Jurnal Lahan Suboptimal
ISSN: 2252-6188 (Print), ISSN: 2302-3015 (Online, www.jlsuboptimal.unsri.ac.id)
Vol. 3, No.2: 181-192, Oktober 2014

Inclusive and Sustainable Management of Suboptimal Lands for Productive Agriculture in Indonesia

Pengelolaan Lahan Suboptimal yang Inklusif dan Berkelanjutan untuk Mewujudkan Pertanian yang Produktif di Indonesia

Benyamin Lakitan[*)1,2]
[1]Ministry of Research and Technology, Jakarta
[2]College of Agriculture, Sriwijaya University, Inderalaya
Telp. (0711) 351364, 08127810024, Fax. (0711) 350793
[*)]Corresponding author: blakitan@ristek.go.id

ABSTRACT

There are uncountable research activities and technology development efforts have been carried out in Indonesia; however, very limited economically and/or socially beneficial technologies have been created. Very few indigenous technologies have been used in producing goods and providing services, including in agricultural sector. This problem is rooted on facts that most of the technologies developed are not relevant to real needs and/or problems of domestic farmers. Even if the technologies are substantially relevant; in many cases, they are not finacially affordable by domestic farmers, do not significantly increase profit if used, and/or less competitive compared to similar available technologies in the market. Limited availability of resources, at present and even more scarse in the future, elevates expectation on technology to contribute in establishing inclusive, productive, and sustainable agricultural development. To assure that developed technology will be relevant to the needs and contribute to agricultural development, farmers ought to be play significant active roles during priority setting, planning, and developing the technology. The real issues at present are increase in food demand as consequence of population growth and conversion of arable lands for uses in other sectors. These trends have led to intensifying agricultural activities on suboptimal lands. Efforts to increase agricultural productivity in suboptimal lands should not jeopardize sustainable function of the ecosystem and participation of local farmers. Sustainability and inclusivity should be maintained while increasing productivity. Traditional knowledge and local wisdom have to be treated as reference for developing technology for establishing productive agriculture on suboptimal lands.

Keywords: Agriculture, innovation, local wisdom, technology, traditional knowledge

ABSTRAK

Kegiatan riset dan upaya pengembangan teknologi sudah banyak dilakukan di Indonesia, tetapi upaya ini belum signifikan menghasilkan teknologi yang bermanfaat. Sedikit sekali teknologi domestik yang telah digunakan dalam produksi barang maupun jasa, termasuk di sektor pertanian. Persoalan ini berakar pada kenyataan bahwa teknologi yang dikembangkan jarang yang relevan dengan realita kebutuhan dan/atau persoalan nyata yang dihadapi petani. Kalaupun teknologi domestik secara substansi sudah relevan, namun sering belum sepadan dengan kapasitas adopsi petani, tidak menjanjikan keuntungan usaha tani yang lebih besar, dan/atau kurang kompetitif dibandingkan dengan teknologi serupa yang sudah tersedia di pasar. Keterbatasan sumberdaya di masa sekarang dan akan datang, menumbuhkan keharusan bahwa teknologi yang dikembangkan dapat berkontribusi nyata terhadap upaya mewujudkan pembangunan pertanian yang inklusif, produktif, dan berkelanjutan. Agar teknologi sesuai dengan kebutuhan dan dapat

berkontribusi nyata terhadap pembangunan pertanian, maka petani harus berperan aktif dan signifikan mulai dari proses penetapan prioritas riset, perencanaan, dan pengembangan teknologi. Isu aktual pada saat ini adalah peningkatan kebutuhan pangan sebagai akibat pertumbuhan penduduk dan konversi lahan-lahan subur untuk kepentingan berbagai sektor lain. Kecenderungan ini mengakibatkan peningkatan kegiatan pertanian di lahan-lahan suboptimal. Upaya untuk meningkatkan produktivitas lahan suboptimal seharusnya tidak mengorbankan keberlanjutan fungsi ekosistem dan partisipasi petani lokal. Sustainabilitas dan inklusivitas harus dipertahankan saat dilakukan upaya peningkatan produktivitas. Pengetahuan tradisional dan kearifan lokal harus digunakan sebagai landasan dalam pengembangan teknologi untuk mewujudkan pertanian yang produktif di lahan suboptimal.

Kata kunci: Inovasi, kearifan lokal, pertanian, pengetahuan tradisional, teknologi

INTRODUCTION

There is no doubt that each and every stakeholder will agree that technology is absolutely needed for agricultural development in all subsystems and sizes of agribusiness, all agricultural commodities, types of agro-ecosystems, and levels of farmer's capacity. However, technology does not work like magic. Technology cannot solve all problems and, vice versa, not all problems require technology solution. Advanced and sophisticated technologies may work appropriately in developed countries but they may be unsuitable for developing country, such as Indonesia. Furthermore, considering high heterogeneity of agro-ecosystems and social-economic dimensions within Indonesia, different technologies might be required for each specific region.

Despite there are many universities, research institutes, and technology-based industries in Indonesia, agricultural development still heavily rely on imported technologies, except for nitrogen fertilizers and seeds of several major crops. Researches at university and R&D institution have not been focused on specific needs and current problems of Indonesian agriculture. Majority of the researches are driven by personal passion or narrowly spaced within academic field of each academician and researcher.

It should be noted that almost all of R&D funding in Indonesia is provided by government. Without stiff directive from government to shift research orientation from supply-push to demand-driven, contribution of universities and R&D institutions in developing relevant and affordable technologies for agricultural development will always be insignificant. Academicians and researchers should be pushed out of their comfort zone, i.e. doing research as they wish. There is no other institution than universities and research institutions that Indonesia can rely on for developing indigenous technologies suitable for its specific agro-ecosystem and social-economic dimension.

For comparison, Pakistan had launched National Science, Technology, and Innovation (STI) Policy in 2012 and stressed the need for development-oriented policy instruments for promotion of STI (Mirza, 2013). Indonesia cannot afford to let potential technology developers at university and research institution for being not significantly contribute to local or national development in agricultural sector. Mirza (2013) believed that investments in STI were the only way forward for Pakistan and reminded the country to harness the benefits of STI for underprivileged segments of society that had limited disposable income. Indonesia should also more focus on this underprivileged society, i.e. small-scale farmers.

With low financial capacity, Indonesian farmers have limited capacity to adopt introduced technology if it requires high investment and/or high operational cost. Even if soft loan is provided through

government programs, farmers may still not adopt the technology if it will not create better income. Agribusiness is characterized by small margin and high risk. Small-scale agriculture activity will not yield noteworthy income for farmers. Domestic technology developers in Indonesia should keep these constraints in mind when developing technology for small-scale farmers.

Ragasa *et al*. (2010) focused their study on performance of agricultural research organizations in Nigeria and concluded that these organizations generally have weak innovation capacity, weak overall organizational capacity, and limited linkages with other organizations. Differences in performance were due to organizational culture and working environment. They recommended that these organizations needed skills development training, more effective ways of delivering training, and holistic and integrated approach of innovation capacity development.

Technically, agriculture-related colleges and research institutions in Indonesia have the required capacity to develop agricultural technology for small-scale farmers. However, agricultural technology developed in many cases are not substantially relevant to farmer's need, or cannot be afforded by low income farmers, or requires high operational cost, or fail to compete with similar technology available in market. Indonesian universities and research institutions should reorient their research activities. Research program should be driven by real needs or actual problems faced by Indonesian farmers.

There are many terms used to represent this approach, including client-oriented (Heemskerk *et al*. 2003), challenge-driven or issue-driven (VINNOVA 2013), and mission-driven (ERAB 2011) research. Essentially, however, all of these terms are rooted on demand-driven approach.

This paper will explore early stage of shifting process from supply-pushed to demand-driven research within framework of establishing agricultural innovation system; arguments for developing relevant, inclusive, and competitive agricultural technologies; considerations on establishing productive yet ecologically-friendly agriculture development; and directives on intensifying agriculture on suboptimal lands in Indonesia

DEMAND-DRIVEN AGRICULTURAL RESEARCH

Low adoption of indigenous technology by domestic users in Indonesia has become a major concern. Expenses on research and development (R&D) and human resource development (HRD) should be considered as long term investment for strengthening national capacity on technology development. After nearly seven decades of Indonesian independence, cumulative R&D and HRD expenses should be significant. Therefore, it is fair to expect more visible contribution of indigenous technology to economic growth and prosperity of the people, as it has been clearly mandated by Indonesian constitution.

Low adoption directly leads to low contribution of indigenous technology to economic development. Despite research has been a major part of academic responsibilities at all universities and for each individual academician, also for each researcher at public and private R&D institutions; there are still very limited relevant technologies have been successfully developed and used. Furthermore, in agricultural sector, there are even less technologies financially affordable and will generate higher profit for farmers. Indigenous technologies created are mostly also unable to compete with similar technologies already available in global market; in terms of price, operational cost, or technical reliability.

In Indonesia, science and technology (S&T) development has been drifted away from economic development. Economic development is mainly based on

exploitation of natural yet non-renewable resources by utilizing foreign technologies. Indigenous technologies are not designed and designated for managing our own natural resources. Moreover, HRD has not been aligned to need for improving national capacity in managing the resources. Even though, conceptual framework of national innovation system has been introduced and frequently discussed at policy level, technology and economic development are still on its own disconnected paths in Indonesia.

Innovative countries, which produce relevant and competitive technologies, since many decades ago had shifted their research strategy, from supply-pushed to demand-driven approach. Recently, some European countries expressed a stronger statement on this issue through 'The Lund Declaration'. Main spirit of this declaration is that research must be focused on real, current and significant challenges. Therefore, the research should be in form of issue-oriented research in relevant fields (VINNOVA, 2013). To increase contribution of technology in prospering its people, as mandated by the constitution, Indonesia should follow these footsteps.

At present, agribusiness in food crop production in Indonesia is perceived as slim margin and high risk business. Consequently, there are very limited investments at medium and large-scale food crop production businesses. Among these few businesses, very rarely have sustained in the business after few production cycles. Only subsidized small-scale farmers are staying in this business, primarily due to very limited other options for them. Continuous and inevitable conversion of arable lands, previously cultivated with food crops, to other more profitable economic activities is a clear indication that agribusiness in food crop production cannot compete with almost all businesses in other sectors. Within agricultural sector, investors are only interested in land-hungry business of oil palm and rubber plantation.

Therefore, in this paper, discussion will focus more on demand-driven agricultural research associated with small-scale farming rather than large-scale agribusiness. Developing relevant and implementable technology for small-scale farming will be more challenging for researchers and academicians yet it is more appropriate for Indonesia at present, since majority of food crop and animal production are managing by small-scale farmers.

Heemskerk et al. (2003) used term of 'client oriented research management approach' (CORMA) and defined it as an approach where clients were assigned a pivotal role in deciding priorities and planning research for improved agricultural technologies and knowledge. This approach is more intensive towards stakeholder participation and have advantages, such as: (1) farmers are at the center of the technology development process; (2) emphasis is placed on what the farmer knows (available local indigenous knowledge) and formal scientific knowledge builds on this; (3) views and interests of market actors (traders, processors, and input providers) are taken into account; and (4) researchers and extension workers rather than controlling the technology generation/dissemination process become catalysts and facilitators (Figure 1).

It should be noted, however, effectiveness of Heemskerk and his colleagues' model depends on ability of all stakeholder, including farmers to foresee the required and affordable technologies; intensity and quality of facilitating process; and effectiveness of related public policies and regulations. During the process, gradual shift of mindset of all stakeholders are required, from linier thinking to more systemic thinking, and from a self-contained actor to a team-oriented partner. Communication and interaction amongst all participating actors should also be intensified in order to establish the system and solidify the team work.

Major portions of researches conducted in Indonesia are funded by government. There is tendency of budget provider to be more dominant in designing the program, deciding scope and focus of program's activities, defining the outputs, and setting the targets. Farmers and farmer associations in Indonesia do not have expendable funding for R&D collaboration with university or R&D institution as their counterpart in developed countries. Farmers in industrial countries were perfectly capable of telling researchers what they needed (Roling *et al*. 2004). On the other hand, Sumberg (2005) argued that in many developing countries, the situation was different, where farmers were insufficiently institutionalized for steering of R&D direction.

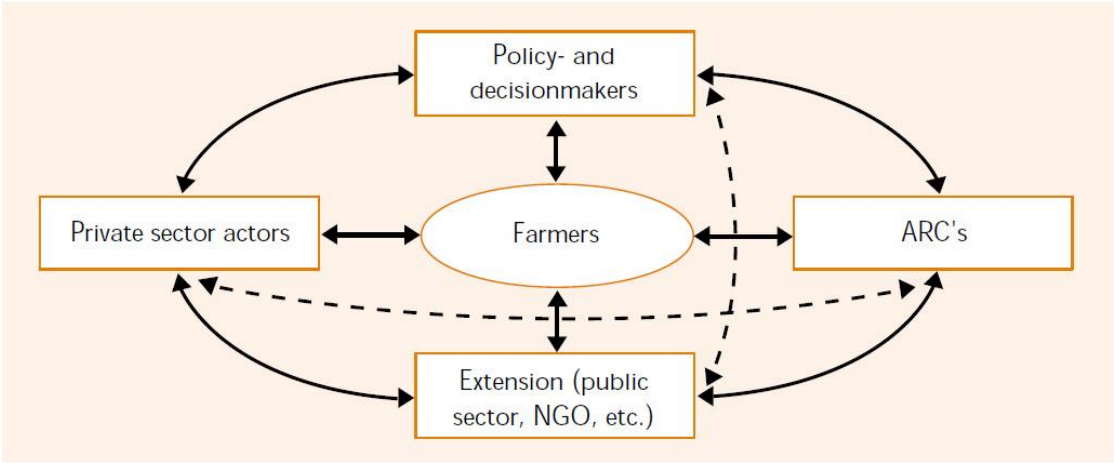

Figure 1. Stakeholder involvement in agricultural research (Heemskerk *et al.* 2003).

Klerkx and Leeuwis (2009) believed that when farmers are not sufficiently empowered, they cannot act as equal partners of researchers. It should also be recognized that sometimes farmers can play a less significant role due to the complexity of some problems. However, farmers should be well informed about what is going on, in reporting formats understandable to them.

For some reasons, farmers in Indonesia do not seem to be confidence on playing the expected role in directing research activities. There seems to be psychological and social constraints for farmers with lower formal educational background (and lower social economic status) to direct researchers or academicians in conducting R&D activities. The fact that funding is fully provided by government while farmers or its associations do not contribute to the fund may also add to the psychological constraint for farmer to take the leading role. However, there is a way to settle this issue. Government has been specifically collected levies from agricultural sector and if government openly declares that the source of fund for R&D in agriculture is taken solely from these levies, then it should boost sense of ownership among farmers and it could boost their confidence in taking the leading role in directing R&D activities toward their needs.

Klerkx and Leeuwis (2008) argued that in such systems of farmer levy funding, farmers would become direct clients of agricultural R&D providers. This empowers farmers to take full control of the R&D process, and therefore the ultimate degree of participation may be attained. However, even farmers as the end-users have the opportunity to raise issues that lead to R&D activities, queries are influenced by several actors in the R&D planning process; therefore, the executed R&D activities may

not adequately reflect farmers' innovation needs. More emphasis is required on signifying farmer's role in the process.

Demand-driven agricultural research has been focused attention on the inclusion of farmers in research planning. Theoretically, this should enhance ownership and increase the applicability of research. However, in practice, several tensions emerge with regard to the operationalization of such planning systems. The tensions are quite similar, dealing with the different and often limited perspectives on innovation of the actors involved, and information asymmetries between the actor groups which influence their capacity to successfully participate in the research planning system (Klerkx and Leeuwis 2009).

Hall *et al*. (2003) explained that rules and norms of institutions within innovation systems governed their roles and processes for research. These include how research priorities were decided, promoted, and executed; how research performance was evaluated and rewarded; and how research was held accountable to different interest groups and society as a whole. Moreover, Hall *et al*. (2001) observed that farmer involvement in agricultural R&D has shifted too much to participatory methods rather than concentrating on the underlying institutional issues.

Some farmers have long experience working in agriculture. Hence, they have accumulated experience-based knowledge which may not be systematically explainable, or in some cases may not be scientifically-sound, but this traditional knowledge could lead to scientifically explainable and replicable relevant technology for improving agricultural productivity and/or more effective in conserving local agro-ecosystem.

Researchers and academicians have to carefully and thoroughly observe rural livelihood at targeted location; systematically study agricultural practices deployed by local farmers; and comprehensively relate preliminary results of these observation and study with other closely related factors, such as accessibility and available infrastructures, non-agricultural economic activities of local community, socio-cultural aspects, and may also religious beliefs. All of these efforts should lead to a better and more comprehensive understanding on actual needs and absorptive capacity of the targeted farmers as potential users of developed technologies.

Inclusiveness in agricultural development should not be only a political jargon. It should be seriously considered in formulation of public policy and regulation. Moreover, it should also be consistently implemented since this is the mandate of Indonesian constitution.

RELEVANT, INCLUSIVE, AND COMPETITIVE TECHNOLOGIES

Technology will contribute to economic growth or provide social benefit only after it has been used to produce goods and/or services which have economic and/or social values. Not all created technologies were, are being, or will be used. Decision to use any introduced technology is depend on relevancy of the technology to user's need or can be used as solution to user's problem, absorptive capacity of potential user, prospect of its use in increasing profit, and lower price and/or higher technical reliability of the technology compared to available similar technology at the market. In addition, surely personal preference or past experience in using technology produced by a specific manufacturer will also influence the decision (loyal customer). There are also irrational users and forced users. However, in this paper, decisions based on need, absorptive capacity, and free-will choice will only be discussed.

Relevant technology is technology substantially match a specific need. It may be newly created or modified, based on demand of specific user group. It may also be an existing technology appropriate for the specific demand. For instance, rice

farmers in Indonesia urgently need a seed drier when their crop was harvested during rainy season in order to maintain quality of marketable rice grain. Therefore, technology for creating rice seed drier is a relevant technology for this specific purpose. Under explained circumstance, obviously rice farmers need the drier. However, it does not automatically mean that farmers will purchase and use this drier.

Each farmer has his/her own absorptive capacity. Absorptive capacity associated with financial capacity and technical skill required for acquiring technology or product of the technology. Technical skill can be trained. Limiting factor for small-scale farmers in Indonesia to acquire technology is mostly on financial constrain. For this reason, to increase possibility of a technology to be used by small-scale farmers, besides it is relevant to their need, it also ought to be less expensive such that it will be affordable for the farmers. Inclusive agricultural development will only be accomplished if absorptive capacity of farmers is seriously considered.

Swaans *et al*. (2014) had identified the potential relevance of innovation system approaches for inclusive innovation, that is, the means by which new goods and services are developed for and/or by the poor. Innovation platforms represent an example of putting an inclusive innovation system approach into practice by bringing different types of stakeholders together to address issues of mutual concern and interest, which could be specifically focused on the marginalized poor. Indigenous technology cannot monopolize domestic market, since Indonesia has ratified several free trade agreements (FTA). Hartono et al. (2007) reminded us that Indonesia was facing the trade liberalization and regional economic integration with several FTAs, i.e. bilateral FTA, regional FTA and multilateral FTA. Their study indicated that Indonesia gained significant benefit in terms of real GDP, output, and welfare; except FTA with India. FTA also increased the household income of rural higher than of urban population. Unskilled labor experienced more advantages than skilled labor. Poor household gained more benefit than the rich household, both in rural and urban areas. Those conditions implied that FTA could potentially be a solution for national poverty reduction.

However, as disclosed by Wang and Tong (2010), every country involved in FTA has its own agenda and targets. For instance, China's initiative in establishing a FTA with ASEAN was primarily politically driven to ease rising concerns of a 'China threat' in Southeast Asia. Before China's WTO accession, concerns were rising among ASEAN members of strong competition from China in both export and attracting foreign investment. While it was a sensible move to allay such apprehension, the China-initiated FTA also gave China a political advantage to become a more important force in the region.

Indonesia should anticipate long term impact of FTA. Benefits of FTA as described by Hartono et al. (2007) may not be last for long period of time. Benefits based on exporting of bulky commodities but, on the other hand, heavily importing processed products will not be economically sustainable. Indonesia has to process its raw materials, and process them beyond intermediary products, in order to maximize benefits from its natural resources. Furthermore, domestic processing industries should not fully rely on foreign technologies. National capacity on research and technology development should be increased and played more significant role in providing required technologies needed by the industries. This objective can only be achieved if Indonesia is able create indigenous technologies which are not only relevant to the needs and affordable by their potential domestic users, competitive compared to similar technologies already available in global market, but also more focused on proven and potentially available domestic resources.

PRODUCTIVE, INCLUSIVE, AND ECOLOGICALLY-FRIENDLY AGRICULTURE DEVELOPMENT

Theoretically, each term of productive, inclusive, and ecologically-friendly associated with agriculture development can be defined very specific and concise, and differences among these terms can be clarified. However, in practice, the terms are actually not independent each other. They are intermingled in many ways. For instance, agricultural practices designed to maximize involvement of small-holder farmers (inclusive) may be developed from traditional practices which have been familiar to these farmers and proven to be suitable and sustainable for local agro-ecosystem (ecologically-friendly). Improvement may be done by small modification on single factor such as by introducing new high-yielding variety for increasing productivity.

Establishing a productive, inclusive, and ecologically-friendly agriculture would be very challenging due to its complicated nature. These three attributes, however, are unlikely to self-align; and in worse case, they might be contradicting or conflicting one to another. Even combining any two of those attributes is not easy. Perch (2011) stated that successful combining of social and environmental co-benefits in policy and practice has remained elusive. Developing productive yet inclusive, or productive and ecologically-friendly agriculture system is clearly not trouble-free. There have been a lot of efforts to increase productivity of agricultural lands, primarily driven by ever increasing demands of food and non-food products associated with population growth and prosperity increase. Some of these efforts end up with serious environmental problems, or widen the gap between the rich and the poor, since the later was not directly involved in the processes.

Productive and Inclusive.

In 2010, there were some 1.4 billion people continue to live in extreme poverty, struggling to survive on less than US$1.25 a day, and more than two thirds of these economically unfortunate population reside in rural areas of developing countries (Perch 2011). Large number of this population can also be found in rural Indonesia. Livelihood of rural poor is highly dependent on agriculture or fishery. Therefore, sensible agriculture and fishery programs should not leave this unfortunate group behind.

Prasvita (2014) believed that efforts to increase productivity of smallholder farms was constrained by the inadequate supply of key inputs including technology, irrigation systems, information on farming techniques, and access to credit. Furthermore, Leeuwis and van den Ban (2004) described that technological innovation in agriculture was related to all sorts of biotic and abiotic artifacts and practices, e.g. new seeds, animal breeds, machinery, cultivation techniques.

Furthermore, Prasvita (2014) noted that limited availability of appropriated technology is associated with low R&D budget allocation. High-yielding seeds resistant to local pests and adaptive to changing weather conditions, as well as improved farming and post-harvest techniques and technology are clearly needed by smallholder farmers. Slow progress in technological change in Indonesia are due to limited intensity of extension services, knowledge and innovation constraints, scattered small research stations and extension centers in the districts level, and poor information and communication technology (ICT) infrastructure. Additionally, small land plots prevent the implementation of more productive practice.

Prasvita's statement that small land area prevents implementation of more productive practices might be bias. Constraint in increasing productivity of small land acreage is not caused by the size of the land itself; it is due to bias in technological development in the past, which by design, more favorable to large

scale agribusinesses. In most cases, technology was developed to extend land acreage that can be managed by individual farmer or farmer's household. Term of 'economies of scale' was yielded following this school of thought.

Involvement of rural poor in agriculture development should not be translated as positioning this less fortunate community as object of the program or just giving them the opportunity to participate in implementing the program; instead, it has to be performed as efforts to empower them. Swaans *et al.* (2014) revealed the importance of social organization, representation, and incentives to ensure a 'true' participatory innovation process. So far, Indonesia has not exhibited significant success on these efforts, as indicated by insignificant increase in Farmer's Exchange Rate (*Nilai Tukar Petani, NTP*).

Mirza (2013) explained that the role of the ST&I policy is to provide a conducive policy framework and an environment that fosters entrepreneurial activities at grassroots level with an active involvement between science and technology research institutes with incentives for private entities to develop solutions that might reap the benefits of inclusive development in long run. This should be coupled with structural alignments of those govern innovation activities across the country. Klerkx and Leeuwis (2008) suggested an open option to organizations that govern funding of R&D. The organizations need to reflect on whether they should shift from developing science and technology capacity to innovation capacity. However, for Indonesian condition, since most of R&D funding is provided by government; therefore, it is wiser to use this public fund not only for strengthening science and technology capacity but should also be extended to strengthen innovation capacity. R&D fund should be treated as an investment, not as a routine academic expenditure. Therefore, in return, farmers will receive benefits from the R&D activities, in forms of relevant and affordable agricultural technologies.

Productive and Sustainable.

Concern on balancing effort to increase agricultural productivity and ecological conservation has emerged since the first half of twentieth century, but the term of 'sustainable agriculture' was coined for the first time by Gordon McClymont in 1950's. Significant increase in agricultural productivity during 'green revolution' was soon followed by escalating concern of excessive application of agrochemical application in agricultural lands. Residues of pesticides and inorganic fertilizers caused negative impacts on ecosystem. Therefore, they create serious treats to sustainability of agricultural production system.

Since then, ecologically friendly agricultural practices gain more attention. More R&D activities in this field have been conducted and more green agricultural technologies have been introduced, including bio-pesticides, bio-fertilizers, organic farming, minimum tillage agriculture, and many more. Yet, in most cases, ecologically friendly agriculture cannot replace conventional agriculture without reduction in productivity.

Challenges in developing productive yet sustainable agricultural technologies will be tougher in the future due to increasing demand for food and other agricultural products generated by population growth and prosperity improvement. On the other hand, suitable lands for agriculture continuously decreasing due to conversion (used for other development sectors) and degradation due to agricultural malpractices and anthropogenic pollutants.

Inclusive and Sustainable

While efforts to increase productivity and inclusiveness or increase productivity and conserving environment for sustainability are very challenging due to contradictory or conflicting nature of the

efforts. Inclusiveness and sustainability tend to be easier in finding a common ground, namely local wisdom or traditional knowledge. Local wisdom is almost certain in favor of conserving local ecosystem for sustainable management of the natural resources. This local wisdom has been practiced by local farmers for many generations. Traditional knowledge has been transferred from one generation to the next and accumulated through the years.

This traditional knowledge with double preferred qualities (inclusive and sustainable) will be a good starting point for further developed into measurable, repeatable, and scientifically explainable technologies, with aim to increase productivity. Success in developing such technology will provide the most appropriate tool for establishing a productive, inclusive, and sustainable agricultural development.

INTENSIFYING AGRICULTURE ON SUBOPTIMAL LANDS IN INDONESIA

Not all farmers are fortunate enough to have the opportunity of working on arable and fertile lands for producing food or other agricultural products. Forced by necessity to fulfill their basic need for food or for improving their livelihoods, some farmers in Indonesia (surely also in many other countries) have to deal with available suboptimal lands. These include acid and nutrient deficient wetlands with high risk of iron toxicity; unpredictable and frequently flooded inland swamps; salinity threatened coastal tidal swamps; acid and nutrient deficient dry lands; and water deficient dry lands at arid climate zone.

In most cases, however, local farmers have developed ways to coup with these unfavorable conditions. They are able to grow crops, raise animals, and/or develop technics for catching and rearing fishes. However, productivity of their activities in general is still considerably low. Many decades of experiences, passed from one generation to the next, have accumulated traditional collective knowledge among members of community in any specific characteristic of suboptimal land. This traditional knowledge is used as main foundation for establishing local wisdom.

Local wisdom may be scientifically unexplainable. However, the wisdom is a resultant of long term experience and has been tested years after years. Members of the community firmly use it as their primary guideline in conducting their agricultural practices. There are at least two positive values in the local wisdom, i.e. it places high priority in securing sustainability of agricultural production; and it is workable by local farmers. So, agricultural practices based on local wisdom are sustainable and inclusive. The only common drawback of these practices is low productivity.

Therefore, agricultural researches associated with management of suboptimal lands should be focused on finding ways to increase productivity. Cumulative traditional knowledge should be used as starting point and local wisdom should not be ignored. Traditional knowledge has to be scrutinized to better understand it. Comprehensive understanding of the traditional knowledge may open doors for advancement and further development of science and technology which, in turn, can be implemented in increasing productivity while preserving sustainability and inclusivity.

Introducing totally new technologies for agriculture activities on suboptimal lands may work, but a lot of failure cases have been observed. In some cases, introduced technologies may be successful in increasing productivity, but at the same time, they create new problems associated with its sustainability and/or inclusivity. Increasing short term productivity but causing serious damage to ecosystem, thus threatening sustainability of the production process, is not what we have in mind. Similarly, increasing productivity but leaving local farmers behind is not the direction that we want to go.

Just for an idea, local farmers at inland swamp (locally known as *'lebak'*) in South Sumatera used a floating seeding bed made of locally available wild plant for floater as base of the bed and mix of soil and biomass of rapidly decaying aquatic plant as substrate for seed to grow. Seedling then being transplanted to rice field after flood water subsides. Use of floating seeding bed makes it possible for farmers to start growing season earlier. Advantage of earlier growing season is to avoid the rice crop from extremely low moisture content of drying soil at the end of reproductive phase, which will reduce crop yield.

Expansion of agricultural and other activities will reduce availability of biomaterial used for constructing traditional floating seed bed. Therefore, alternative materials, most possible are synthetic or fabricated materials, are needed for producing the floating seed bed. Researches are needed for identifying suitable and affordable alternative materials for local farmers; and designing most efficient and preferred seed bed by local farmers. Material used should be ecologically-friendly. Affordable materials and preferred design are for securing inclusiveness of the technology developed. Continuously refining design and materials used for the seed bed should be aimed to produce more uniform and vigorous seedlings. This effort could be the first step towards increasing productivity of rice grown in *lebak.*

Of course, there are many more to be done, many more technologies to be developed and refined at all stages of growing cycle and all types of suboptimal lands before rice productivity in *lebak* can be significantly increased.

CONCLUSION

Success in agricultural development has no longer been assessed solely based on increase in crop productivity or national production. At least two other indicators should also be included, i.e. inclusiveness and sustainability. Even if technology is highly expected to play strategic role, it will not be the only factor required to establish the triple dimension success in agricultural development. Among others, sound public policy and regulation will be crucial in creating conducive ecosystem for nurturing agricultural innovation. Conducive ecosystem will assure the development of relevant, affordable, and competitive technologies becomes more possible to achieve. Regulation should also be in place for driving academicians and researchers to reorient their research activities from supply-pushed to demand-driven approach, i.e. focusing on answering demand and/or providing technological solution to problems encountered by Indonesian's farmers, especially small scale farmers.

Increase in food demand as consequence of population growth and conversion of arable lands for uses in other sectors have led to urgency for intensifying agricultural activities on suboptimal lands. Efforts to increase agricultural productivity in suboptimal lands should not jeopardize sustainable function of their ecosystems and limit participation of local farmers. Sustainability and inclusivity should be maintained while increasing productivity. Traditional knowledge and local wisdom have to be treated as reference point for developing agricultural technology for establishing productive suboptimal lands.

The real challenge in this scenario, however, is to push Indonesian academicians and researchers out of their comfort zone and to change their mindset from doing research as they wish to focus their research on urgent needs and serious problems directly related to Indonesian agriculture.

ACKNOWLEDGEMENT

I would like to thank all of my colleagues for their corrections and suggestions on earlier draft of this paper.

REFERENCES

ERAB. 2011. *Towards a Common Strategic Framework for Research and Innovation*. Brussels: European Research Area Board.

Hall A, Bockett G, Taylor S, Sivamohan MVK, Clark N. 2001. Why research partnerships really matter: innovation theory, institutional arrangements and implications for developing new technology for the poor. *World Development* 29(5): 783–797.

Hall A., Sulaiman VR, Clark N, Yoganand B. 2003. From Measuring Impact to Learning Institutional Lessons: An Innovation Systems Perspective on Improving the Management of International Agricultural Research. *Agricultural Systems* 78(2): 213-241.

Hartono D, Priyarsono DS, Nguyen TD, Ezaki M. 2007. *Regional Economic Integration and its Impacts on Growth, Poverty and Income Distribution: The Case of Indonesia.* Working Paper in Economics and Development Studies No. 200702. Bandung: Department of Economics Padjadjaran University.

Heemskerk W, Lema N, Guindo D, Schouten C, Semgalawe Z, Verkuijl H, de Steenhuijsen Piters B, Penninkhoff, P. 2003. *A guide to demand-driven agricultural research*. Amsterdam: Royal Tropical Institute.

Klerkx L, Leeuwis C. 2008. Institutionalizing end-user demand steering in agricultural R&D: Farmer levy funding of R&D in The Netherlands. *Research Policy* 37: 460–472.

Klerkx L, Leeuwis C. 2009. Operationalizing Demand-Driven Agricultural Research: Institutional Influences in a Public and Private System of Research Planning in the Netherlands. *Journal of Agricultural Education and Extension* 15(2): 161-175.

Leeuwis C, van den Ban A. 2004. *Communication for Rural Innovation: Rethinking Agricultural Extension*. Oxford: Blackwell Sciences.

Mirza B. 2013. *Promoting Science, Technology, and Innovation Policy for Inclusive Development.* Islamabad: COMSATS Institute of Information Technology.

Perch L. 2011. Where People, Poverty, Environment and Development Meet. *Poverty in Focus* 23: 3-4.

Prasvita L. 2014. *Public Private Partnership in Agriculture R&D: an Innovative Approach to help Indonesian Smallholder Farmers.* Discussion Paper for Research Summit on Food and Agriculture, Jakarta: Australia-Indonesia Research Centre.

Ragasa C, Babu S, Abdullahi AS, Abubakar NY. 2010. *Strengthening Innovation Capacity of Nigerian Agricultural Research Organizations*. Washington DC: International Food Policy Research Institute (IFPRI).

Roling NG, Hounkonnou D, Offei SK, Tossou R, Van Huis A. 2004. Linking science and farmers' innovative capacity: diagnostic studies from Ghana and Benin. *Wageningen Journal of Life Sciences* 52: 211–235.

Sumberg J. 2005. Systems of innovation theory and the changing architecture of agricultural research in Africa. *Food Policy* 30(1): 21-41.

Swaans K, Boogaard B, Bendapudi R, Taye H, Hendrickx S, Klerkx L. 2014. Operationalizing inclusive innovation: lessons from innovation platforms in livestock value chains in India and Mozambique. *Innovation and Development*. In Press.

VINNOVA. 2013. *Challenge driven Innovation: Societal challenges as a driving force for increased growth*. Stockholm: Verket för Innovationssystem (VINNOVA).