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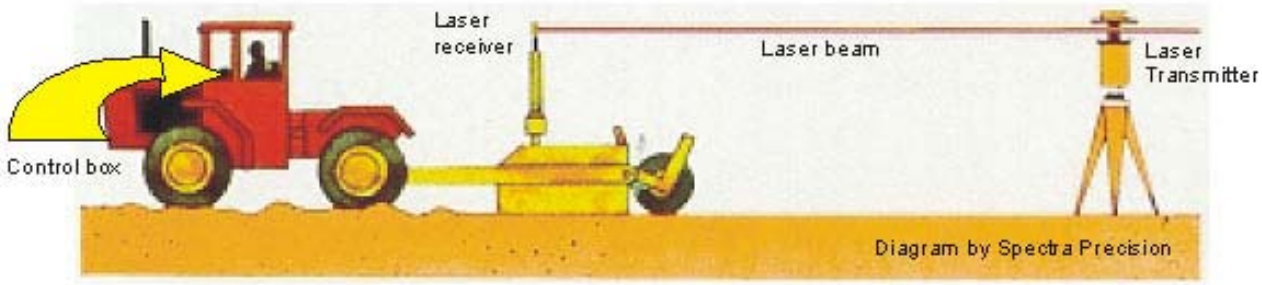
LASER LEVELING ROUND TABLE DISCUSSION



A Discussion Report

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COTENTS

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
DARD	Department of Agriculture and Rural Development
IRRI	International Rice Research Institute
Lao PDR	Laos People's Democratic Republic
MARD	Ministry of Agriculture and Rural Development
MD	Mekong Delta
MRD	Mekong River Delta
NLU	Nong Lam University
RRD	Red River Delta
ROI	Return on Investment
SEA	South East Asia
SIAEP	Southern Sub-Institute of Agricultural Engineering and Postharvest Technology

A brief history of laser leveling for Asian rice agriculture

Presentations from different stakeholders on the origin of laser leveling technology opened the discussion. Mark Heyward of Trimble Agriculture Division described the development of a rotating laser invented by Robert Studebaker and laser receiver designed by Ted Teach. Studebaker and Teach formed LaserPlane Company which later merged with Spectra Physics that became Spectra Precision in 1997. The latter then merged with Trimble Navigation in 2000. In 2001, Trimble and IRRI introduced laser leveling in China and India.

The basis for this successful introduction was laid through cooperation between IRRI and Spectra Precision with the objective to develop laser leveling systems for rice agriculture in Asia. In 1997 Joseph Rickman (IRRI), who worked on the idea with Joe McNamara (Spectra Precision) introduced laser leveling technology in Cambodia in 1997 and ".. designed and built the only box scraper Mc Namara knew of, which could be towed by a drawbar or attached to a three point hitch.."[1]. They had been developing different technologies for both, dry- and wet-leveling. They believed that with laser leveling they can stabilize rice production and make field operations more efficient. Joe Rickman then worked with national partners in Thailand (1999), China and India (2001) to introduce the technology developed in Cambodia in those countries.

Pioneering developments in Vietnam

The technology was introduced in Vietnam through a number of activities: In 2003 Bac Lieu Seed Center (BLSC) was furnished by IRRI with a set of laser leveling equipment and built a laser leveling bucket. In 2004 IRRI provided Nong Lam University (NLU) another laser leveling set and NLU built a drag bucket for mounting behind a 110hp tractor using the IRRI bucket design. In February 2005 two Vietnamese staff from Nong Lam University came to IRRI for a one week hands-on training on laser leveling, which was followed in March 2005 by a training course, facilitated by Joe Rickman, at Nong NLU. NLU staff then trained staff at BLSC on the use of the equipment. In 2005, NLU pioneered leveling of 12 hectares of rice land at the Provincial Seed Center of Bac Lieu Province. NLU also introduced the technology in An Giang through a demonstration leveling of 3 hectares.

[1] Gustafsson, L. and J. McNamara (1998). IRRI-Spectra Precision collaborative development of a precision wet-leveling system. Increasing the impact of engineering in agricultural and rural development, deliberations of a think tank. 26-28 February 1998. M. A. Bell, D. Dawe, and B. Douthwaite. Manila, Philippines, International Rice Research Institute: 61-64.

Recent efforts are focused on establishing a mechanization model in the Mekong Delta where a farmer owning the technology for his/her farm is also able to service other farmers especially the small holder farmers with less than a hectare land. Adaptive experiments are also being done with collaborating institutions to prove the benefits of using the technology. Some of the benefits are:

- Savings in the use of water (around 50%);
- Address the issue of climate change (declining water supply/drought, inconsistent rainfall patterns);
- Better weed control with evenly leveled field;
- Yield increase of 0.35-1.5 tons/ha or 15-20% in better leveled field (profit increase of US$223/ha in China);
- Reduced postharvest losses with the use of combine during harvest (1-10% harvest losses);
- Increase in farmable land;
- Reduced environmental impact (e.g., soil erosion);
- Reduction in diesel cost for pumping irrigation water.

Funded by IRRI's Irrigated Rice Research Consortium (IRRC) the initiative of NLU also reached Lao PDR by capacitating farmers and researchers in Savannakhet in 2008. The technology is now gaining acceptance in the region.

The series of capacity building and promotion activities which were facilitated by NLU with IRRI support to scale out the technology has led to the approval/certification by the Ministry of Agriculture and Rural Development (MARD) in Vietnam to include laser leveling technology in the national extension activities and in national programs.

How the technology works

Laser leveling technology is the application of laser leveler that's commonly used in civil works. It consists of a rotating laser transmitter, laser receiver, a scraper bucket (that's hydraulically controlled) and a 4 wheel tractor where a control box is lodged that's giving the overall guidance in the operation of the equipment.

Dr. Phan Van DU of MARD expressed full support in scaling out the technology. He recognized that Vietnam's rice contribution has reached a level to export but is yet to close the yield gap

The laser transmitter emits laser beam that sets intermittent reference plane above the ground which is sensed by the receiver attached to the cutting/grading implement or drag bucket. Information received by the laser receiver is processed by the control box that activates

the hydraulic system of the tractor to raise, lower or maintain the height of the drag bucket to the desired grade. The use of laser leveling can result in a more uniform tillage depth especially on fields that are not properly leveled.

Current issues

Having known the benefits of laser leveling and tried it in different countries in Asia, the question of how to scale out the technology becomes an important issue. The discussion aimed to look at how to move the technology forward in Vietnam (and Cambodia) and be able to get stakeholders to work together towards wider adoption of the technology.

Dr. Phan Van Du of MARD expressed full support in scaling out the technology. He recognized that Vietnam's rice contribution has reached a level to export but is yet to close the yield gap. He underscored laser leveling as one of the techniques that have been identified so far to help closing the yield gap. At the ministry level, they have supported the technique in the Mekong delta, to help farmers make good land preparation and close the yield gap. He also expressed that the technology has been certified by the MARD committee after seeing all the benefits. He urged companies who are producing the laser to contact them and they will facilitate introducing the technology in the province. At the moment, there is a bigger acceptance of the technology in Southern and Central than in Northern Vietnam. He is hopeful that the round table discussion (RTD) will enhance the use and dissemination of laser leveling technology in Vietnam and its neighboring countries.

Common issues, common experiences

> In Cambodia, one big lesson of uptake is how to get the required commitment from stakeholders. There is a need to get the "right" players together, get commitment and find a champion who will move it forward.

The discussion included short talks and open discussion covered topics of demand, usefulness, dissemination or establishing supply as well as other researchable issues.

Joseph Rickman recounted how he started introducing the technology in Cambodia along with other researchers (including Dr. Meas Pyseth). Key learnings include that all technology has limitations; anyone working with laser leveling should know the limitations and not oversell it. Regarding where it should be applied and how it should be used: It has to be considered that laser leveling is a drag bucket

technology that drags the soil over some distance, so size of the area matters. It is best for fields with less than one hectare. The max drag is 100m with bucket size of $1m^3$. In one hectare, 1 cm of soil is equivalent to $100m^3$. Dragging will become inefficient when it works longer distances than 100m. Acreage between100-1,000 hectares is most cost efficient. They have found that slopes are not a major issue.

The difference between using a drag bucket for leveling (dry leveling) and puddler (wet leveling) was clarified. Sometimes misconceptions arise between the two technologies. The leveler has a bucket that cut and fills and therefore levels the field, while the puddler only levels the surface and not the field. IRRI promotes both laser assisted wet leveling and dry leveling.

Rickman cautioned that fixing the hydraulics of local tractors can use up more time than making the bucket. In an application in India, there was one hydraulic pump that's been blown up and it's because the hydraulic system was used the wrong way. It is important that those operating the laser leveler record modifications and hydraulic tappings/systems of the different tractor types locally used. Another issue that's worthy looking at is the size of tractors. So far there is no record of the different tractor sizes that's been used.

In Cambodia, one big lesson of uptake was how to get the required commitment from stakeholders. There is a need to get the "right" players together, get commitment and find a champion who will move it forward. It could take about 8-10 years from development to adoption. Private sector commitment is also important. The contracting component as a form of usage has to be considered. The cost of the equipment may have to be subsidized at the beginning. Those working with farmers have to be prepared to support cost differentials to lessen the risk to farmers.

Rickman noted that Vietnam is lucky with the potential quick rise in number of adopters. He stressed the need for a driver of the technology (technology champion) who is committed and continues to fight all the way to follow it through until the technology becomes sustainable. He mentioned that Vietnam lucky to have NLU and Dr. Phan Hieu Hien to in this role. The commitment of private sector for development is also important exemplified by the presence of Trimble in Vietnam. The bottom line of all this is to get the contracting company involved from day one. Stabilizing the price for contract service is also important to support the contractor in his/her business. Rickman also mentioned that he will introduce laser leveling to Africa.

The other issue is cost of equipment. Cost is an issue to farmers. In Cambodia, a guarantee program was done with the first adopter farmer- yield will be different with

what they have now upon application of the technology. Consideration and explanation of the financial side is also important– farmers should get the benefits 4 times the cost.

A presentation by Dr. Phan Hieu Hien highlighted major issues/challenges and recommendations in the success/adoption of the technology in Vietnam which includes the following:

- Farmer mechanics were involved in capacity building;
- Farmers who were reluctant at first were given warranty from the DARD-An Giang. One farmer (Mr. Duc) has leveled 100ha (30 ha of his own farm). In Mekong Delta field size is typically 1-2has.
- Small farm sizes can be consolidated to meet the minimum area requirement for cost-efficient operation. In Lam Dong (Central Vietnam) field size is .4-1 ha. Grouped 330 plots = 30ha. In this size combine harvester can also operate. In Hue (Central Vietnam): filed sizes of 0.5ha were consolidated into larger, uniform areas of 2 ha.

Cost-benefit analysis also revealed that the technology can reduce water requirement by 50%. This implies a benefit in addressing climate change issues through savings in water. Farmers are able to save $30 per hectare (before farmer pay 60$, now 30$) in weed control. Reducing level difference of 10cm to 5cm can help suppress the weeds. Yield was observed to have increased from 0.35 to 1.5 ton/ha.

The cost of leveling as payment to contractor is around $200-600/ha. The return on investment (ROI) is after 2-3 crop season. The expenses for 1-2 years can be recovered by farmers. Dr. Hien described laser leveling to be “everything” or a full solution – covering issues of water or climate change, postharvest losses, and food security.

Rice civilization in the context of Vietnam is envisioned by Dr. Hien to have laser leveled areas including terracing sloping lands. The area in South Vietnam is 2-3 times bigger than that of the Red River Delta and Mekong Delta. He estimated the cost of reshaping sloping areas into contour terraces to be approximately US$600-1,000/hectare. Contour terraces can conserve water and soil fertility. A data in Nebraska (Dickey et. al., 1985) showed 80% decrease in soil erosion due to cultivation by the terrace system.

Experience in India, where the government subsidized 50% of the cost of laser leveling (approximately US$10,000) found an increase in wheat yield of 3-4 tons/ha. In Tanzania, sugarcane yield increased to 48-60ton/ha from 25ton/ha due to leveling.

The target dissemination sites for the technology are developing countries where agriculture has a big demand for fresh water used in irrigation. Reduction of water use is one of the major benefits that can be derived from laser leveling.

Mark Heyward expounded on lessons learned from several countries where the technology has been adopted. The models/patterns of scaling out/adopting the technology in the developed and developing countries are noteworthy:

- In USA, Australia and Europe the end-user is typically a contractor or a farmer that becomes a contractor. The main constraint is the high capital investment required so cooperative purchasing is commonly practiced. Contractors provide service to agriculture and construction markets as there are seasonal demands in agriculture.
- In India, the end user is a farmer that becomes a contractor where greater returns are realized from leveling other farmers' field than working at their own farm; there are projected demands of laser leveling technology in India ranging to up to 10,000 which need to be verified. Demand projection is important for the suppliers.
- In China, the technology is subsidized and the end-user is always a farmer who later becomes a contractor. Laser leveling technology is included in catalogues.

Owen Williams of Leica Geosystems shared his company's experience in manufacturing. He noted how business in agriculture has developed alongside machines. He shared similar observation on the success of laser leveling technology in India that benefited from reduction of water losses. The pressure on weeds and increase in yield are additional benefits. He envisioned a realistic growth rate to continue as far as development and adoption of the technology is concerned. The partnership can be continued to help farmers in SEA.

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Leica Geosystems is interested in investing and expressed commitment in working with other stakeholders to bring the technology to the farmers. Leica recognizes that it might be difficult or will take some time to bring the technology to farmers but the company is willing to learn and work into serious partnerships.

IRRI is aware of the increase in yields as potential benefits, but the reports based on experiments vary and this needs to be looked further.

Partnership and dissemination strategies

The partnership issue was also discussed during the meeting. The use of the technology by private sector contractors has been noted as possible dissemination strategy but there is no successful business model in Vietnam so far. Leica Geosystems pointed out that farmers becoming contractors works for them but the challenge is how to roll out this system particularly in SE Asia.

In Vietnam, there is a WB project that provides subsidy to equipment for loans. This could be an opportunity, to get support mechanisms in scaling out the technology further.

Dr. Pham Van Than (SIAEP) shared observations he gleaned from the field that in the Mekong Delta (MD), Red River Delta (RRD) and Mekong River Delta (MRD) farmers don't know laser leveling. However, they contract tractor operators who level their land at high costs. Some provinces near the sea lack water for irrigation especially during dry season, farmers are forced to save water. Farmers need laser leveling to reduce water, fertilizer and herbicide use and reduce PH losses. The farmers are recognizing the benefits of leveling the field. Farmers in MRD are willing to pay services from 200-250$ per hour. The usual charge $120/ha for land leveling using simple bucket which is not very good. If laser leveling is applied, the quality of land leveling could be better improved and cost can be reduced.

Points for consideration on how to work with farmers included working with service providers, farmer-contractors and farmer-mechanics with 1-2 hectares land. Through these contractors further development can be made.

The WB project in Vietnam is focused on investing to a group of farmers (to gather to apply for a loan). Dr. Hien suggested that investments should also be made to individual medium farmers and the government can subsidize 30% of purchase price and apply for a loan. That way, the technology can develop very fast. Similar with the combine harvester technology, farmers apply 30% subsidy which developed very fast. The subsidy was now reduced to 10% only.

Area considerations: farm and social characteristics

Farmers need laser leveling to reduce water, fertilizer and herbicide use and reduce PH losses. The farmers are recognizing the benefits of leveling the field.

The experience of leveling the field in India as to dry land condition was raised. This led to a clarification that for 1cm leveled 100m³ need to be moved

in the field. In the upland, laser leveling is being used to reduce irrigation water but this is dependent on soil type. For upland corn, 10cm for every 100cm is necessary. There is a problem with crop residues which is associated with wetness of soil. The advice is don't burn residues, though you get more rubbish with crop residues mixed with high moisture.

Joe Rickman shared further that in leveling slopes, single equipment must be used. If one is to invest in laser leveling, investments in bund building must be made as well. Levee construction is equally important especially in irrigated fields as water is important to farmers.

Dr. Balasubramaniam, Agricultural Engineering College and Research Institute, Tamil Nadu Agricultural University shared that laser leveling is being used in their institute particularly in highly sloping field. The technique is to transport the top 10cm of the soil to one place and then leveling is done in the field and the soil is put back on areas with lower portions. Tackling the issue of top soil removal, what was recommended in Cambodia according to Joe Rickman was to put more fertilizer in the areas where top soil was taken off during leveling. Yield differences in the field evened out after time. After 2 years, soil type is not much different.

Dr. Hien shared the same experience in Vietnam where the first question asked is what percent of excavated area affects the yield? With 15cm top soil removed, yield was different in the areas where top soil was removed compared to the area where it was shifted to. Total average yield was slightly higher though. However, urea and some organic elements must be put back to the soil where top soil was removed.

The issue on land ownership was brought up by Mark Heyward of Trimble. Differences in land ownership in India and China are quite unique. How to spread the technology to smaller areas remains a challenge. Land ownership/control in China is quite different, a farmer with large block swaps with another farmer, this is why it worked – without doing this no one would take up laser leveling.

Joseph Rickman added that field size is another issue which is common in Thailand. Normally a farmer divides to his 5 children 5-10 blocks each of farmland. Social and customs issue must also be considered.

Other linkages

Alfred Schmidley (IRRI) started the discussion on what else can be done as a group, to think about what the needs are, where to go and what each stakeholder can add in the development of the technology. He mentioned of the on-going ADB-funded project on

Postharvest. He exhorted everyone to explore its potential, create awareness, involve farmers' organization and think of what contractor models will work to enable the private sectors. In Vietnam, contract service is okay but there is a need for an economic business model. Drivers are needed from the market model. The Learning Alliance (LA) which is being facilitated by the project is a guiding alliance that gets stakeholders together. Relevant steps and issues are identified altogether and projects are implemented with national partners. Alfred posed the question on what LA can offer in terms of charting the next steps. This was supported by Martin Gummert regarding the learning alliance as a flexible platform to engage stakeholders from the various sectors in Cambodia, Vietnam and the Philippines.

Evan Christen, Project Leader of an Australian funded project in Cambodia shared his observation that the government in Cambodia is currently developing irrigation. Leveling is practiced by way of bulldozing the field and if laser leveling is a good technology, he said that their project could to adopt the technology in the final land preparation activity.

Extension and financing

Joseph Rickman posed the challenge of how farmers could finance or start contract arrangements on laser leveling, to whom farmers should go for credit, or if tapping savings is a better option.

Dr. Meas Pyseth suggested conducting trials and demonstrations in Cambodia so farmers, government officials and politicians can see the benefits of the technology. Some politicians may have big lands that they may want to put to use or try with the technology. Another option is to use television for promotional activities and this might get strong support from the Ministry. His group will be there to collaborate as long as there are resources to do that. Mr. Rythikun suggested that the ADB project in Cambodia includes laser leveling technology as one activity that should be funded and assistance from private institutions must be sought out for a sustainable intervention.

The strategy of Vietnamese government is to subsidize the equipment for farmers as the cost of the technology is really an issue. A policy to encourage farmers to level their fields in order to address climate change and save water is included. For projects to develop the technology two factors must be considered– technical and economics.

Leica Geosystems expressed commitment that they can utilize business partners to import goods, although as commercial organizations they have to make money in the long run. With the LA, coming back together and develop the idea over time is a good exercise. Their assistance will continue and if the government can provide subsidy they

can look at the financial side such as investment banks and we can engage with local people.

From manufacturers' perspective, Mark Heyward noted that they can provide products to certain projects. Their involvement can be further driven by the government's policy that will dramatically shape future outcome; the government should really push for it. If government is providing incentives, it can get financed. The involvement of private manufacturers should be provided with incentives. He suggested that Cambodia should also gather data on water use improvement, savings on chemicals use energy savings in pumping water for irrigation.

Joseph Rickman noted that farmers' perspective must be considered, although they should start slowly before scaling out. He recommended allowing farmers to commit a small area first. He shared his experience which followed a mushroom effect, around 1-12 farmers leveled their field given minimal subsidy. Farmers had to pay to generate ownership.

Ms Ngoc of Ideal Farm Company, local distributor of Trimble, talked about constraints on the cost of the technology. She stated that their company will set up a leveling-contact service where farmers can pay when they harvest. This is a way of financing the farmers to avail the technology. Their company can also partner with the ADB-PH project for demonstration activities. She also shared that they do service and make money while at the same time supporting the farmers. Their company, though also need support from government through enabling policies and projects.

Martin Gummert closed the discussion with a summary. He also mentioned how the current initiatives of the ADB project in Vietnam, through the support of the public and private sector partners subsidies and certification of the laser leveling technology. IRRI on the one hand is doing a complementary effort by facilitating all areas of concern thru the LA platform. He further reminded the participants that the LA will continue to expand. A website is accessible where everyone can look into for inquiries and concluded that the laser leveling technology will also be considered as one intervention of the ABD-funded PH project.

Annex 1. Participants and contact details.

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Further information:

The IRRI Postharvest Group at IRRIPostHarvest@CGIAR.ORG

Postharvest Learning Alliance Site:
https://sites.google.com/a/irri.org/posthavest-unit/home

Laser leveling on the Rice Knowledge Bank:
http://www.knowledgebank.irri.org/landprep/index.php/laser-leveling-mainmenu-84