augment their income. Consequentially, around 9 million cultivators have left agriculture during the past decade and the total number of holdings came down to 118 million in 2011.

India is the second largest producer of wheat and rice and third largest producer of pulses, sugarcane, roots and tuber crops,

vegetables, coconut, dry fruits, agriculture-based textile raw materials, inland fish and eggs.

Nonetheless, there are growing concerns on manpower availability and shrinking profitability of agriculture as business. Indeed there is an urgent need for appropriate, affordable and energy efficient equipment and technology for cost effective production.

Among various inputs for intensive agriculture, farm mechanization has been making significant contribution in increasing agricultural production and productivity through timeliness in operations, efficient application of inputs, conserving soil and water resources; and reducing losses, pollution and drudgery apart from increase in cropping intensity. The farmers have realized these advantages and mechanization is in an increasing trend in many parts of the country. However, the type of equipment suitable for cultivation and the rate of introduction of new equipment are to be considered with multidisciplinary approach specific to the site needs.

The Indian tractor industry is the largest in the world and accounts for one third of global production. The current size of

tractor industry is 5,25,000 units (March, 2013) and is expected to grow by 8-10 per cent in next decade. The concerted efforts have resulted in the mechanization of critical farm operations of major crops in different states. This has also resulted in generating employment to rural youth and artisans for the production, operation and maintenance of these machines. However due to significant and continuous reduction of the workforce in agriculture, higher levels of farm mechanization are necessary for sustainable productivity and profitability.

Even though farm mechanization shows an increasing trend, there are wide ranging disparities in the levels of mechanization across states. Northern states such as Punjab, Haryana and western Uttar Pradesh have achieved a faster growth in mechanization. The sale of other implements and machines like combine harvesters, threshers and other power operated equipment have been increasing almost throughout the country. Mechanization in Western and Southern states of the country viz. Gujarat, Maharashtra, Rajasthan and certain areas of Tamil Nadu, Andhra Pradesh etc., has increased with the increase in area under irrigation and also with the growing awareness among farmers.

II. Status of Custom Hiring

Availability of appropriate agricultural machinery to farmers has been a serious bottleneck in promoting farm mechanization in many parts of the country including dry lands, hilly and tribal areas, eastern and north-eastern regions. The unorganized sector, producing more than 300 types of agricultural machinery, is the main source of farm machinery in the country. However, this sector is unable to deliver the improved machinery at the required pace of mechanization. Also, the manufacturers are concentrated in particular locations with limited reach to far-off markets. This results into lack of uniform off-the-shelf availability of improved machinery.

India's small farms usually do not present an economic condition to permit the extensive use of agricultural machinery. But through custom hiring of agricultural machinery even small farmers have been able to get the benefit of agricultural mechanization. India's granaries like Punjab and Haryana have set an example in this aspect. Diversification of agriculture, need for the introduction of new machines and the trend among the farmers to use increasingly larger tractors will vastly expand the scope for custom hiring of farm equipment because

in future multi farm use will be the only way to keep the operating cost of farm equipment at a reasonable level.

Custom hiring of farm machines was first introduced in Indian agriculture in the early decades of nineteenth century with a 30-inch (diameter) steam thresher. The machines were taken to about 10 different places, and operated for 2 or 3 days at each location.

However, it was not until the mid-1960s, when the Agro-Industries Corporation (AIC) was established that organized custom hiring was promoted. Between the 1970s and the 1990s, AICs concentrated only on land development and tillage operations. When in 1971 the government of India launched a scheme to set up agro-services centres custom hiring practices started to flourish all over the country. Moreover, under the National Schemes of the 1990s, custom hiring services were further promoted. However, the program encountered only a limited success.

In 2010, the National Initiative on Climate Resilient Agriculture (NICRA) stated a broad collaboration scheme that includes over 100 Agriculture Science Centres (KVKs). To date, these custom hiring centres are managed by farmers through village climate risk management committees. The advantages with the launch of custom hiring services are that:

- Available extension network and technical expertise of KVKs are utilized, that act as a backstop;
- By forming Farm machinery Service Centres / Farmers Committee, requirement of individual village / agro-climatic zone is assessed and use of equipment is tailor made as per requirement / demand;
- Revenue generation is ploughed back to the society; and.
- Operation repair, maintenance aspects are taken care of.

The custom hiring of tractor operated rotavator, high capacity multi-crop thresher, zero till seed cum fertilizer drill, combine are common in Punjab, Haryana, Madhya Pradesh and in other parts of Indo-Gangetic plain of country.

III. Supporting Policies

The Government is giving major focus on custom hiring by introducing:

- (i) Strengthening existing Custom Hiring Centers:

The existing custom hiring centres are being strengthened as per their needs.

(ii) Sub-Mission on Agricultural Mechanization

In order to lay special emphasis on farm mechanization in India and to bring more inclusiveness, a dedicated Sub-Mission on Agricultural Mechanization (SMAM) for the XII Plan (2012-17) has been launched with an estimated outlay of US\$ 350 million. SMAM will put 'Small & Marginal Farmers' at the core of the interventions with a special emphasis on 'reaching the unreached', i.e. bringing farm mechanization to those villages where the technologies deployed are decades old. Besides, the mission also proposes to cater to 'adverse economies of scale' by promoting 'Custom Hiring Services' through 'the rural entrepreneurship' model. The Mission will aim at catalyzing an accelerated but inclusive growth of agricultural mechanization in India.

The Sub-Mission on Agricultural Mechanization will provide assistance for promoting and strengthening of agricultural mechanization through training, testing and demonstration; post harvest technology and management; procurement of selected agriculture machinery and equipment; establishment of farm machinery banks for custom hiring; establishing hi-tech productive equipment centres to target low productive agricultural regions and assistance for increasing farm mechanization.

Credit-linked subsidy scheme for establishment of farm machinery banks and hi-tech high productive equipment hub for custom hiring

In the recent past, custom hiring of agricultural machinery is seen as such arrangement which can promote mechanization of agricultural operations on small farms. To make the cost of machinery affordable and to make them available to all farmers, Govt. of India has now launched a credit-linked subsidy scheme for establishment of farm machinery banks and hi-tech high productive equipment hub for custom hiring with the following major objectives.

- Increasing the reach of farm mechanization to small and marginal farmers and to the regions where availability of farm power is low; and
- Promoting 'Custom Hiring Centres' to offset the adverse economies of scale arising due to small landholding and

high cost of individual ownership

Objectives of Farm Machinery Banks for Custom Hiring:

- To promote mechanization in districts with low farm power availability;
- To facilitate hiring services of various agricultural machinery / implements applied for different farm operations;
- To expand mechanized activities during cropping seasons in large areas especially in small and marginal holdings; and
- To Introduce improved / newly developed agricultural implements and machines in crop production

Objectives of Hi-Tech, High Productive Equipment Hub for Custom Hiring:

- To promote utilization of hi-tech, high value machines for higher productivity;
- To provide hiring services for various high value crop specific machines applied for different operations;
- To expand mechanized activities during cropping seasons to cover large areas; and
- To involve manufacturers for setting up of such centres

Financial Outlay & Capital Subsidy limit:

- a. Farm Machinery Bank: The minimum amount of project cost would be US\$ 0.016 million and the maximum would be US\$ 0.1 million. If the cost is more than US \$ 0.1 million, the subsidy would be restricted to US\$ 0.04 million.
- b. Hi-tech and High-Productive Equipment Hub: The minimum amount of project cost would be US\$ 0.16 million and the maximum would be US\$ 0.41 million. If the cost is more than US\$ 0.41 million, the subsidy would be restricted to US\$ 0.16 million.

Target: The scheme aims to establish a minimum of 1,000 farm machinery banks / hi-tech equipment hub during the next 3 years. The total capital subsidy component for the scheme has been tentatively fixed at US\$ 84 million.

(iii) Consortia Research Platform (CRP) on Farm Mechanization and Precision Farming (FM&PF)

Under the CRP on FM & PF, with an outlay of US\$ 13.6 million, synergy among different components of the whole

value chain of farm mechanization from development of technology to utilization and to fast-track the whole process for the growth of farming sector will be established. One of the activities is to develop / adapt the devices available in developed countries to make them suitable for Indian conditions. The prototypes of agricultural machines and equipment are being produced on demand basis. However, there is need for a fillip in this area. We are planning to establish 30 Agricultural Machinery Development Centers (AMDCs) of different levels for easy availability of agricultural machinery in different parts of the country. The AMDCs of Level A will also manufacture the critical components being used for development of various farm machines by local manufacturers, thus improving the quality of machines available to farmers. Once well established during next 2 years, these AMDCs could be used in business process development (BPD) mode for local manufacturers. The AMDCs are basically meant for prototype production and training purpose, and will act as catalyst to create entrepreneurs for farm machinery manufacture in different regions to tide over the issue of non-availability of farm machinery through promotion of local manufacturers.

IV. Social and Economic Benefits

There are significant economic and social benefits to be reaped from farm-power mechanization and promotion of custom hiring services:

- Economic: increasing the efficiency of labour, reducing costs, increasing the area cultivated, undertaking more timely production, improving the quality of cultivation, increasing yields, adopting crop diversification, reducing harvest and post-harvest losses, and earning a rental income through hiring farm-power services to others;
- Social: reducing drudgery and workloads (particularly for women), improving safety, gaining prestige, and encouraging younger and more innovative people to remain in rural areas and work on the land.

V. Challenges and Constraints Faced

Under existing custom hiring practices, the benefits of mechanization mainly reach influencing farmers because machinery owners ignore the interest of marginal, small and medium farmers. Secondly, due to single hand ownership, there is no involvement of other farmers in machine operation and maintenance. Thus, even farmers that benefit from custom hiring remain completely unaware of the new technologies as well as functioning of machines, the required safety measures and maintenance issues.

The constraints in custom hiring of improved machinery are following:

- High initial cost often prohibits individual ownership especially for small and medium farm holds;
- Lack of knowledge in the aspects of operation, maintenance and repair of equipment, often, restricts the use of farm machinery; and
- Repair and maintenance under individual ownership coupled with lack of space for shelter also constraints the use.

And challenges faced include:

- Virtual or real consolidation of the widely fragmented and scattered land holdings in many parts of the country;
- Extend benefit of mechanization to all cropping systems including rice and horticultural crops;
- Need to enhance the average farm power availability to minimum 2.5 kW / ha to assure timeliness and quality in field operations; and
- To achieve higher production levels, the quality of operations like seedbed preparation, sowing, application of fertilizer, chemicals and irrigation water, weeding, harvesting and threshing will have to be improved by using precision and efficient equipment.

VI. Solutions and Suggestions

The majority of Indian farmers do not benefit from mechanization because of the shortage of capital consequential to the purchase of needed equipment. Therefore, an arrangement to provide custom hiring service facility for farm machinery to farmers by engaging unemployed agricultural graduates is the most appropriate approach in meeting the requirements.

Agro Service Centers (ASC) could provide the machinery on custom hire basis to these small and medium farmers. In the past years, the government made an attempt to promote ASC, but many of those units failed in view of the absence of a regular source of income. Nowadays, these units could be attached to primary farm-processing to ensure regular source of income. These units will also have a better scope for manpower utilization round the year and better productivity, income generation per unit of manpower deployment. This will give the added incentive to the agricultural graduates to not leave the units even if other job opportunities are available.

Strategies

- Need of incentives and policy support for the adoption, development and promotion of farm mechanization technologies particularly suitable for dry land farming, horticulture and orchards, hill agriculture, sugarcane harvesting, cotton picking, rice production etc;
- The farm machinery bank may be established for machines being manufactured elsewhere in the country and supply to users / farmers;
- Banks need to develop hassle free loan origination and disbursement process for tractors and farm machinery on individual ownership basis or custom hiring basis;
- Manufacturing units that are set-up in areas with lower mechanization needs to be supported by extending tax and duty sops;
- There is a need to innovate custom service or a rental model by institutionalization for high cost farm machinery such as combine harvester, sugarcane harvester, potato combine, paddy transplanter, laser guided land leveller, rotavator etc; and
- Large-scale rural entrepreneurship for custom hiring operation of agricultural machinery needs to be developed at a faster pace.

Role the Govt. can play:

In order to underpin initiatives at the household level and to support the infrastructure, governments have to ensure that there is an enabling policy environment to achieve:

- a vibrant economy with a well-developed private sector to deliver and sustain mechanization inputs;

- a profitable agriculture sector with access to markets (domestic and international), effective demand for food products, opportunities for value-adding through processing, fair trade, and production of niche products;
- a diverse economic base in rural areas to enable farming households to generate income off-farm to invest in agriculture; and
- affordable mechanization inputs conforming to national standards

Role the Private Sector can play

For the development of agricultural mechanization there are various measures which may need to be initiated urgently:

- Private sector in India is definitely capable and is in fact offering quality products at competitive prices. However, we are importing many specialized machinery. The private sector needs to indigenize these for bringing down the cost, provided the volumes of economic scale.
- They need to help promote the formation of farm cooperatives which eventually increases the scope of uses of bigger farm machinery and result in minimum wastage of resources.
- Even the concept of contract farming with the help of private sector will go a long way in increasing farm output and hence the earning of the farmer.
- They need to aggressively provide the funding for improving the farm irrigation levels especially in states like MP, Rajasthan, Maharashtra and Gujarat, etc. The improvement in irrigation facilities will enable the farmer to go for multiple cropping and hence there will be need of more machines.
- They need to promote crop specific and location specific, indigenous technologies which are not only cheap and affordable, but also more useful than the mass produced machines.
- The private sector needs to come forward and encourage the concept of custom hiring among the farming community in order to enhance their earnings.

Indonesia

Governmental Support: Custom Hiring in Indonesia

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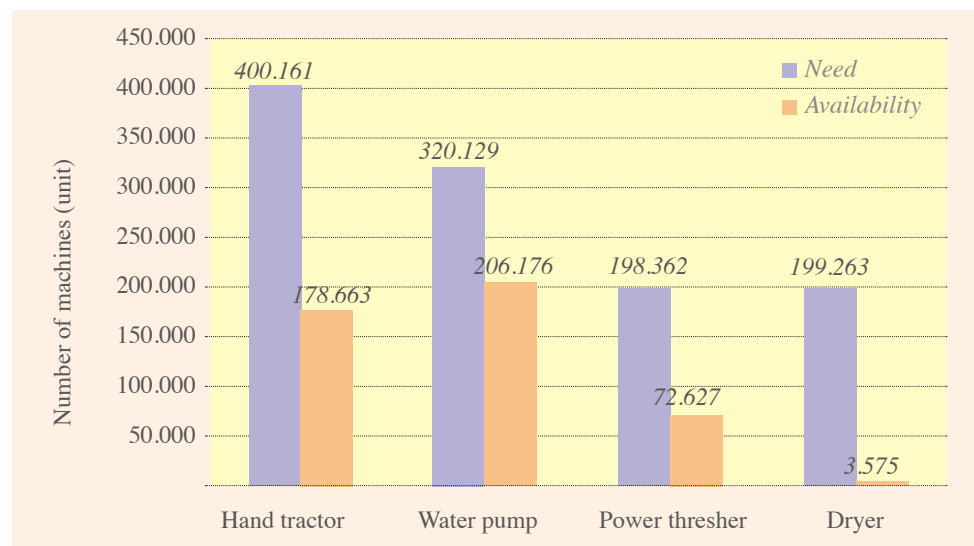


Dr. Astu Unadi obtained his PhD. in Civil and Environmental Engineering at Melbourne University, in Australia in 2000; Master Degree in Agricultural Mechanization and Management at Asian Institute of Technology in Bangkok, Thailand, in 1990; Master Degree in Agricultural Engineering at Universitas Gadjah Mada in Yogyakarta in 1981, and Bachelor in Agricultural Engineering at Universitas Gadjah Mada in Yogyakarta in 1980. From 1991 to 2006, he was the Researcher / Head of Program Division at Center for Agricultural Engineering Research and Development, Agency for Agricultural Research and Development, Ministry of Agriculture, Indonesia. From 2006 to 2010, he was the Director of Indonesian Agroclimate and Hydrology Research Institute, Agency for Agricultural Research and Development, Ministry of Agriculture; and from 2010 to present, he is the Director of Indonesian Center for Agricultural Engineering Research and Development, Agency for Agricultural Research and Development, Ministry of Agriculture, Indonesia.

I. Status of Custom Hiring in Indonesia

Similarly to other countries in the region, Indonesian farmland ownership is characterized by small households, on average 0.4-0.9 ha. Given the lack of education, skills and capital, there is a large problem with in-efficient utilization of agricultural machines if owned by farmers. Moreover, the need of mechanization is evident in the agricultural scenario. Figure 1 compares the need and availability of agricultural machinery in Indonesia.

Figure 1: Need and Availability Of Agricultural Machinery



In this contest, the government realized the importance of custom hiring and strongly supported this valuable activity by facilitating the procurement of machines, improving training and supervision. In 2008, the Indonesian Ministry of Agriculture issued the Decree 25 / Permentan / PL.130 / 5 / 2008, defined as a guideline for custom hiring, the Decree had the scope to optimize agricultural machinery utilization, both for farmers' groups and service providers.

Moreover, Indonesia has been experimenting with new machines in specific pilot areas both on operational capabilities and testing procedures. Facilitation of procurement is carried out by providing financial credit and assistance for purchasing equipment.

As a result of a strong governmental support, today in Indonesia has more than 12,000 institutions that support the rice production by custom hiring. Known as Institution for Rental Services of Agricultural Machineries (IRSAM or UPJA in Bahasa), which can be operated by farmer's group or private sector. Figure 2 and Table 1 show the impressive development progresses of IRSAMs from 2006 to 2012.

Figure 2: Development of Custom Hiring in Indonesia

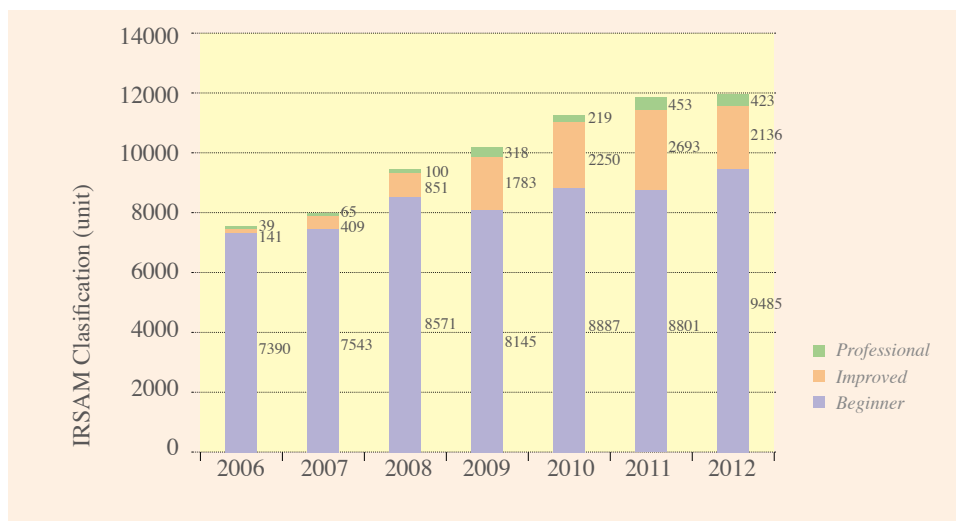


Table 1: Number of Custom Hiring for Rental Services of Agricultural Machinery (CHRSAM) in Indonesia, 2006-2012

Year	CHRSAM class			Total
	Beginner	Improved	Professional	
2006	7,390	141	39	7,570
2007	7,543	409	65	8,017
2008	8,571	851	100	9,522
2009	8,145	1,783	318	11,103
2010	8,887	2,250	219	11,356
2011	8,801	2,693	453	11,947
2012	9,485	2,136	423	12,044

Table 2 depicts the kind of machines utilized in the country divided by level of difficulties (beginner, improved, professional). Specifically, population of tractor, power thresher and irrigation pump in custom hiring in 2010, and machine ownership. The government provides the machines indicated in red, the machines indicated in black belong to private owners.

Table 2: Tractor, power thresher and irrigation pump in utilized in custom hiring (2010)

Machinery	Kendal	Batola	Pinrang	Kampar	Oki
Beginner					
Hand tractor	1A	3A	2A	2A	-
Irrigation Pump	-	-	-	-	-
Thresher	-	1A	-	-	-
Improved					
Hand tractor	2A	3A	5A	3A	4A+1B
Irrigation Pump	2A	1A	1A	1A	3A
Thresher	-	4A	-	2A	2A
Professional					
Hand tractor	1A	-	-	7A	12A+2B
Irrigation Pump	-	-	-	2A	1A+1B
Thresher	-	-	-	1A+3B	7A

The efforts undertaken by the Indonesian government to promote agricultural machinery are very evident. Nonetheless, more than 80% the institutions are still under-utilized, the management needs to be greatly improved. Next session will present the major limitations and possible alternatives for further developing rental practices in Indonesia.

II. Development Constraints & Alternative Efforts for Improvement of Custom Hiring

Similarly to other countries in the region, Indonesian mechanization sector suffers from poor infrastructures for efficient operation, mobilization of machineries and absence of storage facilities. Moreover, the limitations in budget did not allow the renovation of the information system, and organizing of the much needed trainings for operators and managers. Given the abovementioned limitations, the author wishes to suggest the following alternative approaches to custom hiring:

- Encourage the self-development of custom hiring through the involvement of the private sector and farmers participation;
- Increase farmers' ownerships of agricultural machineries through various credit schemes, including down payment subsidy and purchasing guarantees;
- The government should act as a regulator and facilitator in the selection and agricultural machinery procurement;
- Formulate an effective plan to improve the status of infrastructural facilities;
- Introduce of new machineries and pilots for agricultural development programs, followed by intensive training; and
- Develop appropriate Management of Information System for agricultural machinery, integrated with Planting Calendar

Iran

The BSAM System: the Iranian Custom Hiring Model

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Mr. Ali Naseri Nezhad obtained his Master Degree in Mechanic for Agricultural Machinery, specializing in Biosystem Engineering from Tehran University. He is currently the Director of the Agricultural Machinery Testing Division (AMTC) of Agricultural Mechanization Development Center under Ministry of Jihad-e-Agriculture of Iran. Mr. Ali Naseri Nezhad is involved in several activities including farm machinery equipment testing and codification of national standards; he is a member of AMTC technical committee. He is also involved into the study and evaluation of new machines for national and regional conditions. Moreover, he contributed to the project "Determination of suitable notch & plain disk on the disk furrow opener for direct planting on residue conditions".

I. General Information on Agriculture and Mechanization

The introduction of agricultural machines in Iranian agriculture dates back to sixty years ago when the first tractor was introduced in the country. Since then, cultivating and planting developed from animal and labor force into conserving and direct planting by high power tractors. Nowadays, rice is planted by planter machines and harvested by combine harvesters, most of wheat and barley is harvested by 14 to 16 feet wide combines. The hay corn is chopped by self-propelled huge chopper of 5 meters wide. Irrigation is converting from conventional to pressure and rain methods and uses of center pivot, linear, taupe dripped, and polyethylene pipes, etc.

The Iranian agricultural machinery-testing group, with nearly fifty years of experience, plays a very important role in testing and controlling the quality and performance of imported and locally produced machines. Nowadays, there are about 300 national standards in agricultural machinery and even more regarding irrigation.

II. Status of Custom Hiring

5% of farmers own tractors and agricultural equipment, who usually have farming area of 50 ha or more. These farmers usually have both capacity and willingness to buy the machinery. However, most farms own an average of 2 ha. They usually hire mechanization services from other farmers, especially in villages, where farmers usually share their machines and equipment.

The centers that are able to provide machinery services for farmers and occupational machine drivers usually own tractors or combine harvesters and work in other farmer's fields. These centers include rural cooperatives, agricultural products cooperatives, advisory agricultural technical and

engineering unities, and mechanization service unities.

III. Supporting Policies

Historically, Iranian farms have been quite small because of the heritage customs. In 2011, the parliament passed a law to prevent the division farmlands between different heirs.

The Beneficiary Systems of Agricultural Machinery (BSAM) is the name of the group in charge of the establishment of the mechanization unities network. The network is constituted by a group of experts and is equipped by a complete set of machinery. The network can provide different agricultural operations, such as land preparing, planting, keeping crops and harvesting based on scientific principles with high efficiency, low costs and saving time.

This method is the best and the most suitable way to manage the application of agricultural machinery in diversified branches. As shown in Table 1, nowadays, more than five million hectares are operated using this system.

Table 1: Units that operate under the BSAM

The agricultural mechanization servicing unities network		Number	Percent in Network	Area Covered (ha)	Area covered Percent in the Network
1	Mechanization servicing unities	1381	50.27	1907977	33.25
2	Advisory agricultural technical and engineering unities	521	18.97	1026237	17.89
3	Agricultural products cooperative	635	23.12	2088568	36.4
4	Rural cooperative	210	7.64	714987	12.46
	Sum	2747	100	5737769	100

The future plan is to cover about 7.5 million ha of cultivated farms using this mechanization method.

Another operating system to provide services is through occupational machine drivers, especially for tractor holders and combine harvester holders. Nowadays, there are 107,000 tractor occupational drivers and 14,532 harvesters occupational drivers. They cover extensive field areas in different regions and they are very active in providing custom hiring services in the regions. Tractor owners usually have some mounted or draft equipment, and for other purposes they hire them from another or sometimes from equipment holders. Combine harvesters travel from south to the north harvesting wheat, barley and rice cross regions.

According to the new mechanization plan, the government is going to further regulate this service in order to facilitate

the creation of agricultural bank loans to replace the old machines. The government is promoting the renovation of the mechanization service unities networks by providing credit by the “National box developing credit”. Furthermore, in order to encourage the mechanization unities to provide custom hiring to farmers, taxation and prime and total cost of crops has substantially been reduced or exempted.

IV. Social and Economic Benefits

Custom hiring makes high efficiency of using machinery by reducing the unused time of machines and equipment. Saving investment and increase benefit for machine holders and farmers.

Custom hiring reduces the farmer’s drudgery and injuries by using machine power instead labor power bringing benefit to

agriculture and reduce poverty in rural regions.

V. Challenges and Constraints Faced

The low level of literacy among farmers and providers greatly limits custom hiring in Iran. This creates countless problems in the operational phase. Moreover, many providers do not want to work for small farmers because it is not cost-effective. Besides, the specific constraints of custom hiring in Iran are the different costs for hiring services in different regions. Given the lack of a standardized price system, many providers tend to overprice services and this generates a lot of complains. In addition, the after-sale, repair and maintenance services in Iran are still to be further developed.

Most recently, the fuel allocation program has prevented custom hiring activities. This program allows the distribution fuel only at the fuel and gas stations by using fuel cards, many tractors and combine owners have problems to get enough fuel for daily operation.

VI. Solutions

In order to resolve the problems enlisted above, the following points should be implemented:

- Promote training courses by machine sellers and their agents.

With regard to this, it is needed to set a minimum educational requirement for occupational drivers to deliver new tractor and combine harvesters, preferably high school diploma.

- Encourage small farmer to associate into bigger units and share machines.
- Promote exemptions of agricultural taxation and allocate subsidy to units that serve small farmers that works in remote regions. Loans, credits and subsidy have been requested by farmers to buy agricultural machineries for several years. According to the new governmental plans, financial resources are being allocated for mechanizations units, cooperatives and rental centers. To buy new machines, the allocated subsidy is 20% of the total price; the loan is 70% of the total price of machines; and only 10% of the price is to be paid by the suppliants.
- To develop national testing standards.

VII. Suggestions

The author suggests to conduct a cross-region survey to improve the planning and assessment of machines used, work required, and fuel consumption etc. Moreover, in order to upgrade the use of communication facilities, it is crucial to monitor the network systems in the country, such as satellites and mobile networks.

Lao PDR

Status of Custom Hiring of Agricultural Machinery in Lao PDR

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I. General Information on Agriculture and Mechanization

The Lao People's Democratic Republic (Lao PDR) is a landlocked country that covers an area of 236,800 square kilometres. About 20% of the land area is lowland (70-200 msl), the other 80% is upland and mountainous region (200-2820 msl). According to statistical data, 70% of the population lives in rural areas relying on farming, fishing and natural resources.

Recently, mechanization technologies started to spread around the country, for instance small walking tractors are playing a dominant role in agricultural activities, followed by medium and large tractors ranging from 37-95 hp and other related farming equipment such as transplanting machines, harvesters, seed dryer and rice mills.

II. Status of Custom Hiring of Farm Machines

Custom hiring in Lao PDR mostly involves the machines listed below:

Tractors: In general, the first plough operation costs about 25 US\$ per ha. However, the majority of small farmers are using small walking tractors that are affordable to invest by farmers.

Planter / transplanting machine: Services on rice transplanting are also practiced among small farmers. For example, one service package includes seedling and transplantation cost for about 233 US\$ per ha.

Harvester: The cost of harvest operation by combined harvester is about 38 US\$ per ha. The cost of harvest operation by smaller machine is about 12 US\$ per ha, but it needs another step for threshing. In the case of thresh operation, it usually is not charged by cash. For example, one bag will be withdrawn from 20 bags as fee for thresh operation.

Flat bed dryer for rice and corn: Post-harvest losses account for about 15-20%. To obtain good quality rice paddy and corn, the moisture content of the paddy and corn needs to be reduced from over 20% at harvest time to safe level of 14% within 24 hours. This could be avoided by using adequate dryer. The cost of drying operation for rice and corn is about 6 and 4 US\$ respectively.

Rice mill: Rice mill brings value added to farmers while good quality white rice, corn with adequate packaging promotes marketing and brand recognition. The cost of rice milling is about 38 US\$ per ton. In some cases, rice bran will offset the costs.

III. Social and Economic Benefits

On average, farmers own 1.5 to 3.0 ha of arable land in central and southern part of the country, which are mostly allocated to rice farming both in wet and dry season. In general, small farmers cannot own expensive farm equipment units and machines; however, thanks to custom hiring they are making use of modern technology like tillage equipment, harvester and thresher through hiring services. As result of the spread of mechanization, farmers' living standards have raised. Custom hiring of thresher also has widely operated in farmer community in the country; this has totally replaced manual rice-threshing operation.

IV. Challenges and Constraints Faced

It has been observed that the majority of small farmers do not have the necessary managerial knowledge to meet market demand, and have limited technical knowledge of post-harvest handling and marketing techniques. In addition, they find difficulties in accessing financing for market-oriented farm-based activities and the number of workers is insufficient because of competition from the industrial sector.

From government's perspective, challenges and constraints include: 1). Farmers do not diversify cropping patterns; 2). Extension technicians do not meet technical needs of farmers' organizations; 3). Foreign agribusiness investors

lack experience working with Lao farmers; 4). Difficulty to organize farmers in groups (legal framework still unclear, powerful private commercial interests, lack of understanding from both farmers and extension staffs); 5) Linkages between agribusiness and farmers are not easy to establish due to lack of trust; Agreed quality standards are still to be established; and infrastructure needs further improvements); 6). Farmers have a low access to information, technology (on farm process) and knowledge, finance, labor and land (land titling and mapping is in progress and needs to be continued); 7). Agricultural commodity production and marketing models needs to be strengthened and replicated at a larger scale.

V. Solutions and Suggestions

In order to overcome the abovementioned limitations, the author suggests the following points:

- Establish machinery cooperatives at all levels in charge of services provision;
- Promote the involvement of the private sector into farm machine service;
- Diversify agriculture and introduce of related farming equipments for small farmers; and
- Promote training activities on pre and post harvesting technologies and marketing techniques for farmers and services providers.

Malaysia

Practices of Custom Hiring of Agricultural Machinery

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Mr. Sarif Hashim Bin Sarif Hassan got his Master Degree in Industrial Engineering from the University of Miami 1995, while he was already working as a Researcher on the development of small farm machineries at MARDI. His research is now focused on fruit mechanization. Specifically, he has been experimenting with hedgerow planting of tropical fruit trees for optimum machinery utilization in the orchard, and the introduction of air-conditioned cabin cab for safer orchard tractor especially during spraying operation. From 2014, he is the Head of Farm Machinery Testing and Development Center, MARDI.

I. Agriculture and Mechanization in Malaysia

Malaysia is an agricultural country, although its contribution to GDP is the third behind manufacturing and services. The main commercial crop is oil palm, followed by rubber and cocoa. The main food crops are rice, vegetable and fruit. Mechanization in the oil palm industry, which is normally run by plantation companies, is on farm transportation and general crop maintenance. Large tractors of almost 100hp fitted with trailer are the main form of mechanization in the oil palm plantation. Smaller tractors of about 30hp are used in spraying and crop care operation. Rice production in Malaysia is almost 100% mechanized; large tractors of around 80hp are used for rotovation and land preparation, while large combines of more than 100hp are used for harvesting operation.

Table 1: Percentage of machinery utilization in Malaysia rice production

Operation	Machinery	% Machine Utilization
Land preparation	80hp tractor w / rotovator	98
Seed broadcasting	Power blower	85
Transplanting	Riding transplanter	5
P&D spraying	Power sprayer	90
Fertilizer application	Power blower	85
Harvesting	Large combine harvester	97
Bulk transportation	1 ton truck	97

Source: Mechanization Technology Status, Plan for Farm Mechanization and Automation, MoA Inc, (2010)

II. Status of Custom Hiring

As mentioned above, rice production in Malaysia is almost 100% mechanized. Large tractors are being used in land preparation, which include two times of rotovation and one round of leveling. Large combine harvesters are employed together with 1 ton trucks during harvesting and bulk transportation of rice to milling centers. It is in these operations that custom hiring of farm machinery are mostly ran. Machinery contractors own tractors, combine harvesters and trucks and they are hired by the farmers in the locality. Other operation in rice production such as seeding, planting, spraying and fertilizing are either done by farmers themselves or being contracted out to machinery operators. Seeding and crop care are mainly done by knapsack power blowers and sprayers. Some farmers buy and operate these machines, while others contract out the operations. Most rice productions in Malaysia are directly seeded; mechanical transplanting has been recently introduced. Mechanical transplanting is being introduced mainly because of the weedy rice problems. This unwanted weedy rice problems spread very fast with direct seeding practices. Therefore, to break the cycle, mechanical transplanting is being introduced. Mechanical transplanting of rice is being done by 6 to 8 rows riding transplanter and it is being custom hired by the farmers.

Table 2: Number of Machinery Offered by Government Agency (NFO) and Private Sector for Rice Production in Malaysia

Machinery	Gov't (NFO)		Private Sector	
	Quantity	%	Quantity	%
4 wheel tractor	250	7.7	2,950	92.3
Combine	92	7.3	1,116	92.7

III. Supporting Policies

At the moment there is no governmental policy to support or regulate custom hiring of farm machinery. However, the government is in the process of developing a master plan for national farm mechanization. The plan will include statement on custom hiring and custom hiring promotion strategies. Moreover, the Ministry of Agriculture itself through National Farmers Organization (NFO) is also providing custom hiring of farm machinery together with the private sector. Custom hiring offered by NFO is limited to about 10% only, the rest is offered by the private sector.

IV. Social and Economic Benefits

The main beneficiaries of custom hiring are the small farmers. Without custom hiring services of large tractors for land preparation, and combine harvesters for rice harvesting, the rice production system in Malaysia would be almost impossible. Farmers on their own are not able to perform the operations because individual plots are mostly small. They totally depend on the machinery operators for the services.

In terms of social benefit for the community, it seems that custom hiring operations in the fields are conducted in sequential manner. In the end, large tract of fields are served almost at the same time, therefore, other operations such as seeding and planting can be scheduled almost together. Planting

at the same time is the most important, since majority of rice production in Malaysia is based on irrigation schemes. Delivery of water through irrigation canal can be conducted efficiently. The possibility to conduct operations at the same time makes the rice farming community stronger.

Economic benefits are enjoyed both by the farmers and the machinery contractors. Through custom hiring of larger tractors and combines, farmers are able to operate the fields twice a year, while machinery contractors get more pays for their services.

V. Challenges and Constraints

As in any business, even custom hiring faces several challenges and constraints. Weather conditions are one of the main problems, especially harvesting operation during off-season. Most of the time harvesting off-season rice in Malaysia occurs in wet rainy season. Occasionally, combine harvesters are hampered by the rain or in worse cases combine itself got bog down in soft field. Nothing much can be done to improve the situation except by tightly planning and scheduling of planting operation to avoid the wet harvesting time.

Other challenges are the high costs of reparation for the tractors and combine harvesters. Since most of the tractors and combines are of reconditioned units, they tend to demand higher maintenance cost at the end of the production season. Sometimes the profit gained in providing the services is spent in repairing costs.

VI. Solution and Suggestion

Providers are looking to alternative machinery suppliers with acceptable quality and reasonable prices. For the same reason, the government as well is appointing MARDI to lead in the development of farm machinery testing center. Imported machinery will be tested first at the center, and then imported into the country. The procedure is to ensure that only quality and safe machines are imported for the machinery service provider and farmers.

Mongolia

Custom Hiring in Mongolia

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Mr. Galsanbuyan Demchigdorj got his BA in Engineering from the Technical Institute of Belorussia, Minsk in 1985. Since then, he has collaborated with NGOs and governmental institutions. He has worked as Assistant for the Secretariat of the State Great Hural, and as Director of the External Cooperation Division for the Ministry of Food, Agriculture and Light Industry. After that, he has served as Director of the Technical and Technology Division in charge of planning and implementing government policies on mechanisation and technical innovation of the crop sector. From March 2010, he is the Deputy Director of the Crop Supporting Fund at the Ministry of Food, Agriculture and Light Industry.

I. Status of Agricultural Mechanization in Mongolia

The agricultural sector constitutes 21.7% of the total Mongolian GDP, and it employs 40% of the total working force. The production of crops focuses on wheat, potato, vegetables; and it is sold at the local market. Other agricultural products for export include leather, organic cashmere, meat, sheep and camel wool.

Since 2007, the policy promoted by the government as “technical renovation” has increased the number of tractors by 80%, and harvest equipment by 65%. The average harvesting time has reduced by 10-12 days with the assistance of technical renovation harvesting to 30-35 days. Policies for 2014 include an investment with a Chinese credit line of 12 million US\$ to purchase Foton tractors and combines.

II. Status of Agricultural Mechanization in Mongolia

The Government of Mongolia, through the Ministry of Food, Agriculture and Light Industry, is popularizing the concept of ‘custom hiring centers’ as part of achieving the objective of farm mechanization through upgrading technology for raising agriculture and horticulture crops. The Ministry of Food, Agriculture and Light Industry is encouraging big farmers, or groups of farmers, to jointly purchase high cost machinery and run custom hiring centers, or to buy new equipment through the benefits offered by the Crop Supporting Fund (CSF). The custom hiring centers will rent farm machineries to farmers who cannot afford to purchase high-end agricultural equipment. The CSF rents machinery with 20-30% advance payment and get back rest payment by crops within 3-5 years. The centers and CSF play a pivotal role in introducing high technology agriculture machinery, even to ordinary farmers with the objective of boosting crop production and

improve quality of agriculture operations.

III. Supporting Policy & Benefits

Between 2009 and 2012, as part of its efforts to set up the centers in every aimak, (province), the government has set apart 7,7 billion tugriks for facilitating the establishment of custom hiring centers. As a result, in the last four years about 456 farmers benefited by mechanization initiatives of the government. Initially the centers were set up in 36 agricultural divisions in the district, but the strategy was to set up a center in each of the district.

The second part of the strategy, encourages individual farmers to dispense with manual methods of land tilling, seeding, transplanting, harvesting and processing of potato any other crop for that matter. CSF supplies machinery to custom hiring centers, mostly farmers pay back by wheat crop to within 3-5 years (CSF owns 5 wheat storages with 150 thousand tons capacity).

The governmental supporting policy for custom hiring has achieved remarkable results. Firstly, the overall capacity of tractors and combines reduced the planting time to 12-14 days and harvesting and cultivating fallow are in 35-38 days. Also, the quality of fallow has improved and the productivity from each hector increased by 0.6 tn in the last two years. This contributed to a considerable reduction of operational costs.

The government created the opportunity to assist small farmers, that wouldn't have the necessary knowledge for running their own businesses, by investing in public equipment. Public service units that provide technical services were established in 54 soums of 14 provinces. Moreover, advanced technologies are being transferred to Mongolia. For example, the world leading brands such as John Deere, Challenger, Sun Flower, Class, Morris all opened their dealer companies in Mongolia.

Nepal

The Development of Custom Hiring in Nepal

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Mr. Shreemat Shrestha obtained his Bachelor Degree in Agricultural Engineering from Kerala Agriculture University in India in 1991, and a Master Degree in Agricultural Engineering from Govinda Ballav Pant University of Agriculture and Technology (GBPUAT) in India with distinction. Mr. Shrestha is the Division Chief of Agricultural Engineering Division of Nepal Agricultural Research Council. He's been working as an agricultural engineer and research scientist in different capacities in Nepal Agricultural Research Council (NARC) since 1994. Mr. Shreemat Shrestha involved in the design and development of appropriate agricultural implements, viz. jab seeder, pedal operated millet thresher, compeeler, low cost solar dryer, cardamom dryer, coffee pulper, tunnel solar dryer, ginger washing machine, etc and modification of strip till drill, bed planter and animal drawn zero till drill. He also directly involved in field validation and promotion of resource conservation technologies (RCTs) in rice wheat system through participatory demonstration, field trials and farmers' training in the hills of Nepal under different projects. As a member of agricultural mechanization policy drafting committee, he contributed to the preparation of the upcoming agricultural mechanization policy of Nepal.

I. Status of Agricultural Mechanization in Nepal

Nepalese agriculture has traditionally been dominated by subsistence. However, in recent years, the demand for mechanization has substantially increased due to acute labor scarcity during peak season and high cost of production in farming resulting from youth migration and feminization.

The use of modern machines has contributed to attract returned youth migrants to commercial agriculture. Additionally, the betterment of infrastructures and road connectivity in the rural areas has contributed to the use of tractors and other machines. The government has recently developed a Agri Mechanization policy, which includes a very liberal import policy with tax exemption for agricultural machinery, particularly on tractors.

II. Status of Custom Hiring in Nepal

Nepalese house holdings are generally very small and enjoy limited purchasing and technical capacity. For these reasons, custom hiring plays a major role in agricultural mechanization. However, it is mostly an informal business and the government does not officially recognize it.

Services provided by privately owned agricultural machines are more successful than group owned agricultural machinery service providers. Though, due to the lack of capabilities for technical maintenance and management, including record keeping, and lack of substantive government support, cooperatives have never been particularly successful in custom hiring in Nepal.

Most of the services are provided within the owner village, except tractor, power tiller, tractor PTO driven thresher and combine harvester. Generally custom hiring involves three kinds of machines:

- Means of Livelihood (animal drawn plough, traditional water mill).
- Partially commercial (power tiller, pedal operated thresher, winnower, pumping set, sprayer etc.).
- Commercial business (tractor, power tiller, tractor operated thresher, combine harvester, grain processing mills etc.).

From a survey conducted in the country, it emerged that custom hiring service in tillage, water pumping, harvesting and threshing has been successfully used only in certain regions,

while milling and transportation were successful all over Nepal.

Table 1 provides the details on the kind of machines used, while Figure 1 depicts the share of household (HH) using custom hired agricultural equipment and self owned equipment. Although there are various renting charges for the same equipment service depending from the location, Figure 2 shows the average charges expressed in Rs divided by machines.

Table 1: Custom Hiring Equipment.

	Used HH	Owned HH	Custom Hiring HH	Used / Owned
Iron ploughs	1073441	838176	235265	1.28
Power tillers	75671	9123	66548	8.29
Tractor	844700	36158	808542	23.36
Thresher	803154	48157	754997	16.68
Pumping set	548203	136607	411596	4.01
Animal drawn cart	334978	155272	179706	2.16
Sprayer	574014	248790	325224	2.31
Other equipment	290084	81684	208400	3.55

Figure 1: Share of HH Using Custom Hired Agricultural Equipment and Self Owned Equipment.

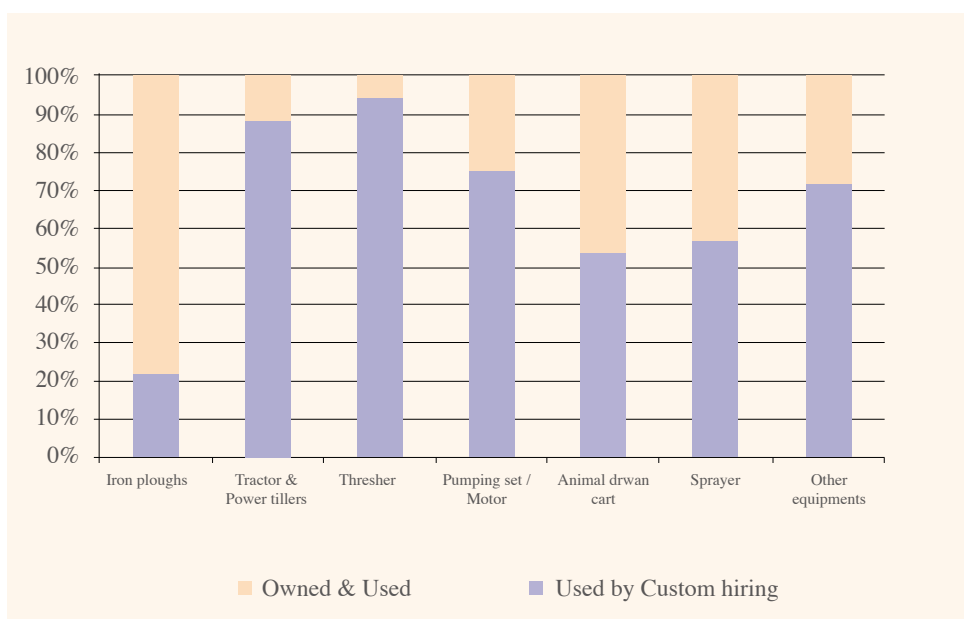


Figure 2: Custom Hire Charge of Agricultural Operation Expressed in R⁵.

Custom Hiring Service	Eastern	Central	Western	Mid Western	Far Western
Tractor with Cultivator (Rs. Per hour)	1200 to 1500	1200 to 1500	1200	1000 to 1200	1100 to 1500
Tractor with Rotovator (Rs. per hour)	1600 to 2000	1500 to 2000	2000	1400 to 2000	-
Power Tiller (per hour)	500 to 600	500- 600	600	300 to 500	400 to 600
Animal Drawn Plough (Rs. Per day)	450 to 1000	1000	1000	700 to 1000	1300
Sprayer (per day)	25 to 100	80 to 100	25 to 40	80 to 100	15 to 50
Pump Set (Rs. Per hour)	300 to 400	250 to 350	300 to 500	250 to 400	250 to 300
Thresher (grain: grain threshed)	1:20 to 1:10	1:12 to 1:8	1:15 to 1:10	1:13 to 1: 8	1: 9 to 1:07
Combine Harvester (Rs. / hr)	5000	5000	4800 to 5000	-	4500

⁵ (1USD= Rs. 98)

Besides, the survey highlighted several important issues raised by provider and farmers, which need to be addressed by the government. First of all, service providers are playing a major role in promotion of agricultural mechanization among smallholder farmers in Nepal and the government should formalize this business as soon as possible.

Moreover, it emerged that among the agricultural machinery used, the hired machines used HH for metallic animal drawn plough is 22%, power tiller and tractor is 88%, thresher 94%, sprayer is 57%, water pump is 75% and other agricultural equipment is 72 %.

Some innovative providers are now starting to promote new services, such as laser land leveling service, rice transplanter, zero till drill, straw harvester, micro hydro powered grain processing mills etc.

III. Challenges of Custom Hiring in Nepal

The practice of custom hiring in Nepal presents different challenges both from the farmers' and the providers' prospective.

One of the major problems highlighted by farmers is the monopoly of custom hiring of the service providers, which caused some cases of high rates of services. As mentioned before, the government does not regulate custom hiring so there is a big difference of rates from one provider to another. Moreover, the lack of regulation does not guarantee high quality service, so that some services are not guarantee at the right time and there are many cases of poor quality services, for example in some cases there were grains cracking in threshing and so on.

From the providers' prospective, the biggest problem come from the lack of governmental support so that almost all providers are providing their services informally. There is a need for facilitating credit availability and concessional loans from the banks. This would not only provide initial capital, but also assist in the provision of spare parts and maintenance services. Moreover, the system is very disorganized so that there is high competition in some places, but in others is very difficult to provide services also because farmers are not requesting services in advance. The other two big difficulties encountered are the lack of qualified operators and the difficulties in collecting service fee especially during tillage. Nonetheless, some innovative providers have recently started to collect

service charges in terms of kind during threshing, milling etc.

IV. Suggestions and Recommendations

Given the above-presented limitations, the author would like to provide a list of suggestions. They are here presented by: government's needed actions, role to be played by farmers and providers.

i. Government

First of all, the government should play a greater role in the promotion of custom hiring. Service providers should be recognized as major stakeholder in promotion of sustainable agricultural mechanization. In order to enable a better environment for custom hiring, the government should undertake the following steps:

1. Develop an appropriate legal framework to recognize and register service providers. This will be sustained by the creation of a database. A monitoring system should regulate the provision of services and charging fees. There is the need to fix a maximum rate of service in consultation with leader farmers and service provider.
2. Establish credit lines with major banks and aviate a subsidy policy for the purchases of machines.
3. Work on capacity development for providers on selection, procurement, operation and maintenance of agricultural machinery, record keeping and service management and marketing skill.
4. Promote R&D activities on appropriate models of custom hiring. This might include demonstration of innovative and efficient agricultural machinery through custom hiring

service providers. Innovative and best custom hiring service provider should be awarded.

5. Human resource development both for operators and technicians. As custom hiring service provider can also be promoter of improved agricultural technology, they should also be trained in improved agricultural technologies.

6. Lastly, consider insurance schemes both for machines and operators.

ii. Role of farmers

It is very important that farmers remodel their operational habits. For instance, agricultural operations should be planned in advance so that they can inform the service provider in advance and the fields are maintained in good operational conditions. Also they should be able to keep a record of services. Generally the production system needs to be commercialized. To do so, farmers need to start to process in farm itself, get information about the new technology available to service providers.

iii. Role of service providers

Similarly, service providers should prepare complete and updated business plans that include technical, financial, marketing and seasonal planning. This will also facilitate record keeping for provision, maintenance and clientele. It is important that they focus on quality service and business profitability. In order to do so, they should integrate ICT for communication to customer and other service providers for timely and quality service. Furthermore, service providers should be organized and create a network to share the problems and lobby the government for favorable policy.

Pakistan

Status of Pakistani Custom Hiring of Agricultural Machinery

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Dr. Syed Ghazanfar Abbas is an Agricultural Engineer from University of Agriculture, Faisalabad, Pakistan. He has completed his M.Phil and Ph.D from Massey University, Palmerston North in New Zealand. Dr. Abbas has lots of international exposure when he has worked with FAO-HQ, Italy, Rome, and in Iraq. He has also taken up various assignments for UNIDO in Afghanistan and in Sudan. Dr. Abbas is working with Pakistan Agricultural Research Council since July, 1985 and currently he is the Director (Farm Mechanization) of Plant Sciences Division of PARC. Before joining PARC, he has worked for private tractor manufacturing company in Pakistan from 1980 to 1985. Dr. Abbas is an associate Member of Club of Bologna, Italy, which is an Agricultural Machinery Manufacturers Association established in 1987. Dr. Abbas carries lots of technical as well as managerial experiences spread around 33 years.

I. A General Picture of Pakistan's Agriculture and Farm Mechanization

Pakistan is basically an agricultural country and almost 70% of Pakistani economy is based on agriculture. The agricultural sector contributes 21% of GDP, employees 43.7% of the total work force. Moreover, the agricultural sector serves as a major supplier of raw materials to industry and as a market for industrial products, and contributes substantially to Pakistan's export earnings. The four major crops (wheat, rice, cotton and sugarcane) on average contribute 31.1% to the value added in overall agriculture and 7.1% to GDP.

In consideration of the role of machinery in modern farm operations, increasing credit availability through the banks has encouraged the use of machinery. The majority of the machines are being manufactured in the country. Two major tractor manufacturers have achieved 85% deletion on parts of their different horsepower range of tractors. The number of tractors has increased from 400,446 in 2004 to 572,688 in 2010. During July 2013 to March 2014, 25,186 tractors were produced in the country. The total farm power in the country is 23.01 million kW, whereas the total cultivated area is 22.75 million hectare. Hence 1.01 kW power is available for one hectare of land.

At present, farm mechanization is limited to crop production. Its scope needs to be expanded to introduce technologies for proper drying and storage of grains, and processing units for value addition to agriculture produce at the farm / village level. There is a great potential to export fruits and vegetables if efforts are made in proper curing / pre-cooling, sorting / grading and packaging of fruits and vegetables at the farm / community level.

II. The Significance and the Status of Custom Hiring in Pakistan

Most farmers are of the view that the farm machines are an expensive input and it is neither affordable nor economically continent to own equipment, particularly for small and medium landholders. Thus, there is already a trend of renting out tractors with tillage implements, sprayers and wheat threshers by individual farmers to their neighbors. Similarly, renting of combines by individual farmers is also broadly practiced.

However, the operators of farm machines have got no formal training and lack of basic operating and maintenance skills. This is not only harmful for operators but also limit desired benefits of mechanization. There is a common complaint on the

poor quality of work by the farmers using the rental services. There is more grain loss with combine harvesters and poor application efficiency of sprayers because of their inefficient use. There is also internal injury to paddy grains resulting in poor head rice recovery by using reconditioned wheat combine harvesters without paddy kits and improper adjustments.

III. Pakistani Government's Supporting Policies

There is no specific policy for agricultural mechanization in the country. However, the government is supporting the farmers by developing and disseminating innovative farm machines through research and development initiatives.

To promote mechanization in the country, the government is providing loans facility for purchasing tractors and other farm machines by the farmers. The government is committed to continue its efforts to promote sustainable agricultural mechanization by:

- Continue the provision of machinery on cost sharing basis;
- Provide training to the farmers and end-users;
- Assist in banking loan facility;
- Promote tax rebates on agricultural machinery;
- Provide higher per acre yield incentive in-term of machinery;
- Contribution of NGOs for promotion of machinery; and
- Organize demonstration, exhibition of agricultural machinery to the farmers and manufactures.

IV. Social and Economic Benefits of Custom Hiring in Pakistan Agriculture

The farm mechanization has impact on both social as well as on economic benefits of farmers. It is a tool for modernization of agriculture that acts as a crucial factor influencing farm productivity both directly and indirectly and had tremendous effect on peoples' way of life. Farm mechanization generates greater cropping intensity and as such improves productivity. The efficient use of scarce agriculture resources and accelerated agriculture mechanization is, therefore vital and demand comprehensive strategic planning for the future that shall lead to:

- Enhance land and labour productivity;
- Decrease cost of production;
- Increase value additions in farm produce by introducing post-harvest technologies; and

- Minimize various crop production operations through provision of implements to the small farmers.

V. Challenges and Constrained Pakistan Faces in Promoting Custom Hiring

Pakistan faces the following constraints in farm mechanization that need to be addressed:

- Increasing cost of inputs;
- Inadequate custom hiring services;
- Non-availability of capital;
- Tractor sales depend on institutional credit;
- Limited use of farm implements;
- High initial and maintenance cost of the pressurize irrigation system and inadequate knowledge / skills at farm to operate the system;
- Lack of standard and quality products;
- Small land holdings and poor economic condition of farmer; and
- Insufficient / non availability of rice transplanting, sugarcane harvesting and cotton picking machinery.

VI. Solutions and Suggestions for Improving Custom Hiring in Pakistan

In light of the above presented points, the author wishes to suggest the following actions:

1. The existing capabilities of public sector agricultural mechanization R&D institutions should be strengthened;
2. There is a need to establish R&D institutes;
3. The National Network for Agricultural Machinery (NNAM) should be re-activated identifying researchable issues and then prioritize those as per market demand;
4. Suitable machinery shall be developed for livestock sector;
5. The scope of agricultural mechanization R&D should be extended to processing agricultural produce for value addition and use of alternate energy sources;
6. Print and electronic media should be used for promotion of agricultural mechanization technologies by developing and adopting simple informal videos;
7. There is a need to establish a centre of excellence in the country in order to improve and maintain quality of locally produced agricultural machinery, provide useful information on performance of the imported machinery, and facilitate enforcement of Pakistan Standards; and

8. Private sector should be encouraged for:

- i) Initiation of in-house agricultural machinery R&D activities;
- ii) Improvement of quality and standard of their products for meeting international requirements;
- iii) Improvement of their manufacturing set-ups in order to manufacture machines and implements according to international market demand at competitive production cost; and
- iv) Establishment of agricultural mechanization services provision, especially of costly agricultural machinery to the end-users.

Sri Lanka

Custom Hiring Practices in Sri Lanka

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Dr. Bandara is the Chief Engineer of the Department of Agriculture of Sri Lanka. Dr. Bandara has 31 years experience in the field of farm mechanization, especially in the testing & evaluation of farm machinery. He obtained Bachelor's Degree in Engineering at University of Moratuwa, Sri Lanka, and Post Graduate Diploma in Farm Mechanization at National Agricultural College in Netherlands. Dr. Bandara is the Chartered Engineer and Member of the Institute of Engineers in Sri Lanka. He has obtained professional trainings from various renowned organizations including International Rice Research Institute (IRRI) in the Philippines, BRAIN in Japan, DEULA in Germany, and TBIC in Japan. He is responsible for all engineering-related activities such as development of infrastructure facilities, maintenance of seed storage facilities and for development of farm mechanization activities.

I. Situation of Farm Mechanization in Sri Lanka

Sri Lanka has a written history of more than 2500 years, and it has been an agricultural based economy since the beginning of its civilization. Hand tools and animal draught implements were used in the cultivation of the staple crop rice and moved gradually to mechanization. Similarly, nowadays the reasons for moving toward mechanization include the need of meeting the increased demand of food, the need to find an alternative to labor intensive work, because the cost of labor is continuously increasing.

As labor migrates away from agriculture, the productivity of those who remain on the land needs to increase significantly. Actually, the percentage share of labor employed in agriculture decreased from 47% of total employment in 1990 to 36% in 1999. Such a low level of performance puts rural Sri Lanka on a collision course with demographic projections that foresee the need for agriculture to absorb over quarter million new workers by 2010. This shortfall can be only filled by mechanization, the only alternative of labor.

The world agricultural scenario indicates that food security is the paramount concern of every nation. All technological advances in both developed and developing countries must gear towards increasing food production. Both the large-scale,

specialized commercial agriculture and small-scale mixed semi-subsistence types of agriculture play vital roles to attain this objective. However, the average operational farm size in Sri Lanka is 1.0 hectare where as in Asia it is ranging from 1 ha to 3 ha.

II. Status of Custom Hiring in Sri Lanka

There are several kinds of custom hiring systems being operated in the country. The most common type of machines involved in custom hiring are four wheel tractor, combine thresher and combine harvester. The size and type of machines are different from region to region depending on the plot size, land holding capacity and the propaganda of the machinery suppliers. Table 1 provides an overview of the most commonly used machines in custom hiring and their average hiring rate per hour.

Table 1: Average Hiring Rate

Operation	Hiring rate (\$)
Ploughing	120 – 140 / ha
Reaping	95 – 115 / ha
Threshing	25 – 30 / ha
Combine harvesting	200 – 235 / ha

III. Supporting Policies

Most of the agricultural machines imported into the country are 100% free of import duty. This policy has been introduced to minimize the price of farm machinery and also to encourage farm mechanization activities in the country. Moreover, government and private banks operate soft loan schemes for machinery purchase. Custom hiring providers can enjoy these facilitations. Nonetheless, at the present, specific subsidiary packages or any other type of special assistance for custom hiring are not provided.

IV. Social and Economic Benefits

Proper usage of agricultural machinery via custom hiring, the farmers and the country in turn would have the following benefits.

- The agriculture will become an attractive livelihood for younger generations;
- Cost of production will go down and profit margin will be increased;
- Will be able to maintain quality of agro produce;
- Crop yield and farmer income will be increased due to increased cropping intensity and reduced losses;
- Water use efficiency will be increased by farming in time; and
- Healthy and happy farming community will be established and maintained.

V. Challenges and Constraints Faced

Custom hiring practices are not properly regulated, so that farmers rarely enjoy the benefits of new technology. The present system of custom hiring does not reach the objective of mechanization. Moreover, several machinery owners are reluctant to rent out their equipment, because of some social

problems resulting from the use of the machines. There are many problems that can be observed in custom hiring system, both for farmer as well as for the machinery owners. Specifically:

- The limited availability of hiring machines at close proximity to the farmers, united with insufficient machines to carter the demand;
- High and inconstant hiring charges, united with financial hardships during the peak periods;
- Only high profit margin machines are available; and
- Excepted quality of work is not guaranteed (for example, in combine harvester operations rate of grain loss is high as 20% - 30%).

VI. Solutions and Suggestions

At the present, individuals carry out hiring of farm machinery and this service is not so effective and not properly organized. Therefore, government intervention is essential to provide sustainable, efficient and reasonable hiring facilities. A few decades ago, the government controlled tractor-hiring units that were not sustained. After introducing tractors to the farmers, they were closedown due to inefficient management and, especially, poor maintenance of the machines. Thus, it is suggested to establish government supported private machinery hiring units. The units can rent directly to farmers or to farmer's organizations. The machines made available by these units should match the capacity of the respective area. The machines kept at each hiring center should be selected based on the needs of the center's respective areas. The hiring centers shall rent the machines to operate by the farmers themselves or with the operators.

Lastly, the government should regulate hiring rates and modes of charging according to the regulatory system included in the proposed farm machinery act.

Thailand

Status of Custom Hiring in Thailand

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Mr. Thepent obtained his Master Degree in Food Processing Engineering in 1985 from the Asian Institute of Technology. He has worked as a Researcher in the Agricultural Engineering Research Institute, Department of Agriculture since August 1980. He is responsible for conducting research on the development of agricultural machines, agricultural process and providing technologies and services to government and private agencies. He has held the position of Director of Postharvest Engineering Research Group since 2003.

I. General Information on Agricultural Mechanization

At the present, most of the agricultural equipments used in Thailand is locally produced, such as tractor, power tiller, disc plough, disk harrow, water pump, sprayer, threshing machine, reaper, combine harvester, cleaning equipment, dryer, rice milling machines, and processing equipment etc. However, local machines produced from small manufacturer, are not standardized in quality, efficiency and durability.

Mechanization plays a very important role in the present agricultural production of Thailand. Labor shortage and the necessity to reduce production costs have obviously shown off. Undoubtedly, the demand for agricultural machinery will remarkably increase during next ten years. Nonetheless, the need of machines will differ from region to region. Sophisticated control-intensive machines such as harvester, transplanter, planter and powered sprayer will be highly needed by farmers in more progressive regions, such as the central plain and the lower part of the north. At the same time, labor intensive machines, such as single axle two-wheel tractors, water pumps and manual operated sprayer will keep expanding in the north and northeast.

Compared to other crops, mechanization for rice production is the most developed. The central plain region is nearly fully mechanized, while other regions are rapidly catching up.

II. Status of Custom Hiring

Currently, there are two forms of utilizing agricultural machinery: as machine owner and machines hiring service. The ratio of machine owner to machine hiring service depends on size, type and price of machine or equipment. Most farmers own the small and inexpensive machines, such as two-wheel tractor, water pump and chemical sprayer etc. Regarding four-wheel tractors (attached with rotovator for land preparation) and power thresher, only 6.4% and 6% of total machines were

possessed by farmers. However, there still are a number of farmers who have small holding area or in the remote rural area. Not only they are unable to possess farm machinery, but also can not call for the hiring service because their production is too small.

Custom-hire contracting for large equipment in Thailand proven to be a reliable and appropriate service for most farmers. More than 99% of combine harvesters are operated on custom-hire service basis. Generally, Thai farmers do not need to invest heavily to own an expensive machine; farmers normally own only small machines. Following this trend, mechanization for agricultural production will keep expanding and will catch up with the requirements of farmers.

III. Supporting Policies

There is no declared policy on farm mechanization by the government of Thailand. After understanding the role played by mechanization in the agricultural development process of many neighboring countries, the government started to formulate specific policies. These includes determining priority needs, selection of suitable agricultural machines, research and development, dissemination of information and extension services, provision of credit, coordination of activities, training of farmers, extension agents, and manufactures, and assistance for manufacturing and on the farm use of mechanization inputs.

Policy and strategies for agricultural mechanization are not usually explicitly stated in the National Development Plan, as they are part of the overall agricultural development policies. Nonetheless, custom hiring was first mentioned in the VI National Economic Development Plan (1978-1991) as long-term policy goal.

IV. Social and Economic Benefits

As mentioned before custom-hire contracting with large farm machinery in Thailand is a very successful system that frees farmers from the need of purchasing large and expensive equipment.

The custom-hire services for rice combine harvesters are used and popular among the farmers in the irrigated areas. Generally, farmers that have irrigation facilities grow rice twice or more a year; these fields are soft and deep clay soil and are in the central part of Thailand. However, custom hiring services are more popular in other parts, because of labor shortage, especially in the northeastern part to avoid losses for local rice varieties, which must be harvested at proper time.

The advantages of custom hiring include: increased utilization of machine; reduced fixed cost for holding machine; increased option to use high performance machine for increasing production efficiency; and addressing the labor shortage issue.

V. Challenges and Constraints faced

Custom hiring operations are challenged by several factors, specifically:

- Generally, the rice combine harvesters for custom hire service are transported to the field by truck or tractor-trailer, this is a big investment cost for the owner. Transportation of the machine on the road is a serious problem, because the total width of the machine is more than the width

of the truck and such width is in violation of the highway traffic rules. Therefore, the contractors have to pay ransom during travelling on the highway, which also increases the hiring charges of the machines.

- One of the common problems faced by both contractors and farmers are frequent breakdown of the components of rice combine harvester. The replacement and repair of which needed a considerable time and effort; and these are one of the most serious drawback of the machine for effective operation.
- Serious accidents were reported while working in the field with rice combine harvester. The main reasons for their occurrence were the operator's skill, machine design, and the condition of surroundings. Direct drive rice combine harvester which using the belt – pulley and chain – sprocket mechanisms in their transmission system, is one of the reasons of accidents. The operator had many accidents due to failures in the other moving parts of the machine such as clogging in the re-threshed grain auger and front auger.

VI. Solutions and Suggestions.

In Thailand, there is urgent need to improve the quality of agricultural machinery via implementing compulsory testing and certification.

In addition, to develop custom hiring services, it is important to promote capacity building activities for farmers and operators for efficient use of agricultural machinery. Moreover, increased knowledge on using, repair and maintenance will increase usage efficiency and reduce repairing and maintenance costs. Specifically, training for operators of big size, high price and high performance agricultural machinery is very much needed.

Lastly, custom hiring should be further promoted in every region.

The Philippines

A Conceptual Framework for the Enabling Environment for Custom Hiring of Agricultural Machinery

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I. General Information on Agriculture and Mechanization

In the Philippines, rice production operations are predominantly done by human, with the aid of hand operated tools, like dike repair, planting, fertilizer application and spraying, harvesting and sun drying. While, plowing, harrowing, threshing and milling are predominantly done using man-machine systems which are mechanically-powered while leveling after harrowing is mainly done by man-animal system.

For the production of rice, two-wheel tractors are most popular in tillage and transport operations, while very few farmers are using four-wheel tractor. The use of combine harvesters is still picking-up, while mechanical threshers are utilized in most farms. Rice milling is done off farm with rubber-roll rice milling equipment as the predominant equipment used.

In the past years, the government has greatly promoted agricultural mechanization. In 2013, the Philippine Center for Postharvest Development and Mechanization (PhilMech) has calculated the available farm power for rice and corn at 2.31hp / ha; while the average power for all farms at 1.23 hp / ha.

II. Status of Custom Hiring

Few progressive Filipino farmers who own two wheel tractors have started practicing custom hiring. After utilizing machines in their own farms, they rent out the units to other farmers in the area. SANRAM enterprise in Laguna is one of the service providers for land preparation and threshing. Benito M. Domingo (BMD) of Cornworld provides a larger scale of hiring services. The enterprise provided services for land preparation, planting, spraying and harvesting use 4-wheel tractors, large planters, sprayers, and harvesters for corn production in the area. Another group of farmers from the San Ramon & San Agustin Farmer Cooperative (Bula, Camarines Sur) is providing services to their members and non-members in the area for rice drying using mechanical dryers and rice milling using rubber-roll.

These are just few of the current modes for agricultural machinery custom hiring services in the country. There are other farmer-cooperatives, private-led and government-led institutions that provide custom hiring services. The demand for custom hiring services can be shown in the study of

Amongo et. al. 2013.

Tables 1 and 2 shows the percentage of farmers availing of custom hiring services for different operations in the production, postproduction of rice and corn in selected regions of the Philippines. The farmers either hire machine or man-animal system to perform the operation.

Table 1. Percentage of Farmers Availing Custom Hiring Services in Rice Production / Post Production Operations in Selected Regions in the Philippines

Operation	Camarines Sur Region V		Iloilo Region VI		Leyte Region VIII		Oriental Mindoro Region IV	
	Machine %	Animal %	Machine %	Animal %	Machine %	Animal %	Machine %	Animal %
Seedling Preparation	15.63	7.29	1.04	2.08	37.89	38.95	16.84	5.26
Irrigation	5.21		2.08		4.21		4.21	0.00
Plowing	35.42	13.54	30.21	18.75	20.00	52.63	26.32	7.37
Harrowing	30.21	19.79	32.29	3.13	60.00	17.89	23.16	12.63
Leveling	6.25	46.88	9.38	36.46	2.11	66.32	6.32	26.32
Weeding							22.11	
Harvesting					1.05		41.05	
Threshing / Bagging	53.13		55.21		72.63		41.05	
Hauling Farm to Road	1.04	2.08	1.04	2.08	3.16		2.11	17.89
Hauling Road to Storage	4.17	1.04	6.25	1.04	22.11	1.05	7.37	
Drying	2.08		8.33		4.21		1.05	
Transportation	5.21		1.04		24.21		0.00	
Milling	52.08		31.25		73.68		18.95	

Source of basic data: Amongo et al. (2013) – UPLB-PHilMech Project

For rice production / postproduction operations, tillage (plowing and harrowing) operations are done using two wheel tractors. Only in Region IV (Oriental Mindoro) utilized four wheel tractors (90hp capacity) for tillage operation. Threshing is mostly done by a machine powered with 10-12hp single cylinder engines while rice milling is done using rubber-roll rice mills powered by multi cylinder engines (3K). Only in Region IV and VIII used rice combines for harvesting operation. Depending on the machine used to perform the operation, rental fees for tillage operation ranges from P 1,200-P 1,800.

Table 2. Percentage of Farmers Availing Custom Hiring Services in Corn Production / Post Production Operations in Selected Regions in the Philippines

Operation	Camarines Sur Region V		Iloilo Region VI		Leyte Region VIII	
	Machine %	Animal %	Machine %	Animal %	Machine %	Animal %
First Plowing	9.38	50.00	3.13	13.54		
First Harrowing	7.29	50.00	2.08	7.29	1.05	
Furrowing		66.67		43.75		
Cultivation - Hilling Up		34.38		6.25		25.26
Cultivation - Off Barring		4.17		3.13		1.05
Dehusking	3.13					
Hauling - Field to		20.83	8.33	19.79		
Hauling - Road to	3.13	8.33	11.46	4.17	5.26	
Hauling - Road to	3.13	8.33	11.46	4.17	5.26	
Shelling	73.96		67.71		2.11	
Drying - Before Shelling	0.00		1.04		1.05	
Drying - After Shelling	10.42		4.17		2.11	
Transportation	2.08		50.00	4.17	63.16	
Milling			1.04		75.79	

Source of basic data: Amongo et al. (2013) – UPLB-PHilMech Project

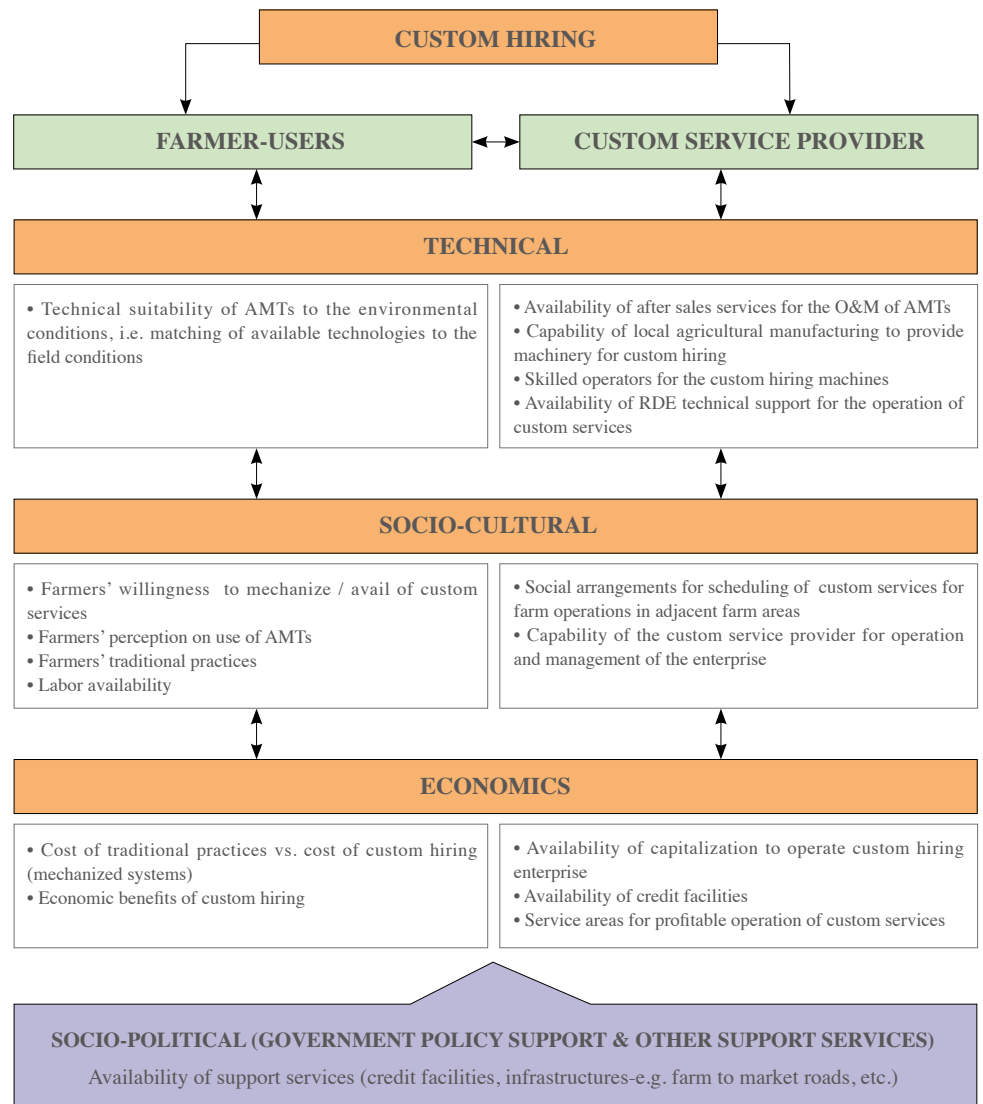
For corn production and post production operations, tillage operation is done using two wheel tractors while the most prevalent machine for custom hiring is the corn sheller, practiced by all regions in the country. Corn mills are widely used especially in corn eating areas (Region VII).

Given right facilities and infrastructure, there are very promising possibilities to expand custom service operation in the country. Currently, its wide adoption is limited due to, among others, lack of credit facilities and loan windows to these kind business ventures. Although the government is advocating this concept and providing credit programs through the Department of Agriculture (DA), Department of Science and Technology, and Department of Trade and Industry, it still needs to work more on these issues. Loan deals are not very accessible; and the interest rates on loans especially in private lending institutions are not conducive for business.

III. Conceptual Framework for the Enabling Environment for Custom Hiring of Agricultural Machinery

This section explores the factors that might influence the success of custom hiring activities. Figure 1 depicts a conceptual framework for enabling the right environment for custom hiring of agricultural machinery. The framework consists of the interrelated and interconnected factors (i.e. technical, social, socio-economics and socio-political) that will contribute to the successful implementation of custom hiring of agricultural machinery enterprise.

Figure 1. Framework for Enabling the Right Environment for Custom Hiring of Agricultural Machines



The important stakeholders of the custom hiring services are the farmers-clients, custom service providers of agricultural machinery, R&D institutions, manufacturing industry, agricultural machinery dealers, private sector, non-government organizations, civic organizations and government support services.

i. Farmers as Beneficiaries of Custom Services

Technical suitability of agricultural machines

Farmers' decision to avail of custom services may be influenced by various factors such as the technical suitability of the available technologies to suite the farmers' field conditions (farm size, topography and availability of irrigation facilities, etc.). For instance, the use of mechanical rice transplanter could only be applicable to lowland rice production systems.

Farm size

Larona (2006) indicated that farmers find it more beneficial to mechanize as their farm size increases since manual labor requirement and cost of production also increase.

Farmers' traditional practices

Farmers' traditional practices should also be considered in establishing custom services. Farmers' may not readily change their practice unless they are socially prepared to do so. Thus, in establishing custom services in an area, rapid rural appraisal is necessary to determine farmers' practices and their machinery preferences, and the actual field conditions – to match the custom services to be provided

Farmers' preferences on use of agricultural machines

Based on the UPLB-PHilMech survey conducted by Amongo et al. (2013) for 4 provinces in the Philippines, the top 5 operations which rice and corn farmers preferred to mechanized are indicated in Tables 3 and 4, respectively.

Results of the study of Amongo, et al. (2013) showed that land preparation, planting, harvesting, and drying are the major rice and corn operations that farmers would like to mechanize. Moreover, the study noted that ownership of large agricultural machines was low and that “there was a good indication that when farmers opted to use agricultural machines, they preferred hiring rather than owning the machines.”

Labor availability

Another social issue in establishing custom services is the possible displacement of farm labor when farmers resort to mechanized systems and / or custom services. However, Lantin et al. (2003) noted that agriculture should not be viewed as sink for employment since the gains that could be generated from farming activities (such as farm labor) is not enough to improve the quality of life of landless farm workers. Other alternative income opportunities should be provided for landless farm workers such as establishment of agro-processing enterprises, training opportunities for possible employment in urban areas, among others.

Table 3: Rice Farm Operations Which Farmers Preferred To Mechanize.

PROVINCE	RICE FARM OPERATIONS
Camarines Sur	Harvesting, planting, drying, weeding, and fertilizer application
Iloilo	Harvesting, planting, drying, weeding, fertilizer application
Leyte	Drying, harvesting, plowing, threshing, weeding
Oriental Mindoro	Harvesting, harrowing, plowing, threshing, and levelling

Source: Amongo, et al. (2013)

Table 4: Corn Farm Operations Which Farmers Preferred To Mechanize.

PROVINCE	RICE FARM OPERATIONS
Camarines Sur	Plowing, harrowing, harvesting, cultivation, and furrowing
Iloilo	Drying, harvesting, dehusking, planting, and fertilizer application
Leyte	Plowing, shelling, planting, harrowing, and harvesting

Source: Amongo, et al. (2013)

Cost of mechanized system vs. traditional practices

The cost of mechanized system versus traditional system may influence farmers’ decision on whether to resort to custom services or retain traditional practices in performing the different farm operations. According to Larona (2006), the major reasons of corn farmers for joining clustering and custom services facilities of a cooperative in Cauayan City were: reduction in production cost; improved production performance; the availability of support services to cooperative and the clustering of farms as a government-supported project; and farm operation efficiency. In the same study and based on 2006 data, the cooperative’s comparative computation of net income was PhP 22,210 for a fully mechanized while PhP13,045 / ha for farms using traditional practices. The increase in income was realized due to reduced labor and input costs.

Economic benefits of custom services

In Table 5, Villa Luna Multipurpose Cooperative (VLMPC) – a coop-based custom service provider for land preparation, planting fertilizer application and harvesting computed some of the quantifiable benefits per hectare from custom services for corn farm operations (specifically, from fully mechanized system) against traditional farm practices. The results showed a reduced labor and input cost and consequently production cost; higher net income; and higher return on investment (VLMPC data as cited by Larona, 2006)

Table 5: Comparative Analysis of 1.0 Hectare Corn Production, Traditional Practice vs. Fully-Mechanized Operations, Cauayan City, Isabela, 2006

ITEMS	TRADITIONAL PRACTICES	FULLY MECHANIZED SYSTEM
A. Labor costs	13,530.00	9,700.00
B. Material (inputs) Cost	13,925	14,090
C. Total Cost of Production / ha	27,455	23,790
D. Yield (metric tons)	5.0	5.0
E. Price / kg (PhP / kg)	8.10	8.10
F. Gross income (PhP / cropping season)	40,500	48,600
G. Net income (PhP / cropping season)	13,045	22,210
H. R.O.I. (%)	47.51	93.36
I. Income advantage (%)		70.26

(VLMPC, Cauayan City data as cited by Larona (2006)

ii. Custom Service Provider

Technical suitability of agricultural machines for custom services

Custom service providers may opt to use locally available agricultural mechanization technologies or imported ones. However, for either type of machines technical suitability is an important criteria for machine utilization. This is an area where technical support of R&D institutions is needed to assist custom service providers matching the machines to the existing farm conditions.

Availability of after sales services

Custom service providers need to be assured of after sales services for the operation and

maintenance of farm machines. This will ensure the sustainable use of agricultural machines especially for operations, which have prescribed scheduling pattern, like land preparation, planting and harvesting. For instance, it is very common that planting window for many areas is only two-four weeks. Farmers would opt to plant within schedule to be synchronized with other farmers since their crop will be susceptible to pest infestation with late planting. Thus, it is crucial that the machines of the custom services providers are always functional with the availability of after sales services meeting farmers' operation schedule.

Local manufacturing

The local agricultural manufacturing industry may be able to help hasten implementation of custom services through adoption and modification of existing machines that will be required by the custom service provider. Local manufacturers as possible sources of machines should provide the necessary training for the skilled operators of custom service providers.

Social arrangements for scheduling of custom services

Proper scheduling of operations in adjacent farms is necessary to reduce operational costs on the part of custom service providers. Larona (2006) noted that utilization or hiring of machines by farmers will require social and institutional arrangements, whereby farmers' cooperation for synchronized operations can be made.

Similarly, scheduling is also important component in the custom services in terms of prioritization of service areas. When machine operators enter the service area, they need to finish the custom services before transferring to another area to save cost and on time (Larona, 2006).

Operation and management of custom services

Result of the perception survey and focus group discussions conducted by Lantin et al. (2003) showed that important criteria on the choice between machinery pooling and custom services is the area coverage for economy of scale and the financial capability of the cooperative to maintain equipment for machinery pooling / custom services. In the same study of Lantin et al. (2003), more respondents favored custom hiring than machinery pooling due to lower investment and maintenance cost in custom services. For both machinery utilization schemes, respondents suggested the importance of discipline, case-to-case management, information campaign and government support. The stakeholders should be able to

evolve and develop their own model based on the existing socio-economic and bio-physical characteristics of the area with technical assistance from the government and private sectors (Lantin et al., 2003).

iii. Government Support & Other Support Services

A strong policy, institutional, infrastructural and other support services will help contribute to the successful implementation of custom hiring services.

Policy support is comprised of government implementing rules and guidelines as stipulated in the RA 10601. Support services consists of the various support systems which are also indicated in RA 10601, to include, among others: development of business plans, feasibility study for the establishment of custom hiring services, conduct of rapid rural appraisals / assessment to determine the machinery requirements in the area where custom services will be established, training of skilled operators for agricultural machines and the implementation of large scale farming where land consolidation concepts can be modelled along side with custom services. Credit facilities and loan windows for those who would venture into custom services business should also be readily available.

The institutional infrastructure for agricultural and fisheries machinery service centers will comprise of the interconnected institutions such as government and private institutions (e.g. DA and other government agencies, manufacturing sector, R&D institutions, among others), custom hiring services enterprises, its farmer clients, and the mechanisms (such as social arrangements by which custom hiring services will operate efficiently).

IV. Challenges and Constraints

There are many challenges and constraints in the establishment and implementation of custom hiring services. The major constraints include:

i. Machinery Requirement Applicable to the Service Area

There are no current studies that would match machinery requirement with the actual production or service area. A master plan for the service area should be considered by the service providers to prevent low utilization of machines in actual field operations. For example, Andales et al. (2013)

indicated that in Isabela province, a primary agricultural province for rice and corn, four wheel tractors and combine harvesters are now prevalently used as a result of the uncontrolled growth of custom hiring services for land preparation and combine harvesting. As a result, there is now a surplus of 4W-tractors and combine harvesters in the province. Moreover, the custom service providers travel to neighboring province to increase utilization of their machines and provide custom service to farmers at lower rates. On the other hand, other major rice and corn areas in the country are still utilizing man, man-animal and man machine systems as source of power in the farm with only intermediate mechanization technologies such as 2w tractors and rice reapers.

ii. Payment Scheme

Payment schemes should be established to ensure that farmers will pay the custom service provider for its services. Andales et al. (2013) reported that difficulties to collect payment from the farmers due to the custom service provider was encountered by the joint Buscayno-Taiwanese Project in Tarlac and Nueva Ecija. Instead of paying the service provider at harvest time, farmers sell their products to traders who offer higher prices. Due to this problem of non-collection, the Taiwanese backed out of the business. Andales et al. (2013) also cited that the PhilRice-ACEF project on custom services encountered this problem as well.

iii. Other Problems Encountered

Andales et al. (2013) also noted that the PhilRice-ACEF (Agricultural Competitiveness Enhancement Fund) Project encountered problems of schedule of irrigation water releases, machine inefficiencies and delays in custom services, ineffective and inefficient collection of service payments resulting in about 30% collectibles; reduced service area of operation due to changes in priorities resulting from changes in policies of new administration officials of DA and / or PhilRice; and concomitant re-structuring of the loan amortization due to reduced revenue in the project operation (Andales, S.; Gagelonia, and Abauag, 2011).

Moreover, differences in field sizes, shapes and orientation will constrain the efficient operation of bigger machines. The lack of field access for large machines like tractors, planters and combine harvesters, will prevent the entry and utilization of machines in these farm areas.

In terms of postharvest facilities, it is a very common scenario that in production areas, drying and milling facilities are usually unavailable. Farmers have to travel to the town having their crops dried and milled. This poses additional cost for transport on the part of the farmers.

There are agricultural machines that require proper field water control and efficient irrigation and drainage system to facilitate the use of agricultural equipment / machines such as planters, tractor, weeders, among others. In the case of combine harvesters, it is imperative that the field is not water logged and that the soil is not soft so to operate these machines efficiently. Otherwise, because of size and weight, combine harvester may bog down due to soft soil and will not be functional accordingly.

V. Conclusion and Recommendations

The successful implementation of custom hiring services of agricultural machines will depend upon the appropriate interplay of various interconnected and interrelated factors contributory to the operation and management of custom hiring services of agricultural machines.

At the farmers' level, important considerations for providing custom hiring services will be farm size, technical suitability of the agricultural machines, farmers' preferences, capability to pay, social preparation and acceptability of the project, traditional practices, timeliness of custom services according to farmers' schedule.

Prior to the operation of the custom hiring services, providers need to conduct rapid assessment in the targeted area of operation. The service provider will also need technical R&D assistance to determine the suitable machines for the area. To establish the custom hiring services as an enterprise, technical assistance is also needed on the preparation of business plan and feasibility study to apply for credit to start up the business. Moreover, institutional and physical infrastructures should be in place for the custom hiring services. More importantly, providers should be able to determine the optimal service area and implement proper scheduling of custom services, to optimize traveling cost to the coverage areas.

To prevent disruptions in the operations of the machines, providers should also be able to have access to after sales services of the machine they have acquired for the business

operation, either from the local or foreign manufacturers. Moreover, during the operational stage, providers should require trained and skilled operators especially for high investment machines for proper maintenance and operation during peak custom service operations.

More importantly, providers should be able to implement a mechanism that will assure collection of fees from custom services to sustain the business operation.

Vietnam

Status of Custom Hiring in Vietnam

Dr. Nguyen Quoc Viet

Head

Department of Science, Training and International Cooperation

Vietnam Institute of Agricultural Engineering and Post-harvest Technology



Dr. Viet holds a PhD. from the Vietnam Institute of Agricultural Engineering and Post-harvest Technology (VIAEP). He graduated from the Faculty of Machinery, Technical University in Brno, the former Czechoslovakia, with Specialization in Internal Combustion Engines, Tractors and Automobiles in 1980. Dr. Viet specializes in agricultural land preparation machinery, farm tractors and internal combustion engines. He worked twenty-one years as Researcher of the Land Preparation and Farm Power Machinery-Tractors and Engines Division of VIAEP. Currently, he is the Head of Department of Science, Training and International Cooperation of VIAEP. He also serves as Secretary of the Institute Science and Technology Council.

I. General Information on Agriculture and Mechanization in Vietnam

In recent years, with the growth of agricultural production, mechanization in agriculture has significantly developed. Several stages of production have been highly mechanized, contributing to solve the problem of hard labor and seasonality, and improving productivity, quality, efficiency and reducing agricultural losses.

The average mechanization rate through five stages such as land preparation, planting, crops-care, harvesting and agro-products preservation for each type of crop has been improved. However, according to 2013-statistical data, the level of agricultural mechanization in Vietnam in terms of available mechanical power is still low, with only 1.6 hp / ha of arable land, including the Mekong River Delta (the region has highest rate) with 1.85 hp / ha compared with other Asian countries such as Thailand, South Korea and China.

II. Status of Custom Hiring

Before 1986, owners of agricultural machines and equipment were mainly state-owned enterprises. They are now moving to private ownership and households. Providers of mechanization services include agricultural cooperatives and private enterprises.

Private households own 94% of four-wheel tractors (with capacity more than 35 hp), 98.5% of 12-35 hp tractors, 99.7% of two-wheel tractors (with capacity under 12 hp). The rest belongs to enterprises, cooperatives, and farms (as of 2007-statistical data). Organizations that are able to provide services in mechanical tillage, harvesting, threshing, drying, storage of grain, efficient transportation were initially formed in rural areas, especially in the Mekong River Delta and Red River Delta.

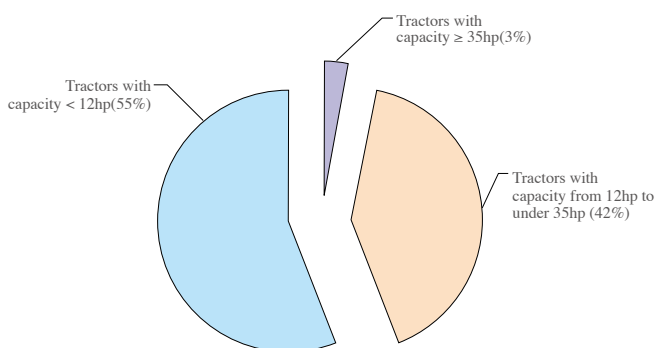
As of 2013, the number of agricultural machines used in agriculture increased by 7% on average. Quantity of some machines increased quickly, such as tractors by 1.5 times compared with 2006, while harvesters by 4.3 times (primarily in Mekong River Delta, accounting for 75% of harvesters in the whole country, increasing up to 18 times).

The "land consolidation" policy had initially achieved positive results, the average number of plots from 6.8 plots / household dropped to 4-5 plots / household. At this scale, most of small-sized agricultural machines can serve effectively. On average, 100 agricultural households own 1.05 four-wheel tractors (with capacity more than 20 hp) and 2.4 two-wheel tractors (with capacity ranging 8-18 hp).

Farms are potential places to apply machines serving agricultural production. Currently, on average, there are 4 four-wheel tractors (with capacity more than 20 hp) and 5.2 walking tractors (with capacity about 8-18 hp) as well as 1-2 units of water pumps over 100 farms; many farms are using small diesel generators and initially running biogas generator.

Engine and agricultural machinery markets in Vietnam are being developed rapidly, of which domestically manufactured machinery shares approximately 40%, providing diversified categories, relevant to the needs of the regions.

Figure 1. The level of Tractors Used in Agricultural Production



Source: Department of Processing for Agro-Forestry-Fisheries Products and Salt Production-MARD, 2014

Moreover, systems of agricultural machinery services through stores and selling agents and logistics are growing very fast. These services are largely operated by private cooperatives, accounting for about 80% of the service providers.

III. Social and Economic Benefits

Agricultural machinery helps to solve the shortage of seasonal workers, in line with the policy of economic and labor restructuring, brings about higher efficiency compared with manual labor. Currently, along with facilitation of advanced rural and agricultural production development in the model of large fields, demand for investment in agricultural machinery is increasingly high across the nation.

Considering the Mekong River Delta, more than 10,000 combine harvesters are available to meet harvesting activities for about 60% of rice area throughout the region. Harvester machine costs only 2.1 to 2.5 million VND / ha, 0.5 to 0.9 million VND / ha lower than manual labor; harvest losses reduced from 5-6% via manual labor to 2% by harvester machine.

IV. Challenges and Constraints Faced

Climate change, causing flooding and drought, affects the application of machinery in the field. Dispersed agricultural production at small scale, and low efficiency limits the application of machinery and modern technologies. Land for agricultural production is fragmented and dispersed, agricultural infrastructure and rural development in many regions are poor, causing difficulties to apply machinery and equipment into production. In many areas, labor force in agriculture still accounts for a large proportion of old people and women; the progress of labor restructuring is slow; and income from agricultural production is low. The quality of machines and equipment for agricultural production manufactured by Vietnam manufacturers is still low.

V. Solutions and Suggestions

In order to develop custom hiring, it would be beneficial to consider reorganizing production towards centralization and intensification to form large-size fields for promoting efficient use of the agricultural machinery and equipment. Households, cooperative groups, and agricultural enterprises could all be specialized in agricultural engineering services (including land preparation, harvesting, repairing and equipment services, parts and supplies, consulting services, etc.) and services in drying and preservation of agricultural commodities.

Moreover, facilities and infrastructure in agriculture and rural areas should be improved. Measures such as planning, renovation, leveling the field, strengthening systems of irrigation and drainage should be considered.

Lastly, Vietnam agricultural cooperatives shall operate as a business organizations. This means that they do not go under Cooperatives Law, but follow business rules. Cooperatives will lease machinery or provide services as enterprises. To do so, it is essential to invest in advanced equipment (for example through preferential loans) for specialized business services including agricultural cooperatives.

The promotions of different models at a pilot scale, to accumulate experience, should be an important first step to expand custom hiring activities in Vietnam.



A landscape photograph showing terraced hills. The hills are covered in a mix of brown and tan soil, with some green grass. In the foreground, a small tree with white blossoms stands on a rocky outcrop. The background shows more hills and some trees.

III. Case Studies of the Service Providers

Photoed by Liang Shengren

Bangladesh: The Metal (Pvt.) Ltd

Mr. Humayun Kabir

Senior Manager: Business Development
The Metal (Pvt.) Ltd
Bangladesh



I. Introduction of the Metal (Pvt.) Ltd.

Custom hiring exists since the very primitive stage of agricultural operations, when farmers shared machines with neighbors. Now it has evolved into a form of business. Initially, we would provide just hiring services, we rented the machines

in the neighboring areas, but this form of business differs from custom hiring. Nowadays, we provide custom hiring services. Table 1 shows the hiring fees of my company expressed both in USD and BDT. For example, we rent 4 wheels tractors at a rate of 86 US\$ per hectare and 2 wheels tractor at a rate of 100 US\$ per hectare.

S/N	Name of Machinery	Use of Crops	Charge (BDT. / ha)	Charge (USD. / ha)
1.	4 Wheel Tractor	Rice (2 pass)	6,670.00	86.00
		Wheat (2 pass)	6,670.00	86.00
		Potato (4 pass)	13,340.00	171.00
		Maize (2 pass)	6,670.00	86.00
		Mustard (2 pass)	6,670.00	86.00
2.	2 Wheel Tractor	Rice (3 pass)	7,780.00	100.00
		Wheat (3 pass)	7,780.00	100.00
		Potato (6 pass)	15,560.00	200.00
		Maize (3 pass)	7,780.00	100.00
		Mustard (3 pass)	7,780.00	100.00
3.	Irrigation Pump	Rice (Full Time)	33,590.00	430.00
		Wheat (3 Times)	8,890.00	114.00
		Potato (3 Times)	8,890.00	114.00
		Maize (3 Times)	8,890.00	114.00
4.	Rice Transplanter		7,410.00	95.00
5.	Rice Thresher		3,950.00	50.00
6.	Wheat Thresher		4,940.00	64.00
7.	Maize Sheller		6,000.00	77.00
8.	Combine Harvester	Rice	12,350.00	158.00
		Wheat	14,820.00	190.00
9.	Transportation up to 5 km (round trip)		1,000.00	13.00
10.	Transportation for 5 km to 20 km (round trip)		1,500.00	20.00

II. Problems and Suggestions

Nowadays, one of the biggest problems we encounter is transportations of the machines since the infrastructural capacity of the rural areas is very limited. In addition, farmers are reluctant to use our machines because they think that using the tractors on their land can damage the soil. When introducing combine harvesters, it is a very big problem to move it from one place to another where the land is very fragmented. In spite of road issue, it is very difficult to reach rural villages since no electricity there.

Another problem we face is the lack of support policies from the government; there are no subsidies for rural development. There is need to establish concessional credit lines. Now the interest rate of loans is more than 15%, which makes it extremely difficult to purchase any new machines.

China: Beijing Xingnong Tianli Agricultural Machinery Cooperative

Mr. CHEN Ling
Chairman
Beijing Xingnong Tianli Agricultural Machinery Cooperative



I. Introduction of Our Cooperative

After graduating from agricultural machinery school, I worked several years as a teacher in my Alma Mater and spent some other years in an agricultural machinery company. Given the rapid development of agriculture and rural economy, I quit my job and opened an agro-machinery store providing also agro-machinery maintenance and custom hiring services. After the Law of the People's Republic of China on Farmers' Professional Cooperatives came to effect in 2007, together with eight farm machinery-owning households, I established the Xingnong Tianli Agricultural Machinery Service Cooperative.

Beijing Xingnong Tianli Agricultural Machinery Service Cooperative was founded in 2008 and is located in Qiansangyuan Village, Zhaoquanying County of Shunyi District, Beijing. With a total asset of 51 million RMB, the cooperative has 312 households as members, 281 units of farm machines and 400 facility greenhouses. Besides, it owns an area of over 30,000 mu (2000 ha) for crop production and 500 mu (33 ha) for seedling fruit trees. Our service covers 135 villages in 30 townships of 9 districts or counties in 5 provinces and municipalities, and has helped 5,000 farming households increase crop production and income.

Our main business areas include: custom hiring, machine part supply, machinery maintenance, and growing crops, flowers, fruit trees and greenhouse fruits and vegetables.

Our major machines include: tillage, sowing, plant protection,

fertilization and harvesting machines.

II. Introduction of Our Operation Model

Below you can find a list of the services we offer:

1. Ploughing and planting for farmers. This is the most basic form of our operation.
2. Crop care service. By this one-stop service, farmers only need to make plans for crop growing and wait for harvest. All the services including ploughing, planting, managing, plant protection, applying pesticides and harvesting are done by the cooperative and harvests are owned by farmers.
3. Land-based shares. From "small land owners" that plow and plant by themselves, farmers became "shareholders" who draw dividends and don't have to care about production and operation. In recent years, by signing land transfer contracts with village units, our Cooperative has rent 6,300 mu (420 ha) of land from over 1,000 farmer households that used to operate on their own; by signing contracts directly with farmers, we have rent around 6000 mu (400ha) of land. In the mean time, land transfer could bring about 1,200 RMB per mu to farmers and facilitate the transfer of rural surplus labor. Our cooperative gives preference to offering jobs for farmers who transferred their land. At the moment, we've provided employment in the Cooperative to over 100 farmers. Besides, our cooperative also organizes farm machinery technology training and has provided a number

of professional farmers with modern technologies.

After pooling the land owned by members of the Cooperative, we have had unified agricultural materials, machinery operation, management, plant protection, harvest, sales and branding while growing high-yield and new varieties and carrying out large-scale machinery operation. In this way, we can give full play to the advantages of large farm machines, reduce planting cost and improve land efficiency and market competitiveness. Before the land transfer, 6,300 mu (420 ha) of land was managed by 1,000 farmer households as their concurrent business; now land management only needs 65 Cooperative members, with a per capita average of 100 mu (6.67 ha). Through land transfer and large-scale operation, grain output and farmers' income have been remarkably improved, especially with grain yield and labor productivity greatly raised.

4. Cross-region operation. Since China is a huge country with a latitude spread of 50 degrees, the growth period of crops are distinctly different. By making use of the time difference, we organize machinery operation in different regions, including Anhui Province, Shandong Province, Hebei Province, and Tianjin at south of Beijing and Inner Mongolia at north of Beijing. Each year, the cross-region operation lasts around 2 months.

III. Experiences in Our Cooperative's Development

From the beginning, we enjoyed preferential policies. The Chinese government provides subsidies on machinery purchase, seeds, fertilizers, pesticides, and some interest payment of loans, as well as some free greenhouse plant protection tools and tax exemption for cooperatives. Relevant government-affiliated departments including agro-technology extension stations, agro-machinery extension stations and soil and fertilizer stations also provide us with technical support on an irregular basis.

Moreover, the government offered preferential policies to launch projects in cooperatives. For instance, the demonstration of agricultural satellite positioning system, extension and experiment of new technologies and varieties of corn and wheat, demonstration of new water-saving irrigation technologies for crops and eco-agriculture demonstration parks.

Previously, rural households were working in individual family units. A household with 8 mu of land needs to put in long-term labor to earn about 10,000 RMB in a normal year. After adopting large-large-scale operation, productivity has been greatly improved and surplus labor could be shifted to the secondary and tertiary industries, which has helped boost

farmers' income.

Moreover, we tried to enhance training and improve personnel quality. Human resource is the most important resource. Training could increase employees' sense of ownership, improve their general capacity, productivity and service quality, so that they could be more competitive on the market and more adaptable to market changes.

Also, we cooperate with universities and explore complementarity. By cooperating with China Agricultural University, the Cooperative has improved its technical capacity and provided a platform for the University through which their technologies could be applied in the industry.

The sustained development of Xingnong Tianli Cooperative comes from innovation, including innovation of its operational and management model. Back in 2012, when the Cooperative already had over 80 employees, we began to introduce a business-like management style, such as making rules, establishing departments, clarifying responsibilities, and identifying incentives and disincentives. Moreover, the Cooperative also has technological innovation. We have succeeded in the application of 6 national patents through agro-machinery R&D.

IV. Difficulties & Constrains

The major difficulties encountered by our business are listed below:

1. Talent shortage.

First, young people are badly needed. Over 75% of our employees are over 45 and less than 25% are under 45. Secondly, we are in lack of professionals with rich experience and knowledge.

2. Management needs to be improved.

We need to enhance training of management staff and make short-term and long-term plans as well as periodic summary.

3. Market awareness is yet to be enhanced.

We've been paying attention to our advantages, but need to do more in identifying market demand and managing client relations.

In conclusion, we are fully confident of the future development of custom hiring in China and we will keep doing it. With huge support from the government, we are full of confidence for our future achievements.

India: Zamindara Farmsolutions Pvt. Ltd., FAZILKA (Punjab)

Dr. Vikram Aditya Ahuja

Director

Zamindara Farmsolutions Pvt. Ltd., FAZILKA (Punjab)



Originally, I have started this business because my company was stuck with a lot of unsold tractors and equipment, so we started to rent out and decided to switch our business into this model. In the past 8 years, we have been trying to standardize our work procedures. Nowadays, Zamindara Farmsolutions uses a combination of library model and radio taxi model. In the library model, all the machines are parked in the same place, farmers come, take the machine, use it and return it; while the radio taxi model works through a call center. The farmers can reach us at our call centers and we send the requested services.

We also provide extensions services. In the Indian model, universities develop new equipment that is supposed to be provided to farmers by extension services of the state Agricultural Department. Usually new technologies do not reach the farmers, but when they have professional service providers like us, the whole process is facilitated.

We rent out a wide range of machines including tractor 4x4 WD, trencher, fodder, direct paddy seeder, laser leveler, turbo happy seeder, sub soiler, rice transplanter, bed maker, gen set, front loader & back hoe, pit digger, precision and many others.

In a previous stage we used to hire personnel, but now village based staffs and rural entrepreneurs provide all our services. Owners, that are our junior partners, organize the ultimate delivery to farmers. Obviously, junior partners have to follow a code of conduct and provide a minimum standard of services.

The challenges regard the high initial costs, in my opinion, to resolve this problem, farmers should pay 1% of the cost for every month they work. For example, if your machine is used for six months you should pay 6%. Any rate over that is not sustainable. I am a supporter of no subsidies. In our system, when farmers apply for subsidies, they get a certain amount related to the amount of acres they own. The problem is that they still need to invest a lot of personal finances for a machine that will probably end up using 6 to 8 hours a year. Instead of giving subsidies, the government should offer a machine at a very low interest rate to a service provider and 100 farmers use the same machine.

To date, Zamindara Farmsolutions is associated with more than 5,000 families that have started to take tractors and implements on rent. For the first time, people have started High Tech Equipment like RMB ploughs and sub soilers.

Thanks to a project funded by Bill & Melinda Gates Foundation, we were able to train farmers that have purchased balers. Not only they earned money, but also protected the environment. We were able to control the burning of fields and substantially reduce it. Moreover, 800 village youth got employment on custom hiring of residue collection machines.

Also, with the help of US Aid we just started a training school for partners and operators, we even trained entrepreneurs from several African countries. In this structure we are training to standardize procedures, I would like to suggest CSAM to develop a similar institution where member countries could work on the standardization of custom hiring practices.

I believe custom hiring can be the key for a second green revolution and the government can help this vital sector by including agricultural equipment for hiring in this sector priority list. Moreover, a favorable tax structure for this sector could be developed, like lower excise rates for cars to be used in the taxi segment. Like the benefits offered to hospitality & tourism sector for import of vehicles / machines.

Indonesia: Agro Service (Pvt) Ltd

Mr. Abdul Basyir

Administrator
Central Java Farm Machinery Rental Association
Indonesia



UPJA Tani Makmur, my company, aims to provide quality services to members in term of fairness, equity, right timing and sustainability based on harmony and prosperity. Similarly to other countries, Indonesia agricultural sector suffers from small size of farmland ownership (0.4-0.9 ha / farmer household), lack of education, skills and capital of farmers and infrastructural limitations. Nonetheless, custom hiring can provide services from land preparation to post harvest, promote farm management innovations and create networking opportunities among clients such as farmers' groups, and farmers water users associations, etc.

There are several factors influencing UPJA's development, they can be divided in internal and external factors. Internal factors that contribute to the crucial importance of custom hiring include managerial ability, technical ability of operator, service quality, financial support, availability of spare parts support, discipline of the member, and financial and management transparency.

External factors include effectiveness and efficiency utilization of the machine, potential of land, young generation involvement, skill and knowledge improvement, spare part availability, operational management regulation, and good networking with farmer group. This last factor is particularly important because UPJAs needs clients to achieve optimum coverage area of the machine, financial support of day-to-day operation and investment to increase number and type of the machine. To this end, we concentrate a lot of our efforts in fostering business relations with farmers' groups, individual machinery owners, machine producers, and finance institutions.

Sri Lankan: Agro Service (Pvt) Ltd

Mr. S. A. Anwar
 Entrepreneur
 Agro Service (Pvt) Ltd
 Irakkamam



I. General introduction to Agro Service (Pvt)

Agro Service (Pvt) started large scale machinery hiring in 2007 with two-wheel type combine harvesters and four-wheel tractors. Mr. Anwar started to rent four-wheel tractors for supporting combine operations and then realized that this business was very attractive.

To date, the company owns five large-scale combine harvesters (one track type and four-wheel type), it employs 12 operators on seasonal basis and covers about 600 ha in Maha and 525 ha in Yala season, that means that in a year Agro Service (Pvt) is able to cover over 1000 ha.

Generally the main income comes from hiring combine harvesters.

II. Problems and Constraints

In the past years, several providers started this business, so Mr. Anwar is now facing very high competition, up to more than 500 providers. This caused a drastic reduction of rates that went from 116 US\$ per ha to about 58 US\$ per ha. Profit margin became extremely low, which influenced also by other factors, such as rising of labor wages, fuel cost and increased repair and maintenance costs and the need to involve a broker. Another problem is the introduction of new technology,

because now track type combines are preferred over wheel type due to the bogging of the fields.

III. Institutional Support

The government of Sri Lanka supports agriculture by waiving duties from imported machines. Moreover, training facilities are available, but not utilized well since people are not aware of the existence of these services. However, the majority of the capital invested is on a leasing base, and even if there are natural catastrophes or other problems, the rate has to be paid. Given the rising frequencies of floods and droughts, this is becoming an increasingly important problem.

IV. Suggestions

In order to further facilitate the development of custom hiring activities, Mr. Anwar suggested the following points:

- Promote the organization of association for machinery hiring entrepreneurs;
- Introduce mechanism to approach farmer directly without the middle man;
- Train operators in government institutes;
- Provide concessionary loans; and
- Support to select appropriate machinery.



IV. Recommendations and Way Forward



Recommendations and Way Forward

INTRODUCTION

This section is developed upon the best practices presented at the 2nd Regional Forum on Sustainable Agricultural Mechanization in Asia and the Pacific, held in Serpong, Indonesia on 9-11 September 2014. It contributes to the proceedings by providing recommendations and way forward for sound development of custom hiring and other modalities and practices of sharing farm machines and implements in the region enabling farmers, particularly small-holders, to benefit from agricultural mechanization. It presents a list of priority areas that need to be carefully considered by public and private sectors as well as regional and international organizations to establish an environment in which custom hiring can flourish.

In the circumstances of shrinking agricultural population and increasing rural labor costs in almost all countries in the region, custom hiring can bring multiple benefits, particularly to small and marginalized farmers, in terms of access to technology, economic affordability and profitability, as well as commendable social impacts. Custom hiring increases the accessibility of agricultural machinery, a carrier of technologies, otherwise too costly or too complicated to be reachable for many farmers. From an economic point of view, custom hiring brings down the average costs of using machinery and equipment and therefore makes agriculture more profitable. Custom hiring reduces drudgery and physical workloads and offers rural agribusiness and employment opportunities, among other social-economic benefits. In essence, as Mr. Zhao Bing, Head of CSAM, put it, custom hiring is a natural and inherent part of sustainable agricultural mechanization.

Overall, custom hiring operators in the region face some common external and internal challenges and constraints in their practices. First of all, they usually do not obtain sufficient and consistent

support from the governments in terms of tax exemption / reduction, low interest loans, or provision of credit and subsidies. Secondly, poor rural infrastructure and fragmented land holding restrict the scaling-up of custom hiring in many countries. Thirdly, information on the supply and demand of custom hiring service, as well as lack of access to repairing and maintenance, are common bottlenecks. Fourthly, the market development of custom hiring service is, in some cases, impeded by lack of proper laws and regulations, leading to unfair competition and sub-standard services. In addition to these external constraints, custom hiring businesses face internal challenges as well, such as limited operation capacity, and lack of capital and human resources. Ms. Rosa S. Rolle, Senior Agro-Industries and Post-harvest Officer of FAO Regional Office for Asia and the Pacific, highlighted that the challenges of custom hiring operators was to provide quality and competitive service to meet the market demand and to make themselves survival and profitable in such not very favorable environment.

Drawing from the information and knowledge shared during the Forum, particularly the experience and lessons learned from the countries in the region, a set of recommendations are synthesized below for public and private-sector stakeholders to consider as they are making new efforts to address the aforementioned challenges and constraints.

I. PUBLIC SECTOR

Public sector in any country is crucial to providing legitimacy, resources, and direction⁷. These include: budget powers; the strong role of public-funded research; legitimacy; ability to coordinate across sectors; the legal responsibility; and the power to make laws and to enforce those laws⁸. Commitment and resources of the public sector on rural infrastructure development is the pre-condition of machinery leasing business, for example, the availability of roads, telecommunication, electricity and fuel, and so forth. When it comes to promoting custom hiring practices, the following measures have proved pivotal from the experiences of member countries.

i. Develop National Sustainable Agricultural Mechanization Strategy (SAMS)

Sustainable agricultural mechanization shall be underscored as one of the priorities in a country's agricultural and rural development strategy due to its prominent role in improving agricultural production, productivity and profitability. Public sectors of member countries shall formulate and implement national agricultural mechanization strategies outlining framework and guidance for supporting policies, investment and interventions. Furthermore, without a national strategy, it is barely possible to achieve coordination and cooperation among various agencies of member countries, which is essential for the sound development of sustainable agricultural mechanization.

In order to ensure the persistence, purposefulness, information-richness, inclusiveness and flexibility of the national strategy⁹, concrete investigation and intensive involvement of key stakeholders to frame the issues and solutions shall be applied in the whole formulation process. Pilot programmes are recommended to collect sufficient empirical evidence before large-scale implementation. In addition, continual monitoring and adjustment of the strategy shall be undertaken to address

⁷ Dovers, Stephen, 2005, *Environment and Sustainability Policy*, The Federation Press, Sydney, p18-38.

⁸ Peters, BG and Pierre, J, 2003, *Handbook of Public Administration*, London: Sage.

⁹ Dovers, Stephen, 2005, *Environment and Sustainability Policy*, The Federation Press, Sydney, p18-38.

uncertainty as well as the complex and interdependent linkages with other economic and social strategies.

It is evident from the presentations and discussions of the Forum that countries with successful custom hiring schemes largely benefited from solid national agricultural mechanization strategies.

ii. Review Legal and Regulatory Frameworks

The legal and regulatory frameworks of member countries shall be reviewed in order to ensure that they facilitate the development of an enabling market environment for custom hiring.

Security of land rights safeguarded by proper legal framework is a fundamental element for increasing local incentives for investment in agriculture, in mechanization, and in custom hiring itself. Land rights can be politically sensitive issues and a wide range of options, from full formal title to legally-backed customary and informal tenure and other mechanisms at the community level, can be employed to promote higher levels of tenure security.

Meanwhile, it is extremely important that government authorities formulate and enforce laws that give formal recognition of custom hiring businesses, and nurture and regulate the market. These measures may include: 1) establishing official recognition and registration systems; 2) implementing tax-free / reduction arrangement; 3) conducting supervision and putting in place penalty schemes for sub-standard services and malignant competition; 4) enforcing compulsive testing requirements to safeguard the quality and performance of machinery and the safety of operators; and 5) regulating and standardizing service charges to protect both farmers and service providers. It will also be helpful, as suggested by some participants of the Forum, if eligible custom hiring service providers can be formally recognized as Small and Medium Enterprises (SMEs) and therefore enjoy the preferential policies offered in many countries.

iii. Implement Supporting Policies for Custom Hiring

Under the umbrella of national mechanization strategy, a series of supporting policies to encourage the practice and extension of custom hiring and other modalities of sharing machinery shall be developed and implemented. They may include:

- Provision of financial supports

On one hand, starting a custom hiring business implies heavy initial investment and constant maintenance; on the other hand, farmers, particularly small-holders, often find themselves financially overstretched to pay the service providers in timely manners. Financial schemes provided by both central and local governments can be a critical bridge to close this gap and sustain custom hiring businesses. These may include exemption and/or concession of taxes, waiving import/export duties and road toll fees, matching grants for use of machinery services, down payment subsidy, low interest loans and other alternatives. In addition, accepting agricultural machinery and other farm

assets as collaterals for loans can also be financially helpful.

- Strengthening supporting services for custom hiring

Good custom hiring schemes require various supporting services from the public sector. Testing and certification of machinery and equipment by the governmental agencies and easy access to related information will help minimize or avoid investment losses of service providers. Connecting supply and demand is another crucial domain for public sector to support custom hiring. Meanwhile, information about the quality, quantity and other features of the service providers would be very useful when farmers choose the services. Furthermore, creditable and accessible repair and maintenance services are also indispensable for both farmers and service providers. The repair and maintenance services in general need to be improved in many parts of the region, both in terms of quality and coverage. In addition, the public sector should implement effective advocacy of custom hiring through organizing pilot projects, demonstrations and extension activities.

Modern information and communication technologies (ICT) can assist in these supporting services, including analysis of supply and demand dynamics, real-time information on tariffs, weather conditions, and fuel and machinery status. Information systems can also be integrated with cropping calendars. Examples of these ICT networks include SMS (Short Message Service), social media and smart phone applications.

- Human resource development

Public sector shall allocate resources for training programmes on human resource development. The training programmes for farmers may focus on: 1) advanced agricultural planning, so that services can be scheduled in advance and the fields are maintained in good operational conditions; 2) record keeping of services; 3) appropriate machinery utilization, and etc., while training programmes for service providers can include areas such as business plan preparation; selection and procurement of machines; operation and maintenance of machines; business management; improved agricultural technologies; marketing techniques; and seasonal planning. In addition, service providers can be trained to expand the machinery renting business into other areas including the supply of seeds, pesticides, and agronomic services.

II. PRIVATE SECTOR

The private sector is the major player in the business of custom hiring of agricultural machinery. Dr. Gajendra Singh, a renowned mechanization professor in the region, pointed out that government should set up stage to let the entrepreneurs play. Supervision and support from the government is necessary, but interference into actual business operations shall be minimized. Farmers shall have freedom to select what machines to buy and whose services to get.

A first step for any entrepreneur who wish to enter this business is to conduct a proper feasibility study and assessment to determine possible business models. The study may include existing supporting institutional, fiscal and tax policies, market needs, infrastructure status, competitor advantages,

potential risks, etc. Based on the study, a business plan shall be developed to identify targeted clients, service scope, machinery types, marketing measures, payment methods, risk management plan, and so forth.

Once the business is started, the service providers shall strive to provide timely, quality, affordable and tailored services to clients. The service providers are expected to contact with the clients in advance to arrange operation schedules. Spare machinery is always desirable to deal with un-scheduled business and other contingencies. In order to address the repair and maintenance need, custom hiring providers may seek to enter into collaborative terms with dealers or even manufacturers for technical and financial supports.

Considering the clients' payment ability and the seasonable nature of agricultural production, diversified and flexible payment schemes may be devised and applied by service providers, preferably in partnership with local government and / or financial institutions. This may exert certain financial pressure on the service providers. However, if cash payment is the major constraint locally, flexible payment then becomes be the solution to maintain and expand business. In addition, sound and prudent risk management plan developed at the early stage is expected to keep the financial risk under control.

To sustain business and long-term development, service providers will need to invest in capacity building of staffs, managerially and technically. The providers could seek the assistance from the initiatives of public sector and cooperate with extension agencies and manufactures. Furthermore, forming associations/networks of the custom hiring practitioners is not only beneficial for information sharing and mutual learning but also raising its visibility and bargaining power.

Service providers can also expand its business into other areas of along the value chains, including post-harvest processing, pesticide and seeds supply, agronomic services, etc. This could help diversify and increase their income sources and address the seasonality issue of machinery renting. Business diversification, however, shall be sought in a manner that will not dilute investment or distract from its core business.

III. REGIONAL & INTERNATIONAL ORGANIZATIONS

For UN agencies such as CSAM, efforts shall be made to exert its influences in the region to raise the awareness among decision makers in member countries of the significance of sustainable agricultural mechanization and the practices of custom hiring. This can be achieved through organizing policy dialogues, facilitating information and good practices dissemination, and providing policy and technical assistance. CSAM will increase its efforts to engage more stakeholders and resources to support capacity building activities.

CONCLUDING REMARKS

An important message from the Forum was that, to create an enabling environment for custom

hiring of agricultural machinery in the Asian-Pacific region, we shall not only ‘talk the talk’, but ‘walk the walk’, as called for by Mr. Marc Proksch, Chief of Business and Development Section, Trade and Investment Division of UNESCAP, who appealed to all stakeholders to make a difference in their respective capacities. As with many other endeavors, there is no “one-size-fits-all” solution to promote the important role of custom hiring of agricultural machinery in this vast and diverse region of Asia and the Pacific. But the discussions and outcomes of the Forum, nevertheless, provided true and valuable experience and lessons from member countries, and offered guiding principles and best practices that can be used to promote custom hiring of agricultural machinery, contributing to sustainable agricultural and rural development across the whole region.





Photoed by Zhang Lian

ANNEX 1:

Summary of the Evaluation Questionnaire

In order to assess the outcome of the forum and gather feedback from the participants, CSAM asked delegates to rank their level of satisfaction in terms of logistics, topics, speakers, and content. Table 1 reproduces the questionnaire and summarizes the answers given by participants.

Out of 47 distributed questionnaires we received 27 completed forms (Bangladesh 1; Cambodia 1; China 2; India 3; Indonesia 2; Islamic Republic of Iran 1; Lao PDR 2; Malaysia 1; Mongolia 1; Nepal 2; Pakistan 2; Sri Lanka 1; Thailand 2; Philippines 2; Vietnam 2; FAO 1; ENAMA 1)

Table 1: Level of Satisfaction of the Responders

I. Objectives			
A. The objectives of this Forum were clearly set out.			
Excellent	19	70%	
Above Average	7	26%	
Average	1	4%	
Below Average			
Extremely poor			
B. The structure of the Forum enabled to reach the objectives.			
Agree Strongly	15	55%	
Agree Moderately	11	41%	
Agree Slightly	1	4%	
Disagree Slightly			
C. The Forum fully achieved its Objectives in general.			
Agree Strongly	14	52%	
Agree Moderately	12	44%	
Agree Slightly	1	4%	
Disagree Slightly			
D. The Forum was useful for knowledge and information sharing among participants on custom hiring of agricultural machinery.			
Agree Strongly	21	78%	
Agree Moderately	5	18%	
Agree Slightly	1	4%	
Disagree Slightly			
E. My capacity to address issues on custom hiring of agricultural machinery was strengthen through participating in the Forum.			
Agree Strongly	16	59%	
Agree Moderately	10	37%	
Agree Slightly	1	4%	
Disagree Slightly			
F. The Forum contributed to my agency having an increased collaboration and cooperation with peers from other member countries.			
Agree Strongly	16	59%	One participant did not answer this question
Agree Moderately	8	30%	
Agree Slightly	2	7%	
Disagree Slightly			

II. Effectiveness and Efficiency			
G. The overall quality and usefulness of the Forum was:			
Excellent	14	52%	
Above Average	13	48%	
Average			
Below Average			
Extremely poor			
H. The quality and usefulness of the lectures and presentations was:			
Excellent	9	33%	
Above Average	14	52%	
Average	4	15%	
Below Average			
Extremely poor			
I. The quality and usefulness of the panel discussion was:			
Excellent	11	41%	
Above Average	14	52%	
Average	2	7%	
Below Average			
Extremely poor			
J. The quality and usefulness of the handouts and documents was:			
Agree Strongly	21	78%	One participant did not answer this question
Agree Moderately	5	18%	
Agree Slightly	1	4%	
Disagree Slightly			
K. The organization of the forum was efficient.			
Agree Strongly	22	81%	
Agree Moderately	5	19%	
Agree Slightly			
Disagree Slightly			
L. The duration of the Forum was appropriate to cover all topics.			
Agree Strongly	15	55%	
Agree Moderately	10	37%	
Agree Slightly	1	4%	
Disagree Slightly	1	4%	
M. The Forum was delivered as scheduled			
Agree Strongly	19	70%	
Agree Moderately	7	26%	
Agree Slightly	1	4%	
Disagree Slightly			
N. I am willing to share and spread the information and knowledge I have received.			
Agree Strongly	23	85%	One participant did not answer this question.
Agree Moderately	3	11%	
Agree Slightly			
Disagree Slightly			

III. In spite of the designated objectives of the Forum, list other benefits you have drawn from this Forum.

Twenty delegates answered this question. The possibility to network with both the public and the private sectors has been indicated as one of the major benefit from the forum. Besides, service providers defined the forum as a good occasion to meet other service providers and exchange business models. Generally, the forum has been perceived as a good platform to forge business relations and exchange best practices with experts and professionals from the region.

IV. What other features of the Forum did you find to be effective and / or helpful?

Nineteen participants answer this question. Regarding the structure of the forum, candidates appreciated the participatory structure and the possibility to share ideas in an open discussion. Both the field visit and the informal dinner have been noted as good occasions to socialize and network. Special consideration was given to the sharing of machinery designs and the workshop on bio-based engineering and sustainability. The later has been particular appreciated by several participants.

V. What are your recommendations on how to expand the reach and impacts of the Forum?

Twenty-one delegates answered this question. Aside from the general impression that the forum needs an increased number of follow up activities, major suggestions include:

- Set up a mechanism to share documents and models (mailing list, website);
- Leave more time for group discussions and presentations;
- Provide more case studies;
- Provide more preparatory material before the forum;
- CSAM should facilitate the implementation of custom hiring in different governments by providing recommendations and follow up documents (a model to implement custom hiring; summary of recommendations; summarization of positive and negative custom hiring methods);
- Enhance the participation of end-users as contractors or selected farmers;
- Enhance the cooperation with the institutions, the universities as well as research centers; and
- Expand the specific discussion on custom hiring models.

VI. What subjects could be covered in the future Regional Forums of CSAM?

Twenty-two participants provided suggestions for future regional forums:

- Set up a mechanism for exchange of designs, blueprints, prototypes and cutting edge technology;
- Conservation agriculture;
- Extension services for small farmers (including private sector involvement);
- Precision agriculture;
- Bioengineering;
- Precision farming;
- Subsidy policy and programs (including private sector involvement);
- Farmer Training;
- Scale management;
- Small scale production of organic products;
- Labor loss in agriculture; and
- Small farm mechanization.

VII. Comments / Suggestions for improvement.

Seven participants answered this question:

- Arrange more time for country presentation and group discussion;
- Involve wider and more diversified stakeholders, including private sectors;
- Improve the communication and linkages between member countries; and
- Assist participants in the preparation of ppt in order to enhance the quality of the presentations.

ANNEX 2: Programme of the 2nd Regional Forum

Tuesday, 9 September 2014	
08:00 - 09:00	Registration
09:00 - 10:10	Opening of the International Forum on Agricultural and Bio-System Engineering 2014 (Grand Ballroom) - Mr. Marc Proksch, Chief, Business and Development Section, Trade and Investment Division, ESCAP - Report from Organizing Committee - Director of ICAERD - Opening Address – Minister of Ministry of Agriculture of Indonesia
10:10 – 11:00	Photo Session / Coffee Break / Press Conference
11:00 - 11:30	Keynote Speech (Grand Ballroom) - Potential biomass and other renewable energy to support self-sufficient energy for agricultural production and its policy - Dr. Mat Syukur, Ministerial Staff for Innovative Technology
11:30 - 12:00	- Challenge and implementation of bio-science, bio-system and bio-engineering toward sustainable bio-industrial agriculture - Dr. Robert Manurung, SITH Institute Teknologi Bandung
12:00 - 13:30	Lunch Break
13:30 - 14:00	Keynote Speech (continued) (Grand Ballroom) - Current technologies on agricultural bio-sensing engineering & the implementation of advanced-technology for agricultural production - Prof. Naoshi KONDO, Kyoto University, Japan
14:00 - 14:30	- Global Challenges: Opportunities for Agricultural and Bio-System Engineers - Dr. Gajendra Singh, Indian Agricultural Research Institute, India
14:30 - 16:00	Poster Session and Coffee Break
16:00 – 16:20	Opening of 2nd Regional Forum on Sustainable Agricultural Mechanization in Asia and the Pacific Moderator: Ms. Seta R. Agustina Welcoming remarks - Dr. Agung Hendriadi, Secretary General, Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture of Indonesia Opening remarks - Mr. Marc Proksch, Chief, Business and Development Section, Trade and Investment Division, ESCAP - Mr. LI Hong, Permanent Representative of China to ESCAP, Permanent Mission of the People's Republic of China to the ESCAP

16:20 – 17:20	<p>Keynote Speeches</p> <p>Moderator: Ms. Seta R. Agustina</p> <ul style="list-style-type: none"> - Dr. Astu Unadi, Director, Indonesian Centre for Agricultural Engineering Research and Development (ICAERD), Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture of Indonesia - Mr. Zhao Bing, Head, Centre for Sustainable Agricultural Mechanization, ESCAP - Ms. Rosa Rolle, Senior Agro-Industries and Post-harvest Officer, FAO Regional Office for Asia and the Pacific - Dr. Gajendra Singh, Adjunct Professor, Indian Agricultural Research Institute (IARI) - Dr. Sandro Liberatori, General Director, ENAMA
17:20 – 17:40	Photo Session
19:00 - 21:00	Welcome Dinner
Wednesday, 10 September 2014 (Meeting Room B)	
08:30 – 10:00	<p>Session I: Country Review (This session is to review the policies and practices of custom hiring in member countries and to share experiences and lessons learned.)</p> <p>Moderator: Mr. Marc Proksch</p> <ul style="list-style-type: none"> - Dr. Ahmmed Sultan, Director Member (NRM), Bangladesh Agricultural Research Council (BARC), Bangladesh - Mr. Saruth Chan, Director, Department of Agricultural engineering / GDA, Ministry of Agriculture, Forestry and Fisheries, Cambodia - Mr. Li Sihua, Division Chief, Production Management Division, Department of Farm Mechanization, Ministry of Agriculture, China - Dr. Kanchan Singh, Assistant Director General (Engineering), Indian Council of Agricultural Research (ICAR), India - Mr. Ali Naserinezhad, Director, Agricultural Machinery Testing Division, Agricultural Mechanization Development Center, Ministry of Jihad-e-Agriculture, Iran - Q&A
10:00 – 10:15	Coffee Break
10:15 – 12:00	<p>Session I: Country Review (continued)</p> <p>Moderator: Dr. Kanchan Singh</p> <ul style="list-style-type: none"> - Mr Kham Ouane Khamphoukeo, Director, Division of Cooperatives and Agribusiness, Department of Agriculture Extension and Cooperative (DAEC), Ministry of Agriculture and Forestry, Lao PDR - Mr. Sarif Hashim Sarif Hassan, Researcher, Malaysia Agricultural Research and Development Institute (MARDI), Malaysia - Mr. Galsanbuyan Demchigdorj, Deputy Director, Crop Supporting Fund, Agricultural Machinery Division, Ministry of Food and Agriculture and Light Industry, Mongolia - Mr. Shreemat Shrestha, Division Chief, Agricultural Engineering Division, Nepal Agricultural Research Council, Nepal - Dr. Syed Ghazanfar Abbas, Director (Farm Mechanization), Pakistan Agricultural Research Council (PARC), Pakistan - Q&A

12:00 - 13:00	Lunch Break
13:00 – 14:45	<p>Session I: Country Review (continued)</p> <p>Moderator: Dr. Syed Ghazanfar Abbas</p> <p>Country presentation</p> <ul style="list-style-type: none"> - Dr. M.H.M.A. Bandara, Chief Engineer, Department of Agriculture, Ministry of Agriculture, Sri Lanka - Mr. Viboon Thepent, Senior Agricultural Engineering Specialist, Agricultural Engineering Research Institute, Department of Agriculture, Thailand - Ms. Rossana Marie Amongo, Director, Institute of Agricultural Engineering, College of Engineering and Agro-Industrial Technology (CEAT), University of the Philippines Los Banos, the Philippines - Mr. Nguyen Quoc Viet, Head, Department of Science, Training and International Cooperation, Vietnam Institute of Agricultural Engineering and Post-harvest Technology, Vietnam - Q&A
14:45 – 15:00	Coffee Break
15:00 – 16:30	<p>Session II: Case studies by practitioners (This session is to share and identify best practices of custom hiring.)</p> <p>Moderator: Dr. Gajendra Singh</p> <ul style="list-style-type: none"> - Mr. Humayun Kabir, Senior Manager, Business Development, The Metal (Pvt.) Ltd., Bangladesh - Mr. Chen Ling, Chairman, BeijingXinnong Tianli Agricultural Machinery Cooperative, China - Mr. Vikram Aditya Ahuja, Director, Zamindara Farmsolutions PVT. Ltd. India - Mr. Abdul Basyir, Administrator of Central Java Farm Machinery Rental Association, Indonesia - Mr. S. A. Anwar, Entrepreneur, Agro Service (Pvt) Ltd, Irakkamam, Sri Lanka - Q&A
16:30 – 17:30	<p>Session III Panel Discussion (This session is to open dialogues and discussions among the representatives on the following topics)</p> <p>Moderator: Dr. M.H.M.A. Bandara & Mr. Zhao Bing</p> <ul style="list-style-type: none"> - How to create enabling environment for custom hiring of agricultural machinery? - What could be done at the regional level to promote "Custom Hiring"?
17:30 – 18:00	Wrap up and Closing
Thursday, 11 September, 2014	
08:00 - 09:00	Visit ICAERD
09:00 – 09:30	<p>Introduction of ICAERD</p> <ul style="list-style-type: none"> - Dr. Astu Unadi, Director, Indonesian Centre for Agricultural Engineering Research and Development (ICAERD)

09:30 – 11:00	<p>On-site Demonstration</p> <p>Indonesia Products of ICAERD and Private Companies</p> <ul style="list-style-type: none"> - Jarwo Paddy Transplanter - Paddy Combine Harvester 1.2m - Power Weeder for Paddy Field - Ratooning Cane Cutter - Post Harvest / Processing Machine <p>Chinese Products</p> <ul style="list-style-type: none"> - Manual rice transplanter - Rice Mill
11:00 - 12:00	<p>Visit the Mini Agricultural Exhibition</p> <ul style="list-style-type: none"> - New products of agricultural machinery - Implementing of agricultural biosystem engineering for bio-industrial model - Machinery Expo from local private companies
12:00 – 13:00	Lunch

ANNEX 3: Participants List

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