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Strategic Plan for Agricultural Engineering in Cambodia 2016-2020: Towards Modernization and Commercialization of Cambodian Agriculture

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Strategic Plan for Agricultural Engineering in Cambodia 2016-2020: *Towards Modernization and Commercialization of Cambodian Agriculture*

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Introduction

The scope of this policy brief is to introduce the strategic plan developed by the Department of Agricultural Engineering (DAEng), of the General Directorate of Agriculture, of the Ministry of Agriculture, Forestry and Fisheries of the Royal Government of Cambodia. According with World Bank data (World Bank, 2017) in the last five years Cambodian economy grew of approximately 7% Gross Domestic Product (GDP), in this context the dynamic Cambodian economy needs a productive agriculture sector, to move from subsistence-oriented and uncertainty to profitability and stability. Agricultural mechanization is thus assuming a more predominant role in due to the need to guarantee food security, promote market-oriented policies, and alleviate consequences of urban migration drudgery and water scarcity. The strategy presented in this paper builds on an analysis of the status quo of Cambodian agriculture to identify five main pillars as the key components to increase mechanization of rice field operations in Cambodia to 68% covering operations from land preparation to milling by 2020.

SECTION 1: STATUS OF AGRICULTURAL MECHANIZATION IN CAMBODIA

In recent years the contribution of agriculture to Cambodia's GDP has decreased rapidly due to the development of the service and industry sectors. As shown in the Figure 1, the agricultural contribution to the GDP decreased from 34 % in 2010 to 28.7% in 2014, whereas in the same period, the contribution from industry and services increased from 22% and 38% to 25.5% and 40.5% respectively (Ministry of Planning (MOP), 2014). Nonetheless, agriculture remains one of the most important sectors in Cambodia and represents one of the main sources of income for rural households.

Farming systems are largely subsistence-oriented and rain-fed. Agricultural production is thus characterized by uncertainty. Most systems are centered on paddy rice production, which is a staple food in the country and 84% of total area is under wet season rice (Ministry of Agriculture, Fisheries and Forestry MAFF, 2014). These circumstances restrict most of the producers to a single rain-fed rice crop per year. Other livelihood options for smallholders include rearing livestock (mostly poultry and pig production), fishing in rivers and wage employment on larger farms or plantations.

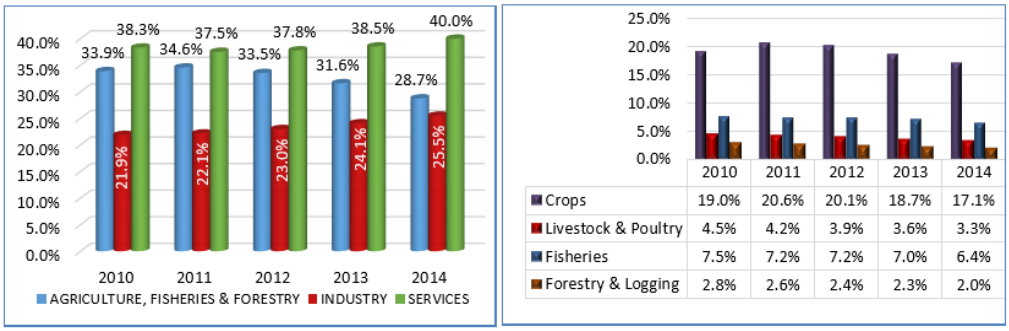

Figure 1. Share of agricultural sector and its sub-sectors in GDP from 2010 to 2014 (MOP, 2014)

The key to unlocking the values in rice-based farming systems is to increase productivity and diversify into higher value activities, both at farm-level and particularly at the post-production stages of the value chain. In order to increase income of smallholder households, agriculture will need to intensify and lower the cost of production, diversify towards higher value products, and ensure that farmers and enterprises are competitive and well-integrated with rapidly growing urban and international markets.

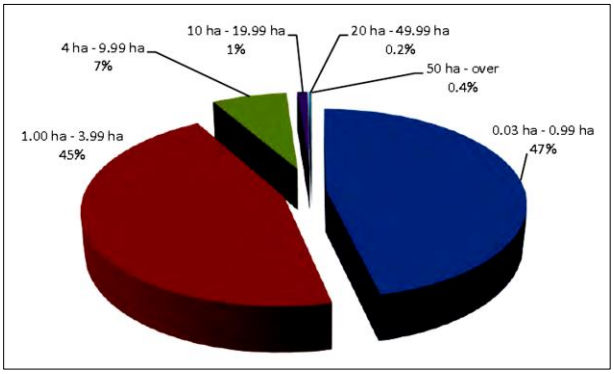

Figure 2. Percentage of agricultural holdings with separate lands by size of holding (Co-operative Association of Cambodia, 2013)

Agricultural mechanization in Cambodia has been increasing widely since 1990s especially in land preparation, irrigation, threshing, and harvesting. The increasing rate of tractors during the last 10 years was about 13% per year (4,247 units in 2006 and 11,960 units in 2015). Nonetheless, in light of the recent labor shortages, there is an increased need of modern agricultural inputs such as machinery. However, the promotion of agricultural mechanization in Cambodia is constrained by a number of factors including:

- **Scattered policies and strategies:** lack of clear policy and development plan of agricultural mechanization as well as lack of supporting laws and regulations to effectively implement its mandate in order to enhance the capacity in manufacturing, assembling, repairing, and trading of agricultural machinery and equipment following technical standards;
- **Human resources in demand:** skilled workforce is still inadequate in agricultural mechanization at both national and provincial levels. No specific staff is responsible for agricultural mechanization below provincial level. The personnel of DAEng declined sharply and there has been only 1-2 new staff allocated to the department per annum. The shortage

of engineers in Cambodia makes it difficult to push forward the mechanization initiatives at the district and sector levels.

- **Limited operational and maintenance skills*:*** repair and maintenance are some of the major constraints in promotion of farm machinery.
- **Missing link between actors*:*** the relationship between public and private sectors has not yet been strong. Generally, the private sector is reluctant to share business information fearing that the released information will benefit their competitors and erode their own profits. Currently, there is no association of existing agricultural manufacturers. Meanwhile, external support and cooperation with development partners on agricultural mechanization are still missing.
- **Limited funding:** DAEng has been making every effort possible to deliver its mandate with fairly good results. However, this effort has remained limited. The vast majority of rural farmers have not benefited from such efforts due to lack of financial support. The annual budget allocated by the government to DAEng is limited. Development partners, NGOs, and credit institutions have not provided and prioritized their support in agricultural mechanization sub-sector. There is no credit scheme from the government to buy farm machinery and equipment.

SECTION 2: THE PILLARS OF THE MECHANIZATION STRATEGY

The vision of the Royal Government of Cambodia (RGC) is to transform Cambodia into a "rice basket" and a major rice-exporting country in the global market. In this regard, the RGC has set the year 2015 as the target year to: (1) achieve paddy surplus of more than 4 million tons and achieve rice export of at least 1 million tons; and (2) ensure the international recognition of Cambodian rice. The strategy is based on the short and immediate term by focusing on promoting paddy production to meet market demand and promote rice export by shifting from the informal export of paddy to a formal rice export. Then the medium and long term vision focuses on enhancing competitiveness in rice export through: promotion of production technology; management of soil fertility; management of water; seeds and fertilizers; organization of farmer associations; quality rice processing; physical infrastructure; land use management; short- and long-term credit; and trade facilitation[1]

The "Agriculture Sector Strategic Development Plan: 2014-2018 (ASDP)" prepared by the Ministry of Agriculture, Fisheries and Forestry (MAFF) in May 2015 in order to achieve the RGC's strategic goals as well as National Strategic Development Plan update 2014-2018. The overall goal is to increase agricultural growth to around 5% per annum through improvement of the agricultural productivity, diversification and commercialization, and livestock and aquaculture farming by considering of sustainable forestry and fisheries resource management.

The ASDP 2014-2018 defined MAFF's main **policy goals into four "basic pillars" as follows:**

- **Pillar-1:** Enhancement of agricultural productivity, diversification and commercialization;

[1]Even though, the target of 1 million tons has not been achieved by the end of 2015. The figure stood just over half a million (538,396 tons). Meanwhile, the climate-resilient rice commercialization sector development program funded by the Asian Development Bank (ADB) targeted to increase paddy production to 9.5 million tons by 2018 and increase rice export 1.2 million tons by 2018 and the Cambodia Rice Federation is developing its five-year strategic plan and set a new target for rice export at 1.5 million tons by 2021.

- **Pillar-2:** Promotion of livestock and aquaculture;
- **Pillar-3:** Sustainable Fisheries and Forestry Resources Management; and
- **Pillar-4:** Strengthening the institutional capacity and increasing efficient supporting services and human resource development.

The pillars are set to achieve through the implementation of **5 priority programmes**:

1. Programme-1: Enhancement of Agricultural Productivity, Diversification and Commercialization;
2. Programme-2: Promote Animal Production and Animal Health;
3. Programme-3: Sustainable Fisheries Resources Management;
4. Programme-4: Sustainable Forestry & Wildlife Resource Management
5. Programme-5: Strengthening Institutional Capacity, enhancing efficiency of supporting services and Human Resource Development.

The **key actions to overcome challenges** related to agricultural mechanization are:

1. Conduct research, experiment works for improvement of agricultural machinery and equipment supporting agricultural production chains and agricultural processing, which will be affordable by the users and suitable for different kind of crops, soil condition, geographical area.
2. Conduct technical training and dissemination on operation and maintenance of agricultural machinery and equipment to both government staffs at national and sub-national level and farmers through provision of training courses, demonstrations, and agricultural machinery supporting activities.
3. Improve cultivation on land and farm irrigation system while technical standard in order to increase productivity and profit as well as be resilient to climate change.
4. Develop and disseminate relevant legal and technical documents for development and management of agricultural machinery.

It is envisioned that by 2020 at least about 67.78% of rice field operations will reach mechanization level from land preparation up to milling in Cambodia.

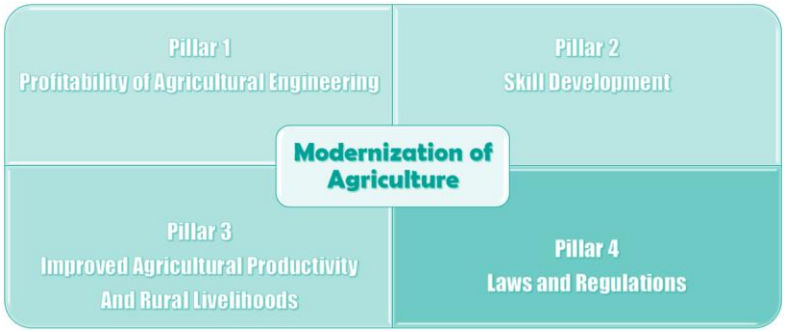

Figure 3. Strategic objectives of agricultural engineering development for Cambodia

Pillar 1: Enabling Profitability of Agricultural Engineering

Given the diversity in terrain types of Cambodia, the appropriate choice of mechanized inputs in farm operations have significant effects on agricultural production and productivity, the profitability of farming, and on the environment. Ultimately, the farmer and other end users should make a decision on the usage and the levels of mechanization options.

Improving Supply Chains

Several market studies on the supply chains of agricultural machinery and equipment will be periodically disclosed to inform relevant players about the current situation and forecasts. It is essential to improve the data collection channel to ensure quality and accuracy of the data collected. A national machinery database shall be established and accessible by relevant stakeholders. Meanwhile, DAEng shall actively continue to involve in the United Nations Centre for Sustainable Agricultural Mechanization initiative of regional database of agricultural machinery in Asia and the pacific.

Financing

Facilitation of access to credit represents an important strategy in enabling agricultural mechanization. The financial sector must be able to provide the necessary capital for the entrepreneurs, the farming community, and other end-users. In this context, the economic feasibility and the profitability of the various mechanization options must be made available to the stakeholders (farmers, end users, entrepreneurs, private sector) involved in financing in Cambodia.

The government shall expand the sources of credit facilities through other banks and Micro-Finance Institutions who have good outreach in rural areas. Since the machineries themselves are used as security against the loans, the government shall motivate and engage other microfinance institutions to provide loans to farmers.

Efforts are also needed to help cooperatives establish strong business models and financial plans. The cooperatives shall use their collective bargaining power to leverage and avail the loan facilities for the machineries. Government shall consider offering credit guarantees to local banks to provide loans to those co-operatives who have a potential for managing agricultural machinery services and repayment capacity. The establishment of women's saving groups should also be promoted to create an accessible environment for their entrepreneurship and mechanization.

Support Services and Enabling Engineering Designs

There is a strong need to establish efficient and effective distribution channels for equipment, spare parts and repair services, as well as other supplies such as fuel and oil. Initially, the government shall help establish service centers through business ventures with co-operatives or private entrepreneurs in the regional Agricultural Engineering Development Centers. The government shall then gradually withdraw and promote local business in rural areas by encouraging local entrepreneurs in setting up centers/workshops for machinery services and spare parts themselves in other parts of the country. Furthermore, the proposed Center for Testing of Agricultural Machinery (CTAM) under DAEng should establish standards and safety regulations for spare parts, implements and machineries, and certified machineries. Safety regulations such as roll-over protection features for tractors, operational procedures, and handling

of implements should be established or redesigned if necessary and strictly adhered.

Alternative Energy and Inputs for Farm Production

Appropriate incentives and efforts should be provided to develop technologies. By using locally available, alternative energy resources, technology should be developed to reduce environmental pollution by studying on renewable energy sources such as, the development of solar dryer, solar pump, and bio-fuels will facilitate the operation of farm implements. Specifically, biogas from farm manure and residues, and biochar from farm residues should be promoted.

Pillar 2: Skill Development and Capacity Strengthening

In promoting agricultural mechanization in Cambodia, the major priority is increasing the capacity and skill levels of human resources. Skills are needed along the entire supply and value chains – artisans, operators, and farmers, other end-users, service providers (mechanics, engineers), suppliers and extension agents.

Capacity Strengthening of Public Institutions

The Department of Agricultural Engineering is inadequately, replenishment of skilled personnel is urgently needed both at national and provincial levels. The roles and responsibilities of technical offices at national level need to be fine-tuned and re-orientated towards achieving the common strategic goals. Special attention is also needed to review and revitalize the mandate and resources of provincial offices. It is expected to dispatch 5 engineers/specialists to each provincial office including design and manufacturing engineer, pre-harvest engineer, post-harvest engineer, testing and demonstration specialist, and networking and public relations specialist.

Technical Skills

Lack of basic technical skills can severely hinder an otherwise potential farmer towards mechanization, for example in driving. To promote basic skills, DAEng can schedule training opportunities for farmers in different parts of the country by sending authorized trainers regularly during the off-season. The trainers shall teach basic operations and safety issues of power tillers, tractors, and other machines on a voluntary basis. Car-driving schools or regional development centers of agricultural engineering shall be authorized to coach and license the driving of agricultural machines. Special certificate courses (1 to 6 months) need to be developed for technicians and service providers; those courses will help to develop skills and offer hands-on training on the design, use and maintenance of machineries and implements, and on management of workshops. Farmers and service providers should also receive training on the integrated use of farm machinery with other inputs more efficient. Such courses shall be offered and sponsored at educational institutions such as RUA and other institutions.

Knowledge management

The extension programs on mechanization should include front line demonstration, agricultural machinery shows, media, publications and face-to-face contacts with farmers and co-

operatives. In addition to extension network, community workshops shall be established at village or communal level. Non-Governmental Organizations and other international aid programs and projects can also play an important role in educating farmers on the feasibility and sustainability of farm mechanization. The extension services should place more emphasis on the development of small-scale farmers in areas such as: the use of appropriate and affordable mechanization options; credit acquisition; effective supply of agricultural inputs (including spare parts); and encouraging farmers' co-operatives to participate in availing and providing services of agricultural machineries. The government should also provide in-service training for existing staff, technicians and artisans to improve their understanding of the different mechanization options available to farmers and to expose them to new technologies and opportunities.

Pillar 3: Improved Agricultural Productivity and Rural Livelihoods

Increased productivity leads to commercialized agriculture. Specialization and the development of markets and trade within the commercialized context are fundamental to economic growth. Promoting technological change in subsistence food crops along with commercial crop production will be one of the most important factors to maximize the potential benefits from agricultural commercialization and minimize damage for household food security. However, commercialization of agriculture will be a gradual process. It will require increased levels of public and, in particular, private investment at all levels of agricultural activities, including primary production, marketing, input supply and processing. Agricultural mechanization in harvesting, post-harvest handling, and storage processes shall initiate the path towards commercialization of agriculture. Farmers in Cambodia need to realize the importance of quality of agricultural produce on the value chain. Besides raising the competitiveness of their products, it will also raise their profitability and sustainability.

Pre-harvest technologies

The farming practice in Cambodia is dominantly traditional with overwhelming participation of small-scale producers with small farm size. Even though implements like ploughs, harrows, planters, and weeder were developed and some were introduced from elsewhere and given out to the farming community effective use of these technologies has been minimal. Moreover, given the importance of climate change, irrigation is likely to become more important for Cambodian agriculture since increasing irrigated area in Cambodia would make a major contribution to its agricultural productivity. The RGC is currently increasing its support and involvement in improving traditional irrigation systems as well as expanding areas under modern irrigation to increase agricultural productivity and improve rural livelihood. It will be implemented through producing market-oriented economic crops and among them rice will be as one of the priority crops.

Post-harvest technologies

Appropriate use of mechanization options in post-harvest handling should be actively promoted because they can reduce the post-harvest losses and improve the quality of agricultural produces at the same time. Therefore, the government shall promote the introduction of affordable and efficient small-scale post-harvest tools and equipment. sustainability of agro-processing shall be ensured by routine examination of standards of machines and operations by CTAM. Moreover, the mechanization of activities in commodity chain enables formation of small to medium scale agro-processing industries in rural areas. Those industries can provide employment in handling,

packaging, processing, transporting, and marketing of agricultural commodities. Small scale processing requires relatively little capital investment and housing. Government needs to establish an active environment to help agro-processing industries' establishment and operation. Given the regional dynamics in trading regulations under WTO, ASEAN and its partners, smallholder farmers in Cambodia need to be informed of the competitiveness and newer avenues to access markets. The government shall provide the necessary market information and construct the missing linkages in commodity chains.

Pillar 4: Better Policy, Legal and Regulatory Environment

Favorable policy is critical to the promotion of agricultural mechanization in the country. All the different policies on agricultural, industrial, labor, energy, export/import, and etcetera, need to be streamlined for agricultural mechanization. Policy support is also needed for the following areas for promotion of agricultural mechanization:

- Co-operative farming and land consolidation for agricultural activity;
- Contract hiring of agricultural machinery;
- Support for agricultural machinery manufacturers;
- Standardization and safety of agricultural machinery;
- Promotion for energy efficient machinery;
- Promotion for conservation farming related machinery and green technologies;
- Promotion for value addition and employment generation related small and medium scale agro-industries.

The collaboration of institutes related to agricultural mechanization is also needed on national, bilateral and multilateral levels. Joint projects could be formulated to address common problems of the region itself.

Formulation of regulatory body related to farm machinery

The law, sub-decree and other regulations and guidelines on the promotion of agricultural mechanization will be prepared and adopted. These documents will encourage and support farmers and agricultural operation organization to use advanced and applicable agricultural machines, promoting the mechanization of agriculture and developing modern agriculture. The guidelines also shall provide domestic industry with similar institutional resources as ones available to the main competitor countries. The reliable governance, policies and regulations will be practical and improve transparency, consistency and accountability of public processes. The sub-decree on the management of workshops will be the first regulation to be adopted in the near future and that will regulate on the repair, modification, and assembly of agricultural machinery and its associate equipment. A regional network for testing agricultural machinery will be useful among national agricultural machinery testing agencies and institutes of member countries since an effective network will improve the efficient use of agricultural machinery and promote green agricultural technology. Cambodia shall actively continue participating in the Asian and Pacific Network for Testing of Agricultural Machinery (ANTAM) promoted by CSAM.

Cooperation between public and private sector and farmers

There is a need to establish a network of agricultural machinery related institutions/players such as research, training, extension, importers, traders, dealers, fabricators, financial intermediaries, policy makers, universities, and etcetera. This network will act as an open platform to share experiences and call for collective actions on promotion of appropriate agricultural mechanization in Cambodia. Meanwhile, DAEng shall continue its initiated mechanism of semester meeting with private sector, annual conference, and annual contest on the design and modification of farm machineries.

Gender mainstreaming

The strategy will take the gender aspects into account starting from technology up to markets, considering the labor intensity of crop production, engagement of women and children, and the DAEng's target of addressing gender issues through introduction of labor-saving technologies for crop production and processing. Specific projects will be developed to train women in small scale business management, operation and economics of small scale machinery use, and to strengthen and sustain the position of rural women in the family and society by acting as entrepreneurs and contributors to additional household income.

Environmental Protection and Climate Change

Cambodia's vulnerability to annual floods and droughts makes to country one of the most disaster-prone countries in East Asia. The strategic development plan will review and consider the two kinds of climate change adaptation strategy: autonomous adaptation options and planned adaptation options. The former includes storing seed and fodder for the next season, selecting different crops and machinery, and diversifying livelihoods. The latter, planned by government and NGOs, will include digging wells and providing pump sets to better crop seeds. While flood response mechanisms develop better in Cambodia, drought-mitigation programs shall be prioritized. The plan will also adopt existing regulatory framework of environmental aspects to protect and promote environmental quality and public health by preventing and controlling pollution. It will also help to conduct environmental impact assessments on all projects before their implementation.

Financial Resources

The total budget estimate of the strategic plan is **6,688,000 USD** over five years. The financial sources would be available from national budget and foreign aids and assistance. The annual budget DAEng receives from the RGC is approximately **500,000 USD**. Therefore, in order to achieve the goals and objectives set in the strategic plan, GDA and MAFF have to prioritize the programs and allocate appropriate budget to support the sub-sector. There will be a strong commitment of the RGC to technical and financial assistance from development partners, NGOs and civil societies including private sectors, and participation from local authorities and farmer communities.

Roles of Stakeholders

The development of agricultural engineering in Cambodia shall rest with private sector. The state shall, however, act as a catalyst ensuring that mechanization, human resources, and legal frameworks are geared towards stimulating farm productivity and private investment. The government, private-sector agencies, and the end-users need to play several important roles in

implementation of mechanization strategies. The ideal situation involves “Triple Helix Model” in which government, public institutions, and industry are intertwined in a mutually supportive cooperative endeavor. Broad partnerships are required during government tasks that cover the areas of infrastructure, education, health, gender, transport, natural resources, fiscal measures and legislation.

The **government** has a role in the broad field of education and training in the creation, funding and management of institutions. The institutions will be responsible for the acquisition of knowledge for the different ecosystem zones. The government needs to provide the development of the required skills and extension services to farmers and other end-users. The government may have a role in facilitating trade relationships with new suppliers of technology or equipment. Supported by supply and demand contacts, management and finance securities or tax waivers would help the private sector to gain momentum in a relatively short period. DAEng, CTAM, CARDI, and Agriculture Universities shall be responsible for ensuring the quality and quantity of mechanization in the country. DAEng could play a facilitative role in identifying potential product suppliers and inviting them to attend the field days organized for farmers. The sector personnel should work closely with local level service providers and product retailers.

The **private sector** shall look after the provision of farm inputs including farm machinery and the associated machinery support services (supply, repair and maintenance of equipment). Building close relationships with the farmers, assessing needs and satisfying demands, while competing with peer companies, are all part of the business venture. In such operational scenarios, the demand for mechanization is likely to be satisfied and the agricultural productivity will be enhanced. Operations are best conducted under commercial enterprises which requires adequate investment and profitable commercial returns. Local manufacturing can be logically preceded by profitable importation, assembly, and distribution support businesses in Cambodia.

Coordination, Monitoring and Evaluation

The DAEng will monitor the outputs and the follow-up effect on the intended beneficiaries outlined here. The institutions and programs who are involved in the logical framework of agricultural engineering strategies will need to elaborate and establish further details of methodology and work plan. Each component will be implemented through annual work plans (activities, time frame, and budget) that are formulated to meet different goals. A Steering Committee of Agricultural Engineering shall review all work plans and budgets and then they will monitor progress internally and annually. Progress on the activities in general will be regularly evaluated by comparing the outputs and milestones against the proposed key indicators. Information will be gathered on the progress according to the program’s plans and schedules. The review will provide decision makers with detailed assessment on the achievements, failures, weaknesses, constraints, opportunities, challenges, lessons learnt, cases and the future plan arising from implementation of the proposed strategies at organizational and field levels, as they pertain to beneficiaries.

Conclusions

In order to achieve the vision of the Royal Government of Cambodia (RGC) to produce a rice surplus of more than 4 million tons and achieve rice export of at least 1 million tons; and ensure the international recognition of Cambodian rice, the RGC implemented the Agricultural Sector

Strategy Development Plan. The four key drivers in promoting agricultural engineering in Cambodia include: enabling profitability of agricultural engineering, skill development and capacity strengthening, improving agricultural productivity and rural livelihoods, and improving policy, legal and regulatory environment. The strategic development plan for agricultural engineering for Cambodia will be greatly useful in an implementation direction. It will provide a more transparent environment for development partners to contribute the resources in the priority activities both for agricultural engineering development and sustainable economic growth.

The policy presented in this brief, emphasizes the importance of solid and constructive partnerships between the public sector, including the DAEng under DGA with support from the Royal Government of Cambodia, international development partners and the private sector. The multi-stakeholder partnership will play an important role in providing financial support and technical assistance to improve agricultural engineering research, strengthen human resource capabilities and work towards a strengthened agricultural sector in Cambodia able to move from a subsistence oriented model to a profitability oriented agricultural system.


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