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Sustainable Land Management to Enhance Food Production of APEC Members

Proceedings of Workshop

Chiang Mai, November 28 - 30, 2012

APEC Agricultural Technical Cooperation Working Group

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CONSULTANTS

Preface

Many threats have recently signaled instability in food production around the world. In order to secure food security, a range of factors need to be considered, including land resources. Therefore, Sustainable Land Management (SLM) is an important tool to support agricultural production and, consequently, to enhance the capacity of food security.

Previous projects have foreshadowed that cooperation among APEC members on these issues are needed. In accordance with the needs and cooperation detailed in the APEC Niigata Declaration on Food Security, Land Development Department (LDD) under Ministry of Agriculture and Cooperatives (MOAC) put forward a proposal to organize a "Scientific Workshop on Sustainable Land Management to Enhance Food Production of APEC Members" in Chiang Mai, Thailand during 28 – 30 November 2012. This event aimed to bring together government officers, scientists and researchers from public and private sectors working on SLM-related issues and allow them to share their experiences and knowledge on SLM strategies, technologies and practices. The workshop outputs were expected to help find options and provide guidance in assessing present and future challenges to food security, to enhance our understanding on the causes of unsustainable food production, and also to address possible losses across the entire food chain of each economy. One hundred and twenty two participants from 13 APEC economies were actively involved during the workshop. Opportunities for LDD and other Thai agencies to show case their efforts were provided. Presentations, discussions, questions, posters and exhibitions were closely concerned with SLM and food security. The main outcomes of the workshop were: a strengthening of collaborative linkages between participants from different APEC economies to work on common land degradation problems, canvassing of SLM opportunities, current techniques, best practices and public participatory approaches in member economies; and exchange of new concepts from different economies. Officers and scientists of LDD and member country organizations (including international experts and consultants) have learned and gained much in the way of new information and exchanges Further application to member economies is dependent on on-going development of networks and collaboration (e.g. national land resource database network). Any follow-up workshops/meetings/joint projects are encouraged in order to further strengthenrelationships among member economies and to provide a more focused approach to SLM.

Therefore, we propose that the proceedings of this workshop should be particularly valuable in the context of APEC food security and to demonstrate the success of this workshop. This proceeding includes **16** presentation papers and nine poster abstracts. It is encouraged and financially supported by the APEC Secretariat and LDD.

I thank all consultants, experts, participants and workshop committee for their contribution and energy. I extend particular thanks to the LDD staff who facilitated every step of the workshop. I fully anticipate that the proceeding will be beneficial in supporting of overall objectives of this workshop and SLM.

A. Chantanaroj.

Mr. Anusorn Chantanaroj
Deputy Director General
Land Development Department
Chair of Organizing Committee

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Opening Remark

By His Excellency Mr. Kriangsak Hongto

Director General of Land Development Department, Thailand

At

Scientific Workshop on Sustainable Land Management

to Enhance Food Production of APEC Members.

Bangkok, Thailand

9.00-9.45 am. November 28, 2012

Your Excellencies,

Distinguished Delegates,

Honorable Participants,

Ladies and Gentlemen

Good morning.

On behalf of the Ministry of Agriculture and Cooperatives, I warmly welcome you to this important workshop in Thailand.

The holding of the Scientific Workshop on Sustainable Land Management to Enhance Food Production of APEC Members is timely and marks a step forward in the strengthening of our collaboration. This is an important issue. As we have heard, food productivity and its security are at considerable risk due to environmental degradation and the exploitation of food resources.

Ladies and gentlemen,

Many threats have recently signaled instability in food production around the world, including production in APEC economies. One of the greatest challenges relates to the projected increase in world population to about 10 billion by the year 2050. This will double the food requirement. To feed the rising population, an additional 120 million hectares of croplands, most located in developing economies, will be needed. The expansion of cropland may be possible in some areas, but not in some economies such as Thailand's, where land has become scarce due to socioeconomic and environmental constraints. Another option for the Thai economy would be to cultivate food crops intensively on the existing land, which is likely to be degraded land.

Thailand is not the only one among APEC economies facing this challenge. APEC economies are among the world largest food exporters and importers. They generate more than half of the global cereal production. Nowadays some economies are faced with the problem of land degradation and its impact on food productivity, while at the same time they are also confronting malnourishment, poverty, and other social problems. In combination, the impact from these factors increases the likelihood of rising food prices, financial crises and social unrest, higher energy consumption, and extreme climate events. These conditions are likely to contribute to increased food security risks.

Given the complexity of factors affecting food production and food security, focusing on soil resource management might be a good step towards sustainable development. It is because soil is a finite and non-renewable resource that it has been considerably degraded due to inappropriate management practices and socioeconomic pressures. Improving soil quality and managing its fertility are of fundamental importance for agricultural production. They are becoming important considerations in determining food security, poverty reduction and environmental management.

With those concerns, several issues with regard to important food resource-based such as soil need an immediate attention and need to be addressed. Several questions that come to my mind are, for example, how to find adequate healthy soil for food production, how to boost soil potential or remove the constraints of soil, what are appropriate strategies and policies need to be addresses, which technology are best suits to be adopted to soil-specific for sustainability, and how to manage such technology, research transfer or shared knowledge in cost effective way.

In order to answer those questions and find options to compete with the rising food demand and handle the challenges, soil must be first secured in a sustainable way. Therefore, Sustainable Land Management approach or SLM has been implemented in an effort to minimize and rehabilitate degraded area. Nonetheless, the concept of SLM is broad, the particular issues need be proposed by the APEC member economies to screen and find solution options to manage soil sustainability in respond to their interests and economies. And that this is the reason why we are gathered together here today in the first SLM workshop in Thailand.

The purposes for implementing SLM approach is to strengthen the land capacity to produce, and to go on producing outputs that meet APEC demands. The result of this SLM workshop is expected to help us find options and provide guidance in assessing the capacity that indicate present and future challenges of food security, to enhance our understanding on the causes of an unsustainable ability in producing food, and also to address possible losses across the entire food chain of each economy. We expect to seek options to manage land sustainability that indicates possible solution in order that contribute to the achievement of food security to the APEC's community.

Ladies and gentlemen,

This workshop is the most appropriate platform for sharing and exchanging of ideas to achieve our common goals of encouraging more collaboration among APEC member economies and ensuring food security for all.With the cooperation and collaboration among the APEC community, all of us could overcome this challenges together and finally increase the capacity of economies to improve food security situation systematically and assimilatory. Most importantly, we are here together with high ambition to conserve natural resources and not cause an irreversible damage to the environment. This is to ensure that the next generations have healthy natural resource available for them to obtain enough food.

It is now time for us to proceed towards our goals. I wish you have a very fruitful discussions and wishing all of you have a nice stay in Thailand. I now officially declare the conference open.

Session 1: Over Review

Participation and Social Capital in Sustainable Land Management: Lessons Learned from International Landcare

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ABSTRACT: Sustainable Land Management addresses the overutilisation and the under-maintenance of natural resources, and accounts for negative external environmental costs. Scale issues pose a challenge for sustainable land management. To be effective, often these practices must operate at the landscape level.

This paper argues that participatory sustainable land management that attempts to build social capital among groups of resource users, can attempt to achieve sustainable *landscape* management.

The paper briefly canvases the lessons that can be learned regarding the reported benefits of PSLM, as well as potential strategies for fostering this process. Criticisms of inappropriate participation are highlighted. The relevance to SLM of building social capital among resource users is discussed, and strategies for building social capital identified.

Lessons learned from the experience of three countries involved in international Landcare, viz. Australia, South Africa and the Philippines, are utilised to inform the discussion on how APEC economies might address the issue of scale in SLM, and build or strengthen national PLSM programs.

KEYWORDS: participation, social capital, international Landcare, landscape approaches

1 INTRODUCTION

Sustainable Land Management (SLM) is largely concerned with developing systems for addressing the overutilisation and the under-maintenance of natural resources, and accounting for the negative external environmental costs (negative externalities) that occur in land management decision-making.

One great challenge for SLM is the issue of scale. Individual resource users such as farmers, foresters, and pastoralists, must engage in sustainable practices in managing their crops, soils, forests and pastures at the household level. Often these practices, to be truly sustainable, must operate at the landscape level. A few farmers, or foresters, sustainably managing their land will be unsuccessful if the remainder of the community is engaging in inappropriate practices. In recognition of this challenge, sustainable land management research, extension, education and capacity building, is increasingly focusing on the community-level engagement with resource users. The compelling need to build the capacity of communities in the area of sustainable land management, has thrown into sharp focus the concept of building social capital for sustainable natural resource management.

Participatory SLM (PSLM) that attempts to build social capital among groups of resource users, can explicitly target overutilisation and under maintenance, while also internalising formally external costs and benefits, through sustainable *landscape* management. There are several lessons that can be learned regarding the reported benefits of PSLM, as well as potential strategies for fostering this process. Nevertheless, criticisms of inappropriate participation must also be acknowledged. In this paper, the relevance to SLM of building social capital among resource users is discussed, and strategies for building social capital identified. Lessons learned from the experience of countries involved in international Landcare are utilised to inform the discussion on how APEC economies might address the issue of scale in SLM, and build or strengthen national PLSM programs.

2 DEFINING PARTICIPATION AND THE BENEFITS OF PARTICIPATION IN SLM

Over the last two decades, it has become widely accepted that participatory approaches to SLM may deliver additional benefits over non-participatory initiatives (Bechstedt 2005, Pretty 1995). Strategies such as participatory rural appraisal (Chambers 1997), farmer participatory research (Okali et al. 1994), and participatory technological development (Bechstedt 2005) abound in the literature. Participation may take place during the planning and design phases of SLM activities, during the implementation phases, in evaluating SLM activities ('participatory monitoring and evaluation'), and in undertaking SLM-related research. This latter area of SLM-related research or 'farmer participatory research'[1] is a growing field of professional practice and methodological learning, evident in several APEC economies (e.g. Mariano et al 2012, van de Fliert and Braun 2002) and in Africa (e.g. Hounkonnou et al. 2012, Freeman 2001).

Nevertheless, defining 'participation' is fraught with hurdles. Normative definitions of participation, which assume homogeneous communities, and by extension, that community members have equal and unfettered access to participation forums, and share common views, rarely have application in SLM. Community heterogeneity related to culture, ethnicity, gender, age, power, wealth, education and geographical location, amongst many other things, will determine people's ability to participate. Diverse communities with differing interests may also include existing or potential conflicts. Assuming homogeneity, and ignoring conflicts, will not allow for the design of the consensus building and dispute resolution strategies necessary within SLM planning.

Participatory sustainable land management (PSLM) is defined here as:

The process, and objective, of involving natural resource users in sustainable land management decision-making, where user's knowledge, needs, interests and concerns are actively sought, and have some degree of influence on decision-making. The extent to which participatory processes influence decision-making is explicit, and is communicated clearly to participants. Participatory strategies are carefully selected and skillfully employed, so that those individuals or groups that have difficulty in participating are explicitly targeted. Participation activities are also designed to achieve capacity building, and attitudinal and behavioural change among the participants, including those, such as government officials, who are convening participation processes.

Thus participation also involves multiple-pathway knowledge-exchange between community participants and those convening participation forums, such as government agencies and non-government organisations (NGOs) concerned with SLM.

Is participation in SLM, in itself, a worthy objective? This paper asserts that the answer is generally, yes, for the following reasons.

- Resource users should be viewed as having a 'right' to participate, where relevant, in SLM decisions which will have an impact on them.
- SLM planning, and research and extension activities, are likely to deliver better outcomes when they incorporate an understanding of local issues, problems and conditions achieved through participatory processes.
- Well-designed participation processes, themselves, can engender an understanding and acceptance by participants of critical SLM issues and practices.

---

[1] "Farmer participatory research is an approach, which involves encouraging farmers to engage in experiments in their own fields so that they can learn, adopt new technologies and spread them to other farmers. With the scientist acting as facilitator, farmers and scientists closely work together from initial design of the research project to data gathering, analysis, final conclusions, and follow-up actions. This step, sometimes known as "innovation evaluation" is essential for communication as well as for initiating diffusion." (International Rice Research Institute 2012, http://www.knowledgebank.irri.org/extension/index.php/fpr)

- Well-designed participatory processes can contribute significantly to building social capital in natural resource user groups, discussed below.

Against this growth in participatory approaches, there has also been some criticism of participation techniques that are poorly designed, tokenistic, or used to capture and exploit local knowledge or local goodwill.

3 CRITICISMS OF PARTICIPATORY APPROACHES, AND POTENTIAL SOLUTIONS FOR PSLM

The extensive growth in the participation for development field has also prompted a number of criticisms which challenge the prevailing orthodoxy of participation (Bechstedt 2005, Cook and Kothari 2001). These criticisms fall into the following categories:

- That the discourse around participation has lacked intellectual rigour, and participation objectives and techniques have entered development orthodoxy with insufficient critical appraisal.
- That tokenistic and exploitive participation has allowed the superficial legitimisation of the development objectives of organisations to be imposed on communities, thereby disempowering them.
- That there are dangers inherent in privileging local knowledge over 'legitimate' expert knowledge.
- That local communities may be portrayed as benign and homogeneous, without understanding the complex array of power, advantage, needs, and conflicts that may be present.

These criticisms have merit, and there is sufficient case-study research of poor participation experience to validate these concerns (Cook and Kothari 2001). Nevertheless, most of these criticisms also hold for non-participatory development, and there is also sufficient case-study research to demonstrate the benefits of well-designed and conducted participation in SLM (Freeman 2001, Holt-Gimenez 2002, Metcalfe 2004, Pretty 2005, Prior 2002, Spaliviero 2011).

Bearing these criticisms in mind, the following guidelines should be considered when designing PSLM exercises (Allen 1998, IAP2 2006, Prior 2010, Wondolleck and Yaffee 2000).

Participation approaches should:

- communicate clearly at what stage of the decision making process ('upstream' or 'downstream') [2] communities are participating in, and what power they will have in the decision making process;
- not assume that the 'community' is homogeneous, and that their views are unanimous;
- not over emphasise the views of the more powerful, organised and articulate groups, or advantage the more powerful over the less powerful;
- gain the views of disadvantaged or unorganised groups through explicit engagement strategies;
- provide feedback to participants as to how, and why, their views have or have not been acted on;
- value both formal and informal engagement;
- be careful not to unrealistically raise community expectations;
- demonstrate integrity, and explicitly build trust in the participation process; and
- include strategies and skilled facilitators/mediators to deal with community conflict if it emerges — for example community forums may amplify community anger.

Arnstein (1969) originally questioned the extent to which 'public participation' techniques are used to manipulate, inform, consult or empower communities; that is, the extent to which the participation process and its outcomes are able to influence the planning process, or the extent to which they are merely

[2] The term 'upstream' is shorthand for the early stages of the planning process involving issue identification and initial design phase.The term 'downstream' is shorthand for later implementation stages of the planning cycle.

tokenistic or manipulative. Several participation models are now available which address Arnstein's concerns. One relevant model is that of the International Association of Public Participation (IAP2 2009).

The IAP2 model describes an increasing degree of community power in the spectrum from inform, consult, involve, collaborate, empower. The IAP2 participation spectrum, the accompanying goals and promise to participants (in this case farmers), adapted to a SLM context, are illustrated in Table 1.

Such a framework requires that those conducting participation exercises be explicit, during both the planning and implementation phases, about the goal and purpose of participation processes. The framework also makes explicit to communities how they will be engaged in the process, and the decision-making power they can expect to achieve. This framework is relevant to SLM planners, researchers and extensionists.

Table 1: Spectrum of Farmer[3] Participation in SLM Decision Making (adapted from IAP2 2009).

	FARMER PARTICIPATION SPECTRUM in SLM				
	Increasing level of farmer impact on decision making →				
	Inform	**Consult**	**Involve**	**Collaboration**	**Empower**
Farmer participation goal	To provide farmers with balanced and objective SLM information to assist them in understanding the issues, problems, alternatives, opportunities and/or solutions.	To obtain farmer feedback on SLM problems, issues, and new technologies or practices.	To work directly with farmers throughout the SLM research or extension process to ensure that farmer concerns, interests and wishes are consistently understood and considered.	To partner with farmers in each aspect of SLM planning and implementation, including the problem or issue identification, and the development and testing of locally relevant behaviours, practices and technologies.	To place the final decision making in the hands of the farmers; e.g. adaptive SLM research or local innovation process
Promise to farmers by SLM planners, researchers and extensionists	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how your input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the SLM activities, and provide feedback on how your input influenced the decision.	We will look to you for advice and innovation in formulating SLM solutions, and incorporate your advice and recommendations into the SLM decisions to the maximum extent possible.	We will implement what you decide.

Different sections of the spectrum may be relevant at various stages in the SLM process. For example, the 'inform' and 'consult' participation goals are likely to be more important very early in the planning process when proposed activities are ill-defined, while the 'involve', 'collaborate' and 'empower' goals

[3] The term 'farmer' is used here as shorthand for any natural resource user, including farmers, fishers and foresters, among others.

may be more appropriate during the middle or later planning and implementation stages of SLM initiatives, and when dealing with more specific decision-making processes or choices.

Well-designed and targeted participation techniques may achieve much more than give voice to the views of local communities in SLM decision making. Participation strategies can contribute to the building of social capital among resource user communities, so that the communities themselves can take greater responsibility for identifying SLM issues, strategies, technologies and practices; and extending sustainable practices and technologies from farmer to farmer and community to community. In addition, critical lessons can be gleaned from the experiences of international Landcare regarding how to build social capital at multiple scales.

4 BUILDING SOCIAL CAPITAL FOR SLM: LESSONS LEARNED FROM INTERNATIONAL LANDCARE

Social capital refers to the features of social organisation such as networks, norms, and trust, that increase a society's productive potential (Fukuyama 2000). Social capital can help build human capital, and vice versa (Coleman 1988). Social capital is generally considered an attribute of communities, whereas human capital[4] is considered an attribute of individuals (UK Office of National Statistics 2001). It is now broadly accepted that improvements to social capital contribute to poverty alleviation and sustainable development (World Bank 2009) and to general community well-being (Productivity Commission 2003). According to the World Bank (2011):

Social Capital refers to the norms and networks that enable collective action. It encompasses institutions, relationships, and customs that shape the quality and quantity of a society's social interactions. Increasing evidence shows that social capital is critical for societies to prosper economically and for development to be sustainable. Social capital, when enhanced in a positive manner, can improve project effectiveness and sustainability by building the community's capacity to work together to address their common needs, fostering greater inclusion and cohesion, and increasing transparency and accountability.

Comparative research in northern and southern Italy demonstrated that higher levels of social capital were linked to more effective democratic institutions (Putnam et al. 1993), and comparative studies of the social capital levels in the US have demonstrated a long-term decline, and a more recent revival (Putnam 2000). On the other hand, in the UK, social capital stocks appear to have risen in recent years (UK Office of National Statistics 2001).

Social capital is productive, but it can be reduced if strategies are not implemented to enhance it. The more communities and groups work together, the more social capital is produced; and the less people work together, the greater the depletion of community stocks of social capital (Halpern 2005).

However, social capital building can sometimes also have negative impacts on more utilitarian social and economic outcomes. Self-interested, isolated or parochial groups with high internal social capital (e.g. drug cartels) can work towards outcomes which suit their needs, but which may have negative impacts on broader society (Portes and Landolt 1996).

Issues examined within social capital studies often involve those related to community health, such as feelings of trust, safety and levels of crime. Social capacity indicators can be described and quantified (ABS 2004, Bullen and Onyx 2005, Grootaert and Van Bastelaer 2002, Grootaert et al. 2004). The concept of social capital and local institutional development have been increasingly explored in relation to agricultural development and sustainable natural resource management over the last few decades (e.g. de Sherbinin et al. 2008, Esman and Uphoff 1988, Love et al. 2010, Ostrum and Ahn 2003, Pretty and Ward 2001).

[4] Cultural capital is sometimes incorporated as a component of human capital.

In the context of SLM, social capital would refer to those aspects of social organisation that lead to better SLM outcomes, and that contribute to, or enhance, community participation, internal and external communication, community decision making, consensus building and conflict resolution. From the point of view of government, NGOs or industry wishing to engage with communities, those communities with low social capital are less likely to effectively participate, to innovate, to resolve conflict, to build consensus, and to make collaborative decisions and reach agreement. In many APEC economies, traditional natural resource-dependent communities may have existing high levels of social capital based on kinship relations, cultural or religious ties, ethnicity, or geographical proximity.

Important aspects of social capital that contribute to SLM are likely to be the building of community trust; local resource mobilisation; group learning and co-learning opportunities; the ability to extend knowledge, and influence the attitudes and behaviours, both within groups and between groups; landscape approaches to SNRM; the ability to attract and utilise greater resources; and the ability to form horizontal and vertical linkages with other groups.[5] It is also necessary to identify the key components of social capital in order to understand what is meant by the term, to explain how it can contribute to community engagement in PSLM, and to identify strategies that can be used to enhance and build this social asset.

The growing literature on social capital has identified a number of important themes and indicators including core concepts (Bullen and Onyx 2005), and studies of groups involved in SNRM have identified additional issues (Colliver 2006, Love et al. 2010, Pretty 2003, Prior 2002). These attributes of social capital relevant to SLM are:

- Participation in networks
- Reciprocity
- Trust
- Social norms (expected behaviours)
- Proactivity
- Problem or issue identifiers
- Local resource mobilisers
- Learning from successes and mistakes, and upscaling and extending best practices (adaptive management)

Each of these attributes, their SLM implications, and possible indicators, are briefly outlined below (adapted from Prior 2010).

1. Participation in networks

Central to the concept of social capital is the existence of interlocking networks of relationships between individuals and groups. Research by Esman and Uphoff (1988) found that successful rural groups tended to develop vertical and horizontal linkages with other groups. Over the next two decades, many other studies and reviews have also confirmed the importance of these linkages (DAFF 2007, Halpern 2005, Pretty 2003, World Bank 2009).

SLM Implications
Participation in networks allows individuals to take advantage of the opportunities provided by group membership including co-learning, attracting larger bundles of resources and services, and sharing experiences and the outcomes of, for example, on-farm adaptive trials, and participating in planning and

[5] Recent social capital literature distinguishes between *bonding* social capital and *bridging* social capital. Bonding social capital generally refers to inward looking social relationships that reinforce and bind homogeneous groups. Bridging social capital refers to outward looking linkages to other groups (Halpern 2005). Both concepts are relevant to SLM. Horizontal linkages are likely to involve both bridging and bonding social capital, while vertical linkages are more likely to involve bridging social capital.

decision making activities. Effective PSLM strategies are likely to explicitly target existing networks, and work with them throughout the engagement process.

Indicators:

- Number of, and quality of, horizontal linkages (involving provision or sharing of resources, exchange of information, formation of partnerships etc.) formed with other groups at the same functional level or similar geographic area (e.g. other similar community groups; schools, local government, agribusiness)
- Number and quality of vertical linkages formed with other groups at a higher level (e.g. district and provincial/state government agencies, NGOs, industry groups, catchment organisations, and research institutions).

2. Reciprocity

Reciprocity, or the expression of mutual relations (giving and receiving) between individuals or groups to each other, is also at the centre of social capital.

SLM Implications
Collective actions such as the formation of community welfare groups, sharing of valuable information and knowledge, loans of equipment, cooperative works, and donations of time and resources, are all based on the principle of reciprocity. Encouragement of reciprocity within PSLM activities can be an effective contributor to consensus building, both within and between groups.

Indicators:

- Number and variety of cooperative group works or activities.
- Extent of sharing of local knowledge (for example within SLM planning or sub-catchment planning workshops and field days, conservation agriculture, and production benchmarking and cooperative learning activities).

3. Trust

Trust is based on the expectation that others will act in mutually supportive ways, or at least will do no harm. Trust engenders a willingness to take risks in a social context.

SLM implications:
Trust within participating communities is a critical issue with regard to SLM. Once achieved, it demonstrates a more mature level of social capital. Demonstrations of trust within members of a group, or in particular, between groups, e.g. between community groups and government or industry organisations, illustrate higher levels of social capital. Trust can take some time to build, but can be lost very quickly. Building of a trusting relationship between community groups and the agency undertaking PSLM should be a priority of any PSLM strategy.

Indicators:

- Sharing of personal or potentially sensitive information within the group, or between groups.
- Devolution of power vertically downward from government to community groups.
- Exhibitions of trust and the development of relationships between groups, government, NGOs and industry, demonstrated by such actions as the use of organisations' extension and advisory services, and cooperative behaviours when dealing with sensitive issues.
- Transfer of management responsibility for programs, projects and funding allocation from industry, NGOs, local and state government organisations to community groups and networks.

4. Social Norms

Social norms are the standards and patterns of acceptable or desirable behaviour set by the group or network.

SLM Implications
The advantage of positive social norms in relation to SLM is that where groups set high standards of participant behaviour (or natural resource management behaviour), then there is some compulsion for the group members to at least meet these standards, or improve upon them. The group may impose formal or informal sanctions upon those individuals who do not observe the community group's accepted standards of SLM-related behaviours. Social norms also relate to behaviours associated with participation, planning, conflict resolution and consensus building, all of which are of critical relevance to SLM.

Indicators:
- Group rewards appropriate behaviours and penalises inappropriate behaviours.
- Consensus-building behaviours may be included within a group's acceptable social norms.
- Individual and community SLM works, and other works, are well-maintained, and group monitors and audits the timeliness and quality of an individual's works.

5. Proactivity

A critical outcome of the development of social capital is that of personal and collective action.

SLM Implications
The advantage of proactive groups and communities for SLM is that they are likely to demonstrate motivation, accumulate information, seek opportunities, and take actions that will lead to better SLM outcomes. Proactive groups are more likely to see value in, and thus participate in SLM.

Indicators:
- Group strategically plans at the group level, and monitors and evaluates plan implementation.
- Innovative community development and SLM project proposals.

6. Problem or issue identifiers

High social capital groups or communities have the ability to identify issues or problems at the early stages of their emergence, or even predict future issues or problems before they occur.

SLM Implications
Where community groups can identify SLM problems or issues at the early stages of their development, then funds and support services can be allocated to the appropriate direction. Problems and issues are more likely to be identified early within the PSLM process.

Indicators:
- Groups identify and work to address problems or issues in the early stages of their development, or where local awareness or recognition of an issue is still low.
- Project proposals seek to address new issues.

7. Local resource mobilisers

Groups with high social capital have the ability to mobilise local resources.

SLM Implications
Clearly, the advantages of a local resource mobilisation with regard to SLM and community development, are that investments made by governments and other organisations may be multiplied many times, once local resources are mobilised, delivering high internal rates of return on investments.

Indicators:
- Level of group contributions in cash or in-kind to projects.

- Investment multipliers for government, industry, or NGO investments.

8. Learning from successes and mistakes and scaling up and extending best practices (adaptive management)

High-capacity groups have the ability to learn from their mistakes, identify successful strategies and technologies, and scale-up and extend these strategies and technologies throughout the group, and to others outside the group.

SLM Implications
Within community groups and networks, there is a continual need to improve upon old strategies and technologies and develop new ones. The advantage of learning from mistakes and successes is that such groups learn quickly, and constructively and adaptively manage their natural resource base. The lessons they learn from PSLM experiences and activities, are more likely to be institutionalised and maintained within their organisations.

Indicators:

- Absorptive capacity of group progressively improves over time.
- Evidence of lessons learned, group learning, successful technologies and best practices being accumulated, practiced and documented.
- Successful technologies, innovative practices and lessons learned being extended both within the group and outside the group.
- Field days, seminars and trainings conducted by group for members and non-members.

8.1 Strategies for building social capital

Effective strategies can be employed to utilise existing social capital, or to build new capital. Such strategies will be more effective where strong partnerships are formed between government, non-government and industry organisations and civil society to implement them.

1. *Use existing institutions and networks where available, and develop new institutions and networks when necessary.*

   Building social capital is essentially a community development activity, and should be viewed as a medium to longer term undertaking. Consequently, in a PSLM process it is advisable to commence by seeking out and engaging with existing networks and institutions that already exhibit some level of social capital, bearing in mind that some existing networks and institutions may also have low levels of social capital. Existing networks and institutions may include village groups, farmer groups, women's groups, youth groups, local government organisations, and indigenous groups.

2. *Use of community facilitators to build social capital:*

   The pivotal role of community facilitators in community development processes has been recognised in the international development arena for over 30 years. Love et al. (2010) highlighted that a critical requirement for building social capital in the Australian Landcare Program was the employment of skilled and active community facilitators.[6] Community facilitators within a PSLM process may require additional skills in strategic planning, consensus building, conflict resolution and mediation. Community facilitators stimulate and manage social capacity building processes, and undertake planning, training and works-based activities with groups. Facilitators may operate at a local district level, as well as at subregional and regional levels.

[6] For the purposes of this paper, 'facilitator' is defined as a person using facilitation and coordination strategies, techniques and skills to engage with community groups to build their capacity. The role of facilitators is to facilitate planning, decision making, consensus building, and social capacity-building processes with community groups.

3. *Funding of activities that build social capital; or incorporate social capital-building strategies and outcomes into SLM research and extension strategies*

   Social capital can be enhanced within communities through engagement strategies that encourage and facilitate collaborative decision making. Properly designed, managed and facilitated SLM planning can involve consensus building and joint fact-finding activities that build social capital. The importance of small amounts of SLM funding, contributed under cost-sharing and mutual-obligation arrangements, can be important catalysts to stimulate social capital building processes (Prior 2002). Alternatively, existing SLM funding arrangements can enhance social capital by incorporating social capital-building strategies and outcomes into project funding criteria. For example, projects that require group-level, landscape-level or subcatchment-level planning can encourage collaborative behaviours, sharing of information, trust building, and the articulation of shared goals and needs.

4. *Build institutions that facilitate scaling-up of social capital-building processes*.

   Local institutional development case-study research has demonstrated that successful groups tend to have strong vertical and horizontal linkages with other groups (Esman and Uphoff 1988; Halpern 2005, World Bank 2009). Both vertical and horizontal social linkages are important for SLM, but vertical linkages are more challenging for networks, as the link between grass-roots needs and interests, and subregional and regional needs and interests, must be maintained. The more complex vertical networks, and associated planning processes, must be coordinated and integrated in a multi-level participatory fashion. Thus social and human capacity must be built at the required spatial and social scales, facilitation needs must be met, institutions and networks developed that are representative and inclusive, and government must have the necessary institutional and governance frameworks and support in place, with adequate resourcing.

5 BUILDING A NATIONAL PSLM PROGRAM: LESSONS LEARNED FROM AUSTRALIAN AND INTERNATIONAL LANDCARE

For many APEC economies, there will be interest in moving beyond local PSLM activities or projects, and scaling up to regional or national PSLM programs. A number of interesting lessons can be gleaned from the experiences of Australian and international Landcare for those interested in developing national PSLM programs. In particular, the experiences of Australia, and later South Africa and the Philippines, highlight effective strategies for building social capital.

5.1 Brief history and achievements of Australian Landcare

In response to worsening land degradation, the Australian Landcare movement commenced as a grassroots farmer movement, concerned with combating severe land degradation, in the Australian State of Victoria in the mid-1980s, and was subsequently adopted as a national Government-sponsored program in 1990 with a decade-long policy commitment (Johnson et al. 2009). Federal government funding stimulated state governments to also adopt a Landcare program and approach. Over the first two decades, Australian Landcare grew dramatically from a base of 200 SLM groups in 1988, to over 4500 groups in 2003 (DAFF 2003). Membership rates were estimated as being over 45% of farmers, while 75 % of all farmers claimed to have participated in Landcare activities. By 2003, total Landcare membership was estimated at around 135,000 members (Curtis 2003).

Perhaps more important than participation rates have been the qualitative improvements to both human and social capital (targeting SLM) produced through farmers' participation in Landcare. These improvements have been extensively documented (Cary and Webb 2000, Curtis 2003, Curtis and de Lacy 1996, Prior 1996). Human capacity has been enhanced in terms of individual farmer's sustainable natural resource management knowledge, understanding, attitudes, skills and behaviours. Social capacity had been enhanced in terms of the quality and frequency of interactions within and between Landcare groups (farmer to farmer learning and innovation), and between Landcare groups and other organisations such as government agencies, the business sector, and research and education institutions.

One significant outcome of the increasing farmer participation rates and the consequent number of Landcare groups, has been the formation of these groups into sub-regional or regional networks (or ‘groups of groups’). Such networks may incorporate less than ten groups to well over 100 groups. These networks are normally supported by community Landcare ‘facilitators’.

Regional Landcare networks have evolved in response to their own needs and aspirations. They have also developed in response to changes in federal and state government policies. One significant stimulus has been the increasing trend within the states towards the regionalisation of natural resource management, particularly through the formation of catchment management organisations. Another policy stimulus to the evolution of regional Landcare networks was the introduction of the regional delivery model for the devolution of Federal SLM funds directly from the national level to regional catchment management groups.

The significance of regional Landcare networks was highlighted by the National Landcare Program Review conducted in 2003 (DAFF 2003, 49). The review concluded that Landcare networks and their farmer-members were more likely than non-members to:

- engage in whole of catchment planning;
- adopt professional management approaches, including those related to accounting for government invested funds, monitoring resource condition, and documenting group decisions and project outcomes;
- attract substantial funding, and in-kind resources, to address on-ground issues;
- provide effective communication between, and learning opportunities for, groups and members;
- apply new norms of SLM behaviour, test new practices, and monitor and document key results from trials;
- share resources and meetings to pool information to address common issues;
- offer effective leadership as they draw from a wider leadership pool, and build leader competency;
- undertake large scale on-ground works, and influence significant changes in the practices of landholders;
- influence the priorities of regional catchment groups.

Not only have local community Landcare groups in Australia been effective at undertaking SLM activities, but such local groups have also forgedstrong linkages and networks with other similar groups at the district, regional, state and national levels. The relationship between these groups and their networks is illustrated in Table 2 and Figure 1.

Table 2 (from Prior 2010), lists membership of the 7 regional Landcare networks in northern New South Wales (NSW) that comprise the New England and North West Landcare Network Chairs Group (NENWLNC). Through their linkages with the NENWLNC, an individual Landcare farmer-household, or a Landcare group of say 20 farmers, now has a SLM knowledge and learning network comprised of almost two and a half thousand farmer-households. Such a network can generate enormous social and political (policy influence) capital.

Figure 1 illustrates how the NENWLNC (a Level 3 network), in turn, can generate powerful social and political capital through its vertical networks that reach up to the NSW state level (Level 4) and up to the national level (Level 5). Similar networks with these nested scales can also be found in other Australian states such as Queensland and Victoria. The ability to generate social capital at multiple scales, has been one of the distinguishing features of the Australian Landcare movement. Such networks are in a powerful position to comment upon, and influence, government natural resource management policy. In addition, National and State governments, their institutions and SLM extension staff, made critical contributions to building social capital. This experience, coupled with the lessons gleaned from

Table 2: Landcare networks, their farmer membership and SLM partner organisations, comprising the New England and North West Landcare Network Chairs Group in northern NSW, Australia (Prior 2010).

Landcare Network Name	Central Town	Number of Member Groups	Number of Farmer Families	Number of Collaborating Partner Organisations
Southern New England Landcare	Armidale	29	875	19
Granite Borders	Tenterfield	25	730	15
GLENRAC (Glen Innes Natural Resource Advisory Committee)	Glen Innes	9	100	5
GWYMAC (Gwydir-McIntyre Landcare)	Inverell	30	400	13
Upper Gwydir Landcare	Bingara	9	119	6
Liverpool Plains Land Management Committee	Gunnedah	20	125	15
Tamworth-Manilla Landcare	Tamworth	6	70	3
TOTAL		**120**	**2419**	**76**

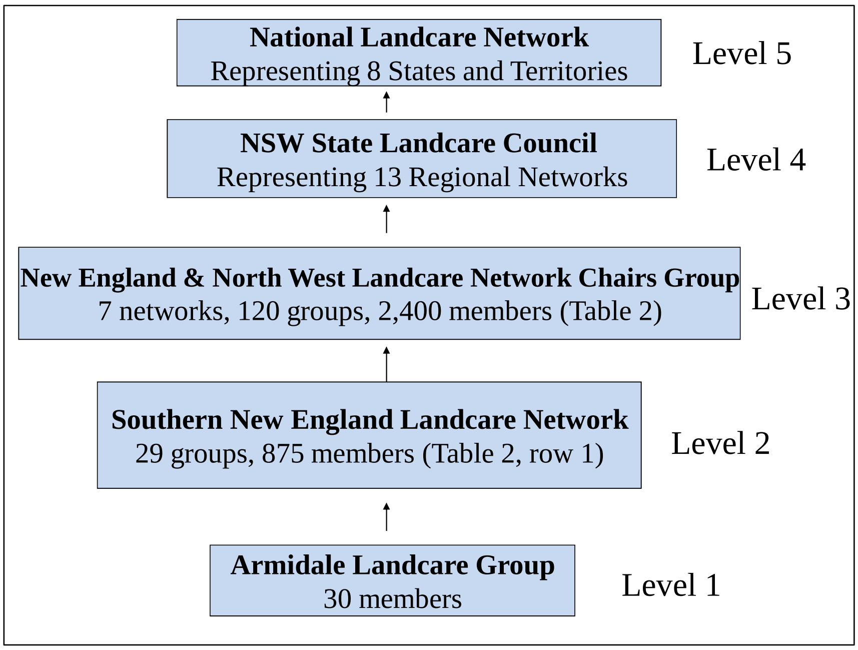

Figure 1: Australian Landcare networks at various scales from local to national

international Landcare, enables key strategies to be identified for building social capital for SLM at multiple scales.

5.2 Lessons Learned from International Landcare

Based on the positive Australian experience, over the last decade Landcare has steadily spread worldwide with over 15 countries implementing Landcare in some form, and constituting part of the international Landcare network. Countries with established Landcare activities, including some APEC economies, are: Australia, Fiji, Germany, Iceland, India, Indonesia, Kenya, Malawi, New Zealand, Philippines, South Africa, Sri Lanka, Tanzania, Uganda, Namibia, Zimbabwe, Botswana, Canada and the United States of America. The multilateral organisation, the World Agroforestry Centre (ICRAF), has explicitly adopted a

Landcare approach in its SLM research and extension program. It is important to emphasise that each country has adopted its own version of Landcare, in a manner that reflects local conditions, cultures, and needs (for example see Catacutan et al. 2009 for a range of country descriptions).

Most APEC economies will have successful existing experiences with PSLM involving SLM communities, government agencies, NGOs and industry. In adopting a Landcare approach, it is important that these existing experiences are used as learning opportunities, and their achievements are recognised, celebrated and used to build the capacity of other communities and other partners. A Landcare approach offers a clear 'brand-recognition' and network that binds together, and links these PSLM hubs within a common identity. Figure 2 illustrates that Landcare can add additional layers of impacts to existing strategies and activities, in a manner that builds networks and social capital, and that can extend from the local through to the national and international scales.

Apart from the Australian experience, the Landcare programs in South Africa and the Philippines are among the most mature and sophisticated. Distilling the lessons learned from the experiences of all three countries, enables the identification of some broader guidelines that may be relevant for those APEC economies interested in developing their own national Landcare, or similar, programs.

Referring to Table 3, the Australian experience demonstrated that, with the design and implementation of appropriate policy and institutions, governments can develop a national PSLM program that can build social capital and extensive farmer networks, define and promote positive SLM behavioural norms, and

Table 3 Lessons Learned from the community-Landcare experience in Australia, the Philippines and South Africa (adapted from Cresencio-Catacutan 2007, Mercado and Garrity 2000, Metcalfe 2004, Prior and Holt 2006, Prior and von Maltitiz 2004).

Lessons Learned from the Landcare Program in each country	
Australian Landcare Experience	**Philippines Landcare Experience**
1. Clear vision is required regarding the need for *community participation and empowerment* in natural resource management	**1.** Where possible, use existing community institutions & build their capacities, & undertake targeted training in a wide range of livelihood areas
2. Landcare 'Champions' are essential	**2.** Engage government at the 'local' service delivery level
3. Government policy and institutional support critical	**3.** Utilise simple, easily replicated, low cost 'Landcare' technologies that have clear advantages over existing technologies
4. Cultural change in government necessary	
5. Trained community facilitators are essential	**South African Landcare Experience**
6. Landcare began with a focus on the physical aspects of natural resource degradation, but evolved to a holistic approach including social & economic dimensions, including agricultural production systems	1. Clear definition of local Landcare Model: • the 6 LandCare Principles • Landcare Good Practice criteria • Exemplar Landcare communities
7. Constructive media coverage is critical	2. Capacity building training programs for govt. NGOs and communities
8. Structured approaches were needed for engaging groups in learning	3. Real partnerships between government, NGOs and communities are critical
9. Capacity building and training necessary for communities, government, and NGOs	4. Responsive Landcare policy and institutional frameworks

achieve substantial improvements to SLM activities on a landscape-scale around Australia. This experience also demonstrated the importance of political and institutional champions, the value of effective use of the media, the need for cultural change in government agencies, and the critical importance of community facilitators. The South African experience demonstrated all the above, but added additional insights. South African Landcare highlighted the value of identifying, recognising and celebrating existing PSLM experiences, and the value in bringing this collective experience under the same banner, called 'Landcare'. The South Africans also demonstrated the value in progressively articulating a definition of, and success criteria for, Landcare, and highlighting how Landcare might add value to other existing activities. The Philippines experience demonstrated the effectiveness of building on existing local institutions, the importance of the engagement of local government as partners, and the need for effective, replicable, and attractive 'Landcare' SLM technologies, which would prove to be a positive incentive for farmers continuing engagement in Landcare community groups.

All three international Landcare programs have demonstrated the critical importance of local community facilitators. Landcare facilitators are necessary to build social and human capacity, help mobilise local resources, to facilitate the spread of technologies, and generally support community-based SLM. Experience in numerous countries has demonstrated that an effective Landcare facilitator network is a fundamental requirement for the rapid development of Landcare program. Landcare facilitators must be provided with the necessary attitudes, skills and knowledge required to foster the Landcare approach.

5.3 Defining, promoting and extending local Landcare Principles, and good Landcare practice

Initially most countries have defined Landcare quite broadly or loosely. This is appropriate, given that such countries must allow sufficient time for Landcare to be defined in way that reflects local culture, development history, natural resource management issues and problems, and the policy context. However, over time it is important that local Landcare programs progressively identify and refine those policies, institutions, technologies, and development approaches which are consistent with the Landcare philosophy. Each country needs to develop a coherent view of what *its* 'Landcare' encompasses. The danger in not doing so is that Landcare can become all things to all people and thus have no clear identity, nor challenge prevailing practices (Prior and von Maltitz 2004). The other concern is that, where change is required to current natural resource management approaches, those who resist change can easily argue that they are already adopting some loosely defined Landcare approach. The South African experience highlighted the value of the following strategies.

- Defining locally-relevant 'Landcare Principles'.
- Identifying Landcare good practice success criteria for Landcare project design and evaluation.
- Based on the Landcare principles and good practice criteria, identifying and promoting exemplar 'Landcare' communities and projects selected from the existing SLM activities around the country; and using these projects for capacity building and training of government and NGO staff and other communities through 'look and learn' visits.

By defining Landcare in a locally relevant manner, those sponsoring Landcare can also progressively define what is regarded as good Landcare practice. Having done so, working examples of such good practice within Landcare communities can be identified, analysed, and used for promotional and educational purposes, both with supporting agencies and funders, and with other participating Landcare communities.

Landcare in South Africa identified six *indivisible principles* that should define and guide Landcare policy, approaches, processes and projects (Prior and von Maltitz 2004). With local adaptation, these principles may be generally appropriate for the Landcare programs of many countries. For the South Africans, Landcare involved:

1. *IntegratedSustainable Natural Resource Management* addressing *primary causes* of natural resource decline.
2. *Community-based and led* natural resource management within a participatory framework.
3. The development of *sustainable livelihoods* for individuals, groups and communities utilising empowerment strategies.

4. Government, community and individual *capacity building* through targeted training, education, and support mechanisms.
5. The development of active and true *partnerships* between governments, LandCare groups and communities, non-government organisations, and industry.
6. The blending together of appropriate upper level *policy processes* with *bottom up feedback mechanisms* to give voice to local communities.

Within South Africa, eight examples of Good Practice Landcare Communities were initially selected from throughout the country (Prior 2002). These examples were used for media exposure and promotional and educational purposes, for training of Landcare support staff, and for 'look and learn' visits by other participating Landcare communities. The good practice models provided a powerful catalyst for clarifying what Landcare could achieve, and extending its impacts into new areas. Even at the early stages of the development of a national Landcare program, most countries with a history of SLM will be able to identify exemplar projects which largely reflect the application of locally defined Landcare principles.

6 HOW A NATIONAL LANDCARE PROGRAM MAY ADD VALUE TO EXISTING SLM ACTIVITIES WITHIN APEC ECONOMIES

A national Landcare program can add value to existing SLM activities within the country in the following ways, (illustrated in Figure 2):

- through aggregating, under a 'Landcare brand', existing high-quality examples of PSLM involving a wide a variety of donors, partners, communities and technologies;
- under the Landcare banner, participating communities and their government, NGOs and private sector supporting partners, automatically become part of a larger network that can be used for cross-learning, capacity building, marketing and promotion;
- by becoming a part of an international Landcare network, the benefit of branding and cross-learning and capacity building can be amplified through international study tours and training.

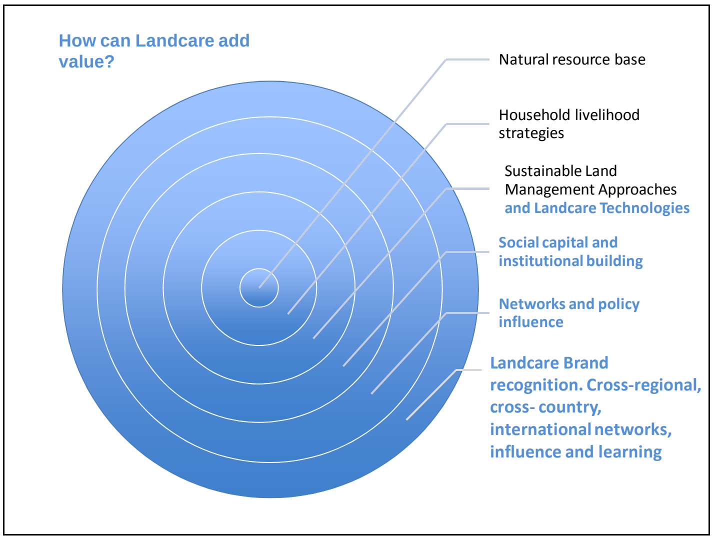

Figure 2 How a Landcare Approach can add value to existing SLM Initiatives

International Landcare's experience has demonstrated that Landcare communities and their supporting government agencies, NGOs and donors can still maintain their own identity and integrity, and claim credit for their individual achievements, while at the same time promoting those achievements very effectively on a grander national or international Landcare stage.

For both the South African and Philippines Landcare programs, participation in study tours and training programs in Australia, plus linkages to Landcare networks in other countries, proved to be very effective in catalysing and inspiring national efforts.

In recent years, regional Landcare networks have emerged, such as the East African Landcare network, operating in several East African countries, and initially financially supported by the Australian Government, and more recently by the South African Government. It is hoped that regional networks will provide increasing opportunities for regional learning, capacity building and SLM policy influence.

7 CONCLUSIONS

This paper has explored the concept of participatory sustainable land management, and highlighted some of the potential benefits, and pitfalls; and identified useful conceptual frameworks and strategies for implementing participatory processes. The value of building social capital in natural resource user groups for SLM, and strategies for building social capital, were also discussed.

Lessons learned from the international Landcare experience for building social capital at multiple scales, and for landscape management and policy influence, were outlined, and the potential application of a Landcare approach to APEC economies highlighted. The fact that Landcare in some form has taken hold in excess of 15 countries, is a demonstration that there may be merit in this approach for many APEC economies.

Ultimately, the effectiveness of participation and social capital building for SLM is determined by enabling policy and institutions. The capacity of organisations to engage effectively with local communities for SLM revolves around the existence of an institutional commitment to these processes and outcomes.

Given the above discussion, there is an opportunity for APEC economies to:

- share and document their PSLM and social capital building experiences, in a co-learning and capacity building environment;
- learn from the international experience regarding how to create favourable policy and institutional environments for PSLM and building social capital at various scales;
- develop an APEC PSLM identity and 'brand' that aggregates this collective experience under a common APEC banner, to build the co-learning network between APEC economies.

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Sustainable Land Management Responding to Food Security and Climate Change Challenges: A Discussion Paper

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ABSTRACT: Sustainable Land Management is one of the promising solutions for a sustainable local landscape management promoted by institutes like WOCAT, UNCCD, GEF and the World Bank. SLM provides options to increase food security, enhances soil carbon sequestration, reduces surface runoffs, and maintains or increases local landscape biodiversity. Lessons learnt from the preparation and implementation of SLM projects, in particular experiences gained from SLM project in Bhutan funded by GEF/WB are discussed. The paper argues that the important factors to consider for the adoption of SLM technology are policy support, awareness and education of stakeholders, understanding local culture, farming system, and physical limitation of landscape. Engagement of relevant stakeholders in participatory debates and discussions guided by a skilled local moderator, well informed on soil/ land science, is important. A selective case study is proposed to quantify these contributions by SLM in economic terms at local landscape that would add high value for the promotion of SLM among politicians, policy makers and donors.

KEYWORDS: Sustainable Land management, participatory approach, land degradations, climate change, local knowledge

1 CONTEXT

During the Conference of Parties (COP) of the United Nations Convention to Combat Desertification (UNCCD) in Havana, Cuba, 2003, the Global Environment Facility (GEF) announced its readiness to serve as a financial mechanism of UNCCD and its decision to designate land degradation as a new focal area(UNCCD, 2003). Bhutan was one of the few countries from the Asia and Pacific region that accessed this fund through the Operational Program (OP) 15 of GEF with assistance from the World Bank. The project called “Sustainable Land Management” (SLM) was implemented from 2006 to 2012 with a grant support of US $ 7.6 million. A series of consultations with the stakeholders were carried out to prepare this project. Most of the key stakeholders from the central agencies, local institutes and the community had limited knowledge on SLM technologies and land degradations issues. Some of the most frequently asked questions during the multi-stakeholder consultations were (Norbu, 2011), what would be my sector’s budget share from this project? What incentives do we get as party to this project? And how would I be compensated for using my land as experimenting ground? Following these consultations and awareness building on SLM, more than 20 projects on land degradation focal area under GEF Small Grant Projects (SGP) managed by UNDP were implemented by the communities from 2005 to 2012. These land degradation activities were targeted to enhance SLM knowledge of communities, increase food security and reduce environmental risks through plantations.

The studies on climate change impacts in the Asia/Pacific region have indicated that the production of rice, maize, and wheat in the past few decades has declined in many parts of Asia due to increasing water stress arising mainly from increasing temperature, increasing frequency of El Nino and reduction in the number of rainy days (www.ifad). In addition, more frequent and extreme events, such as droughts and floods, are expected to make local crop production more difficult. It is projected that climate change will put around 49 million more people at risk of hunger by 2020. The climate change impacts on agriculture may threaten not only food security, but also the national economic productivity of the least developing countries.

The first quarter of 2008 saw a sharp rise in prices of cereals (GFC, 2008). The average world wheat prices were 130% above their level a year earlier, soy prices were 87% higher, rice had climbed 74%, and maize was up 31%. Plausible reasons debated were droughts in major wheat-producing countries, sharp rise in oil prices, high meat consumption habits and diversion of cereals to agro-fuels. Reports of riots and demonstrations were reported from many corners of the world because of food shortages and hoarding.

The proposed policy options for the affected countries were to increase investments in local agriculture research and development, pursing self-sufficiency and food security as one of the top priorities of the nation in ensuring socio-economic development of the . Today globally, close to one billion people suffer from hunger and more than 200 million children under five years of age suffer from malnutrition according to the Food and Agriculture Organization (FAO).

A number of funding mechanisms were established to help countries support adaptation and mitigation measures to combat these climate change impacts. The Least Developed Countries Funds (LDCF), Special Climate Change Fund (SCCF) and Green Climate Fund (GCF) are widely known in addition to bilateral supported by the developed countries. Accessing such funding mechanisms, however, is a big challenge for many affected countries because of lengthy processes. In addition, a number of conventions, meetings, workshops and seminars are organized annually to educate, create awareness and find solutions to combat climate change impacts and food and nutrition insecurities. A lot of convincing scientific findings from global climate models are now available to indicate that climate is changing and it is due to accumulation of GHG in the atmosphere contributed by increased anthropogenic activities. One of the promising solutions for a sustainable local landscape management is Sustainable Land Management (SLM). It is an affordable and doable practice by smallholders to increase food production, reduce environment risks and adapt/mitigate climate change impacts. This discussion paper explores definition of SLM; factors to look for on SLM farm adoption; its contribution to food security and combating climate change. The arguments provided and discussed are mostly derived from the empirical knowledge and review of works, and focuses around small holders of upland mixed farming systems.

2 WHAT IS SUSTAINABLE LAND MANAGEMENT (SLM)?

2.1 SLM Defined

The World Overview of Conservation Approaches and Technologies (WOCAT) defines SLM as the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long term productive potential of these resources and the maintenance of their environmental functions. WOCAT has carried out its activities with more than 50 national and regional groups, documenting more than 470 SLM technologies and 235 SLM approaches. The World Bank defines Sustainable Land Management as a knowledge-based procedure that helps integrate land, water, biodiversity, and environment management to meet rising food and fiber demands while sustaining ecosystem services and livelihoods. Likewise, UNCCDhas taken an initiative to document the best practices of SLM technology by the parties for the first period of reporting on the implementation of 10^{th} year strategy framework of the convention so that the countries can learn from each other(UNCCD, 2010). The essence of these definitions are to stop and reverse land degradations so that there is increase food production, reduced sediment loads in the streams and rivers, prevent flash floods and landslides, improve biodiversity conservation and sequestration of carbon at the local level.

2.2 SLM in Bhutan

The farmers in Bhutan adopt SLM to increase crop and fodder production, reduce surface soil erosion and increase vegetation of local landscape. The farmers in the early days of 1980s were provided with cash incentive of Nu.500 for making contour bunds and terraces on one acre of land; and Nu.300 for compost pit making as part of soil fertility improvement program. These soil and land management strategies did not work. Like wise, a number of soil conservation projects initiated by the donors died down after the closure of the projects. The land management report prepared by the department of agriculture in 2005 cited main reasons for these failures were that approach was a top down, physical limitations of sites not studied and that the farmers were not consulted before the introduction of these technologies (DOA,2005). There were also a number of soil and land management components under different projects and programs funded by the donors under various ministries implemented independently without coordination or consultations with the relevant stakeholders. Realizing these deficiencies, a national land management campaign was carried out in Bhutan in 2005 to educate, create awareness and seek active participation of stakeholders. Most of these selected sites were degraded soil and land because of poor agronomic practices coupled with loss of vegetative covers. The physical works included establishment of hedgerows (fodder grasses planted), terraces and contour bunds along the contours of sloping farm land; construction of stone and log check dams in gullies and ravines; and planting of fodder and tree saplings on the degraded land. The farmers, local leaders, planners, researchers, and the heads of the departments of the agriculture ministry participated in this campaign. This national campaign helped local leaders to mainstream SLM into their regular annual plans of the sector.

3 FACTORS TO CONSIDER IN THE PROMOTION AND IMPLEMENTATION OF SUSTAINABLE LAND MANAGEMENT PRACTICES

Policy

The exposure of planners and decision makers to SLM stakeholder consultations is an important component of mainstreaming. These participatory consultations re-enforces the value of consolidation of SLM activities that were implemented under different projects and programs to address themes like food security and environment issues under different ministries. The participation of local institute planners also adds high value to harmonization and consolidation of SLM programs. For example, SLM is now recognized as one of the means to local land resources management for the 11^{th} plan period (2013-2018) of the Royal Government of Bhutan. Inclusion of SLM in the plan documents of the government is likely to influence, and change the donors' agenda of pursuing independent SLM projects or activities. This move is going to reduce duplications and increase efficiency in implementing SLM across the board.

3.1 Participatory Approach

The farmers that are living far away from road heads are slow to respond to new farming technologies compared to those who are within the vicinity of markets or highly accessible areas. For these reasons interactive participations of the farmers and professionals are critical in the promotion of improved technologies and understanding their local beliefs and cultural norms. These processes provide a platform to understand their needs, farming systems, traditional knowledge, and importantly to educate participants on SLM know how although the process is both time and resource consuming. This participatory approach has also helped the professionals of line departments and ministries to come together to share and help in implementing SLM activities effectively. One clear advantage from these processes was the enhancement of SLM knowledge of the local communities. This was evident from the community feedback during evaluation of on farm SLM activities.

3.2 Farming System

The farming systems and cropping sequences of local area are dependent on the bio-physical aspects of the local landscape as well as access to markets. The farmers grow more than one crop in a year depending on the altitude, soil moisture and access to market. It is usually easier to promote and maintain hedgerows of grasses where the farmers practice improved cattle stall feeding than traditional free grazing. For example, the farmers in Bidung village (one of the land management sites) could not keep away stray cattle grazing their fodder hedgerows because it was the traditional practice to allow cattle into the fields after harvests. Unlike in the developed countries where farmers specialized as corn farmer or dairy farmer, the small farmers in Asia grow more than one crop in a season, keep livestock and depend on forest produce. This poses a big challenge for extension and research system to come up with specific improved farming technology recommendation.

3.3 Type of Soil

The soil type and elevation of the site are two important physical factors to consider while introducing SLM technology. Experiences from the national land management campaigns have shown that SLM technologies developed elsewhere that were directly applied or adopted without assessing local conditions or conditions of its origin have poor rate of adoption by the farmers. In many instances, these approaches result in the failure of technology, and above all, the farmers lose trust and faith in the research and extension system of local institutes. One example point is the currently available technical guidelines to establish contour that is not suitable for steep farming land of light soil texture where upland crops are grown. This guideline may be good for heavy soils where terraces are constructed to cultivate irrigated paddy. It is crucial to listen to farmers and study physical limitations of local landscape before introducing farming technologies.

4 SLM CAN CONTRIBUTE TO FOOD SECURITY

SLM provides a wide range of options for the farmers to grow cereals, fruit crops, leguminous trees and fodder grasses. This approach provides opportunity to increase cropping intensity to harvest more than one crop in a year. Depending on the local farming system and environment, one could combine these crops and trees to meet seasonal food requirements. The adoption rates are high among those farmers where there is no scope to expand arable land to increase food production. The returns from SLM investments, however are usually mid to long term as one grows fruit crops along the hedges or plant leguminous shrubs to increase soil fertility. The farmers with small land holding usually seek immediate seasonal returns from their investments to feed their family or the cattle. For this reason the fodder grass species like *Gautemala, Napier, tall fescue, Italian rye grass, cocks foot and desmodium* were promoted along hedges to meet immediate fodder needs. The farmers who do not keep livestock may not prefer to grow grasses along the terraces. For example smallholders from Salamji village have opted to go for fruit plants and fodders species along the hedges. This has positively changed the landscape of the site and also increased the income of farmers (Norbu,2012). Similarly, the small farmers who had adopted SALT in the Philippines, have reported increased net incomes from P4,595 to P15,981 ha/year (WA..1998). The Sloping Agriculture Land Technology (SALT) developed in the Philippines to increase crop production and reduce soil erosion introduced alley cropping or hedgerow intercropping system. SALT is a simple, applicable, low-cost method of upland farming. The perennial leguminous trees grown were along the contours, and cuttings from these bushes were incorporated into the soil to increase soil fertility and reduce soil runoffs. The species used in the hedgerows include *Leucaena leucocephala, L. diversifolia, Calliandra calothyrsus, Gliricidia sepium, Flemingia macrophylla* and *Desmodium rensonii*. The farmers, extension staff and researchers from Bhutan in the 1990s visited SALT sites in the Philippines, but was not successful in its promotion because of small land holdings and physical limitation of the farms.

When the altitude of the site is very high (above 2,000 masl.), and the promotion of perennial plant species along the hedges is not feasible, the farmers are encouraged to build stone bunds or terraces by providing incentives like labor cost or free seeds and seedlings. These bunds are known to retain fine nutrient rich soils particles of the farmland from running down into local streams and rivers because of surface erosions, and sheet erosion in particular on sloping land.

5 SLM CONTRIBUTES TO CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES

The greenhouse gases (GHG) like carbon dioxide from burning debris or fossil fuel for farm mechanization, methane from rice fields and cattle herds, and nitrous oxide from poor management of nitrogenous fertilizers increases its concentration in the atmosphere. This increasing concentration of GHG in the atmosphere is warming our planet. The farming sector is regarded as one of the biggest polluters and the global figures are estimated around 12-32 % of the total GHG emitted. The farmers in Bhutan use very little chemical fertilizers and do not keep large numbers of cattle in confined areas, yet the contribution of GHG from the sector is highest and is estimated around 60% of the total GHG emission in 2000 (NEC, 2011). Unlike in developed countries where manures are mostly in slurry form, the cattle manures in Bhutan are mixed with forest litter and crop residues to produce farmyard manure. When farmyard manures (FYM) are matured, it is applied to the fields as a source of plant nutrients. FYM is major source of plant nutrients and the farmers apply around 3 to 5 tons per ha of cultivated area. The emission of GHG (methane and nitrous oxide) from manure is likely to be limited since it is dried and mixed with plant residues, and importantly it is not in slurry form. The emission of GHG (methane) from the paddy fields is also likely to be very minimal. The paddy fields are submerged in water for a period of 3 to 3.5 months and the water temperature during the period remains below 20 centigrade on average while optimum temperature for methane production is around 27 centigrade. The combination of traditional plant nutrient management practices with SLM technologies has a good potential for the agriculture sector to sequester carbon in cultivated soils. According to some estimates, SLM practices have about 50 to 60 % potential of soil carbon sequestration.

The high altitude rice farmers in 1996 lost more than 80 % of their paddy to the outbreak of rice blast. The farmers growing maize above 1800 masl lost more than 50% of corn grains to out break of the northern corn blight in 2007, and the severe windstorm destroyed crop harvest of more than 320 households in 2008 (MOAF, 2011). These out breaks of diseases were due to unusual or erratic weather pattern like extended duration of rainfall and mist/foggy days. The farmers who lost crops during these periods were compensated with seeds for the next season and no food items were distributed to feed the farmers. Many researchers associated these incidences with changing climate and the farmers being able to adapt through mixed farming practices. For example, if one crop was lost, they had another crop or livestock products to fall back on. SLM technologies provide these options. These traditional mixed farming systems commonly found among smallholders of remote communities combined with SLM technologies is a strong adaptation measures against many extreme weather events.

The shifting cultivation or slash and burning is a popular crop cultivation method among many Asian farmers living in the remote farming areas. For a small like Bhutan, it is not a wise use of limited land and it emits substantial carbon dioxide from burning biomass. This type of farming has been discouraged. The programs and projects were initiated to convert slash and burn areas into permanent cultivation. Depending on the type of landforms, either the land is converted into permanent agriculture land or community or private forest land. SLM project funded by GEF/WB has converted more than 3368.42 ha of shifting cultivation sites into orchards/other land use, and 3345.67 ha barren and degraded areas into community/private forests (NSSC,2012). Increasing biological productivity of land through plantations is always a good mitigation mechanism of capturing and storing of carbon dioxide.

SLM practices reduce loss of top soils from farming land. The loss of top soils through surface erosion is one of the mechanisms of depletion of soil carbon for the cultivated soils according to the World Bank report 2012 (WB, 2011). The estimated annual rate of soil loss ranges from 7.6 Gt for Oceania to 74.0 Gt for Asia that translates into carbon emissions ranging from 0.02 to 0.04 Gt per year and 0.030 to 0.44 Gt per year respectively. These losses are associated with the land management factors like erosion, tillage, residue removal and drainage. The results from SLM soil erosion plots established in 2009 under different land use showed a big difference in the soil loss rate. The highest soil loss rate of 24.6 t/ha was observed on bare reference plot followed by the loss of 6.42 t/ha on traditional practice plot, and 3.36 t/ha loss SLM plots (NSSC, 2009). The rill or sheet erosion, a form of surface erosion is dependent on soil types, rainfall intensity and types of crops grown. These surface erosions are main causes of increased sediment loads in the rivers, decrease in crop yield and loss of biological productivity of land. If unchecked, these rill erosions can lead to formation of ravines and gullies over a period of time. The increased sediment loads in the river system for Bhutan is a big concern since the economy of Bhutan is dependent on export of hydropower energy. These sediment leads to siltation of dams, and reduces life span of turbines used to generate renewable hydropower. Hydropower provides one of the highest GDP (recorded at 19% of the total share), and the local communities have reduced consumption of firewood with the supply of energy from the hydropower sector. The estimated potential for hydropower generation from the four main river basins in Bhutan is around 30,000 MW.

6 FINAL THOUGHTS

Many economies started working on Sustainable Land Management programs and projects to tackle land degradation issues at the economy and regional level after GEF decided to support the implementation of UNCCD activities. The process of preparing SLM projects is time demanding and it is dependent on how complex is the local institutional set up, culture, farming systems, land use and resources ownerships. During the process, a series of consultations with the stakeholders identifies gaps on data, institutional links, coordination mechanism, fixes responsibility and above all participants learn from each other. The farming communities in rural areas are always busy with their farm works, labor is scarce, and they do not have time to come for consultations time and again as desired by many agencies. Planning and coordination among donors and implementing agencies is important to reduce the frequency of consultations although it is an educative process.

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How Can Foreign Direct Investment in Agriculture Contribute to More Sustainable Land Use and Food Security?

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ABSTRACT: This paper focuses on selected aspects of the economic and social dimension of sustainable land use for agriculture. The main emphasis is on the contribution of agricultural foreign direct investments (FDI) to lower food prices, which would help to strengthen global food security and reduce hunger and poverty. FDI in agriculture in developing countries have increased tremendously as a reaction to the recent price hike on global food markets. With two simple simulation models I show that additional FDI in cereal production can have discernible price effects on global markets. The first model makes use of the OECD-FAO projection for production and utilisation during the period 2011 to 2020, and is augmented with an econometric price equation. The second model is based on econometric estimates of global cereal production, utilisation, stocks, and prices. Derived from the "supply of storage" model I hypothesise that prices are the higher the lower the stock-utilisation ratio is, and vice versa. Econometric estimates support the hypothesis. Simulations indicate that the additional expansion of harvested land through FDI to the tune of 5, 10, and 15 million hectare over the period 2011-20 would lead to price declines relative to a reference scenario of about 7%, 15%, and 22% respectively (if FDI-induced production growth has repercussions on other producers the rates of decline are about 5%, 10% and 15%). As the majority of the poor are net food buyers, such price effects would certainly help to strengthen the food security of the poor.

KEYWORDS: Land grabbing, food supply and demand analysis, supply of storage hypothesis, poverty, hunger

1INTRODUCTION

The concept of sustainable development encompasses three dimensions: ecological, economic and social sustainability. These three dimensions can also be applied to the request for sustainable land use for agriculture. In the paper at hand we put the main emphasis on the economic and social dimensions of sustainable agriculture, and we focus on a specific aspect of the global food system: we try to analyse to what extent agricultural FDI in developing countries can contribute to increase supply and thereby reduce presently high food prices, which would help to strengthen food security and to reduce hunger and poverty at the global level.

Agricultural FDI, measured in terms of land acquired, have increased tremendously in recent years. Land acquisitions alone in the year 2008/09 are estimated at up to 56 million hectare (m ha), more than ten times the average acreage in the years before (4 m ha/a; Deininger et al., 2011, p xiv; see also earlier estimates that confirm this quantum leap: Cotula et al., 2009; von Braun and Meinzen-Dick, 2009; Görgen et al., 2009; Friis and Reenberg, 2010). This massive boost of agricultural FDI is a reaction to the recent price boom on global food markets. The FAO Food Price index, comprising prices for cereals, dairy, meat, oils and fats, and sugar, reached its first peak in the middle of 2008, declined for a few months, but then rebounded again. In 2011 the index averaged at 210 points (in real terms; 2002/04 = 100), about twice the level it was throughout the 1990s (FAO, 2012). The average price index for cereals,[7] the commodities on which we focus in the paper at hand, was in 2011/12 also more than twice as high (about 220 points) as during the 1990s, and about 5% higher than the annual average in the "crisis"

[7] In the FAO classification cereals comprise: barley, buckwheat, maize, millet, oats, rice, rye, sorghum, and wheat.

year 2008 (FAO, 2011). It seems that forecasts of higher and more volatile food prices than in the past come true: cereal prices prevail far above historic levels, and they hamper progress in reducing hunger and poverty (e.g. FAO, 2008a; OECD-FAO, 2008; UNCTAD, 2008; von Braun, 2008; World Bank, 2008; Kappel et al., 2010).

It is broadly agreed that the high prices are caused by many factors, but opinions about the size of partial effects vary widely (e.g. Heady and Fan, 2008; von Braun et al., 2008; Piesse and Thirtle, 2009; HM Government, 2009; Hochmann et al., 2011). A first set of causes comprises longer-term trends and repeated short-term shocks of global demand and production. They include: a strong global demand for cereals, inter alia driven by high income growth in emerging economies, such as China and India, and in many other developing countries; a strong demand for bio-fuels due to high prices of fossil fuels and energy policies, above all in the USA and Europe; repeated weather shocks that discernibly reduced global production in many years; export restrictions and other hoarding mechanisms that kicked in when export countries tried to protect their populations from increasing prices; and declining stock utilisation ratios resulting from deliberate policies to reduce stocks (China) and from the cumulative effect of global utilisation outpacing production: between 1998 and 2008 accumulated global utilisation of cereals exceeded production by about 200 million tons (Kappel et al., 2010). A second set of determinants includes a weak US dollar, which led to high dollar-denominated commodity prices, and high oil prices, which increased fertiliser costs and transportation and storage costs.[8] Most observers expect that many of these factors will keep cereal prices at high levels in the foreseeable future.

Particularly the trade barriers of cereal exporting countries contributed to a loss of trust in the world trade system and an increasing interest in land acquisitions abroad to secure more steady supplies and less volatile prices. As mentioned before, FDI in land and agricultural production are nothing new, but reached another order of magnitude. Unfortunately, precise statistical data from national authorities are hardly available. Researchers must analyse media reports and websites with many uncertainties about the size, the financial volume, and the degree of finality of land transactions. Deininger et al. (2011), for instance, use the careful wording that foreign investors "*expressedinterest* in around 56 million ha of land globally in less than a year" (emphasis added). In addition, the stipulated time horizon for actually bringing up production on the newly acquired land is largely unknown.

But despite these uncertainties the trend change can hardly be dismissed. This refers not only to the acreage of transactions but also the motivation of investors. In past decades agricultural FDI frequently targeted perennial tropical cash crops, and were mainly driven by profit-making motives of international agribusiness companies. Today many FDI operations focus on staple food crops and are carried out (or are backed) by sovereign wealth funds and parastatal companies. Investors often originate in countries with severe land and water constraints (e.g. countries in the Middle East and North Africa), countries with large populations and food security concerns (e.g. China and India), and countries that exhibit strong demand growth for bio-fuels (above all North America and Europe). This motivational setting is very different from that in the past (von Braun and Meinzen-Dick, 2009; Arezki et al., 2011).

In the subsequent discussion we try to answer a very specific question related to agricultural FDI: to what extent can additional FDI in cereal production in developing countries contribute to calm global markets and bring down prices? The term “additional” is used here in the sense that the observed quantum leap in land acquisitions strongly indicates a deviation from past investment and production trends on a global scale. Put differently, the FDI-induced additional production of cereals, triggered by the recent price increase, reflects a shift in global supply behaviour.

The large majority of agricultural FDI flows to developing countries, above all in Africa, which have large potentials for cereal production growth, both with respect to expanding land under cultivation and

[8] We refrain from adding effects of financial speculation on futures markets, because the transmission process into spot markets and the direction of causality are not at all clear and highly contested.

increasing yields per hectare.[9] While theoretical discussions of FDI in agriculture tend to attest unequivocal benefits for receiving and sending countries (e.g. Chaudhuri and Banerjee, 2010), in the real world the potential size and distribution of benefits from these investments is hotly debated. Simply speaking, five questions dominate the academic and political discussion about the pros and cons of agricultural FDI. First, do land transactions respect traditional user rights of local people, and are the exchanges indeed voluntary? Second, do local people get adequately compensated in exchange for the land they used, and to what extent do they benefit from new production schemes? Third, to what extent cause the FDI-driven, more intensive land uses additional resource degradation? Fourth, are agricultural FDI-inflows beneficial for (net) food importing countries that suffer from food insecurity? And fifth, do FDI for the production of food commodities used for bio-fuels contribute to food security on the global scale? (see e.g. Cotula et al., 2009; Hallam, 2009; Borras and Franco, 2010; Deininger et al., 2011; Anseeuw et al., 2012).

Although it is generally agreed that FDI *can* be beneficial for all actors involved, preliminary results from empirical analyses show deeply divided opinions about the effects that may prevail. Some authors argue that "win-win" solutions can and should be achieved (e.g. von Braun and Meinzen-Dick, 2009; Deininger et al. 2011), while others expect that FDI will cause net welfare losses in receiving countries, above all among the rural poor (e.g. Borras and Franco, 2010; Anseeuw et al., 2012). Available research results, which consist mainly of qualitative case studies and anecdotal information, indicate that the rights and needs of local populations are often neglected. And a quantitative cross- analysis of Arezki et al. (2011) confirms that a low quality of “land-governance”, inter alia reflecting a weak protection of traditional user rights and the danger of displacement, is a pull factor for agricultural FDI. Nonetheless, at this early stage of a new trend in agricultural FDI the final jury about their overall impact is still out.

Although we do not analyse all these important questions in the present paper, we consider one important link between FDI and poverty and hunger: there is ample evidence that the majority of the poor are net food buyers, even in rural areas, and that lower cereal prices would therefore improve their livelihoods (e.g. Ravallion, 1989; Aksoy and Isik-Dikmelik, 2008; Zezza et al., 2009). After the price shock of 2008 estimates of scholars and international organisations put the additional number of people going hungry at levels between 63 million (Tiwari and Zaman, 2010) and 75 million (FAO 2008b). Moreover, Ivanic and Martin (2008) concluded that the price hike pushed about 100 million people under the poverty line of 1 PPP[10] Dollar a day. The World Bank estimated that with the renewed price hike in 2010/11 68 million net food buyers fell under the poverty line of 1.25 PPP Dollar, while 24 million net producers escaped that extreme poverty (World Bank, 2011). A reversal of these price-induced effects through additional FDI in agriculture to boost global food production would be a welcome impact.

We use the decade 2011 to 2020 as the time horizon for our analysis, and we apply two simple simulation approaches. The first is a scenario-based simulation model, which makes use of the OECD-FAO-projection of global cereal production and utilisation for the period 2011-20 (OECD-FAO, 2011). We add to this projection an econometric price equation that links the cereal price index and the global stock-utilisation ratio, and then analyse the impact of additional FDI-induced production on prices. The advantage of this approach is that it uses the medium-term OECD-FAO projection, which arguably belongs to the best we have.

The second simulation approach is based on a simple econometric model of global cereal production, utilisation, stocks, and prices. The model is recursive but represents the complete set of feedbacks between prices and quantities. The external driving forces of the model are the growth rate of global gross domestic product (GDP) on the demand side and FDI-induced additional production on the supply side.

[9] Some authors rightly argue that the potential for FDI-induced production growth in post-Soviet Eurasia often tend to be underestimated or even neglected (e.g. Visser and Spoor, 2011).
[10] PPP = corrected for purchase power parity

Based on a global GDP-growth scenario and FDI scenarios we simulate again cereal utilisation, production, stocks, and prices over the period 2011-20.

The rest of the paper is structured as follows. Section 2 describes the theoretical concept on which both simulation approaches are based. Section 3 explains the scenario-based model and the simulation results. Section 4 describes the econometric model and the simulation results. Section 5 concludes.

2 THE THEORETICAL CONCEPT

For storable goods, such as cereals, the global equilibrium price must not equate global production and utilisation: growing or declining stocks act as buffers and smooth prices. During periods of production exceeding utilisation the demand for additional stocks dampens rapidly declining prices, and during periods of production falling short of utilisation declining stocks dampen rapidly increasing prices (see e.g.; Hochmann et al., 2011; Wright, 2011; Timmer, 2009; Wright, 2009). The implications of this "supply of storage" model have also served to explain the recent price hike on global cereal markets. For instance, Piesse and Thirtle (2009) emphasize: "If a single factor is to be identified as the cause of the recent price spikes, it has to be low stock. In any model intended to explain commodity prices, the stock to utilisation ratio is the key variable". Likewise, McCreary (2011) states: "… stocks relative to total use becomes a key determinant of prices". And the Development Committee of the World Bank and the IMF concluded at its 2011 spring meeting that international markets "are clearly very sensitive to changes in perceptions of stocks likely to be available for sale" (Development Committee, 2011).

Figure 1 depicts this link between utilisation, demand for stocks, production, carry-over stocks from the previous period, and price. The balance of total demand D_t (demand for stocks DS_t plus utilisation U_t) and availability A_t (production X_t plus carry-over stocks from the previous period S_{t-1}) determines the equilibrium price P_t. In other words, the supply of storage model suggests that a quantitative shock, with utilisation exceeding production, causes a higher price increase the lower the stocks are. As we are interested in simulating demand and supply developments in the medium term, and not short term demand or supply shocks, we translate that linkage into the hypothesis that the price is the higher the lower the stock-utilisation ratio is, and vice versa. This linkage secures the necessary condition that "borrowing from the future is not feasible" (Wright, 2011), i.e. stocks cannot become negative.

This relationship is given by equation (1), which states that the current price P_t is a function of P_{t-1} and the stock-utilisation ratio SU_{t-1} of the previous period.

(1) $P_t = f_1 (P_{t-1}, SU_{t-1})$ with $\partial f_1/\partial SU < 0$

Equations (2) and (4) below illustrate that the price increase caused by a declining stock-utilisation ratio will increase production and reduce utilisation, which counteracts the decline of the stock-utilisation ratio. This is the mechanism to prevent stocks becoming negative.

Equation (2) shows that current production X_t is a function of the price P_t, of yield shocks dyh_t, which are caused by climatic variations, and a polynomial time trend g(t), which accounts for technological changes in the broadest sense

(2) $X_t = f_2 (P_t, dyh_t, g(t))$ with $\partial f_2/\partial P > 0$

Equation (3) explains that availability A_t is the sum of production X_t and the stocks carried over from the previous period S_{t-1}.

(3) $A_t = X_t + S_{t-1}$

Utilisation is a function of income Y_t and the price P_t.

(4) $U_t = f_3 (Y_t, P_t)$ with $\partial f_3/\partial Y > 0$, $\partial f_3/\partial P < 0$

Stocks S_t, to be carried over to the next period, are the difference between availability A_t and utilisation U_t.

(5) $S_t = A_t – U_t$

Finally, equation (6) determines the new stock-utilisation ratio.

(6) $SU_t = S_t / U_t$

The hypothesised causal relationship from the stock-utilisation ratio to price is not unchallenged. For instance Headey and Fan (2008) raise such doubts, although they explicitly accept that stock-utilisation ratios are inevitably the result of cumulative changes on the production and utilisation side. However, referring to the price hike in 2008, they explain that China decided in the late 1990s to reduce its allegedly "oversized" cereal stocks, which strongly affected the subsequent decline of global stock-utilisation ratios. Excluding China, stock reductions were much less dramatic (see also Dawne, 2009). This argument is correct, but only part of the story. It is also true that Chinese stock reductions satisfied a strongly growing domestic utilisation, and that this development sooner or later raised a simple question: how would future demand be satisfied after China had reached the desired stock level? Nobody expects that China will be able to expand domestic cereal production at a fast pace in the foreseeable future. Hence, China's decision to reduce cereal stocks must be seen in the context of the global development of stocks, production, utilisation, and prices.

While the stock-utilisation ratio in Asia declined from 51% in 1998 to 23% in 2004, and increased again to 27% in 2008, the stock-utilisation ratios in Latin America and Africa remained at their relatively low levels during that period (around 15% and 9% respectively), and the stock-utilisation ratio of the developed world declined from 23% to 15% (Kappel et al., 2010). In eight out of ten years global cereal utilisation was higher than production, which resulted in a cumulative production deficit of about 200 m t. It is evident that the decline of the global stock-utilisation ratio was the counterpart (and a perfect indicator) of that deficit, and it is simply inconceivable that market participants did not observe it as a signal of a "perfect storm" in the making (Headey and Fan, 2008). Moreover, it should be noted that not only the most recent price hike but also the massive price shock in 1973/74, as well as the smaller ones in 1981 and in 1996, were preceded and accompanied by declining stock-utilisation ratios (e.g. Piesse and Thirtle, 2009; Development Committee, 2011). Hence, based on evidence and the theoretical concept presented above we see good reasons to test the causal chain from stock-utilisation ratios to prices.

3 SIMULATIONS WITH THE OECD-FAO PROJECTION

3.1 Data

Table 1 shows in the upper part the development of cereal production, utilisation, stocks, and prices from 1996 to 2010, and in the lower part the OECD-FAO projection for 2011-20. For the retrospect production data are taken from the FAOSTAT Production Statistics, while data on utilisation and stocks come from FAO's bi-annual World Food Outlook. We restrict the time series back to 1996 because for earlier years FAO data on China do not cover all stocks held by the .[11] The FAO cereal price index is monthly and annually updated in the World Food Situation reports. We use these data to estimate the price equation (1) as described below in section 3.2.The projection of the world cereal market in the lower part of table 1 is taken from OECD-FAO (2011).

The retrospect illustrates that the growth rate of global cereal production between 1996 and 2010 (1.51% p.a.) was mainly driven by the growth of yields and much less by an expansion of the area harvested.[12] It should be noted, however, that harvested land increased in the developing world and declined in the developed world. Although the average annual growth rate of production exceeded that of utilisation (1.44%), the cumulative production of cereals in that period was lower than utilisation, which explains the decline in stocks. Cereal prices at the end of the decade were more than double the prices at the beginning of the decade.

[11] It is broadly agreed that data on global stocks of cereals are quite problematic because it is difficult to get reliable information at the country level (e.g. Dawe, 2009)

[12] Growth rates in table 1 are estimated with OLS. The growth equation reads as: $\ln x = a_0 + a_1$ time. The growth rate g is then: $g = e^b - 1$. All growth rates are significant at the 1%-level, except for the area harvested1996-2010, which is not significant at conventional levels.

The OECD-FAO projection for 2011-20 exhibits an annual production growth rate of 1.4%, again predominantly driven by the growth of yields (1% p.a.), and a somewhat higher utilisation growth rate of 1.52%. Nonetheless, cumulative production during the decade exceeds total utilisation, so that stocks at the end of the period are a bit higher than at the beginning. Despite a slightly declining stock-utilisation ratio during the decade the price index in 2020 is about 10% lower than in 2010. This is a nominal price index, and the Outlook emphasizes that cereal prices are expected to fall in real terms more than in nominal terms. Nonetheless, nominal and real prices are expected to remain significantly above levels in previous decades (OECD-FAO, 2011). All in all, OECD and FAO expect a rather modest relief on cereal markets and relatively high prices throughout the period 2011-20.

Although higher investment requirements to satisfy growing global food demand are mentioned time and again in the Outlook, the report never explicitly refers to the recent boost of FDI summarised in section 1. As table 1 illustrates, OECD and FAO expect an average global expansion of cultivated land for cereals of 3 m ha/a, a significantly lower amount than the average annual land expansion for these crops of about 6 m ha since 2002, which occurred almost exclusively in developing countries.[13] This strongly indicates that the trend change in FDI, as diagnosed in the studies quoted before, has not entered the OECD-FAO projection. Deininger et al. (2011) also note the “conservative nature of FAO estimates” and expect at least a 6 m ha/a global expansion of land until 2030.

3.2The Model

With the OECD-FAO projection as a reference, we tackle the question to what extent additional FDI in cereal production could contribute to reduce prices. The term “additional” means that these FDI exceed the (unknown) level of FDI implicit in the OECD-FAO projection. We add to the projected production X_t annual FDI, measured in m ha and multiplied with an exogenously given yield. In three scenarios we vary the additional land expansion for cereals from 0.5 to 1 and 1.5 m ha/a, i.e. 5 to 15 m ha for the whole decade. Considering the quoted estimates of recent land deals up to more than 50 m ha, and considering that at least one third of the land deals cover cereals[14], these orders of magnitude are plausible. Compared with the average global expansion of land for cereals quoted above (6 m ha/a since 2002), the FDI imply an additional expansion to the tune of about 8, 17 and 25%. We set the initial yields of FDI to 3.1 t/ha, i.e. the average global cereal yield in 2010. This is more than twice the average yield in Africa (1.4 t/ha in 2010), where about two thirds of the recently reported large FDI deals have taken place.[15] However, there is ample evidence that FDI in Africa make use of technological improvements such as better water management practices and irrigation, use of high-yield seeds, fertilisers, and pesticides, soil restoration and conservation practices, etc., which can easily double yields (e.g. Sanchez, 2010, referring to cereals in general; particularly for maize: Same, Byerlee and Jayne, 2011; Rockström et al., 2009). Moreover, we let yields of FDI grow by 1.68% p.a., the average annual yield growth observed in Africa since the late 1990s.

To analyse the impact of FDI on prices we estimate the price equation mentioned in section 2:

(7) $$P_t = a_{10} + a_{11} P_{t-1} + a_{12} SU_{t-1} + e_{1t}$$

with P being the price index for cereals, SU being the stock-utilisation ratio, and e being the error term. We expect $a_{11} > 0$ and $a_{12} < 0$. We estimate equation (7) with the nominal (P_n) and the real (P_r) FAO price index. Results of the estimates are given in table 2, and they clearly support the hypothesis of a negative

[13] After a continuous decline throughout the 1990s the area harvested with cereals in the developed world stagnated between 2002 and 2010.

[14] This share is derived from the data provided by Görgen et al. (2009, p. 66 ff), which contains an inventory of recent FDI in some 40 developing countries, adding up to about 20 m ha. Cereal production covers almost 7 m ha. However, in many investments listed in the table the product to be produced is given as "unknown", and in some (large) investment cases the financial volume is given but not the area. Therefore the share of one third for cereal production is certainly on the conservative side.

[15] It is less than the average yield of about 4 t/ha for Latin America and Eastern Asia.

linkage between the stock-utilisation ratio and the price indices.[16] The results of the two estimates are so similar that we use only the equation with the nominal price index for the subsequent simulation.[17]

Adding production from additional FDI to the OECD-FAO production scenario leads of course to increasing stock-utilisation ratios and declining prices. However, declining prices will increase utilisation, and that will counteract the growth of stocks and the price decline. Hence, we must introduce a price elasticity of demand and adjust the OECD-FAO utilisation scenario to the new price development that deviates from the projected development. The price elasticity of demand implicit in the OECD-FAO projection is unknown to us. Based on recent econometric analyses of Roberts and Schlenker (2009, 2010), and on our own estimates presented in section 4, we assume that the price elasticity of global cereal utilisation is -0.05. In our simulations we calculate the difference between the price index of the respective FDI-scenario and the OECD-FAO reference projection, and adjust utilisation using this price elasticity.

(8) $$U_{At} = ((1 + \eta_U)(P_{Ft} - P_{Rt}) / P_{Rt})\, U_{Rt}$$

with U_{At} being the adjusted utilisation, η_U being the price elasticity of utilisation, P_{Ft} being the price index of the FDI-scenario, P_{Rt} being the price index of the reference scenario, and U_{Rt} being the utilisation of the reference scenario. We do not adjust production with a price elasticity of supply, because otherwise the additional condition for the simulated FDI would not be fulfilled. However, we consider such repercussions from prices to producers in the simulations with the econometric model in section 4.

3.3Simulation Results

Figure 2 displays the projected and simulated price indices. The continuous line labelled "OECD-FAO-projection" depicts the price index presented in table 1. The dashed line labelled "Reference" pictures the price development with our price equation and the OECD-FAO production and utilisation projections. The curve is rather close to that of the OECD-FAO price projection, but shows slightly stronger “swing” behaviour. The other three curves illustrate that additional FDI to the tune of 0.5, 1, and 1.5 m ha/a in the coming decade lead to significant price declines: end values in the year 2020 are between 7 and 22 % below the value for the reference scenario (Table 3). The data also illustrate that slightly less than 50% of the additional production are absorbed by increased utilisation and the other half serves to replenish stocks to levels between 631 and 742 m t in 2020. These end values correspond to stock-utilisation ratios between 24 and 28%. It should be noted that such ratios were reached and surpassed in previous years. As illustrated in table 1 global cereal stocks in 1999 were 687 mt, and the stock-utilisation ratio was 36%. In other words, most of the infrastructure for additional stocks is available, so additional storage costs are mainly running costs and do not require large additional investments.

All in all the simulations indicate that additional FDI to the tune of 0.5 to 1.5 m ha/a over the next decade would have a discernible impact on cereal prices. The differences between the FDI-scenarios and the reference case are particularly relevant for poor consumers: bearing in mind that the majority of the poor in developing countries, also in rural areas, are net food buyers, the price impact of additional agricultural FDI can contribute to improve the food security and livelihood of these people.

4 SIMULATIONS WITH AN ECONOMETRIC MODEL

4.1 Data

Data on cereal production, utilisation and stocks for the years 1970 to 2010 are taken from the Foreign Agricultural Service Division (FAS) of the United States Department of Agriculture (USDA, 2011). The

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[16] We used a Prais-Winsten estimator to control for serial correlation. In addition we estimated equation (7) with price data from the IMF, the World Bank, and USDA, and the results (not reported here) are very similar.

[17] We also tested non-linear versions of equation (7), but the results were so similar to the linear estimate that we use the latter as an acceptable approximation.

data include time series for the same grains as in the FAO classification, which we aggregate into one single cereals category. It is well known that data from USDA and FAO differ quite considerably, particularly those for stocks (see also Dawe, 2009; Paulino, 1980). Data on yields were taken from FAOSTAT, and the data on cereal prices were retrieved from the World Bank's Global Economic Monitor Commodities catalogue (World Bank, 2011b). The price series is an index in constant 2005 US Dollars, deflated with the US consumer price index. Data for global real GDP is taken from the World Development Indicators of the World Bank (2011b).

4.2 The model

Based on the theoretical concept described in section 2, we estimate the equations for the price index, for production, and for utilisation. Following Roberts and Schlenker (2009 and 2010) we use the natural logarithms of all variables, with the exception of yield-shocks and the time variables in the production equation. We estimate the model with ordinary least squares (OLS) and two stage least squares (TSLS). For the OLS-estimates the price equation reads as:

(9) $\ln P_t = a_{20} + b_{21} \ln P_{t-1} + b_{22} \ln SU_{t-1} + e_{2t}$

with P being the price, SU the stock-utilisation ratio, and e the error term. We expect $a_{21} > 0$ and $a_{22} < 0$. We use equation (9) to calculate predicted values P^*_t.

Production is a function of the price and a polynomial time function that captures technical change and other production enhancing factors. In addition, as mentioned in section 2, we must take care of (above all) weather-induced short-term yield shocks. Therefore we estimate a linear trend equation for yield/ha and calculate annual yield deviations, which enter the production equation.

(10) $yh_t = a_{30} + a_{31}\, t + e_{3t}$

with yh being yield/ha, t being time, and e being an error term. We then use predicted trend values yh* to calculate annual yield shocks dyh:

(11) $dyh_t = (yh^*_t - yh_t) / yh^*_t$

The production equation is then:

(12) $\ln X_t = a_{40} + a_{41} \ln P^*_t + a_{42}\, dyh_t + a_{43}\, t + a_{44}\, t^2 + a_{45}\, t^3 + e_{4t}$

with X being production, P* being price, dyh being yield shocks, t being time, and e being an error term. We expect $a_{41} > 0$.

The utilisation equation reads as:

(13) $\ln U_t = a_{50} + a_{51} P^*_t + a_{52} Y_t + e_{5t}$

with U being utilisation, P* being price, and Y being GDP, and e the error term. We expect $a_{51} < 0$, and $a_{52} > 0$.

In the TSLS-estimates the variables of the price equation (9) plus all exogenous variables of the model are used for the first stage. The instrumented price variable is then employed in the second stage to estimate the equations for production (12) and utilisation (13). The results are presented in table 4.

The OLS results show again the expected negative relationship between the price and the stock-utilisation ratio. The price elasticity of production of 0.055 is at the lower end of the range of results reported by Roberts and Schlenker (2009, 2010), while the price elasticity of demand of -0.047 falls in the middle of the range of values reported by these authors. The parameter of 0.5 for the income elasticity is plausible. The TSLS estimates presented on the right hand side of table 4 give very similar parameters as the OLS estimates, with the exception of the price elasticity of supply, which is about one third higher.

4.3 Simulation results

For the subsequent simulations we use only the OLS estimates (the statistically insignificant exogenous variables in the price equation of the first stage of the TSLS estimates do not generate plausible values in the simulation). To make simulations comparable with the ones discussed before we generate a reference scenario with cereal utilisation close to the OECD-FAO projection that we used in the previous reference scenario. In the OECD-FAO projection utilisation grows from 2253 m t in 2010 to 2588 m t in 2020; in the reference scenario with the econometric model we have utilisation growing from 2235 m t to 2586 m t, which is generated with an annual growth rate of world GDP of 3.5%.[18]

For the FDI scenarios we use the same exogenous assumptions as before. The simulation results are presented in figure 3 and table 4. For the reference scenario the model predicts over the next decade a small price decrease of about 8% relative to the price level of 2010. For the final year 2020, and relative to the reference scenario, the three FDI-scenarios lead to price declines of about 8%, 16% and 22% respectively. Hence, the FDI-induced price declines are almost identical to those of the scenarios with the OECD-FAO projections, although the time path of the price development differs. About 55% of the additional production is absorbed by the growth of utilisation and the rest goes into stock replenishment. These ratios are again quite similar to those of the simulations with the FAO-OECD projection. However, the resulting levels of stocks and stock-utilisation ratios are higher than in the first set of simulations. Table 4 shows that stocks grow from 426 m t in 2010 to levels between 689 and 801 m t in 2020, and stock-utilisation ratios increase from 19% in 2010 to values between 27 and 31% in 2020. Again, if compared to data from the past, these values are not unprecedented. According to the USDA time series global stocks amounted in 1999 to 586 mt, which then corresponded to a stock-utilisation ratio of 31%.

As in the first set of simulations we assume that production from FDI is fully additional, i.e. the FDI-induced price declines do not have repercussions on other producers. When we drop that assumption, other producers reduce production due to the price decline. As a consequence the replenishment of stocks and the overall price impact of FDI are lower. Figure 4 and Table 5 illustrate that in 2020 the price levels of the FDI scenarios are only 5, 10 and 15% lower than in the reference scenario.

Of course, we are fully aware that simulations over a period of 10 years stretch the underlying model, the database, and the estimation procedures to their utmost limits. Perhaps this first attempt to get some ballpark figures about the global impacts of additional FDI in cereal production will trigger further research to better understand the potential contributions of such investments to global food security.

5 SUMMARY AND CONCLUSIONS

The possible impacts of agricultural FDI reflect some important aspect of sustainable land use at the global level: if managed properly, they can contribute to strengthen the ecological, economic and social dimension of agricultural systems. Despite uncertainties in available data and information, there can be no doubt that agricultural FDI in developing countries did increase significantly as a reaction to the recent price hike on global food markets. Given the longer-term causes behind the price boom, significantly higher levels of agricultural FDI than in the past can be expected to prevail. The impacts of these investments on the local population in receiving countries are still uncertain. The danger of discriminating against poor users of allegedly “underused” or “unused” land is one of the most severe risks associated with large (foreign and domestic) land acquisitions. However, if such risks, and other related perils, can

[18]This growth rate is slightly higher than the observed average annual growth rate of real GDP during the last decade, measured in constant 2005 US-dollars. We conclude that our estimated income elasticity may be a bit too small as they cover the long period of 40 years; this may insufficiently capture two new cereal demand trends in recent years that will also continue during the coming decade: first, the high growth of incomes in emerging economies, which leads *inter alia* to a strong demand growth for meat and accelerates cereal utilisation; second, the bio-fuel mandates in the USA and Europe, which also spur the demand for cereals.

be prevented or at least minimized, agricultural FDI may offer attractive opportunities to increase global food production and to reduce prices. As the majority of the poor are net food buyers such developments would help to improve the food security of the poor.

With two simple simulation models we show that additional FDI in cereal production would have discernible price effects on global markets. Derived from the “supply of storage” hypothesis we hypothesize in both models that prices are the higher the lower the stock-utilisation ratio is, and vice versa. Our econometric estimates support this hypothesis. The simulations then indicate that the additional expansion of land for cereal production through FDI to the tune of 5, 10, and 15 m ha during from 2011 to 2020 would lead to price declines in 2020 of about 8%, 15%, and 22% respectively. If we do not assume the production from FDI to be fully additional rates of decline would be about 5%, 10%, and 15%.

Regarding the plausibility of stock developments we have already noted that the stock-utilisation ratios of the FDI-scenarios are within the range of ratios observed in the past. This indicates that the costs of higher stock-utilisation ratios are not unbearable. However, it would be beyond the scope of this paper to discuss costs and other requirements to hold higher global cereal stocks (e.g. Wright, 2011; McCreary, 2011). We can only note that recent national initiatives in quite a number of countries show a clear interest to increase stocks (HM Government, 2009).

FDI in agriculture should neither be seen as a panacea to reduce high cereal prices and volatility on global markets, nor should they generally and irrevocably be dismissed as “land grabs” with net negative effects for receiving countries in general and the poor in particular. To be sure, the risks associated with large land acquisitions must be avoided as much as possible. Formal and traditional property and user rights should be respected, transactions should be voluntary, and land users should be adequately compensated and be included in new production schemes to the extent possible. Moreover, all processes leading to new land uses should be transparent and supervised by impartial authorities. Guidelines for codes of conduct that could and should be applied by all actors involved already exist, and we share most of the recommendations included in these proposals (e.g. von Braun and Meinzen-Dick,2009; Deininger et al., 2011; Anseeuw et al., 2012). There are certainly many ways to increase the net benefits of FDI in agriculture in developing countries, and it would be deplorable if these opportunities to reduce hunger and poverty would be neglected.

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Table1: Past developments on cereal markets and projection of OECD-FAO

Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Growth rate**
FAO 1996-2010												**(OLS, %p.a.)**
Area harvested (Mio ha)	704.019	699.736	680.400	670.657	672.693	672.938	660.194	671.091	677.982	690.104	681.380	
Yield (t/ha)	2.674	2.720	2.780	2.805	2.766	2.837	2.788	2.823	3.064	2.980	2.968	
Production (Mio t)	1882.66	1903.15	1891.26	1881.47	1860.63	1909.14	1840.73	1894.52	2077.57	2056.52	2022.31	
Utilisation (Mio t)	1854.00	1858.00	1875.00	1893.20	1896.40	1928.40	1927.60	1959.50	2004.10	2037.60	2061.90	
Stocks (Mio t)	584.00	660.00	686.00	687.60	635.40	575.10	483.50	416.30	465.20	471.40	426.40	
Stock-utilisation ratio	0.315	0.355	0.366	0.363	0.335	0.298	0.251	0.212	0.232	0.231	0.207	
Price index	140.73	112.08	99.81	90.26	84.55	86.19	94.57	98.05	107.38	103.43	121.50	
	2007	**2008**	**2009**	**2010**								
Area harvested (Mio ha)	698.079	712.226	708.495	708.670								0.21
Yield (t/ha)	3.058	3.219	3.195	3.18								1.34
Production (Mio t)	2134.93	2292.30	2263.30	2256.34								1.51
Utilisation (Mio t)	2156.60	2181.80	2226.00	2225.92								1.44
Stocks (Mio t)	426.70	520.40	552.40	539.93								
Stock-utilisation ratio	0.198	0.239	0.248	0.243								
Price index	166.84	237.88	173.73	182.61								
Projection												
OECD-FAO 2011-20	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	
Area harvested (Mio ha)	708.67	711.51	714.36	717.22	720.10	722.98	725.88	728.79	731.71	734.64	737.59	0.4
Yield (t/ha)	3.18	3.21	3.24	3.28	3.31	3.34	3.38	3.41	3.44	3.48	3.51	1
Production (Mio t)	2256.34	2285.28	2317.44	2350.05	2383.12	2416.66	2450.67	2485.15	2520.13	2555.59	2591.55	1.4
Utilisation (Mio t)	2225.92	2259.75	2294.10	2328.97	2364.37	2400.31	2436.80	2473.84	2511.44	2549.61	2588.37	1.52
Stocks (Mio t)	539.93	522.37	535.34	545.85	553.88	559.39	562.37	562.79	560.62	555.83	548.40	
Stock-utilisation ratio	0.243	0.231	0.233	0.234	0.234	0.233	0.231	0.227	0.223	0.218	0.212	
Price Index	182.61	186.74	166.1	165.26	164.09	164.13	164.87	165.85	166.56	166.32	166.02	

Table 2: Regression results for the price equation

Equation	1.1	1.2
Dependent variable	P_n	P_r
$P_{n\ t-1}$	0.667	0.622
	(-0.002)	*(-0.007)*
SU_{t-1}	-307.916	-218.165
	(-0.023)	*(-0.041)*
Constant	128.529	105.483
	(-0.015)	*(-0.023)*
No. of observations	14.000	14.000
R^2 adjusted	0.734	0.641
DW transformed	1.972	1.954

Numbers in brackets are *p*-values.

Table 3: Impact of FDI-scenarios; reference generated with OECD-FAO projection; production from FDI fully additional

	Production 2020 (mt/a)	Production difference to 2010 (%)	Utilisation 2020 (mt/a)	Utilisation difference to 2010 (%)	Stocks 2020 (mt)	Stock difference to 2010 (%)	Stock-utili-sation ratio 2020 (%)	Stock-util. difference to 2010 (%)	Price index 2020	Price index difference to 2010 (%)
OECD-FAO projection	2591.55	14.86	2588.37	16.28	548.40	1.57	21.16	-12.77	166.02	-9.08
Reference	2591.55	14.86	2588.37	16.28	575.62	6.61	22.03	-9.17	167.67	-8.18
FDI 0.5 m ha/a	2609.86	15.67	2597.83	16.71	631.05	16.88	24.29	0.14	155.40	-14.90
FDI 1 m ha/a	2628.17	16.48	2607.26	17.13	686.57	27.16	26.33	8.56	143.18	-21.59
FDI 1.5 m ha/a	2646.48	17.29	2616.66	17.55	742.18	37.46	28.36	16.93	131.01	-28.25
Differences between FDI-scenarios and reference scenario in the final year 2020										
	Production (mt/a)	**Production (%)**	**Utilisation (mt/a)**	**Utilisation (%)**	**Stocks (mt)**	**Stocks (%)**	**Stock-util. (%)**		**Price index (index pts.)**	**Price index (%)**
FDI 0.5 m ha/a	18.31	0.71	9.47	0.37	55.43	9.63	10.25		-12.27	-7.32
FDI 1 m ha/a	36.62	1.41	18.90	0.73	110.95	19.28	19.52		-24.48	-14.60
FDI 1.5 m ha/a	54.93	2.12	28.29	1.09	166.57	28.94	28.74		-36.65	-21.86

Table 4: Regression results

	OLS		TSLS	
			First stage	
Dependent variable	**$\ln P_t$**		**$\ln P_t$**	
$\ln P_{t-1}$	0.602		0.431	
	(0.000)		*(0.004)*	
$\ln SU_{t-1}$	-0.598		-0.600	
	(0.000)		*(0.003)*	
$\ln Y_t$			1.979	
			(0.204)	
dy_t			0.869	
			(0.274)	
t			-0.045	
			(0.478)	
t^2			-0.002	
			(0.238)	
t^3			0.000	
			(0.160)	
Constant	3.900		-13.886	
	(0.000)		*(0.359)*	
No. of observations	40		40	
R^2 adjusted	0.821		0.846	
			Second stage	
Dependent variable	**$\ln X_t$**	**$\ln U_t$**	**$\ln X_t$**	**$\ln U_t$**
$\ln P^*_t$	0.055	-0.047	0.741	-0.047
	(0.000)	*(0.006)*	*(0.000)*	*(0.012)*
dyh_t	-1.099		-1.166	
	(0.000)		*(0.000)*	
t	0.038		0.037	
	(0.000)		*(0.000)*	
t^2	-0.001		-0.001	
	(0.000)		*(0.000)*	
t^3	0.000		0.000	
	(0.000)		*0.001*	
$\ln Y_t$		0.496		0.492
		(0.000)		*(0.000)*
Constant	6.693	2.636	6.588	2.680
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*
No. of observations	40	40	40	40
R^2 adjusted	0.996	0.981	0.995	0.979

Numbers in brackets are *p*-values.

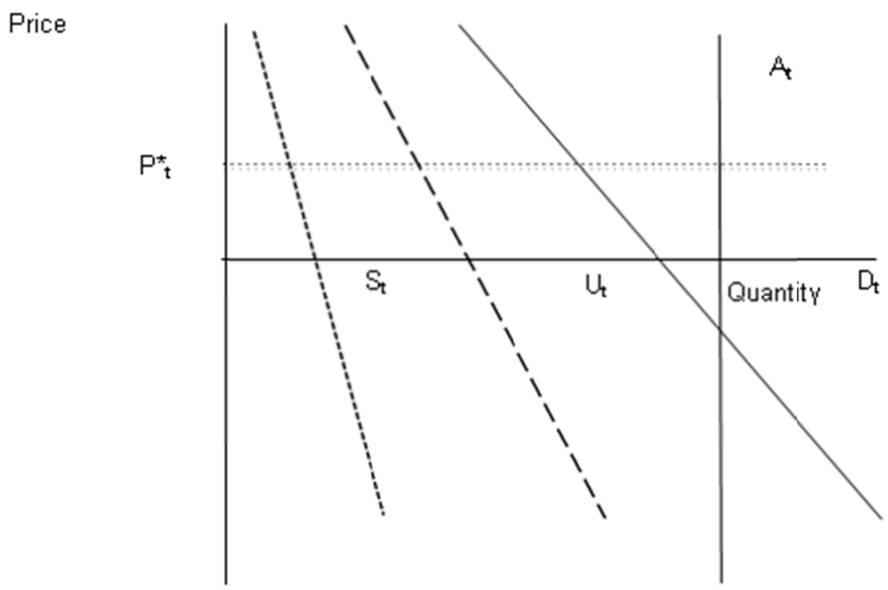
Table 5: Impact of FDI-scenarios; reference generated with econometric model; production from FDI fully additional

	Production 2020 (mt/a)	Production difference to 2010 (%)	Utilisation 2020 (mt/a)	Utilisation difference to 2010 (%)	Stocks 2020 (mt)	Stock difference to 2010 (%)	Stock-utili-sation ratio 2020 (%)	Stock-util. difference to 2010 (%)	Price index 2020	Price index difference to 2010 (%)
Reference	2624.56	20.47	2585.62	15.67	634.81	49.11	24.55	28.91	164.75	-7.93
FDI 0.5 m ha/a	2642.87	21.31	2596.31	16.15	688.70	61.77	26.53	39.28	150.78	-15.74
FDI 1 m ha/a	2661.18	22.16	2606.53	16.61	744.05	74.78	28.55	49.88	138.58	-22.56
FDI 1.5 m ha/a	2679.49	23.00	2616.33	17.05	800.78	88.10	30.61	60.71	127.85	-28.55
Differences between FDI-scenarios and reference scenario in the final year 2020										
	Production (mt/a)	**Production (%)**	**Utilisation (mt/a)**	**Utilisation (%)**	**Stocks (mt)**	**Stocks (%)**	**Stock-util. (%)**		**Price index (index pts.)**	**Price index (%)**
FDI 0.5 m ha/a	18.31	0.70	10.69	0.41	53.89	8.49	8.04		-13.96	-8.48
FDI 1 m ha/a	36.62	1.40	20.91	0.81	109.25	17.21	16.27		-26.17	-15.88
FDI 1.5 m ha/a	54.93	2.09	30.71	1.19	165.97	26.14	24.66		-36.90	-22.40

Table 6: Impact of FDI scenarios, econometric model; reference generated with econometric model; production from FDI not fully additional

	Production 2020 (mt/a)	Production difference to 2010 (%)	Utilisation 2020 (mt/a)	Utilisation difference to 2010 (%)	Stocks 2020 (mt)	Stock difference to 2010 (%)	Stock-utili-sation ratio 2020 (%)	Stock-util. difference to 2010 (%)	Price index 2020	Price index difference to 2010 (%)
Reference	2624.56	20.47	2585.62	15.67	634.81	49.11	24.55	28.91	164.75	-7.93
FDI 0.5 m ha/	2634.91	20.95	2592.34	15.97	665.78	56.39	25.68	34.85	155.82	-12.92
FDI 1 m ha/a	2645.40	21.43	2598.96	16.27	697.83	63.92	26.85	40.98	147.51	-17.57
FDI 1.5 m ha/	2656.04	21.92	2605.50	16.56	730.95	71.70	28.05	47.30	139.76	-21.90
Differences between FDI-scenarios and reference scenario in the final year 2020										
	Production (mt/a)	**Production (%)**	**Utilisation (mt/a)**	**Utilisation (%)**	**Stocks (mt)**	**Stocks (%)**	**Stock-util. (%)**		**Price index (index pts.)**	**Price index (%)**
FDI 0.5 m ha/	10.35	0.39	6.71	0.26	30.97	4.88	4.61		-8.92	-5.42
FDI 1 m ha/a	20.84	0.79	13.34	0.52	63.02	9.93	9.36		-17.24	-10.46
FDI 1.5 m ha/	31.48	1.20	19.88	0.77	96.14	15.15	14.27		-24.99	-15.17

Figure 1: Global equilibrium with demand for stocks



$A_t = X_t + CS_{t-1}$; A_t = availabilty; X_t = production; CS_{t-1} = carry-over stocks
$D_t = S_t + U_t$;D_t = total demand; S_t = demand for stocks; U_t = utilisation
P^*_t = equilibrium price for $A_t = D_t$

Figure 2: Impact of FDI on price index of cereals; reference generated with OECD-FAO projection; production from FDI fully additional

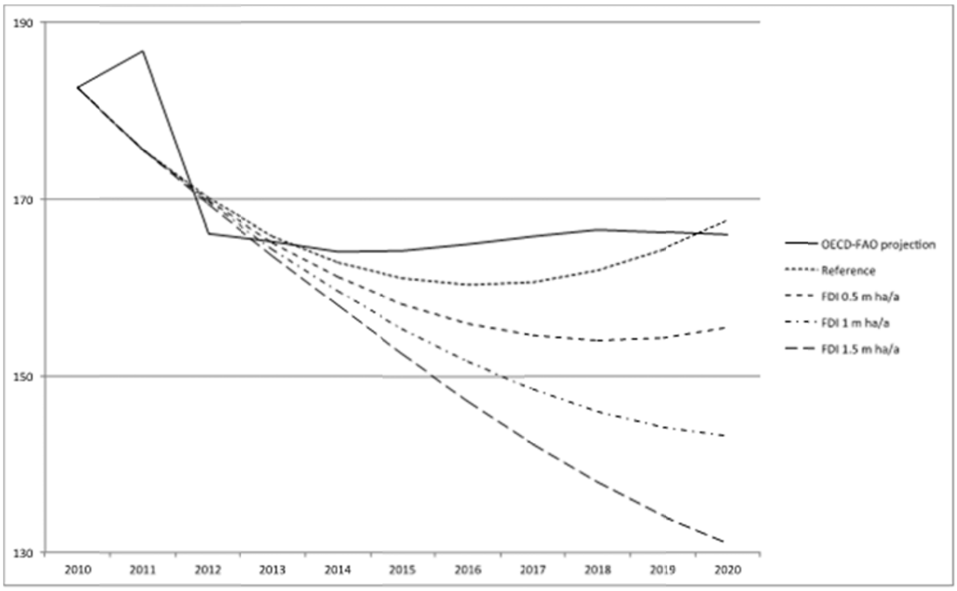


Figure 3: Impact of FDI on price index of cereals; reference generated with econometric model; production from FDI fully additional

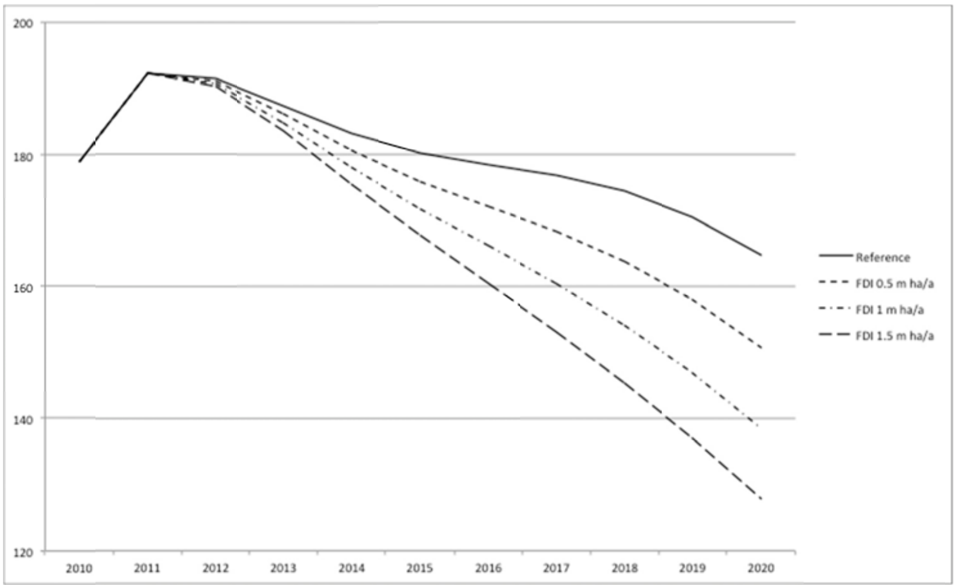
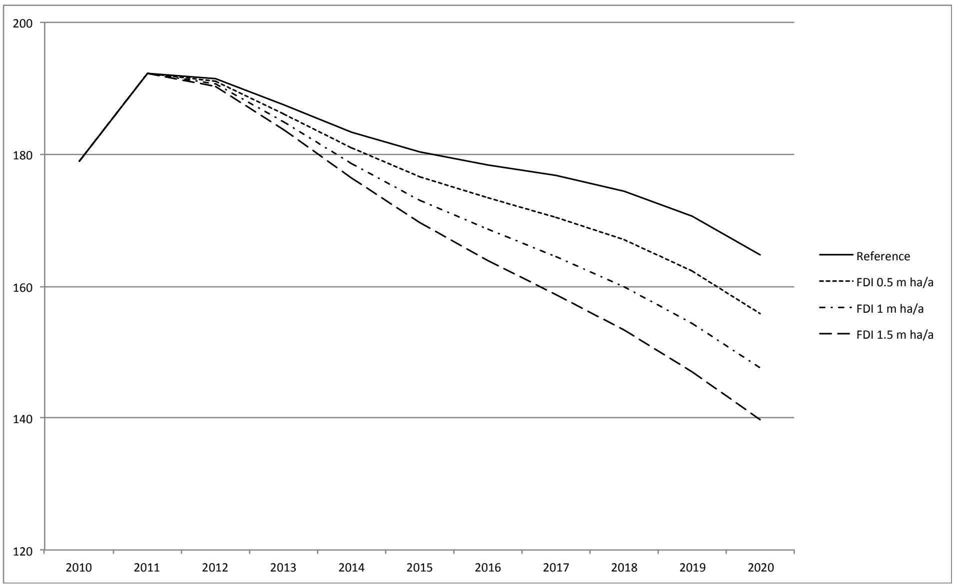


Figure 4: Impact of FDI on price index of cereals; reference generated with econometric model; production from FDI not fully additional



Session 2: Case Study of APEC Economy

Chilean Soil Recovery Programme

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ABSTRACT: Several international and Chilean organizations like the Food and Agriculture Organization (FAO), agreed that the soil erosion must be controlled in order to maintain a sustainable food production[19]. The government of Chile has developed several programs to achieve this goal like the Soil Recovery Program (SRP)

The World Trade Organization (WTO) categorizes the program as a “minimis program”, which provides minimal supports allowed by WTO because it does not generate price and commerce distortions.

The Chilean Soil Recovery Program (SRP) aims to recover the former productive potential of agricultural soils and maintain the upgraded levels achieved in order to obtain sustainable Chilean soils. The program consists in a state benefit for a list of previously defined environmental conservation practices. It is based on five sub-programs, which include;establishment of vegetative cover, incorporation of essential chemical elements, elimination, cleaning or destruction of physical or chemical impairments, use of soil intervention methods for conservation (like crop rotation) and incorporation of phosphorus-based fertilizers. The program is managed by the Ministry of Agriculture, through institutions like the Agricultural Development Institute (INDAP) and the Agricultural and Livestock Service (SAG)

By 2012, the budget of the SRP reached the amount of US$ 134,723,568. In 2011 the number of beneficiaries reached 80,283 land owners and the recovered area achieved by the program was raised to 260,841 ha.

KEYWORDS: Soil erosion, conservation, sustainable food production, vegetative cover,physical or chemical impairments.

1 INTRODUCTION

Soil erosion and degradation are an environmental problem that comes along with different situations like the loss of soil fertility potential and sustainability. This matter has always been a problem that concerns the government of Chile. Different organizations, like the Food and Agriculture Organization (FAO), agreed that the soil degradation caused by erosion affects fertility and soil potential to produce food. Also, the United Nations Convention to Combat Desertification (UNCCD) is aware of the dangers of land degradation as reflected in its goals: *"To forge a global partnership to reverse and prevent desertification/land degradation and to mitigate the effects of drought in affected areas in order to support poverty reduction and environmental sustainability"*. These goals are under the 10-year strategy of the UNCCD (2008-2018). In the same way, the National Forestry Corporation of Chile (CONAF)recognizes that among the environmental problems of Chile, erosion processes are the most serious at national level.

The Food and Agriculture Organization also highlights the importance of government initiatives in the creation and administration of environmental programs that ensure the soil conservation. Rest in them is the responsibility to elaborate systems in order to maintain a balanced and sustainable food production. A sustainable agriculture is a benefit for society as a whole rather than individual farmers. Under the World

[19] *- Prado Wildner L. and da Veiga Food M. (1992).*
- Varas Rona R., Francke Campaña S., Tokugawa K and Makita K. (1998).
- Kelly H.W. (1990).

Trade Organization (WTO), considered this programme like a “minimis program”. This kind, are minimal supports allowed by WTO because do not generate prices distortions.

The Ministry of Agriculture, has been implementing over the past years different policies that ensure the conservation and sustainability of soils, in order to secure the future food production and conservation of soil fertility. Under this gaze, the Ministry of Agriculture, across institutions like The Office of Agricultural Policies, Trade and Information (ODEPA), The Agricultural Development Institute (INDAP) and The Agricultural and Livestock Service (SAG), implemented the Soil Recovery Program (SRP), which has as primary objective, to recover the productive potential of agricultural soils and maintain the upgraded levels achieved.

The following document seeks to present to the different APEC economies, the Chilean Soil Recovery Program administered by the Ministry of Agriculture. The paper begins with a program description, focusing in the five main sub-programs through which the general program is executed. Then, it will explain the operation and technical functioning of the program and finally, the SRP results will be analyzed under parameters of budget, beneficiaries and benefit surface.

2 SOIL RECOVERY PROGRAM

2.1 Description of the Program

The primary objective of the Soil Recovery Program (SRP) is to recover and maintain soil from erosion, aiming to a sustainable agriculture and also to achieve the upgraded level.

The program consists in a state benefit for some defined environmental activities related to soil conservation; these activities are defined each year in an annual cost table.

When the benefit is for small farmers, it can be an additional benefit related to spare the costs of technical support in order to help in the elaboration and execution of a conservation management plan.

The SRP consists in five sub-programs that are group practices according to the objectives defined in the 20.412 Act. The program supports the following activities:

- Incorporation of phosphorus-based fertilizers.
- Incorporation of essential chemical elements.
- Establishment of vegetative covers in uncovered soils, or in soils with deteriorated vegetative covers.
- Use of soil intervention methods like crop rotation among others, and practices that are oriented to avoid the loss and erosion of the soils and favor its conservation.
- Elimination, cleaning or destruction of physical or chemical impairments.

2.2 How Does the Program Operates?

The benefits of the program are granted by the Agricultural Development Institute (INDAP) and by the Agricultural and Livestock Service (SAG) through public contest. Both INDAP and SAG are agencies of the Ministry of Agriculture of Chile. The Office of Agricultural Policies, Trade and Information (ODEPA) is in charge of the coordination of the program with activities like report information about the program to the Minister or to his advisors and distribute the budget among the different activities.

The users of the Agricultural Development Institute will have the right to a benefit of 90% (max.) of the net costs of the approved practices in their conservation management plan. The public contests are managed through decentralization in each region of Chile by the Agricultural Development Institute Regional Directors for the small farmers or small agricultural producers (which are previously defined in the Article 13 of the 18.910 Act) and by the Agricultural and Livestock Service regional directors for the rest of the agricultural producers.

For the previous management, the Regional Directors of the Agricultural Development Institute and Agricultural and Livestock Service are advised by a regional technical committee integrated by representatives from the public and private agricultural related sectors.

2.3 Who Can Apply to the Program?

According to the 20.412 Law, all those persons, natural and juridical, that can prove to be owner, usufructuary, lessee, or that are using under commodatum or sharecropping the extent of soil proposed to improve will be able to apply the program. The applicants must present to the Agricultural Development Institute or to Agricultural and Livestock Service, depending on the case, a conservation management plan that should be approved by the formerly mentioned institutions. The conservation management plan must be made by certified professionals who are enrolled in the register of operators of the Agricultural Development Institute or Agricultural and Livestock Service.

2.4 SRP and World Trade

In Chile, the SRP it is not applicable to fruit crops, because the fruit production is one of the main exportable products of Chile, therefore the program do not affect prices in the world trade. SRP aims to the whole general agriculture. The SRP it is an environmental program seeking recover eroded soils, which have lost their former productive potential. It does not aim to enhance production itself rather than to recover eroded soils and their sustainability. It is a conservation oriented program. Also, SRP is a mechanism that is decoupled from the production itself; that is why it does not affect commerce or prices.

Under the World Trade Organization (WTO), the SRP program is not a price distorting program. In that way, the Chilean Soil Recovery Program it´s considered like a “minimis program”. This kind, are minimal supports allowed by WTO because do not generate prices distortions.

3 HISTORIC EVOLUTION OF THE PROGRAM

For the Ministry of Agriculture, the management of eroded soils has been one of its main priorities. Accordingly, since 1996 different instruments and programs have existed with soils recovery objectives. As previously explained, the SRP program has been growing in matters of budget, beneficiaries and cover areas. All these three parameters are discussed below:

3.1 Budget

The resources of an effort destiny to recover soils potential have been growing in time. Table 1 and Figure 1 show the evolution of the resources destiny for the SRP. All amounts are in US$, using the following exchange rate: 500 Chilean pesos ($) = 1 US$.

Table 1 Evolution of the budget for the SRP

Year	Amount (US$)
2010	25,163,096
2011	55,119,810
2012	54,440,662
Total	**134,723,568**

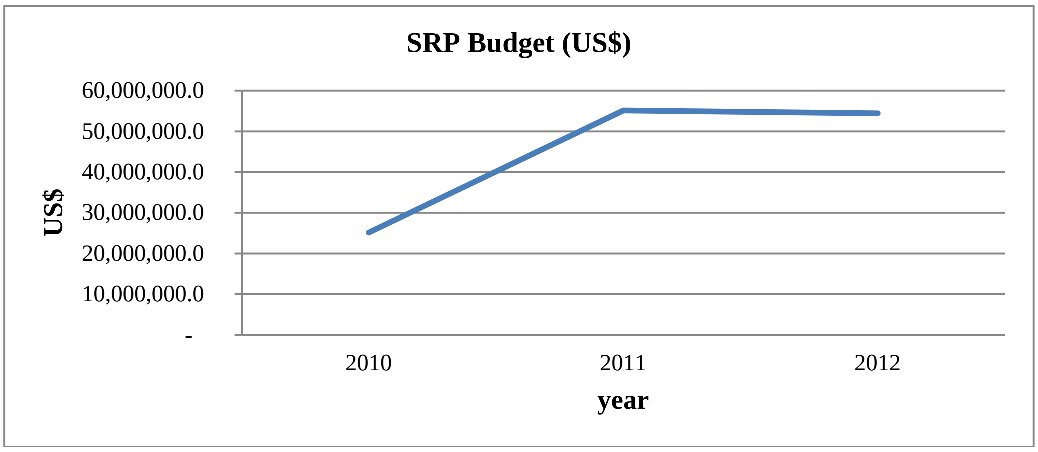

Figure 1: Evolution of the budget for the SRP

3.2 Beneficiaries

From the years 2010 to 2011, the amount of beneficiaries of the program has increased by 189.1% from 6,316 farmers in 2010 to 18,260 in 2011. Table 2 and Figure 2 show increases of beneficiaries of the program.

Table 2 Beneficiaries of SRP for the years 2010 and 2011

Year	Farmers benefited by SRP
2010	6,316
2011	18,260
Total	**24,576**

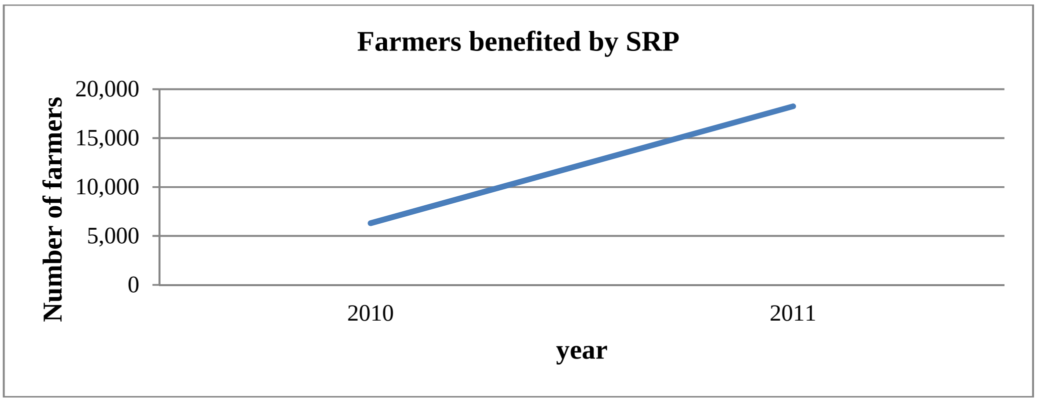

Figure 2: Beneficiaries of SRP for the years 2010 and 2011

Recovery Area

Up to 2011, the Soil Recovery Program has recovered an amount of 260,841 ha in Chile. Between 2010-2011, the recovery area increased 33%. Details are shown in Table 3 and Fig. 3.

Table 3: Recovery area (ha) by SRP from 2010 to 2011

Year	Recovery area (ha)
2010	111,949
2011	148,892
Total	**260,841**

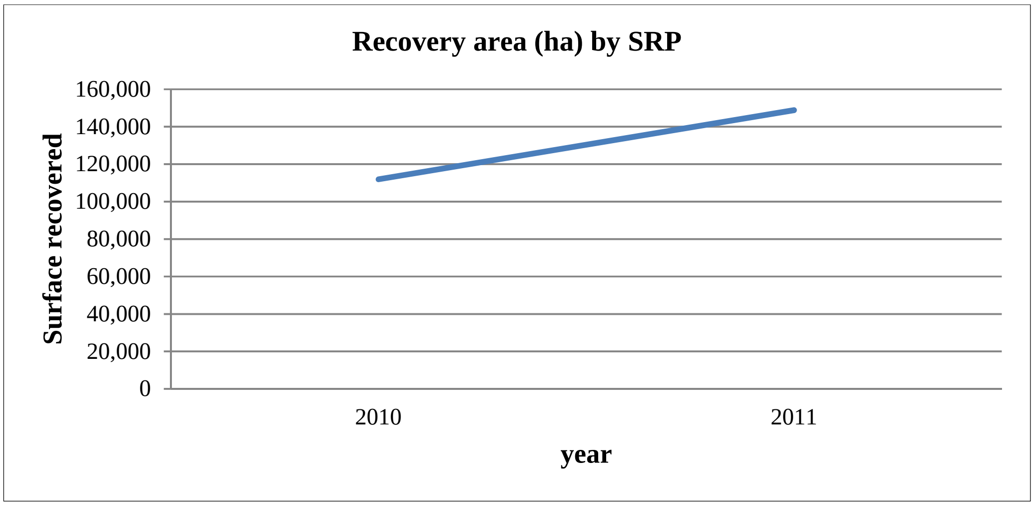

Figure 3: Recovery area (ha) by SRP from 2010 to 2011

4 BUDGET BREAKDOWN BY REGIONS AND SUBPROGRAMS

4.1 Breakdown by Regions

Chile is divided into 15 regions; each with its own characteristics, that is why the budget is conveniently divided by the region. The budget breakdown for the year 2011, explained in Table 4 and Figure 4, shows that the Los Lagos and the Araucanía Regions use around 45% of the total available resources of the year. In these regions, the mostly-used programs are the incorporation of phosphorus fertilizers, incorporation of essential chemical elements ($CaCO_3$) and conservation methods related to wheat crops.

4.2 Breakdown by Sub-programs

As shown in Figure 5, most of SRP budget is used in soil conservation methods that include crop rotation and the construction of infrastructure like protective fences. These kinds of practices are oriented to avoid the loss and erosion of the soil and favor its conservation. Also, the use of phosphorus-based fertilizers is widely used, consuming 25% of the total budget for the year 2011.

Table 4 Budget breakdown by regions of Chile, year 2011

Region	**Budget (US $)**
Tarapacá	601,907
Antofagasta	482,232
Atacama	443,144
Coquimbo	1,704,548
Valparaiso	399,094
Libertador	2,538,452
Maule	4,052,343
Bío Bío	6,558,262
Araucanía	8,694,853
Los Lagos	13,.226,295
Aysén	3,.036,169
Magallanes	1,539,095
Metropolitana	588,147
Los Ríos	4,781,179
Arica y Parinacota	407,651
Total	**49,053,372***

**No operational costs consider*

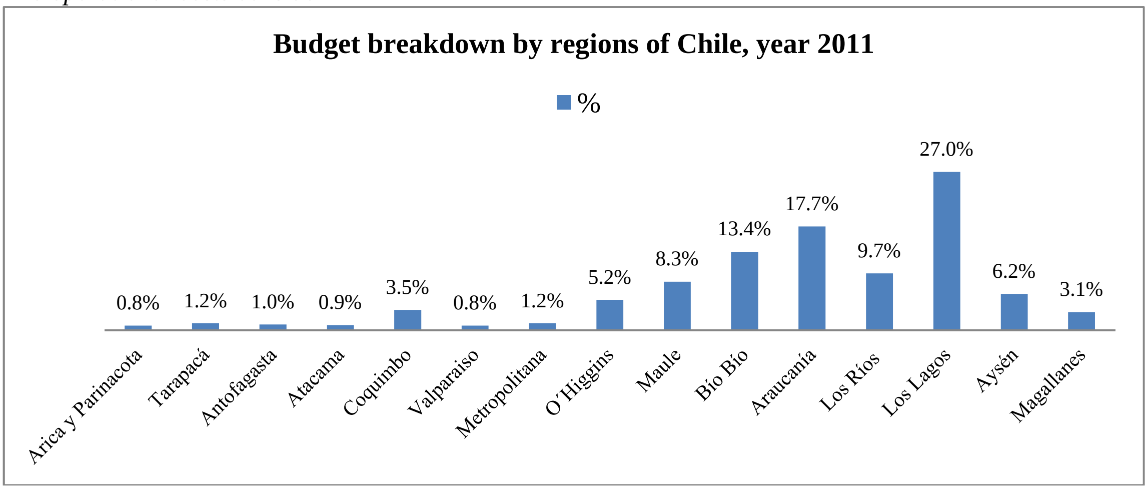

Figure 4: Budget breakdown by regions of Chile, year 2011.

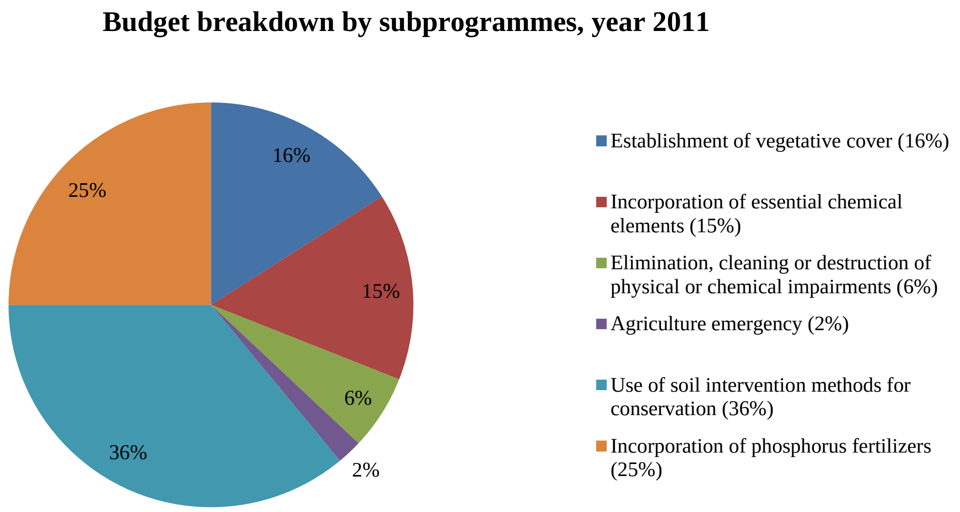

Figure 5: SRP budget breakdown by sub-programs, year 2011

5 CONCLUSSIONS

Over the years the Chilean Soil Recovery Program has achieved different goals in environmental conservation. According to several international and domestics sources, the continuous control of erosion and soil degradation is important, and must be maintained over time in order to have a future sustainable food production and agriculture.

The Government of Chile, through the Ministry of Agriculture, manages the Soil Recovery Program and it as extended over the years the budget, the beneficiaries and most important the benefit surface with indicates the direct conservation gain in the Chilean soils.

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Agrosylvopasture as Sustainable Land Management to Enhance Food Production in Dry Sub-humid Areas in Indonesia

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ABSTRACT: Eastern part of Lombok Island in Indonesia is a dry subhumid area. Farming practices in this area were generally traditional with simple techniques. The farmers were practicing shifting cultivation even on steep land. Using these practices the farmers were generally quite poor and so was their land. This was because the poor farmers could not give any input to the degraded land and consequently the land gave low productivity to the farmers. The objective of this research was to find sustainable land management systems for combating land degradation and enhancing food production in dry subhumid areas in Indonesia. To achieve this objective, various agrosylvopasture (ASP) systems were introduced since 2006. The results of this research showed that, one ha of agrosylvopasture systems using multirows of legume trees (*Sesbania* sp.) for fodder mixed with livestocks and food crops had provided enough food (carbohydrate + vegetables + protein) for a family with 3 - 5 members. After three years, these systems had increased farmers income from US$ 6-28 to US$ 226-449 per month. In 2012 these systems have been adopted by about 17,000 farmers. It is believed that these systems will also be effective to increase stream baseflow, enhance biodiversity in this area as well as carbon sequestration; a further indepth study will be carried out to proof this believe.

KEYWORDS: Lombok, land degradation, shifting cultivation, low productivity, biodiversity, carbon sequestration, farming sysrem development.

1 INTRODUCTION

In dry sub humid areas, particularly in Lombok Island, Nusa Tenggara Timur (NTB), about 1.7 million people (50% of NTB population) live in degraded land, and more than 60% of this population live under the national poverty line. Their monthly income is only about US$ 72 (US$ 333 per year). In general their income comes from traditional agriculture. General farm conditions in the degraded land, particularly at the project locations are low rainfall (<1000 mm/year), simple/traditional agriculture technologies and poor farmers. These conditions caused the development of sustainable agriculture to become costly and somewhat difficult. Therefore some farmers, in order to sustain their lives, had to undertake activities that had deteriorated the environment such as: cutting woods in the forest, squattering forest land and practicing shifting cultivation, farming on steepland, and other farming practices without adequate soil and water conservation techniques.

These conditions have resulted in low family income (poor farmers), many children at school age did not go to school, many divorce cases, lack of food, malnutrition diseases, low agriculture production, poor environment conditions, severe erosion, and high unemployment. The government of Indonesia tried to eradicate poverty in Lombok Island in many ways; among others was farming sysrem development (FSD). The aim of FSD was to rapidly identify useful local practices, as well as introduce new technology for the benefit of small farmers. Agricultural extension workers work with families to help choose farm management practices which fit local ecological and socioeconomic conditions. This participatory approach to upland rural development considered total farming systems (agroforestry and/or mixed farming systems) is one among others that could be appropriated. Income generation and food production are important, but sustainability is the ultimate goal. Therefore the appropriate farming systems may be involved tree crops, horticulture crops, food crops, industrial crops, medicine crops, fish, and/or livestocks depends on local conditions.

The success of FSD depends on the combine effort of farmers, researches, extension workers and planners. Scientists, sociologists and economists work with farmers to understand the limits to production and sustainability at the farm level. FSD bridges the gap between research and on-farm utilization while taking into consideration other influences such as markets, availability of labor, access to credit, level of surrounding infrastructure, extension support and government policies. Agrosylvopasture was considered as the most appropriate farming systems for sustainable land management (SLM) and combating land degradation in this area.

2 MATERIALS AND METHODS

2.1 Project Location

Proposed project for sustainable land management (SLM) and combating land degradation was in eastern part of NTB. Project Area Characteristics: Annual rainfall is less than 1,000 mm with 9 months of dry season and 3 months of rainy season; low rate of topsoil development caused by serious fire, very low land productivity, vegetation were scarce (savanah) as caused by over grassing, farmers income were very low, less than 1 US$ per day.

2.2 Project Activities

The project was mainly consists of three major activities. They are:

1. Establishing appropiate agroforestry systems,
2. Establishing embung (Rainfall harvesting reservoirs) where necessary and appropriate, and
3. Developing of appropiate integrated farming systems (including food crops, tree crops, livestocks, grasses).

2.3 Agrosylvopasture (ASP) Development

This project developed agrosylvopasture by involving *Sesbania* tree, goat/sheep, cow, buffalo, food crops (upland rice, corn, cassava, ground nut), and vegetables (string bean, cabbage, chilli). The type of Agrosylvopasture System that was introduced consisted of:

1. Planting *Sesbania grandiflora* (a leguminous tree) to impove degraded land and to provide fodder,
2. Food crops (upland rice, peanut, corn, vegetables),
3. Tobacco, and
4. Raising livestocks (goat, cow, and buffalo).

Planting distance of *Sesbania* trees was 2.5 m x 0.6 m with east-west direction to make about 6,400 trees/ha. The food crops were planted in between *Sesbania* rows according to seasons. The livestocks were kept in special stable. The *Sesbania* leaves were cut regularly to feed the livestocks in the stockyard. Livestock manure was used to fertilize food crops. In general corn or uplandrice was planted during rainy season and usually intercropped with vegetables; and followed by peanut afterwards.

2.4 Investment Aspect Involves

This project needed investment for seeds of so many kinds of trees, food crops, medicinal plants, grasses, fertilizer, livestock (goat, cow and buffalo), tools, and materials.

2.5 Capacity Building Aspects

Capacity buildings were carried out through meetings at local level to establish required organization for the implementation of the project, small workshops at local level to formulate action including data inventory, indigenous knowledge, and appropriate new technologies (innovation), and training of farmers.

Material needed for capacity building at appropriate level included the followings: building of indigenous and exogenous knowledge, farming systems developmet, and agrofrestry systems development.

3 RESULT AND DISCUSSION

Productivity of the systems has been increasing consistenly as folows:

1. Foodcrop productivity has been increased from only 1.7 tons/ha/year of corn to 3 tons/ha/year and 1.4 tons/ha/year of rice to 2.5 tons/ha/year (Table 1). The increasing productivity of food crops is likely due to the using of additional manure from livestocks of the Agrosylvopasture (ASP).
2. Livestocks ownership has been increasing from only 1-2 cows and 2-3 goats/sheeps to 2-3 cows and 6-7 goats/sheeps (Tables 2 and 3).
3. Tree productivity has increased from almost nothing to 1,500-6,400 trees/ha.
4. From the increasing productivity, the system has increased farmers income from US$ 72- 333/year to US$ 2,716-5,933 (Table 3).
5. The ASP systems have also extended economic activities and job opportunities of the farmers all year around from only 4-6 months during rainy sesaons before the implementation of the systems (Tejowulan, 2012) .
6. This system has also increased hydrological function of the watershed indicated by the emerging of spring water in many parts of the watershed and increasing biodiversity and carbon squestration; eventhough these phenomena were not observed systematically yet.
7. The number of farmers to adopt the ASP system has been increasing year after year. The farmer involvement has increased from only 69 in the first year of the project to 15,000 farmers in 2007, and kept increasing to 17,000 farmers in 2012 (Tejowulan, 2012). This is likely due to successfulness of the ASP system to increase farm productivity and farmers' income, and restore environmental conditions.

Table 1 Annual farmers income from food crops (Tejowulan, 2012)

Crop component of ASP	Yield(ton/ha/yr)	Net Income(US$)	Net Income(IDR)
Corn	3.0	167*	1 500 000
Upland rice	2.5	189	1 700 000
String bean	1.1	100	900 000
Chili	0.4	167	1 500 000
Tomato	1.3	111	1 000 000
Others	-	178	1 600 000
Total	-	912	8 200 000

Table 2 Annual farmers income from livestocks (Tejowulan, 2012)

Livestock	Farmers (owner)			Farmers (Penkadas/leasing)		
	No. of livestock	Income (US$)	Income (IDR)	No. of livestock	Income (US$)	Income (IDR)
Goats /sheep	9	1 110	10 000 000	9	555	5 000 000
Cow	3	1 000	9 000 000	3	500	4 500 000
Total		2 110	19 000 000		1 055	9 500 000

Table 3. The role of ASP system to increase farmers income.

Source of Income	Range of income (per year)			
	Before ASP		After ASP	
	IDR (million)	US$	IDR (million)	US$
Livestocks	*		9.5 - 19	1 055 - 2 111
Foodcrops	650 – 3 000	72 - 333	7.4	822
Sesbania trees	0	0	7.5 - 27	833 - 3 000
Total annual income			24.3 - 53.4	2 716 - 5 933

**Goats 2 and cow 1, US$ 2,716 - 5,933/year or US$ 226.3 - 449.4/month*

4. CONCLUSIONS

From the results and discussions the following conclusions can be drawn:

1. he agrosylvopasture (ASP) system has increased food crops productivity, livestock ownership of the farmers, tree population and farmers’ income significantly.
2. The ASP system has increased the quality of environment, i.e. stream baseflow, biodiversity, and carbon sequestration.
3. The ASP system has extented economic activity and increased job opportunity

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Developing Rural Land for Sustaining Agricultural Activities: A Case Study of the Customary Land Development in State of Negri Sembilan, Malaysia

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ABSTRACT: The Malaysian government has identified various strategies to help alleviate rural poverty since the early days of independence. Various strategies were formulated and implemented. However, despite the efforts undertaken by the government, the major problem posed to the government agencies is the increasing rate of idle agricultural land. Data were collected from interviews with affected landowners in Negeri Sembilan, the *adat* leaders, the State Authorities responsible for land administration and development, Federal government agencies established to address rural development strategies to identify the reasons for the increase in the idle agricultural land. There are various policies and measures undertaken by the government to cultivate idle land. However, research identified that there are certain factors impacting adversely on the successful implementation of the government's plans to develop idle agricultural lands. This problem if left unattended will lead impact on the supply of agriculture land available for development. This paper sets out the measures adopted in addressing issues relating to idle agricultural land, the problems faced and the proposals to overcome the problems to prevent the loss of supply of land available for agriculture development which is very crucial to ensure food security and promote sustainable development of the rural community.

Keywords: Development of rural land, *adat* or customary land, idle agricultural land, law enforcement.

1 INTRODUCTION

Rural development has been the core focus of the Malaysian economic policies since independence in 1957 through the 1990s based on the ideology that rural development is pivotal to the Malaysia's economic growth, upgrading of social structure and to a certain extent political stability. Post independent rural sector's salient characteristics were, high incidence of poverty leading to social problems, low productivity or agricultural land, lack of basic economic knowledge, lack of infrastructures and market imperfections creating imbalances. One of the major social problems of the rural sector is poverty arising from lack of fixed income, technology know-how, access to credit and etc. Although poverty is a universal problem, its higher occurrence and incidence in the rural sector makes it predominantly rural phenomenon.[20] The incidence of poverty in Malaysia was quite high in the 1970s, that is, almost half of the populations lived in poverty, with the rural sector being the most effected group. As the rural economy is mainly based on the agriculture sector, the Government strategized and developed various agricultural policies to chart agrarian reforms as major measures responsible in transforming the poverty-stricken community to one that is commercially-oriented.

Development efforts are governed by the two prong strategy of achieving growth with equity. The government policies had to a great extent achieved the intended results but poverty and inequality within and between sectors and the major ethnic communities were still significantly visible.[21] Malaysia in line with the goals set out in the Millennium Development Goals of the United Nations also focuses on

[20]Chamhuri Siwar (1996) Rural Development in Jomo K.S. and Ng Siew Kiat (eds.) Malaysia's Economic Development Experience, Kuala Lumpur: Pelanduk Publications.
[21]Jomo Kwame Sundaram. UNRISD, The New Economic Policy and Interethnic Relations in Malaysia.

rural development and retained it as an important agenda in the Malaysia's effort to reduce poverty.[22] Since poverty is very often linked to the rural community, the government has taken various efforts to improve the agricultural sector that is the predominant rural economic activity. Alongside the undertaking to develop rural areas and various related aspects, the authorities are also faced with the task of rehabilitating idle agriculture land left by the owners who are no longer interested to cultivate the land due to various reasons.[23]The problem of idle padi land has attracted national attention in recent years. The total area under all crops in Peninsular Malaysia is approximately 8.6 million acres. However, more than a **million** acres or about 12 percent of the total acreage are left idle and about 30% of the idle agricultural land has been found to consist of alienated padi land.[24] The problem of idle padi land is especially acute in Negeri Sembilan where 20,784 acres or 57 % of all gazetted padi land are left idle. This study examines the factors contributing to the abandonment of padi land and to suggest alternative uses of the land. In Negeri Sembilan, about 57 % of the gazetted padi land is abandoned.[25]

The objectives of the study are to determine the factors that contribute to the abandonment of padi land in the state and to suggest alternative uses of the land. The study shows that factors such as shortage of skilled labour, low productivity of padi land, shortage of water, multiple land ownership of inherited land are significantly influencing the farmer's decision to abandon their padi land. The research in these areas also indicated that the smaller idle padi land has been economically well utilised by smallholders by adopting integrated farming activities. Incorporation of short term crops such as pineapples, chili, maize, livestock rearing especially feedlot (cows), sheep and poultry, apiculture and mushroom cultivation with perennial crops and forest trees. Normally, this system lasts at the most three years before the canopy closes in. For agroforestry system to be sustainable, correct designs and techniques of planting tree crop, short-term crop and forest trees and choice of forest trees was established.[26]The increasing cases of idle agricultural land can be a drawback to the strategies adopted to develop rural land aimed at ensuring food security and the other for poverty alleviation if not given serious attention. The government being aware of the fact that if the land is left to remain idle it could have a long term impact on the policies for alleviating rural poverty as well as sustaining agricultural activities for purposes of ensuring food security.

This paper seeks to set out the policies and efforts undertaken by the government in tackling the issue of idle agricultural land by taking the state of Negeri Sembilan as a case study. There are only six administrative districts that are still practicing *Adat Perpatih* in Negeri Sembilan, that is Rembau, Seremban, Jelebu, Jempol, Kuala Pilah dan Tampin. There is no customary land in Sungei Ujong (Seremban). There are about 12 tribes (*suku*) in Negeri Sembilan left at the moment. The study has as its main objective to identify the constraints faced in developing these lands that has led the land being left idle and unproductive. It is proposed to introduce legal measures to enforce the development of idle agricultural land which could in turn be converted to be productive and sustain the growing needs of ubsistence agriculture. The distribution of customary land in the Districts in Negeri Sembilan as at 1983 is set out in Table 1.[27]The Districts in Negeri Sembilan where adat land is available is in Figure 1.

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[23]Mohd Ariff Hussein and M. Thiran, "Utilisation of Idle Padi Lands in Negeri Sembilan,"*Pertanika* 5(1), 105-113 (1982)

[24]Department of Agriculture, 1979, p. 6

[25]Department of Agriculture (1979): Perangkaan Asas Pertanian Negeri 1978. Mimeograph Seremban Negeri Sembilan.

[26] Faridah Ahmad, Sustainable Agriculture System In Malaysia, Paper Presented At Regional Workshop on Integrated Plant Nutrition System (IPNS), Development in Rural Poverty Alleviation, 18-20 September 2001, United Nations Conference Complex, Bangkok, Thailand.

[27] Negeri Sembilan Town and Country Planning Authority, *Negeri Sembilan State Structure Plan, 2002-2020*

Table 1 Distribution of Adat Land in the Districts in Negeri Sembilan as at 1983

	JELEBU	*K.PILAH*	*JEMPOL*	*REMBAU*	*TAMPIN*	*SEREMBAN*	*PORT DICKSON*	*TOTAL*
LOTS	**64**	**9,950**	**809**	**8,261**	**1,013**	**NIL**	**NIL**	20,097
GRANT NO	**63**	**9,973**	**751**	**8,587**	**992**	**NIL**	**NIL**	20,366
TOTAL ACRE AGE	**96**	**18,000**	**1,699**	**12,698**	**2,072**	**NIL**	**NIL**	34,565

Figure 1: Distribution of *Adat* Land in the State of Negeri Sembilan

2 BACKGROUND INFORMATION ON THE SALIENT FEATURES OF THE *ADAT* LAND

The customary land in Malaysia is very much a unique feature of the Malay community in Negeri Sembilan where the State boasts the caption, “Negeri Sembilan Negeri Beradat” (loosely translated as

Negeri Sembilan Negeri Beradat (loosely translated as Negeri Sembilan the State with Custom). Traditionally, the Malays in Peninsular Malaysia used and held their lands according to their *Adat* or customary laws. *Adat* might have differed *slightly* from Malay state to state or district to district but, generally, everybody understood how land could be used, acquired and inherited. There were never any written land laws. Sir W.E. Maxwell, the Straits Settlements Land Commissioner, wrote in 1884 that, generally, among the Malays there were only two kinds of land: *hidup* (alive) or *mati* (dead). Land that was being cultivated or occupied was considered as alive, and land that was not utilized or abandoned is considered to be dead land. Sir Maxwell in the Malay Digests at p.121 aptly described the Malay customary land tenure as:

" … the Malay cultivator can transfer only the interest in the land which he himself possesses; that interest … is merely a permanent and inheritable right of occupation, conditional on the continuous occupation of the land on the payment of tenths and taxes, and on the rendering of certain customary services; and … the price to be paid has no reference to the value of the land itself … but is calculated if garden land, by estimating the value of the fruit trees, or, if padi [i.e. rice-fields] land, by assessing at a reasonable sum the probable, value of the labour bestowed by the first cultivator in clearing the forest and bringing the filed into cultivation."

A *sawah* (field) was deemed dead if it was abandoned for more than three years. An orchard, however, would be considered dead only if it had been abandoned and had stopped fruiting. In other words, the cultivator could still claim his produce as long as the orchard continued to fruit. Once it stopped producing, it was up to the *Raja, Pembesar* or *Penghulu* (headman) to decide whether to allow anyone else to occupy or cultivate the orchard. The land's occupant or cultivator had the sole right to its products, but he never actually owned the land. He did not have to pay land taxes but was obliged to give a certain fraction of his land's product to the *Pembesar* or *Raj*a, or whoever was in power in the district or state at the time; this served as a show of allegiance. The concept of ``ownership'' as comprehended by the modern society never existed then. There were occasions, however, when an unjust ruler would wait to terminate the occupant's right to the land and seize the land either for himself or to give it away to some favoured persons.

British intervention in the Malay States in the last quarter of the 19th century introduced a major change in land issues. Believing that the sultans were the virtual owners of land, the British fully took over its administration. They then introduced laws that divided land into different functions, such as agricultural land, mining land, customary land, Malay reserved land, etc. to help ensure optimization of land use based on the nature and quality of land. Next, they decreed that ownership of land had to be registered with the newly set up land offices upon payment of certain fees, which subsequently became a major source of revenue for the state. Application for land ownership registration was then opened, especially for commercial purposes such as for mining and agriculture. The majority of applicants were European and Chinese entrepreneurs. Land which was already occupied by Malays, were classified as customary land and registered under the *Mukim* Register. Fees charged for the administration of customary land was comparatively lower than those for commercial purposes. Under the new regulations, all land with the exception of the Customary and Malay reserved lands could be bought, sold, mortgaged or leased. Land had thus become a commodity. The liberal land policy of the British facilitated the opening up of thousands of hectares of land, especially when mining and commercial agriculture became major revenue earners for the states. The Chinese and the Europeans, and with very few Indians and Malay elitists, played major roles in developing these two sectors.

However, the Malays were generally encouraged to cultivate rice to feed the growing labour force used in the manufacturing and commercial agricultural sectors. The British readily granted land to Malays, local as well as immigrant, so that they could form a settled peasantry to produce rice. Some Malay peasants preferred to sell their land, especially to non-Malays who offered them comparatively high prices. They evinced no worry that they were losing their land because the British were still liberal in offering land for food production. As rubber prices kept soaring in the markets, the consequence was an alarming number of transactions of Malay land. Many European and Chinese planters and miners bought up isolated Malay land as well as *kampung* land to expand their estates. Substantial Malay traditional land had changed hands in the various states Malaya. Thus, came about the need to introduce legal measures to prevent any form of transaction of Malay land to non-Malays so that Malays would retain their customary land for purposes of assuring continued production of rice for Malaysia. A proposal from R.J.B. Clayton, suggested that only the Malays were likely to form a permanent agricultural population and labour force in the Federated Malay States, thus their rights to the land should be protected. If not, it would defeat the main objective of the British policy to create a permanent agriculture population.

3 DEVELOPMENT POLICIES FOR TACKLING IDLE RURAL LAND PROBLEM

Policies were formulated to guide and direct the development of the agriculture sector since the early years of independence.[28] The First Malaysia Plan (1966-1970), 2nd Malaysia Plan (1971-1975), 3rd Malaysia Plan (1976-1980) and 4th Malaysia Plan (1981-1985) indicated some significant institutional effort initiated by the government. The First Malaysia Plan emphasized the agricultural sector. The New Economic Policy was introduced during the Second Malaysia Plan (1970-1975) period to restructure the economic development of Malaysia.[29] This has resulted in the establishment of various agencies to handle redevelopment of rural based economy including the Federal Land Development Authority (FELDA) and Federal Land Consolidation and Rehabilitation Authority (FELCRA). The function of FELDA was to promote and assist the investigation, formulation and carrying out agricultural based projects for the development and settlement of landless people with the objectives:

a) to reduce unemployment in rural areas,
b) to solve the problems of land ownership,
c) to establish a developed and progressive new community; economically and socially.

FELDA was successful in eradicating rural unemployment and landlessness.[30]
FELCRA was established in 1966 for purposes of consolidation and rehabilitation and to develop land as agreed or requested by the state government or on its own, consolidate, rehabilitate and develop land on request from the land owners. FELCRA objectives are:
a) to ascertain a strong returns on its output for the developed estates,
b) to increase the quality of living for its participants and staff,
c) to improve the productivity levels with knowledge and up-to-date technological management,
d) to enlarge technology and land management,
e) to upgrade value-added economy.

With the function of FELCRA, most of the efforts are focused on rehabilitation and to develop individual idle land. Since 1967 until June 1989, there are 225,867 ha of land has been redeveloped and managed as mini estates. It is clear that, with the establishment and operation on agriculture land management, huge areas of idle land has been improved and managed for productivity. However, there are landowners who are not totally satisfy with the bonus and the way FELCRA cutting off their debts instalment.

The phase after the introduction of National Agriculture Policy (1984) until the 8th Malaysia Plan (2001-2005) had its focus on the commercialization of agriculture products for food security including developing technology, to increase size of land, attempt to increase the scale of economic, size and management efficiency in developing agriculture and commodity sector. In doing so, the government institutionalized other agencies such as Rubber Industry Smallholders Development Authority (RISDA)

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and Farmers Organization Authority (FOA). The objective of the FOA is to produce commercial farmers who would contribute towards the development of agriculture industry through promotion, stimulation, facilitate and undertake economic and social development organizations and to register, supervise farmer's organizations and allocate funds on matter relating to farmers. To a certain extent, the government was successful in strengthening the agriculture institutions and to revive idle land by way of securing both economies of scale and the effective transfer of technology. However, the effort by FOA was not smooth due to constraint within the informality such as old age of landowners, small size of lands and passive attitude.

The government in realising the importance of rural sector to the Malaysia's economic growth, social and political development, has taken several steps to sustain the development of land in rural area regardless of whether it is adat land or free land. The issue of idle land has been much discussed in the 7th Malaysia Plan (1996-2000) and continued throughout the 8th Malaysia Plan (2001-2005) period. For the former, the concept of *landlord-in-trust* was introduced.The Ministry of Agriculture attempts to implement the new concept to redevelop the idle land through the establishment of the Incorporated Ministry of Agriculture (MOA Incorporated) to handle and redevelop idle lands in selected areas. It was a mandate on the government to give more attention for agencies to redevelop idle land and increased productivity of land. From this concept, all the agencies under Ministry of Agriculture acts like a team of consultants, led by Agriculture Department. By 2001, the Agriculture Department was successfully executed redevelopment of idle lands at 12 different locations or about 919 hectares of land involving 392 farmers. In 2004, Ministry of Agriculture has allocated about RM13 billion to undertake redevelopment of idle land. However, there are problems with multiple ownership constraints due to risks on rental, passive attitude and unsatisfactory term and references of contract agreements.[31]Unfortunately, despite the good planning for the development of land, the issue of idle agricultural land remained unresolved and it was reported in 9th Malaysia Plan, that approximately 163,000 hectare of agricultural land remained idle due to the difficulties to incorporate the land.[32]

A brief analysis of the Malaysia Plans shows the institutional efforts undertaken by the government to deal with the agriculture idle land issues. Beside the formal institutionalized effort by the government, the agricultural sector also evaluated the responses from the landowners on the reason as to why they are no longer keen to develop their padi land despite the customary rule requiring them to continuously cultivate the land or risk losing the land. The factors contributing to the growing phenomenon of idle land are discussed in the preceding paragraph.

4 PRESENT DEVELOPMENT OF CUSTOMARY LAND IN NEGERI SEMBILAN

The proactive *adat* landowners have managed to utilise their land which are not suitable for planting padi with various other activities that have been able to generate income for them. It is proven that the adat land is capable of being developed with the right attitude and support in terms of finance, planning and technology.

4.1Planting of Alternative Crops

Initiatives were taken by the various districts in the State if Negeri Sembilan to develop the idle agricultural land. Landowner in the Kuala Pilah district cultivated dragon fruits, corn, and other form ofvegetables on their customary land. Tourism is another activity that is gaining prominence in the Kuala Pilah district. Meanwhile, in Lenggeng, the villagers took initiative to plant lemon grass on idle land. They partnered with the Jabatan Pertanian which provided some financial assistance for the project. In Kampung Pelegong, some landowners developed their *adat l*and into fruit orchard such as guava and

[31]"Improving Idle Land Management in Malaysia – An Institutional Framework for Analysis", 1st. Real Estate Educators and Researchers Conference, Universiti Teknologi Malaysia, Kuala Lumpur, 26-27th. September.

[32] Azima Abd Manaf. 2007. *Keupayaan pendekatan Institusi dalam menghurai punca-punca tanah pertanian terbiar di Kuala Pilah, Negeri Sembilan.*Jil 2 Bil 2 Jurnal E-Bangi, Universiti Kebangsaan Malaysia

shared the profit between themselves. In Astana Raja, in the district of Rembau about 32.3 hectare of idle land was used to cultivate sugarcane. These projects have yielded good returns to the landowners who have benefited from the development. Focus on using small plots of *adat* land to plant vegetables and other cash crops for local markets. The investment needed for these activities are not big but the returns and quality of the produce can be increased by educating the farmers on the modern techniques of farming. There are many crops that could be planted for the export market especially fruits like papaya, banana, dragon fruit, pineapple and many more. In the early twentieth century it was the agricultural sector which came to the forefront. Large tracts of Malay reserve land can be used for planting of cash crops to meet the needs of the local and export market. Agricultural activities if planned and implemented with suitable policies will be able to yield good profits.

4.2 Establishing Consortium to Develop *Adat*Land

Alternatively the State Authority can plan and establish consortiums partnered by the landowners to hold the idle land in trust for the landowners and develop the idle land. This will be a very a useful initiative especially in assisting the landowners who are holding the land under multiple ownership which are uneconomical to be developed individually, The consortium can issue share certificates to the landowners based on the value of their land. While agribusiness is normally associated with western multinational companies, Malaysia provides an alternative example of a Third World agribusiness, the Federal Land Development Authority (FELDA). FELDA has evolved through an advisory stage and then a major land settlement agency phase, assisting Malaysia's rural poor, to its present position as a major employer of immigrant agricultural labour and as a large commercial business in palm oil exporting. This recent agribusiness approach is best exemplified by FELDA's Sahabat complex of 54 schemes in Eastern Sabah. There, mono-cultural oil palm cropping has been successfully developed. Plans for Sahabat have been modified to accommodate immigrant labourers from Indonesia and the Philippines rather than local settlers from Malaysia. A modernised plantation approach has taken over from the initial contract farming and social engineering approach. The experiences of FELDA in developing the rural land to develop plantation can provide a suitable model to develop the *adat* land into plantations which could yield economic benefits for the Malay society and the nation in terms of food security. *Adat* landowners have also entered into joint venture with FELDA & FELCRA to use the idle *adat* land for planting of rubber and oil palm. This venture proved to be beneficial as the idle land is developed to be productive.

4.3 Home-stay Projects to Attract Local and Foreign Tourists

The other alternative project developed on customary land is home-stay. One popular model of Home-stay is the Warisan home-stay located in Padang Lebar, Kuala Pilah. The family adheres to the *adat* perpatih custom and share the various customs with their guests.Home-stay project has proven to be an excellent way to use the agricultural land which is no longer suitable for agricultural purposes, promoteunderstanding of the unique multi-racial culture in Malaysia and enables tourists taste the typical Malay *kampung* or Malaysia life. The program allows tourists, local or foreign, to stay with a host family and be part of the family and their community to experience the local culture. It has been noted that Warisan home-stay is different from the normal home-stay project introduced using the concept of *Kampung* Stay where the tourist can participate in several of activities organized by the villagers nearby.The landowners planned and carried out promotion in television, newspapers, internet and mouth to mouth. Kampung Pelegong also developed Home-stay project. It can easily be reached via the Seremban-Labu road. It is only 15 km from Seremban and Nilai, 30 km from the Kuala Lumpur International Airport (KLIA), 55 km from Kuala Lumpur and only 2 km from theTiroi Commuter Station. It offers a range of village activities such as freshwaterfish rearing, bread making and some traditional handicraft activities. Jungle trekking, night trails, Pelegong Explorace and camping activities were planned. In addition, visitors are taught to play traditional games such as *galah panjang, congkak, batu seremban* and top-spinning. Rubber tapping, fishing, swimming in the river and making Malay traditional sweetmeats such as the kuih bahulu are some of the activities available for the both the local and foreign tourists. The initiatives taken by some land-owners are commendable and the tourism activities ensures the preservation of the tropical rainforest in certain areas where its' scenic and suitable to be developed for tourism.

4.4 Food Processing Industry

In Jempol, food processing industry was established to help promote cottage industries such as ketchup, chilli sauce, and various other local traditional delicacies for commercial purposes. These products are marketed throughout Malaysia and have been well received. The *adat* leaders have been instrumental in promoting the industry and offering their advice to the landowners on any new projects that are proposed under the one village one industry project.

4.5 Animal Husbandry Projects

The *adat*land which are not suitable for agricultural activities due to soil unsuitability can be used to rear cattle, poultry and various other animal husbandry on large scale. Animal husbandry projects have been proven to generate good income for the landowners.

5 CHALLENGES FACED IN DEVELOPING IDLE AGRICULTURAL LAND

Amongst the factors identified to have influenced the development of *adat* land are:

5.1 Land Unsuitable for Agricultural Development

The British owned most of the fertile lands and merely reserved some small-sized unfertile agricultural lands for purposes of Malay Reservation with pockets of land in sub-urbans.[33] Most of the land that had been declared as Malay reservation by the British was considered third and fourth class.[34] Moreover, the Malay reservation land has been located at hilly areas and it is normally thick jungle, which makes cultivation almost impossible.[35] This may be the reason why Malay reservation land has been abandoned by the landowners. There was an allegation that the British intentionally planned for this as the Malays were known not to keen to be involved in plantation activities and prefer subsistence agriculture. In addition, the Malays were lacking in agricultural skills. The alienation of fertile land around Kuala Lumpur to Thomas Heslop, Ambrose Beatty Rathborne and Martin Lister, was the best example of the British policy in disposing fertile land to British citizens.[36] This land, which is now known as Golden Triangle, was later owned by Loke Wan Tho.[37] It is perceived that despite being aware of the economic inability of the Malays to own this prime land due their low purchasing power, the British did not declare any urban area in Kuala Lumpur as Malay reservation. If they could have declared the whole of *kelantan* and nearly most of the *kampong* lands as Malay reservation, they could have declared the city of Kuala Lumpur as Malay reservation if they genuinely intended to protect the Malay race's property rights.

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[33] Nik Hashim Mustapha, Redzuan Othman, Mohd Fauzi Mohd Jani, Zainal Abidin Hashim, Zulkifli Senteri, Jamal Othman and Tuan Haji Hassan Ali, 'Pembangunan Tanah Rizab Melayu Dari Perspectif Ekonomi' (Persidangan Pembangunan Tanah Rizab Melayu, November 9th 1996) pp.1-2, 11; Saodah Sheikh Mahmood, *Malay Reservation and Malay Land Holdings: A Case Study of Economic Protection Discussed in the Context of Trengganu Reservation Enactment 17/1360,* (Unpublished thesis submitted to the Faculty of Economics and Administration, University of Malaya, Kuala Lumpur, 1971) pp.12-13; Mohd Azmi Bin Abdul Hamid, 'Disappearing Malay Reserve Lands' (Land: Emerging Issues And Challenges, 12-15th 1997, Penang) p.4.

[34] Nik Abdul Rashid, 'Kearah Meninggikan Nilai Tanah Rizab Melayu', (Seminar Ke arah Meninggikan Nilai Tanah Rizab Melayu,Kuala Lumpur, July 1st 1979), p.5.

[35] Mohd Ridzuan Awang, *Konsep Undang-Undang Tanah Islam,* Al-Rahmaniah, Kuala Lumpur, p.44; Yahaya Bin Udin, *Malay Reservations- Are There Adequate Safeguards,* (Unpublished Masters Dissertation submitted to Kulliyyah of Laws, International Islamic University Malaysia, May 20th 1991) pp 63-64.

[36] Ho Chin Soo, "Golden Hope vs Guthrie", *The Star,* Monday August 21st 2000, p.21.

[37] *Ibid*.

5.2 Location of Land and Lack of Infrastructure

Most of *adat* land is situated in remote areas with limited accessibility and infrastructure.[38] It shows that the British declared only *kampong* land or wasteland as Malay reservation. In the extreme cases it overlaps with forest reserves. Some of this land according to Mohd Ridzuan Awang, are neglected and not cultivated by the owners.[39] Any land that had development potential, urban areas, mining land was excluded from reservation. The British colonialist is said to have revoked the status of Malay reservation of some land after discovering tin deposits in the land. It is believed that the British viewed the Malays as incapable and not keen in developing their land. Thus, they choose to declare rural areas with no infrastructure facilities as *adat* land limiting the *adat* communities access to development due to expensive costs.[40]

5.3 Fragmentation and Multiple Ownership of Land

Another obstacle to the development of Malay Reservation land, especially in the urban area, is the issue of fragmentation and multiple ownerships which makes them less valuable and unsuitable for beneficial development. Efforts to change the mind-set of the Malays towards development of Malay Reservation land, issue of market value as well as establishment of a specific consortium for development of Malay Reservation land have been proposed by many parties for quite sometime. Unfortunately, there is a lack of positive outcome and perhaps the government as well as the Malay companies should work hand in hand with other agencies such as the Peninsular Malaysia Malay Chambers of Commerce, Malay Contractors' Association as well special development agencies like Urban Development Authority (UDA) to develop Malay Reservation land.

5.4 Low Market Value of Land

It is an acceptable fact that the market value of Malay reservation land is much lower then other types of land.[41] Lands within the Malay reservation were valued, in practice, based on sales of similar such lands in the neighbourhood. Being lands restricted to a certain market however such sales were comparable and hence the value of the acquired land was generally lower than for lands outside the Malay reservation. Wan Suleiman F.J. in *Collector of Land Revenue, Kuantan v. Noor Chahaya Binte Abdul Majid*[42] further confirmed this contention. In delivering his judgement he said that 'the fact remains that in law no non-Malay can own reservation, and this restriction must remain a disadvantage, which must necessarily be reflected in a lower market value.'[43]The value of the *adat*land is lesser compared to freehold land principally because the Malays either lack the ability to pay a higher value or takes for granted the true value of the *adat* land.

5.5 Lack of Financial Capacity

It has always been said that the *adat* community are poor and therefore unable to finance development.[44] Nik Abdul Rashid said poverty is one of major problems of the Malays in the rural areas.[45] Therefore, any

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[38] Mohd Azmi Bin Abdul Hamid, 'Disappearing Malay Reserve Lands', (Land: Emerging Issues And Challenges, 12-15th 1997, Penang) pp. 5-6.
[39] Mohd Ridzuan Awang, *Konsep Undang-Undang Tanah Islam,* Al-Rahmaniah, Kuala Lumpur, p.368.
[40] Nik Mohd Zain, "Pembangunan Tanah Rizab Melayu Dari Perspektif Sejarah, Perundangan Dan Pembangunan Masa Depan', (Persidangan Pembangunan Tanah Rizab Melayu, November 9th 1996) p.32.
[41] Muhammad Said Abd. Kadir Al-Haj, *Siri Kefahaman Akta Pengambilan Tanah,1960: X Prinsip-Prinsip Jadual Pertama* (Kuala Lumpur, Kementerian Tanah dan Pembangunan Koperasi, 1995) p.6
[42]*Collector of Land Revenue, Kuantan v Noor Chahaya Binte Abdul Majid* [1979] 1 MLJ 180
[43]*Ibid* p.181.
[44] Nik Hashim Mustapha, Redzuan Othman, Mohd Fauzi Mohd Jani, Zainal Abidin Hashim, Zulkifli Senteri, Jamal Othman and Tuan Haji Hassan Ali, 'Pembangunan Tanah Rizab Melayu Dari Perspectif Ekonomi'

efforts to develop their land have been hampered by the fact that the landowners are not financially capable to do so. Moreover, according to Nik Hashim Mustapha apart for financial lacking owners are also lacking in management skill.[46]The land owners require financial support as incentives to undertake agriculture production *on* the land. They need money to build fences for farming and to protect the crops from wild animal. Landowners had tried to get financial assistance from Agriculture Department but failed due to wrongly interpreted financial incentives. According to the District Director of Agriculture Department, there is no financial support available for the construction of fence to the landowners. The financial support to build fence is only available to developers who are developing their rented agriculture land.Even if they manage to obtain loans or funding from the financial institutions, they are not able to develop their land owing to lack of financial management skills.

5.6 Problems of Access to Credit - Financial Institutions Reluctance to Fund Development

Hashim Bin Aman**,**afinancier, believes and argues that the financial institutions are reluctant to invest in the development of *adat* land.[47] According to him the banks are reluctant to release loan for development of *adat* land as there are inherent financial problems such as the land can only be owned by Malays, most of the Malay reservation land is classified as agricultural land and the lower market value of the land.[48] Nik Hashim Mustapha and H.M. Jajuli, also argues that the banks are the caused for the lower market value of adat property.[49] Despite the *adat* land being freehold land, it is normally valued at a lower rate. In consequence, the registered owner or a developer will have limited cash flow or insufficient financial capacity in developing the said property. Lack of access to credit for developing land due to the nature of ownership, location, uneconomical size of the *adat* land is. Banks are reluctant to offer loan to multiple sisterhoods. Interview with Mr.Huzairi from Bank Pertanian Malaysia Berhad (agriculture-based bank), indicated that there are some cases whereby banks failed to offer financial assistance due to the multiple sisterhood land ownership. In other words, land owners of *tanah adat* are still facing unavoidable unattractive problem in dealing with the regulation of the banking system. As a result, this unattractive nature of *tanah adat* has discouraged the landowners from developing the land thus, responsible for the idyllic nature of the agriculture lands.

5.7 Lack of Policy Directions for Developing Adat Land

Despite the Federal Government implementing the various Malaysian economic development policies and plans such as the five yearly Malaysian plans, national development plan, Vision 2020, yet there is no clear policy on development of *adat* land. There are no special policy drawn by the Federal Government to resolve the problems developing the reserved land and no special body established to study the development of the land. In addition, there is no coordination amongst government departments and agencies to deal with the *adat* land.[50] The present government provides very little incentive for the development of *adat* land. In one hand, it appears as if the Government is being very protective and sense the needs of the Malay reservation institution, whilst it legally condoned dealings with non-Malays. This leads one to wonder to uncertainties and confusion on the actual intention of the Government.

(Persidangan Pembangunan Tanah Rizab Melayu, November 9th 1996) p.12.

[45] Nik Abdul Rashid Bin Nik Abdul Majid, 'Malay Reservation Land: Concepts' (Malay Reservation Land: A Development Perspective, Kuala Lumpur, August 28th 1993) *Buletin INSPEN*, Jilid 8, Bil.4, 1993, p.3.

[46] Nik Hashim Mustapha, et.al.pp.3-12.

[47] Hashim Bin Aman, 'Development and Investment in Malay Reservation - A Financier's View', (Seminar on Malay Reservation Land -A Development Perspective, Kuala Lumpur, September 28th 1993) pp.4-5.

[48]*ibid* p. 5

[49] Nik Hashim Mustapha, Redzuan Othman, Mohd Fauzi Mohd Jani, Zainal Abidin Hashim, Zulkifli Senteri, Jamal Othman and Tuan Haji Hassan Ali, 'Pembangunan Tanah Rizab Melayu Dari Perspectif Ekonomi' (Persidangan Pembangunan Tanah Rizab Melayu, November 9th 1996) 8; H.M. Jajuli, 'Tanah Simpanan Melayu: Masalah Orang Melayu', *Widya*,July, 1983, p. 38

[50] Sallehuddin Ishak, *The Development of Malay Reserve Land: A Case Study of Seremban, Malaysia* Unpublished Doctoral Thesis on Land Economy at the University of Aberdeen, 1998) p.7.

5.8 Ideology on Preservation of Adat Land

It appears that the Malays perceived the Malay reservation institution as a design by the British to **protect** them and their land. They actually believed that it was their Malay Rulers who persuaded the British into implementing the laws.[51] This attitude appears to be the principal obstacle for achieving economic and sustainable development of the land. This thought has remained with the Malays until the 21st century. They were complacent with the laws and could not accept any changes to the law. Whereas, little did they know that the restrictive nature of the law pushes them into poverty. It is not used as a regulatory framework to promote economic development. Malay reservation land has been treated as a sanctuary that needs to be preserved and protected rather than as a platform that can be used to develop the Malay community.

5.9 Ignorance of Malay Proprietors on Importance of Development

The Malays were perceived to be simple people and according some authors, the time of the British arrival in 1776, and of the Pangkor Treaty of 1874, the Malay cultivator was still at the base of the social system, "owing loyalty and obedience to his local chief and with little knowledge of a world beyond his own and nearby villages".[52] Frank Swettenham is said to have remarked that, "these people had no initiative as they were there simply to obey orders of their petty chiefs – no more, no less.[53] Thus, it would not be an understatement if one were to state that the attitude of the *adat* land proprietors and their ignorance of the importance of development of land is a factor to be considered about. The attitude of the proprietors must be reoriented in order to promote effective development of the land.[54] Some landowners give out their prime land for rental to obtain easier and speedier returns from a development project by becoming a dormant partner in joint venture deals with non-Malays or "lend" their names to non-Malay companies,[55] as such they fail to benefit from the actual value of any development projects awarded to them by the government.

5.10 *Tanah Adat* Regulations on Matrilineal Lineage

Most of the landowners are old ladies and their daughters who inherited the land usually do not stay in the village thus, hindering the development of the land. Interviews with landowners identified that their daughters are not interested to work on the idle lands. The sons who are not allowed to inherit the traditional land are precluded from developing the land despite the *adat* principles stating clearly that the sons can have a share of the profit (*makan hasil*). However, the womenfolk who inherit the land hardly observe the rule on sharing the produce with the male sibling.Additionally, the problem is more acute when dealings with multiple land ownership of all–sisters-akin (known as *nisab ibu*) or multiple sisterhood. Multiple land ownership makes it difficult for landowners to undertake development or renting out the land to developers. Moreover, developers are reluctant to take risk for fear of uncertainty in indecisive land owners. This has led to the agriculture land being left idle.

5.11 Old ages and physically incapable

Most of the landowners are old and physically incapable to develop their lands. With the average age ranging from above 50 years, they are not strong and incapable to develop their land themselves despite availing financial incentives. The landowners are also reluctant to pay third parties to develop the land for fear to take risk of being cheated.

5.12 Unfair Bargaining Terms in Renting Contracts

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[51] Roff, William, (1967) *The Origins of Malay Nationalism,*Yale University Press, New Haven.
[52] ibid.
[53] Cited by Roff, ibid at p.9.
[54] Muhammad Said at p.2.
[55] Mahathir Mohamed (1970) *Malaya Dilemma,* Singapore-Asia Pacific Press Pte. Ltd. p.46.

There are loose agreements between landowners and developers such as uncertainty in renting terms and conditions. This leads to insecurity in land tenure and resulted in lower productivity of the agriculture lands. For example, some landowners had rented their land to developers to cultivate paddy for 3 seasons with RM60 payment of rent for one season. Once the developer stops their cultivation after a season, the landowners has no right for any sort of compensation due to nothing stated in the agreement about the early departures of the land developers.

5.13 Limited Market for Renting

Most landowners were disappointed with the limited market for their land to be rented or leased as the law restricts the land from being dealt with persons coming from outside the *suku*. This restricts the market for development as Malay developers are not keen to invest in the *adat* land. The small land size also hinders the landowners from securing rental income from the land.

5.14 Attitude of Landowners

The younger generation of landowners adopt the attitude that being involved in agriculture is a hindrance to economic development owing to the long hours and low returns generated by the agricultural activities. They rather work as labourers in the industrial administrative sectors. The younger generation are not interested to be farmers and the parents never encouraged them to continue the farming activities for fear to having to face retaliation from the children. This can be linked to the colonial legacy where the Malays were left out in the economic development owing to the colonial policy. The landowners are worried that if their children continue with agricultural activities they will lose out in the modern development. They fear of being burdened with the continued British policy of retaining the Malays, to form a settled peasantry community where they are required to retain their customary land for purposes of assuring continued production of rice for Malaysia. However, they failed to realise that with modern technology and assistance from the government agencies, agriculture activities can yield more profits compared to the wage earned as labourers or clerical workers.

6 PROPOSED SOLUTIONS

The following solutions are proposed to address the problems of idle *adat* land to avoid losing valuable agricultural land that is essential for Malaysia to for cultivating subsistence agriculture for ensuring food security. It is proposed for the State Authority responsible for land administration to enforcing the law on forfeiture of abandoned land. The proposal may seem to be harsh and negative reaction from landowners but at times, it is necessary to take harsh measures to ensure government policies can be effectively implemented for the benefit of the landowners themselves.There is already in existence an express legal provision in section 129(4)(c) of the National Land Code 1965, the principal law for land administration in Malaysia where the State Authority can forfeit land left idle. This is in consonant with the *adat* law itself where uncultivated land can be forfeited.

It was legally recognised by the *adat* principles and the British Courts that proprietary right is created by clearing "dead land" by way of cultivation or building a house on the land and thus causes the dead land to "live." Such right is absolute so long as it is followed by the continuous occupation or the land bears signs of appropriation. This concept was accorded judicial recognition in *Abdul Latif v Mohamed Meera Lebe*[56]Court of Judicature of Prince of Wales Island Singapore and Malacca where Claridge R, said:

"There are two kinds of land, first the 'living land' and second, the 'dead land.' With regard to 'dead land' nobody has property rights to it, (when) there is no sign of it being under cultivation by someone, (then) certainly nobody can lay a claim to that land. If someone cultivates it into a (rice field, be it) a huma or ladang or sawah or bendang, no one can proceed against him. Thai is what is understood by 'living land'."

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[56]*Abdul Latif v Mohamed Meera Lebe* (1829) 4 Kyshe 249

In the same case, it was further held that: “The custom in Malacca for a cultivator of land to pay a tenth of the produce to the proprietor of the land in lieu or rent – and as long as the cultivator does so he cannot be ejected – it is good and reasonable custom, and one the court will recognise and uphold.”

However, such right or “private ownership” of land was nothing more than a right of occupation, although it was capable of being inherited. The occupier was required to pay a tithe in the form of one-tenth of the harvest or the income derived from the land, regularly and without fail, to the Ruler. He also had to ensure that the land remained in constant cultivation and in default of which the land would be subject to forfeiture by the Ruler. He also has to ensure that the land remained in constant cultivation, in default of which the Ruler will forfeit the land. Sir Benson Maxwell CJ in in the case of *Sahrip v Mitchell & Anor,*[57] upheld this custom:

“It is well known that by the old Malay law or custom of Malacca, while the sovereign was the owner of the soil, every man had nevertheless the right to clear and occupy all forest and wasted land, subject to the payment, to the sovereign, of one tenth of the produce of the land so taken. The trees he planted, the houses he built, were his property, which he could sell or mortgage or hand down to his children. If he abandoned the paddy land or fruit trees for three years, his rights ceased and the land reverted to the sovereign. If, without deserting the land he left it uncultivated longer than usual or necessary, he was liable to ejectment.”

A *sawah* (field) was deemed dead if it was abandoned for more than three years. An orchard, however, would be considered dead only if it had been abandoned and had stopped fruiting. In other words, the cultivator could still claim his produce as long as the orchard continued to produce fruit. Once it stopped producing, it was up to the *Raja, Pembesar* or *Penghulu* (headman) to decide whether to allow anyone else to occupy or cultivate the orchard. The land's occupant or cultivator had the sole right to its products, but he never had nor claimed ownership of the land. He did not have to pay land taxes but was obliged to give one tenth or tithe from his land's produce to the *Pembesa*r or *Raja*, or whoever was in power in the district as a show of allegiance. There were occasions, however, when an unjust ruler would wait to terminate occupant's right to the land and seize the land to be used for any purpose he wishes.

The forfeiture exercise must not be done harshly but made with proper procedures especially by ensuring the landowner is given an opportunity to defend his case and to to develop the land. The State Authority can also consider making some compensation to the landowners who are made landless to help them. This is in compliance with the *adat* practice that is clear that abandoned land must be returned to the group and redistributed to ensure the sustainable use of the land. The concept of *adat* land ownership requires the land to be held in groups (the tribe) but this has been abolished by the British when they introduced the land registration schemes and rendered the ownership of the land to individual female member. It would be useful to restructure the *adat* land ownership scheme and reintroduce the group ownership which can to a certain extent prevent the land from being left idle.

7 CONCLUSION

Empirical research identified the existence of various factors that are posing as hindrance to the development of idle agricultural land in the case study area. The legal framework regulating the *adat land* sparked off informal constraints thus, compounding the development. Due to the strict regulations regulating the *adat* land, especially the issues relating to transfer of the land within the tribe or *suku* had restricted the landowner from making decisions to deal with the land thus halting development on the lands. Factors such as age and financial incapability, location of land, access to credit and land rendered unsuitable for agriculture demoralised the landowners efforts to develop the land. At this juncture the leaders of the*adat* institution must be prepared to change the law that can assist the related government departments to come forward and undertake efforts in developing the idle agriculture land. Various agencies under the MOA Incorporated need to contribute to the process of institutional change. Steps should be undertaken to educate and promote benefits of agriculture land management schemes to

[57]*Sahrip v Mitchell & Anor* (1879) Leic 466

landowners and all other stakeholders. The government agencies should be prepared to establish a one stop centre to provide legal, financial, planning and other related advise to the landowners to motivate and facilitate the development of the idle agricultural land.

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Soil Management for Sustainable Land Management in Papua New Guinea: Observations and Comments

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ABSTRACT: Soil management is considered to be one of the important integral components of sustainable land management in Papua New Guinea (PNG), where the basic components of land reforms and land ownership/utilization are still evolving. PNG, with 7.5 million people, has a huge land mass of 459,854 km^2, of which only 30% is cultivable. Although various legislations, institutions and programs for land management are being developed, the progress has been slow. There is, therefore, a need to look at ways to enhance and sustain land management for enhanced food production and assured food security. A number of indigenously developed soil management practices such as compost mounding, mulching, water management, use of leguminous crops, crop rotations/ intercropping, etc. are found to be efficient under the given farming and technology regimes. Compost mounding system has been observed to be at variant in its performance under different soil fertility regimes but found to be performing superior under the low soil fertility conditions. Therefore, there is a perceived need to study and assess the indigenous systems of soil management to contribute to the sustainable land management under changing use of land for improved productivity, new cropping and farming systems and adaptation to climate change effects.

1 LAND AS BASIC RESOURCE FOR AGRICULTURAL PRODUCTION

It is needless to emphasis that like any other agriculturally based developing countries, land is a major resource for agricultural and food production in Papua New Guinea (PNG). While, all other factors of production such as labor, management and other capital ingredients (including cash) play secondary role. PNG with an estimated population of 7.5 million in 2012, has huge land mass of 459,854 km^2, of which only 30% is cultivable and 25% is actually cultivated, mostly extensively (up to 80%) under root and tree crops, using short to long fallow systems. Of the total cultivable land, only about 3% is alienated land, remaining being customary communally owned by clans and tribes throughout the . About 95% of the alienated land is leasehold, while remaining 5% is freehold. It is recognized from experiences elsewhere that land needs to be effectively organized through surveying, registration and reforming so that it can be effectively used for sustainable food production and wealth creation. PNG government has been making appropriate efforts through various legislations such as Incorporated Land Group Act (1974), Land Act (1986), Land Registration Act (2009), and has a National Land Development Program (NLDP) towards improving public sector land administration of alienated land and recognizing ownership by applying customary laws of the respective areas. Also various institutional developments have been made so as to seek oversight and enforcement of land rights. These efforts are seen to be making slow progress towards efficient and sustainable land management. While these efforts need to be enhanced and concerted, ways need to be found for sustainable land management, especially during short to medium terms, for enhanced food production and assured food security.

2 INDIGENOUS METHODS OF SOIL FERTILITY MANAGEMENT

Over the centuries, people in PNG have been practicing farming for food production by using indigenously developed practices and technologies. For example, use of drainage systems for improving crop production is recorded to be present some 9,000 years ago in swamps in the central highlands area of PNG. There have been a number of such practices including compost mounding, bed planting, mulching, water management, fallow management, use of leguminous crops (casuarinas), crop rotations/inter-cropping, newly introduced crops, and frost management techniques. These are observed to be used under the evolving systems of farming for meeting the subsistence and semi-subsistence needs. These are briefly observed and commented as follows.

2.1 Compost Mounding (Figure 1)

In the high-altitude highlands (1,800 to 2,400 masl.), temperatures usually remain below 10^{o}C and slow down crop growth. For instance, sweet potato takes up to 12 to 16 months to fully mature under this environment as compared to only 4 to 6 months at the sea level and up to 1600 masl. This slow growth is attributed to low temperatures including low soil temperature and low microbial activities in the soil. The soil mounds of 1.5 m in height and diameter, developed using composts in the high-altitude highland (especially in Enga province of PNG) are found to be effective in raising and sustaining sweet potato productivity. These mounds are composted, using crop residues, grasses, and other vegetations. Besides improving soil fertility (nutrient levels), the compost mounds allow soil temperature to rise, helping microbial activity in the mounds, thus contributing to enhanced and sustained production of crops, especially sweet potato under the high-altitude environment.

2.2 Mulching (Figure 2)

On plane lands with warmer temperatures, raised beds are provided with shallow drains to help optimal moisture retention for crop growth.

2.3 Mulching (Figure 3)

Barren and crop planted lands are mulched with grasses and other vegetations to protect soils from sun-drying and from soil-moisture losses due to evaporation. This practice is also used to protect crops from soil hibernating insects and pests.

2.4 Drainage for Water Management (Figure 4)

Swampy and plane lands are provided with deep drains and the crops are planted on flat beds so as to allow excess water to drain out effectively and crops are grown with optimal soil moisture levels.

2.5 Flood Irrigation (Figure 5)

For efficient growth of crops during dry periods, flood water irrigation is provided for moisture sensitive crops such as vegetables. Generally this system of irrigation is followed in low lying flat areas of PNG.

2.6 Use of Legumes Crops/Trees (Figures 6 and 7)

Traditionally legume crops such as winged bean and other pulse crops are grown to sustain and improve soil fertility, especially for nitrogen. Also casuarinas trees are usually inter planted with tree cash crops such as coffee to improve soil fertility. Such trees are also used as timber for houses, fuel wood, etc.

2.7 Short and Long Fallows (Figure 8)

Slash and burn type of cultivation practices had been followed using long fallow periods of 10 to 15 years. These were practiced under the extensive land use systems, where population pressure was low. However, recently due to high population pressure, especially in the highlands, the fallow periods have been declining to 3 to 4 years and such follows are often planted with leguminous plants to help enriching the soils.

2.8 Andean Tubers for Frost Management (Figure 9)

NARI has been working on introduction of frost tolerant crops such as Andean tubers (Oca seen in Figure 9). Frost occurs frequently in the high-altitude highlands and these areas are exposed to loss of entire vegetation, except some perennial long duration trees. Andean tubers and some indigenous tubers are considered to be alternative crops for these areas for food and sustenance.

2.9 Wheat Sweet Potato Rotation

Volcanic ask soils in the PNG highlands are also characterized to be retaining phosphorous (P) in soils and the root crops such as sweet potato are found to be incapable of utilizing such retained soil P. On the other hand, wheat grown in the tropical highlands (recently introduced from China) can utilize such retained P. Therefore, a promising system of wheat and sweet potato rotation is being tried to make use of P on the volcanic ash soils for optimal and sustainable food production.

2.10 Integrated Water Harvesting (Figure 10)

Most of PNG is blessed with moderate to heavy rainfall with an average well distributed rainfall of 2000 mm per annum. Most of cropping systems followed are rain-fed and moisture sensitive, with a prolonged dry period resulting in wilting of crops. In absence of any water harvesting (rainwater collection and utilization), the food production gets adversely affected, often creating seasonal hungry ('tim' hungry) periods. Therefore, NARI has proposed and designed a water harvesting system using natural topography for rain water collection that can be channeled and used for irrigating crops, drinking purposes, livestock, aquaculture, etc. The proposed water harvesting system is to use a variety of irrigation methods such as tanks, rope and washer pump, header and storage tanks, bamboo drip irrigation system and clay and plastic pipes as appropriate. These systems are being assessed for technical feasibility and will be piloted for practical feasibility. Based on results, such systems can be out- and up-scaled to cover larger areas in PNG

3 ADAPTATION OF ENGAN COMPOST MOUNDING TECHNIQUES:

Given the proven effectiveness of compost mounding in improving and sustaining crop production in the high-altitude highlands, this technique has been experimented at other two locations. One location is at the lower altitude wet areas around NARI Aiyura research station, and another is in mid-altitude dry areas with gravely soils of Simbu Province. Various other soil fertility management techniques such as mulching, small compost mounds have been also tried.

Figures 11 and 12 below show that composting, in general, irrespective of using the Enga type large mounds or small mounds performed equally well at Aiyura, giving cumulative yield of about 65 tons/ha over three seasons.

Figure6: Sweet potato on compost mounds

Figure 7: Sweet potato on raised Beds

Figure 8: Mulching for young taro crop

Figure 9: Drainage for potato

Figure 10: Flood irrigation

Figure 11: Intensive intercropping

Figure 12: Casuarinas coffeintercropping

Figure 13: Cropping after long fallow

Figure 14: Andean tubers - Oca

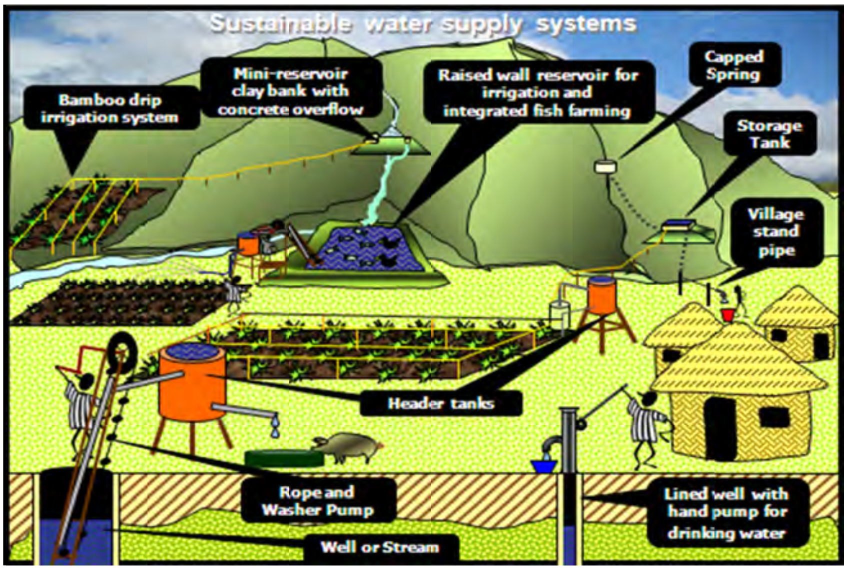
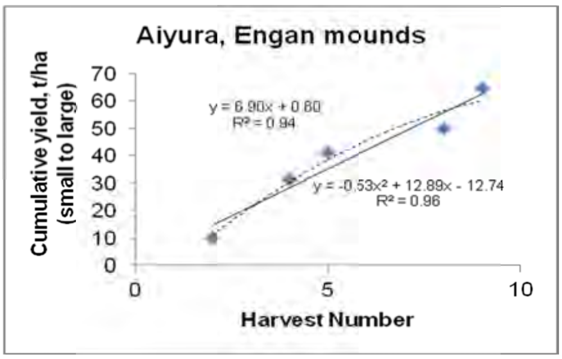


Figure 16: Integrated water harvesting model



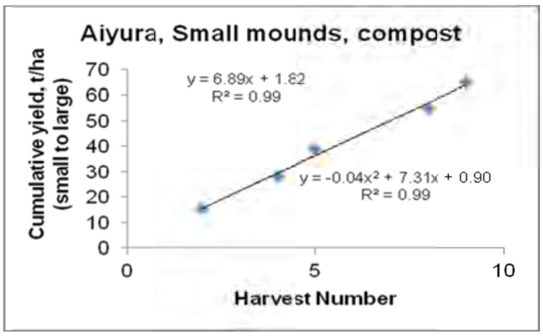


Figure 17: Cumulative yield – Engan compost mound **Figure 18: Cumulative yield – small compost mounds**

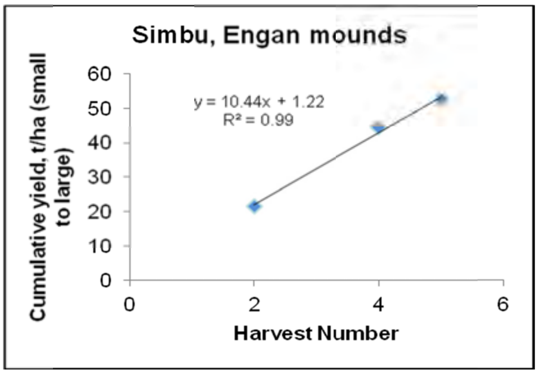


Figure 19: Cumulative performance compost mound

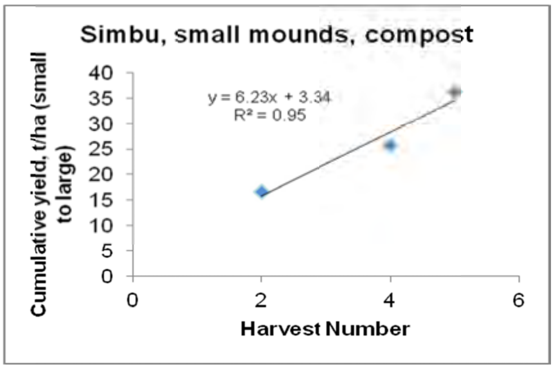


Figure 20: Cumulative performance small compost mounds

However, as seen in Figures 13 and 14, both the Engan mounds and small mounds performed with much lower level of cumulative yields, under the Simbu environment Thus, the preliminary and rather inconclusive results suggest that the performance of compost mounding varied from location to location. No one technique has been found to be efficient at all both the locations. However, under low fertility regimes, the compost mounding performed better at both the locations. It is necessary that such studies need to be conducted systematically at more representative locations and over longer periods to understand and assess the processes involved, especially in realizing and utilizing the available soil nutrients for better and sustainable food production. Such promising results can then be systematically piloted and up-scaled on larger areas for the wider impacts and national benefits.

4 SUMMARY AND CONCLUSION

In PNG, as almost 97 per cent land being communally owned customary in nature, systematic and concerted efforts are needed to have appropriate land policies and land registration programs that can help recognizing land ownership at individual and group levels so as to help sustainable land management and enhanced land productivity, reflecting in enhanced food production.

Many indigenous soil management practices that are evolved over centuries, such as compost mounding, beds and furrows, mulching, irrigation, drainage, legumes, casuarinas, intercropping, fallow and frost management, have been proven to be effective under the extensive systems of agriculture. However, these need to be assessed and improved to adapt to changing environment such as intensive cropping for higher food demand, introduction of new crops such as cereals and pulses, use of inorganic inputs, and adverse climate change effects.

Compost mounding has proven to be effective in managing and improving the soil fertility and crop productivity in major altitudes of the highlands and this technique needs to be promoted for adoption in such other areas. New crop like wheat can be potentially adopted as rotation crop with sweet potato to help improving the availability and utilization of soil nutrients and improved land productivity. These and such other options are promising towards sustainable land management in PNG.

Institutionalizing and Land Water Management for Food Security

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ABSTRACT: Over the years Peru has increased agriculture production despite the fact that Peru's arable land does cover most percentage in Peru and that water is scarce. As one of two main elements for agriculture, water has been at stake in the coastal region in Peru. Noteworthy is to mention that Peru is rich in water on the mountainous region. However, 98% of the water runoff towards the Amazon Basin, whereas 2% run off towards the Pacific Basin to replenish 52 of coastal valleys and where 52% of population lives. Peru is not the economy with high percentage of arable land and already the Inca´s agricultural management designed based on terraces explained the efforts to gain more agricultural land and better quality and diversification of crops. This paper presents a discussion for choosing paradigms to manage land and water in an integrated system to strengthen food security in Peru.

Agriculture production for consumption and subsistence agriculture have continued to be the main types for agriculture production, however the increasing production for exportation is steadily in augmentation. The concern rises when these products are gaining land for domestic production and have high water consumption. On these lines, ecosystem services are debated as a mechanism to institutionalize water, land and nature conservation. The paper sets up the debate on what control management strategies for integrated land and water management better fits Peru: prediction and control management or management by learning? Under centralized or decentralized regime? The paper considers definition of scale of the unit of analysis, networking, meeting the gap bottom-up -- top-down; these questions are discussed under the light of Asian experiences to come up with methods that could work in the Peruvian context.

KEYWORDS: Peru, sustainable land management, water management, ecosystem services, Inca´s agricultural management.

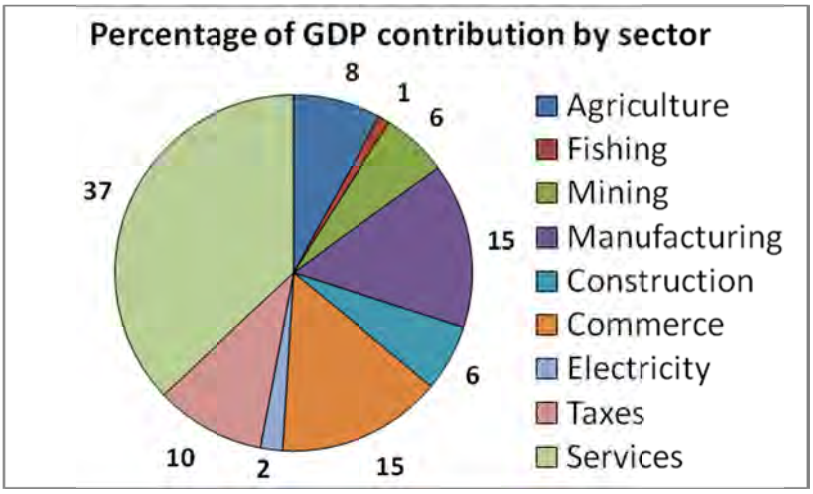
1 LAND AND WATER MANAGEMENT USE IN PERU

Peru is in central-western South America near to Ecuador and Colombia in the upper part, with Brazil in the middle portion, and in the south portion with Bolivia and Chile. Peru has a surface area of 1.285 million km² and a population of 29.5 million as of 2010 (Alegria, n.d.). Even that population growth (measure as births/100 inhabitants) in Peru is diminishing between 1961-1972 as 2.8% and 1993-2008 1.6% population density is increasing in the coast and sierra region (INEI, 2012). This concentration of the population reflects a difference in economic growth and resources distribution between regions.

Peru geography can be divided in three sections according to the natural regions: coast, mountains (*sierra),* and jungle (*selva/forest*). This division is highly important not only in an environmental aspect but also in an economic context due to production and resources that varies by region, and the cultural differences within this geographical division. The water distribution in Peru is divided in three hydrographic regions: Pacific, Amazon, and Titicaca. The Atlantic Basin concentrates 97.7% of the total water available in Peru, while the Pacific and Titicaca Basin have 1.8% and 0.5%, respectively of the total water in Peru (Alegria, n.d.). Freshwater extraction is mainly for three purposes: 85% for agriculture, 7% for domestic use, and 7-8% industrial use (INEI, 2011).

1.1 GDP and Natural Resources Exploitation

The Gross Domestic Product (GDP) is the market value of all the officially recognized final goods and services produced within the economy in a given period of time. The GDP in Peru has been increasing steadily over the last 50 years (Fig.3). Over the last ten years, the GDP percentage is reported stable on around 6-8%, with the exception of 2009 due to the economic global crisis. The GDP growth reflects an economy that reached its peak during 1990's.



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Agriculture is amid the more important sectors after: services, commerce, manufacturing, and taxes (Fig.2). Peru's economy is tightly related to exportation; exports have increased six times in nominal terms over a single decade, growing from 14.8% of GDP in 1999 to 28.7% of GDP in 2011 (World Bank 2012a). Agricultural crops production for exportation follows this tendency starting in the 1990s. This fact reflects the dependence of Peru's economy on other economies, which perhaps could affect the agricultural GDP and Peruvian economy growth if supply and demand changes.

Peru is a rich economy in natural resources, which are used to generate wealth, as approximately 10 to 15% of the GDP is generated by rents of natural resources. Over the last years, mining, oil and natural gas have got an important raise on the rents contributing to the GDP over the rest of natural resources, meanwhile forest and coal contribute in a small proportion (FAOSTAT, 2012).

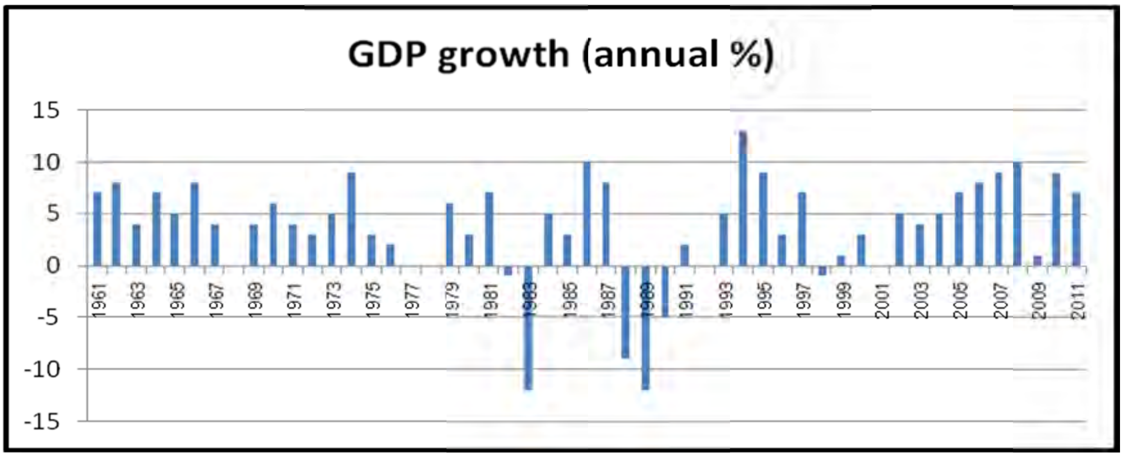
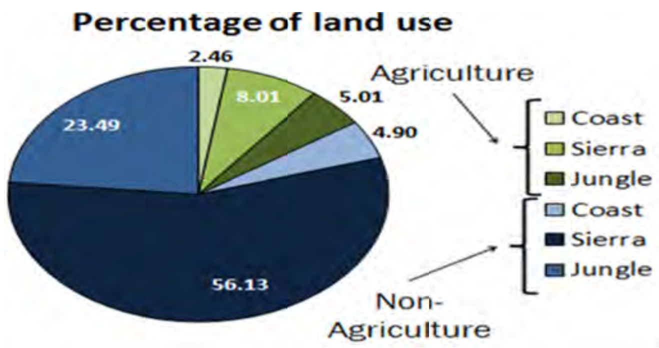


Figure 3: GDP growth by annual percentage. Source: based on data from World Bank (2012b).

1.2 Land Use and Agriculture

In Peru, approximately 35,381.3 km² are dedicated to agriculture and farming purposes, meaning 2.75% of the total area. Land use changes depending on its location. The *sierra* is the most representative region for non-agriculture, farming and related activities, covering more than 56% (Fig.4), it is also representative for the agricultural usage with 8% not such a significant area but the highest in agriculture.



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Contrary to the sierra and the jungle regions, the supporting regions for food security, the coast has a small participation in agriculture with around 7%, even though most of the population is located in coastal areas.

According to the Ministry of Agriculture (2008), agriculture production in Peru can be classified in 4 types (Fig. 5):

- Type 1: Nontraditional exports (100,000 ha). Examples: mangoes, paprika, olives and asparagus.
- Type 2: Extensive agriculture (1,200,000 ha). Examples: potato, rice, maize, cotton, coffee, sugar cane, onion and tomato.
- Type 3: Agriculture with potential exportation. Examples: *kiwicha*, *tara*, *sacha inchi*, and *palmito.*
- Type 4: Subsistence agriculture and extreme poverty (400,000 families - 2,000,000 ha).

Examples: wheat, barley, green beans, *olluco* and *oca*.

The most extensive type of agriculture in Peru is the subsistence one (Fig. 5), meaning that crops are not distributed in the market but are allocated for self-consumption. Modern agriculture type conform the least area usage, however technology compensates for small land area allocated for crop production.

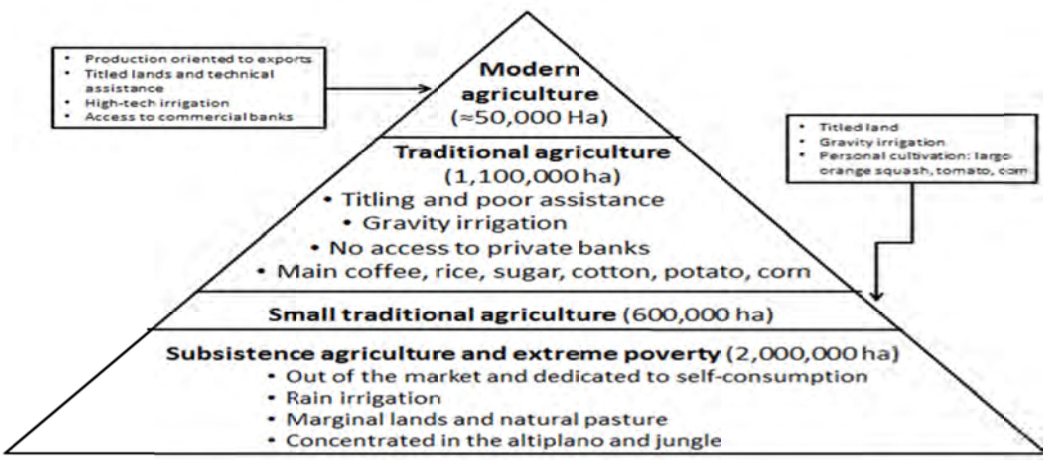


Figure 5: Agriculture classification in Peru. Source: Giugate (2006).

Fig. 6 explains changes over time in the types of crop production in Peru. Subsistence agriculture has been relatively stable over time, and since 1990s agriculture with potential exportation has slightly increased production. Nevertheless, among all types, only nontraditional agricultural production for exportation shows a constant pattern for increase production.

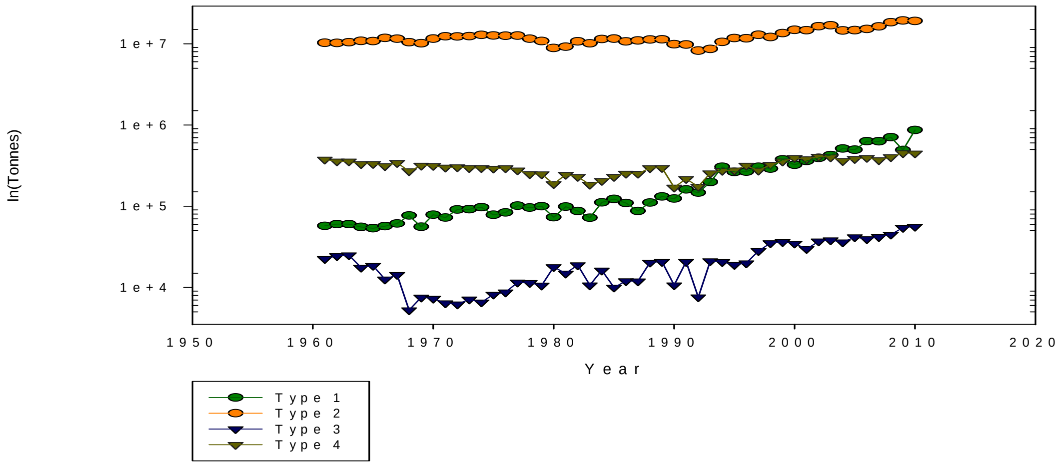


Figure 6: Total production of by crops classification. Source: FAOSTAT 2012.

In regards to land ownership management, INEI (2011) reports the agricultural large land area as 77.6% of total agricultural area in Peru, medium size plots as 11.9%, small plots comprises the 7.3%, and the smallholding 3.2% of the total area for agriculture. A relevant fact is the nature of ownership. Jurisdically, the land officially registered concentrates in natural persons as owners as of 39.9%, and peasant communities as of 39.8%. The balanced percentage among them should be reflected in the importance rights for peasants and local communities should have in equal comparison to the natural person owners.

Regarding livestock production, the numbers of heads have increased over all. It is noteworthy that chicken production has increased importantly from approximately 60,000,000 heads in 1990 to approximately 140,000,000 heads in 2010, more than double in twenty years. There is also a considerable rise of number of heads of cattle and camelids - Alpacas (FAOSTAT, 2012).

1.3 Land and Water Systems: Their Relationship with Ecology and Importance for Food Security

Land and water disturbance alter the normal ecosystem cycles, which affects ecosystem services production patterns and decrease their ecological value and as consequence augment the risks for food security. The concept of sustainable productivity provides de maximum benefit from ecosystems without decreasing their capacity to produce ecosystem services in the future. The relationship in between land and water resources is interlinked in the water cycle (Fig. 7).

Noteworthy to mention is the relevance of the collaboration and allocation of responsibilities between local and regional governments to achieve an integrated approach. Usually highlands depend on regional governments and local authorities manage lowlands on ecosystem services provided by the highlands maybe on regional level decision making officials. Thus an integrated management is not a purely local issue.

Food security depends directly on land management and water management. Water and land are managed together for irrigation purposes but usually the relationship is forgotten for conservation and preservation of land and soils management.

2 INSTITUTIONS FOR LAND AND WATER MANAGEMENT

There is a great diversity for management alternatives within each land and water systems. The integration of both systems makes it even more complex, although it is necessary to achieve sustainability. Global Water Partnership (GWP) identify several common components on both systems: (1) Optimizing land and water supply and use, (2) Managing demand, (3) Providing equitable access, (4) Establishing policy, (5) Inter-sectorial policy and (6) Sustainable use of resources.

The path to sustainability, according to the authors, needs to be identified through actors in charge of these components and through the allocation of responsibilities for each actor acting in the integration of both systems. In Peru, the management of land and water for agricultural purposes is the Ministry of Agriculture (MINAG).

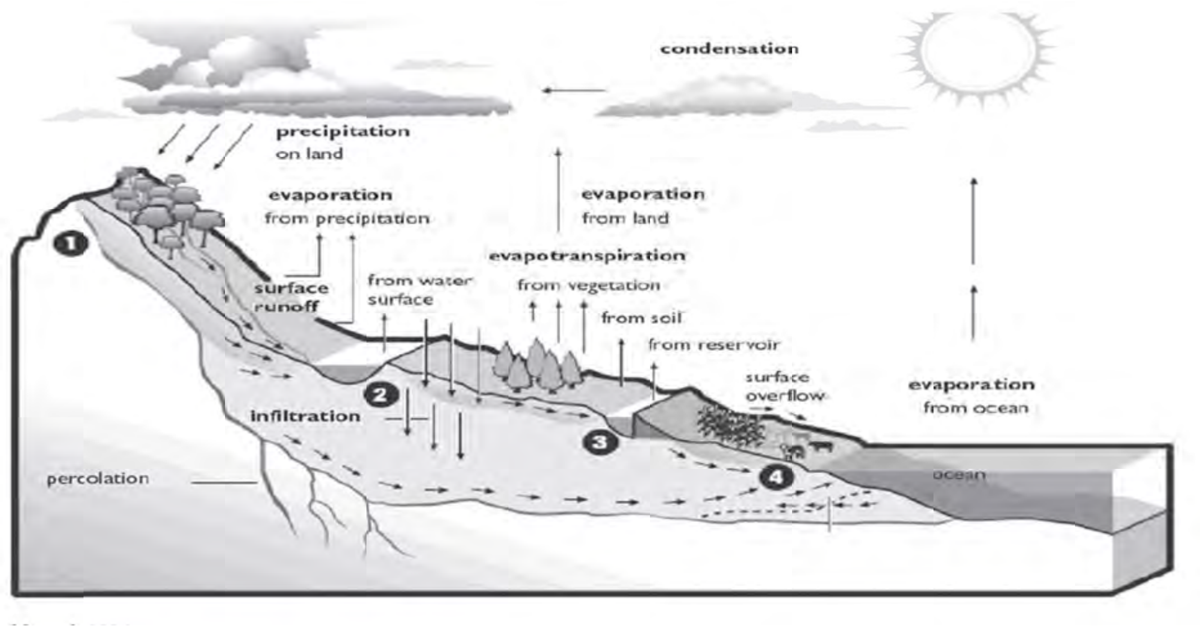


Figure 7: Graphical representation of the relationships between land and water resources. (1) forest catchments. (2) dams and reservoirs. (3) irrigation canals. (4) coastal settlements. (From World Bank, 2008)

2.1 The Role and Functions of MINAG

The main functions of MINAG are to formulate plans, to coordinate, execute, implement, supervise and evaluate the agrarian national policy. MINAG also brings technical support to local and regional governments to comply functions after decentralization. Peru went into a decentralization regime for development like many Asian and Latin American countries; municipalities were allocated functions for land and water management however there was needed a transition to build capacity to absorb these functions in the beginning. The specific functions of MINAG can be summarized as to elaborate development plans, to elaborate water resources management legal framework, to manage agrarian infrastructure, to integrate the agrarian statistical system, to comply national policy for sustainable forest resources, and to elaborate agrarian security legal framework (Legislative decree nº 997). MINAG comprises also operative functions as to sanction and to coordinate the agrarian sector defence.

The goals that MINAG have set to strengthening mechanisms on ecosystem services are: (i) assessment of value, (ii) redistribute; and (iii) preserve. Different tools have been designed to stimulate agricultural development in Peru. Elías (2010) mentioned some of the most representative financial tools as: (1)

fundsby contest: “Agroemprende”, a program that compensate for competitiveness and where users don't have to pay back the money if they accomplish the project, and (2) projects to incentive innovation and competitiveness: for the Agro Peruano (INCAGRO) funded by contest, fund for the development of strategic services (FDSE), Agrorural: Rural development. (3) funding for the creation of specialized institutions such as (i) program of sub sectorial irrigations (PSI), (ii) national institute of agriculture innovation (INIA), (iii) National service of agriculture sanitization (SENASA).

Supporting the national policy, MINAG have actively participated in legislative efforts to secure land ownership from 1993. Nevertheless the legal package set in 2008, reduced significantly the protection for communal lands, the right of land ownership and inheritances. Perhaps, most importantly the law caused more confusion and problems due to the interpretation and application of law (Pastor et al., 2010). Nevertheless, the aim of Peruvian Society to compromise with a formal commitment to preserve the environment is reflected in the constitution. As a consequence water and food production are in a way secured.

2.2 Integrated Water Resource Management (IWRM)

Solutions to water problems depend not only on water availability, but also on many other factors. Water problems have become multi-dimensional, multi-sectoral, and multi-regional and filled with multi-interests, multi-agendas, and multi-causes, so it is included in the multi-dimension of land management. Thus, it is imperative a multi-institutional and multi-stakeholder coordination to enter into the path of food security. Still there are many options that are not considered such as socio-economic-political issues that need to be accounted for an integrative dimension as an approach. There is a search for looking after a new paradigm for management, which will solve the existing and the foreseeable water and land problems all over the world.

Most quoted definition for IWRM is formulated by GWP (2000) as “a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.” It is Biswas (2004) who sets up the question whether this well-intentional and good-sounding definition has any real meaning in terms of its application and implementation to improve existing water management, or is it just an aggregation of trendy words which collectively provides an amorphous definition which does not help water planners and managers very much in terms of actual application of the concept to solve the real life problems. Biswas (2004) continues with criticisms to IWRM indicating that the comprehensive and holistic theoretical approach that many assumed to produce best results is overwhelmed by the reality. In the real world, IWRM, even in a limited sense, becomes difficult to achieve because of extensive turf wars, bureaucratic infighting, and legal regimes. In addition, the merger of such institutions produce an enormous organization that is neither easy to manage nor control (Biswas, 2004).

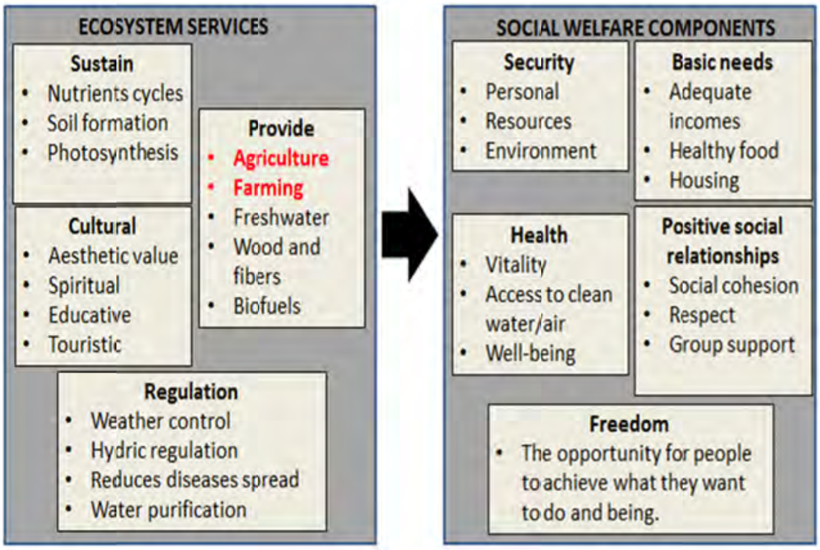
Water management must be responsive to the needs and demands of a growing diversity of central, state and municipal institutions, user groups, private sector, NGOs, and other appropriate bodies. Concentration of authorities into one or fewer institutions could increase biases, reduce transparency, and proper scrutiny of their activities. In addition, objectives like increased stakeholder participation, decentralization, and decision making at the lowest possible level are unlikely to promote integration, however it is defined, under most conditions (Biswas, 2004).

In despite of criticisms, IWRM is working. Within consensus and willingness environments, the approach of IWRM has been successful, most specially at local levels. The criticism is that most cases this cooperation or collaboration is practice only through elites to be converted in a command and control management strategy, a reductionist approach (Biswas, 2004). The IWRM approach is not the panacea. There are cases that do not work at local levels, and contrary to expected successful solution shows much more flexibility in application. It is undeniable that cooperation among actors is mandatory, there is no one group that can solve problems for others. Moreover the involvement of one group most likely will generate problems for others (Waalewijn et al., 2005). No group can represent society without consensus, because it is through consensus of different points of view where an effective, equitable, and sustainable water management occurs.

2.3 Environmental Services as a Tool for Sustainability

Ecosystem services are defined as any benefits humans derive from ecosystem goods and functions. Figure 8 enlists some of the forms that ecosystem services can take and describe their relationship with social welfare. These services are fundamental to sustain life. Our relationship with ecosystems normally it is defined in an economic context, in which the structure and production of the ecosystem are not taking into account by the ecologic value (the importance of maintain the normal cycles). Our normal consideration of ecosystem is by the economic value (opportunity cost, supply and demand).

Ecosystems services provide crops and cattle for our survival, after we have given the nature the right sustain and regulation to make crops grow.



The fundamental question to consider is the ecologic value of an ecosystem, understanding the importance of maintaining the vital cycles can have the same or greater significance society assign to services that uses. The economic consideration of an ecosystem have a sense in the context that give us an estimate of the total value of the ecosystem and what we want to recognize or pay for the services it supply. The awareness that food security for our survival depends on nature capacity could be a detonator for civil society's motivation for ecosystem services. Then, ecosystem services can have competitive outcomes if with supporting society the organization adapts to natural context, to the interaction human-nature for conservation.

2.4 Land Reform: Lessons Learned from Asian Countries

The reason for renewed emphasis on land reform is twofold: first, a populist resurgence in Latin America has set up redistributive policies such as land reform back on political agendas throughout the region; and second, analysis of the resounding economic success of East Asian countries over the past twenty years identified land reform as a major tool for restructuring feudal societies and stimulating long-term economic growth. By examining and contrasting divergent land reform movements in Asia and Latin America with an eye toward contemporary reforms, five core elements are identified to distinguish success from failure: (1) inclusive policies; (2) individual land ownership/rights; (3) clear, marketable title to land; (4) democratic redistribution mechanisms; and (5) post-distribution extension support. Meanwhile the economies of Japan, Korea, Chinese Taipei, and later, Malaysia, Indonesia, and Thailand, harnessed market forces to achieve impressive and sustained economic growth, Latin American countries, under the guidance of the Washington Consensus, stagnated and saw living standards fall. In the East Asian countries, the GDP increased substantially while poverty rates fell to single digits. Governance and human development indices increased notably, distancing these countries from the rest of Asia and Latin America. These two regions, which had been very similar in economic and social indicators in the 1960s, were now on virtually opposite ends of the development spectrum.

Asia's remarkable growth was characterized by an underlying social and economic structure that allowed all sectors to participate and collectively harness this growth. This phenomenon is called the model of collective growth, with policies which involved all sectors of society as actors in the new economy. The redistribution of wealth through land reform was one of a number of policies that incorporated large sectors of the population into the formal market economies of the East Asia countries and positively impacted in the phases towards a long-term industrialization. These new policies created a foundation that allowed rural-based economies to adapt to the needs of international markets by creating a large land-owning and asset category holding by the middle class and allowing previous landholders to make a successful transition to industrial entrepreneurs.

Land reform was a complex tool for restructuring society using both liberal redistributive policies and elements of the neoliberal emphasis on property rights and free market elements. Instead in Latin America, land reform has been a political tool used to garner popular support for candidates, parties, and movements, while largely ignoring the neoliberal and market-based elements. Latin America and East Asia have both implemented land reform with varying emphases on liberal redistribution of land and creation of land markets. The "Latin American model" placed its emphasis on redistribution of land while neglecting the rights, laws, and policies that must accompany reform in order achieve successfulness. Important characteristics from Asian reforms, such as family ownership, market-based compensation, landowner inclusion, and universal land title, were absent in LA.

Latin America has failed to achieve success despite its own attempts at land reform and economic restructuring. Analysis from Mennem (2008) reveals five major differences between the two regions' models of reform.

(1) Inclusive Policies: The political models behind the land reform programs employed in Latin America are striking. Governments then either controlled production of these large communal farms or slowly allowed the return of the previous owners. In contrast, Asian reforms incorporated the landowners they were displacing, either by involving them in the local land committees that valued and redistributed their land or through active economic restructuring from inefficient agricultural production to shareholder interests in new industries. Asian reforms were also implemented on purely economic and shared growth rationale rather than political constituency building, even though they succeeded in the latter as well. The revolutionary spirit of Latin American reforms imparted a false sense that redistribution could come at the expense of the landowners. Landowners merely found ways through their considerable resources to undercut the reforms and maintain their interests. As a result, most Latin American reforms were never completed and by no means came close to their redistribution objectives.

(2) Individual Ownership Rights: The communal ownership and collective production aspects of Latin American reforms were nowhere to be found in the successful Asian models. Instead, Asian reforms focused on individual ownership and family farm production. This emphasis on individual ownership set the foundation for the market-based economies that would drive these countries' successful economies. The possession of land on the individual level represented the most efficient and useful distribution of these assets, allowing for market redistribution without tying down land assets and collateral in cumbersome communal forms. Market-based growth in Asia has been fundamentally linked to the creation of market dynamics throughout the countryside and allowed for individuals and firms to harness capital with the flexibility required for market adaptation.

(3) Clear, Marketable Title to Land: The market-based model of Asian land reforms leads to the third important difference of the two land reform camps. The vesting of clear, unhindered title to land was a priority and occurred much more frequently in Asia than in Latin America. Clear title not only prevented previous landowners from reacquiring their land through surreptitious means, but also allowed new owners to access credit for farm improvements and created the legal requisites for healthy land markets. Title created an easy and widely accessible source of collateral throughout the fledgling Asian rural economies and stimulated the creation of large markets for land, credit, and other services. Latin American reforms, on the other hand, seemed to treat titling as an afterthought, with redistribution being the most important aspect. The current land tenure crisis in Latin America also illustrates the failures of the region's land reforms to prioritize legal recognition of property rights.

(4) Democratic Redistribution Mechanisms: One of the more interesting aspects of the successful Asian land reform model was the decentralization of land committees and the focus on mass democratic participation and local control. As part of the inclusion process, a hierarchical structure of land committees, from the village to regional level, were created under the national land reform administrative body. The local committees included both landlords and beneficiaries and were responsible for all local aspects of the reform. Regional committees reviewed decisions of the lower committees to ensure compliance with the reform and to prevent landlord cooptation. Decentralization in this form was largely lacking in the centrally-administered reforms of Latin America. As a result, local elite were excluded from the redistribution process, while also having more leeway to co-opt and undermine program benefits. Reforms were inflexibly administered from the central offices and failed to respond to local situations and needs. Beyond the actual redistribution, one of the major benefits to the democratic processes of the Asian reforms seems to have been the establishment of functioning democratic institutions on the local level institutions.

(5) Post-distribution Extension Support: An important part of land reforms is the extension of technical agricultural services to beneficiaries post-redistribution. Redistribution is not enough in itself, but must be reinforced by technical capacity building. Latin American reforms, hampered by a lack of decentralized reform institutions, lacked the ability to respond to beneficiaries' technical needs. Agricultural extension along with continuous monitoring and follow-up were important aspects of the Asian reforms, but are also largely products of the democratic and decentralized nature of these reforms. Latin American reforms were either undemocratic or never decentralized, or were decentralized without institutional support. In either case, they failed to provide the support to those beneficiaries the reforms did reach. Virtually every country in Latin America has failed to reach the level of wealth distribution required for a country to success-fully launch a liberal, market-based approach to economic development. (Mennen, 2008)

3 THOUGHTS FOR FOOD: GETTING IT TOGETHER

We ought to remember that food security is important to all of us. We depend on food and the crops depend on water. Such a simple statement is easily forgotten. In concentrating in food security, we recognize that it depends on farmers interest, and farmers interests and objective is to increase their income and assets, sustainably or not, and to reduce vulnerability for their own life well being. Water is an essential prerequisite besides land tenure. For a profitable farming, the farmer also requires access to markets and cost-effective technology. These needs set up the priorities for agricultural policy: market development and research and technology transfer. Focus on sustainability has not been mentioned and that is also a prerequisite for human being survival; thus, it is needed to add food policy.

The objective to improve farming profitability sustainably gets an alternative through "modernizing" large-scale irrigation. Large-scale irrigation (LSI) is believed to improve service at the least public cost, however changing markets and profit opportunities makes the prerequisites and follow up of LSI policy difficult to implement due to the incomplete interaction of irrigation delivery system and institutional structure. Thus, physical agronomic improvements are necessary as well as institutional change.

Traditionally, decentralization reduction of the role of national government means in Latin America the reduction of the role of national institutions and instead delegates to local governments the management and financing, and promotion of decentralization, agency accountability, and scheme financial autonomy as an interim milestone toward full scheme management transfer. It has been legalized also among the legal framework for public services, a complement to involve private sector through public-private partnerships (PPP). Priorities are a focus on the objective of farmer profitability through improved service delivery; a market-driven demand orientation; integration of physical investment, agronomic improvements, and institutional change including a reduced role for government; involvement of users throughout; efficiency improvements to reduce costs; and scheme financial and managerial autonomy.

Improving the profitability of small- and medium-scale irrigation. Water productivity on traditional and small-scale is typically low and mostly subsistence agriculture. Government support is best provided through community-driven approaches and financing mechanisms, or working through nongovernmental organizations (NGOs) as part of a broader package of rural development that ensures that rural and market infrastructure develop in step with one another. However as Asian experiences taught us, individual ownership and responsibilities are much rewarding than community owned land ownership and working areas. Therefore, in terms of achieve an efficient system, individual participatory irrigation management (PIM) and irrigation management transfer (IMT) should be systematically encouraged.
An issue that is not much taken in account for planning is to ensure more sustainable development of groundwater irrigation. Unplanned mining of groundwater has severe costs for the rural economy, particularly for the poor, and the challenge is to recover sufficient control to allow optimum economic benefits to be achieved. First best solutions rely on a rights-and-regulation framework, but in most countries this will be a very long-term solution. One alternative is to strengthen existing rights and promote self-regulation, with supporting changes to the incentive framework. In particular, governments need to eliminate or reduce energy subsidies, which drive overdrafts everywhere. As policy guidelines is not new that demand-side measures improve the efficiency of water use should be combined with supply-side measures, such as aquifer recharge enhancement, rainwater harvesting, drainage, and urban wastewater reuse to set up an agenda as nature conservancy for survival of food security.

Current institutional framework and institutional capacity

Issues	Land / agriculture organizations	Water organizations
Facts	Fragmentation of plots and dispersion. Individual planning for land tenure and even more independent on innovation.	Future limited access to water Challenges agriculture to produce more food /water It needs for modernization in irrigation
Roles	Land is quite related to water organizations. More common lately to attempt to work with urban environments.	Water users and river basin organizations: Operation and maintenance of hydraulic infrastructure, distribution of water, and administration of water fares/rates. Regional water agencies: development of plans of basin water management, control and oversee of water resources, and promote sustainable use of the water resource. Lack of clear roles for actors?
Independ-ence	Weak institutional development in agriculture sector	Heavily influenced by traditional actors
Model of engage ment	Centralization Insufficient allocation for rights over natural resources	Stakeholders recognised in formal processes but limited to water right holders
Financial capacity and auto-nomy	Limited commercialization Insufficient public investment in sierra and jungle.	Financial management at basin level is limited and also self-financing tools not fully applied Lack of stable human and financial resources for water agencies
Functions	Limited access to basic and productive	Associated

	small agrarian producer services Non associated Agrarian associations with land reform but failed Not enough information due to lack of infrastructure and communication media-difficult geography	Responsibility limitation for engagement with all functions due to lack of resources Limited advance in the allocation for water use rights. Irrigation water that are not register to pay.
Coordina-tion	Lack cross-sectorial coordination Weak institutional development in public and private agrarian sector Disarticulation of intra and inter institutional.	Lack cross-sectorial coordination
Flexibi-lity	Rigid traditional institutional framework long lead time for response (except for floods)	Lack of adaptive management in RBO Interference of government in affairs beyond irrigation
Monitor-ing and control	Inadequate agrarian services	And enforcement hardly practiced.

What are the Management Alternatives for Land and Water Systems?

There are definitely many alternatives for management but they need to be separated on issues coming from institutions and those from organization. The leverage also counts, on they are local, regional or national, since we have mentioned the differences of local level and national levels. The centralization or decentralization regimes for the new land and water system definitely will effect on policy. The usual deconcentration system or an incomplete decentralization process for management systems has had as a consequence the fragmentation of management. Then, is decentralization the solution? A combination might also be a consideration for future studies.

The relatively new alternative is the adaptive management under adaptive governance. Under these lines future studies lies on polycentric or multiple centers governance for the integrated land and water resources system management. Coordination of different units of governance as land and water are into the issues for future research. This alternative introduce us into coping and include the alternative of learning management, and evolution method that requires the flexibility and adaptation of all actors, extremely difficult but not impossible. Can learning management is the fitting alternative for Peru? On the other hand is prediction and control and command the alternative?

In both alternatives a crucial issue is left aside: cultural basis and mental models of actors, as well as the consequences for uncertainty perception. Latter, brings to the research a subjective connotation that is not least important in the decision making at all levels.

The path towards an integrated land and water systems is still to be discovered but not by all politics but through our learning and assimilating sustainability in our daily life will bring as a response at the societal level.

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Sustainable Land Management in the Philippines

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ABSTRACT: Sustainable land management begins with land degradation assessment. A more holistic approach to land degradation assessment was initiated in the Philippines with the launching of FAO-LADA Project, initially developed in drylands and the methodologies are being tested in a monsoon area. The results of the initial study are presented. More marginal areas originally under forest are now intensively used for agricultural production either under subsistence or commercial level. In many areas in Luzon, Visayas, and Mindanao, corn is being planted in areas with slope and fertility limitations because of the high demand for yellow corn by animal feed producers. Since the Philippines has already developed its best agricultural lands and further expansion areas are already marginal, productivity increases are to be attained through strategies and interventions in rain-fed areas such as promotion of small water impounding projects, development of high yielding seeds, capability building and skills development, and financing - post harvest - marketing services. Organic agriculture is the current national government thrust; for soil fertility management – promotion of composting using compost fungus enhancers, vermi-composting, and use of bio-fertilizers are part of the program. The participatory approach to sustainable land management is anchored on Soil Conservation Guided Farm. The on-going project in San Roque, San Jose del Monte City, Bulacan is shared with the APEC members our experiences on sustainable land management.

KEYWORDS: Soil Conservation Guided Farms, soil fertility management, organic agriculture, agricultural zoning , land use system map

1 INTRODUCTION

Sustainable land management (SLM) refers to a type of land management that does not damage the ecological processes and functions nor impacts negatively the environment by diminishing the bio-diversity but rather enhances natural capital – the soil, water, and air and contributes to the health and prosperity of the communities.

Since agriculture is exploitative and nutrient mining in nature, SLM is strategic component of the national agriculture program as expressed in the Philippine Development Plan 2011-2016. It addresses both processes of agricultural resource degradation and the underlying causes of unsustainability, and recommends courses of actions.

SLM is a national concern and undertaking and this paper only covers the agricultural component. The forestry, fisheries, biodiversity, and environmental sub-components of SLM are coordinated by different government agencies - the Forestry Management Bureau (FMB), the Bureau of Fisheries and Aquatic Resources (BFAR), the Parks and Wildlife Bureau (PAWB), and the Environment Management Bureau (EMB).Except for BFAR which is under the Department of Agriculture, the other bureaus are under the Department of Environment and Natural Resources. Because the Philippines is a Party to the United Nations Convention to Combat Desertification (UNCCD) with the National Action Plan (NAP) as its main implementation instrument, a member also of the World Conservation Approaches and Technologies (WOCAT), the Asia Soil Conservation Network (ASOCON), and currently undertakes land degradation assessment (LADA) under a UN Food and Agriculture Organization (FAO) technical cooperation, much of the principles, concepts, and approaches to sustainable agricultural land management are based on what these international bodies espoused. UNCCD-Philippines where the Bureau of Soils and Water Management (BSWM) is the Focal Point, coordinates the SLM-relevant activities of the other natural resource management agencies, including those of the academe for a holistic approach to NAP implementation and monitoring.

2 LAND USE AND ITS EFFECTS ON FOOD SECURITY

Within the context of UNCCD/FAO-LADA, assessment of the complexity of land degradation is based on DPSIR analysis – Driving Forces, Pressures, State, Impacts, and Responses. Land use is considered the major driving force of land degradation as it is focused on interventions on the land which directly affect status and impacts on goods and services. To characterize land use in a systematic and harmonized way, Land Use System (LUS) mapping is done to include other sets of biophysical and socio-economic information of relevance to land resources and ecosystem degradation. This provides a basis for national assessments. The land cover change is the basis for determining hot spots and bright spots.

Figure 1 presents the Land Use System Map of the Philippines and Table 1 presents the accompanying area summary. This is not yet formally released by the BSWM as the technical cooperation project with FAO/LADA is still on-going. The Land Use System Map is based on 2003 Land Cover Map by the National Mapping and Resource Information Authority (NAMRIA) which originally had 23 classes. Using ArcGIS 10, the original 23 land cover classes were categorized into "Ecosystem Based on Land Cover and Major Land Cover".Additional spatial data were inputted for processing such as the irrigated areas from the National Irrigation Administration and livestock density data computed based on the LADA Manual. Area overage per LUS was already harmonized with official area statistics for 2003.

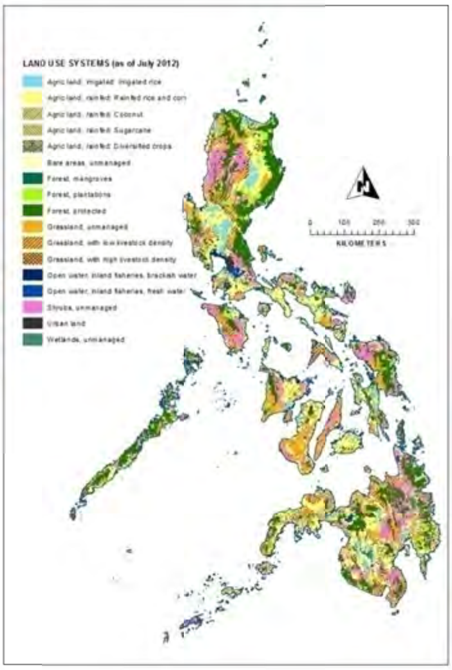

Figure 1: The Philippine Land Use System Map.
(Source: BSWM-FAO/LADA TCP, 2012 based on 2003 Philippine Land Cover Map by NAMRIA)

Table1 Philippine land use system area summary (Area summary as of August 2012)

Land Use System	Area
Agricultural land, irrigated: irrigated rice	1,272,283.18
Agricultural land, rainfed: rice and corn	6,044,257.57
Agricultural land, rainfed: cCoconut	3,562,485.22
Agricultural land, rainfed: sugarcane	374,996.77
Agricultural land, rainfed: diversified crops	24,805.69
Bare areas, unmanaged	99,783.41
Forest, mangroves	212,256.80
Forest, plantations	1,045,681.18
Forest, protected	6,286,312.17
Grasslands, unmanaged	3,164,905.32
Grasslands, with low livestock density	1,526,856.43
Grasslands, with high livestock density	144,267.83
Open water, inland fisheries, brackish water	189,596.81
Open water, inland fisheries, fresh water	261,204.52
Shrubs, unmanaged	5,009,810.86
Wetlands, unmanaged	154,405.32
Urban lands	222,584.27
Total Area	29,596,493.35

Since the 2010 Land Cover Map from NAMRIA is not yet available, to be able to conduct land use change analysis, the 2009 Global Cover (GC) map was compared against 2000 GLC for the Philippines. The GC 2009 was released by the European Space Agency (ESA) and was produced using 12 months of data from Envisat Medium Resolution Imaging Spectrometer at resolution of 300 m.

The map legend used the UN FAO Land Cover Classification System. The GLC 2000 was the output of the collaboration of a network of international partners lead by the Global Vegetation Monitoring (GBM) Unit of the Joint Research Center (JRC) using data acquired by SPOT4 Vegetation instrument covering 14 months of pre-processed daily global data. Since the two images were already pre-processed and not compatible, the results of the pixel by pixel analyses were not reasonable but overall, the exercise was useful in terms of assessing land degradation trends. It was reasonable also in the sense that most of the land use changes were along forest margins.

Figure 2 shows the results of the initial overlay for the Philippines with the red-colored mapping units representing change in land use. It can be seen that most of the forest edges have been encroached by other land uses. Table 3 is the summary of the initial results for forestry. We are still working on the analysis of the agricultural areas since we decided to segregate the upland rice and corn, coconut, sugarcane, and diversified upland crop farming systems from the original rain-fed agricultural areas.

Both Figure 2 and Table 3 actually have no segregation yet of the rain-fed areas.

Despite unreasonable pixel by pixel analysis, it is evident that from the results of the GIS generated overlay of GLC2000 with GC2009 as presented in Table 3, that the minimum of 10% conversion of forest to other land uses has been exceeded in all regions of the Philippines; in fact, most of the regions showed more than 30% of their forests were converted for agriculture and shrubs. This means that more marginal areas originally under forest are now intensively used for agricultural production either under subsistence or commercial level. In many areas in Luzon, Visayas, and Mindanao, corn is being planted in areas with slope and fertility limitations because of the high demand for yellow corn by animal feed producers.

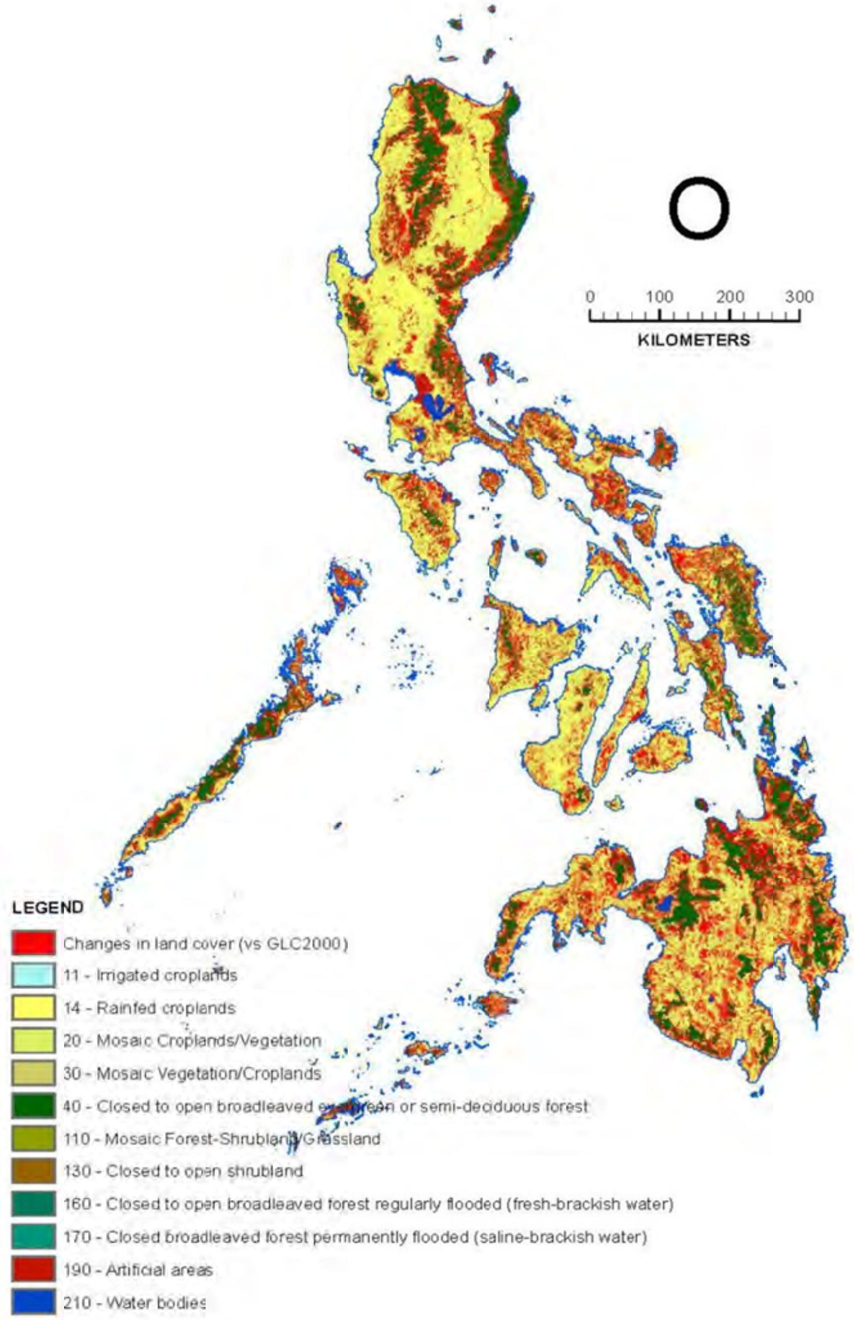

Figure 2: Results of overlay, GLC2000 vs GC2009 for the Philippines (Source: BSWM-FAO LADA TCP)

We have not totalled the forest area lost to other land uses for all the regions because this is not the true picture and the unreasonable pixel by pixel results of the study. We also have to consider the total forest gained from the reversion of other land uses back to forest from 2000 to 2009. However, based on the initial (at aggregated agricultural rain-fed areas) study, forest and shrub areas posted a net increase compared to agricultural areas. There is also conversion of forests and agricultural areas to shrubs. Some of the slash-and burn agricultural areas might have regenerated to secondary forests.

Table 2 Summary of extent of forest conversion to agriculture and other land uses per region based on comparative GLC2000 and GLC2009 study

Region	2000 forest area lost in 2009 (ha)	% change of forest cover to other LUS
ARMM	111,611.82	26.9
CAR	310.776.74	34.9
Region 1	63,437.08	37.5
Region 2	436,208.70	37.5
Region 3	209,900.13	37.9
Region 4A	169,681.29	36.6
Region 4B	322,218.71	33.0
Region 5	146,119.22	37.9
Region 6	65,719.74	37.6
Region 7	27,859.97	33.0
Region 8	270,347.77	29.3
Region 9	103,932.89	33.7
Region 10	171,324.05	31.1
Region 11	123,970.69	21.9
Region 12	93,216.79	27.4
Region 13	314,683.05	31.5

It is noticeable that as we look at the initial data for GC2009 as summarized in Table 4, there has been practically an increase in almost all LUS, including agricultural areas.

Table 3 Initial summary of GC2009 and % change compared to GLC2000

Land Use System	Area	% change
Agricultural land, irrigated: Irrigated rice	1,243,678.96	0.938
Agricultural land, rainfed	10,055,735.91	6.332
Bare areas, unmanaged	119,859	0.405
Forest, mangroves	284,878.57	0.963
Forest, plantations	189,379.01	0.640
Forest, protected	6,682,449.70	22.578
Grasslands, unmanaged	3,189,500.49	10.776
Grasslands, with low livestock density	1,607,140.31	4.024
Grasslands, with high livestock density	152,122	0.514
Open water, inland fisheries, brackish water	214,105.98	0.723
Open water, inland fisheries, fresh water	312,908.57	1.057
Shrubs, unmanaged	5,092,190.94	17.205
Wetlands, unmanaged	150,173.52	0.507
Urban lands	302,743.37	1.023
Total Area	29,596,866.57	

(Note: computations based on March 2012 LUS area coverage, the % change computations not yet final. The August 2012 LUS area update is officially released, already harmonized with official 2003 area statistics. Initial summary released for APEC conference just to show trends)

There are inherent limitations in change detection analysis as we compare the GLC2000 with GC2009; with some unrealistic changes such as from forest to water bodies and from water bodies to agricultural or forest LUS. In fact, as far as the BSWM/FAO-LADA project is concerned, this is more of exercise to comply with the project terms of reference. The reasons are as follows:

1. Errors due to different pixel resolutions: GLC2000 has about 1km x 1km while GC2009 has 300m x 300m, land cover that can still be discriminated into different classes by the 300 x 300m image would not be recognized by a 1km x 1km image. A number of examples can be illustrated by some known water bodies (lakes) that were not detected by GLC2000 but were clearly mapped by the GC2009. This would result into a detection of change from for example forest into water body or shrubs into water body or agricultural land into water body.

2. Spectral limitations of the imageries to segregate land cover classes: For example, the identification between forest and shrubs may be based on contiguity of canopies, thus shrubs that are clustered closely may be identified as forest. Thick vegetation along agricultural lands may also be identified as forest in the imagery which may only be closely clustered fruit trees on the ground. The difficulty in discriminating agricultural lands against shrub-lands and even grasslands may also be attributed to spectral limitations of the imageries.

3. Inter-seasonal variation: This is another limitation of the imageries being used, the production of GC2009 for example was mosaic from a number of multi-temporal data sets, hence cutting across different seasons. Imageries of the same area during the dry season would significantly be different during the wet season. Rice paddies for example may be identified as water bodies when waterlogged during the start of the wet season, while simply agricultural land or even grassland during the dry season. Shorelines of lakes are also affected by inter-seasonal variation, during the dry season lakes may have less water hence receding shorelines, and vice versa during the wet season. This may help explain some land cover changes that tend to show for example shrubs to water body or water body to agricultural land.

4. Inter-tidal variation: Significant differences may also be identified when imageries are taken during high tide as against low tide. Some mangroves or other vegetation may disappear during high tide while detected as forest during low tide. Coastlines may also be significantly different between high and low tides, resulting to significant land cover changes along the coasts.

Despite the spectral limitations of the satellite images, these provide baseline data with which to validate existing agricultural land use data and its implication in the national food security concerns. The total agricultural land in the Philippines is about 11 million ha. Of this figure, we have about 8 million ha for food crops and 3 million ha for non-food crops. Of the area utilized for food production, we have about 1.5 million hectares for irrigated rice and another 2 million ha for corn and rain-fed rice or total of 3.5 million ha. We have another 1 million ha interphase (planted to either rice or corn or other crops like sugarcane or root crops as dictated by market forces) or total of 4.5 million ha for food grains. The remaining 3.5 million ha are for other food crops, with coconut-based farming system most dominant at about 3 million. The remaining 3 million ha for non-food crops are not only pertaining to fibre crops and industrial starches but also to energy crops which include sugarcane and coconut. Because we still import corn to complement animal feedstock supply, present government policy does not allow the use of corn for bio-fuel production.

At 1.5 million ha for rice, or 3 million ha at two cropping seasons per year, and with population of about 104 million, per capita consumption of 267 g per day (Abdullah et al., undated), and total rice production at 17 million mt – there is indeed a great deficit and the importance of rice imports to tide over the until the next rice harvest as well as to have sufficient buffer stock. Recognizing this reality, the Department of Agriculture is now pursuing staple food rather than rice sufficiency program. Food Staples Sufficiency Program is the current administration's banner medium term program to attain food sufficiency, increase productivity and income of farmers and for them to be globally competitive (National Rice Program, 2012). While rice remains the main focus of this program, other equally healthy staples are included in the program. These include white corn, cassava, sweet potato, and cooking bananas which are eaten either solely or in combination with rice in some rural areas of the Philippines. As the eighth largest consumer of rice in the world, and the global rice market far from ideal, the production and consumption of non-rice staples as substitute for rice is being promoted and encouraged. Nevertheless, the Department of Agriculture is optimistic to harvest 22.73 million metric tons of rice by the end of 2016, raising further current statistical yield data. Since the Philippines has already developed its best agricultural lands and further expansion areas are already marginal, productivity increases are to be attained through strategies and interventions in rain-fed areas such as promotion of small water impounding projects, development of high yielding seeds, capability building and skills development, and financing - post harvest - marketing services. Organic agriculture is the current national government thrust; for soil fertility management – promotion of composting using compost fungus enhancers, vermi-composting, and use of bio-fertilizers are part of the program.

3 PROBLEM AND CONSTRAINTS ON LAND MANAGEMENT AND CROP PRODUCTION

3.1 Land Use Policy

There are three categories of lands in the Philippines (1) forest (protected areas), (2) alienable and disposable lands, and (3) privately owned lands. Of the total 30 million ha of land area, 15.88 million ha are forests and 14.12 million hectares are alienable and disposable which are generally titled and privately owned. As could be seen from Table 1, based on 2003 Philippine Land Use System Map which was extracted from 2003 NAMRIA Land Cover Map, the total for the forest protected and forest plantation is barely 7.39 million. Since forests have been defined as lands with slope higher than 18 percent, a look at the BSWM Slope Map shows the following:

Table 4 Area summary of slope map (Source: BSWM spatial data holding)

Slope (%)	Description	Area (ha)
0-3	Level to nearly level	6,638,097.92
3-8	Gently sloping to undulating	2,334,443.70
8-18	Undulating to rolling	4,834,515.09
18-30	Rolling to moderately steep	4,743,427.19
30-50	Steep	4,665,094.65
>50	Very steep	5,773,911.09
	Rivers	466,704.69
Total		29,456,194.33

The total for the lands above 18 percent is 15,182,432.93 ha which is very close to the official estimates of forest at 15.88 million which are supposed to be non-alienable and non-disposable. The Philippines'forest cover was 21 million ha in 1900 and down to 7 million ha by 2003.

Logging was initially responsible for forest denudation. But not all logged primary forests become secondary forest. Soils classified as Ultisols, or low fertility acid soils, become grasslands, unable to regenerate forest again. Logging opens up the area initially to shifting cultivation. It was a long period of forest-fallow type of subsistence farming. Intensive cultivation follows later as population pressure drives migration to these ecologically fragile areas. Agricultural intrusions have been made on our forests, and that slopes higher than 18 degrees are being intensively cultivated at commercial level of production. Resource degradation follows.

At the lowlands, we also have issues of agrarian reform lands being converted to non-agricultural uses. The current political economy that establishes social preferences on land use results in the absence of a clear and consistent land use policy (Llanto and Ballesteros, 2003). The sectors that demand land for housing, business, and other non-agricultural uses are being favored and various laws have been enacted for the reclassification of lands into other uses. We have for instance Presidential Decree 399 which reserves strip lands along highways for human settlements and other non-agricultural uses. Republic Act (RA) 7279 defines urban lands and potential urban lands and reserves them for urban development and social housing purposes. RA 7916 identifies areas reserved for economic zone development and prescribes the manner of identifying such areas. RA 7160 also known as the Local Government Code provides the mechanism for apportioning agricultural lands at the local government level. RA 7357 and 7668 reserves certain lands for tourism development. RA 8370 or the Indigenous Peoples' Rights Act recognizes ancestral domains on lands or pre-conquest ownership of protected lands by tribal or cultural communities. RA 7942 also known as the Mining Act provides that all natural resources particularly minerals are owned by the State. There is a need to review these laws for a consistent and socially acceptable land policy framework that supports the requirements for sustainable economic growth, equity, and poverty alleviation.

3.2 Agricultural Zoning

RA 8435 or the Agriculture and Fisheries Modernization Act (AFMA) identifies a Network of Protected Areas for Agriculture and Agro-Industrial Development (NPAAAD). Within this network of agricultural protected areas is the Strategic Agriculture and Fisheries Development Zones (SAFDZ) or the best of the prime agricultural lands. These are not only highly suitable for the production of agricultural crops but these are strategic in the sense that adjacent are post-harvest and agro-processing facilities, markets, good roads, piers and airports, urban and commercial centres. Zoning power is vested upon the local government and BSWM only provides the technical assistance in the delineation. The law provides that SAFDZ has to be integrated with the comprehensive land use plan of the local government. With local government elections being held every three years, a change of local government could mean non-continuity of previous programs or change in priority or both.

In theory, SAFDZ's are delineated but in practice, the implementation is left much to the hands of the local government units whose resources are already spread too thinly for the sub-zones (crops, livestockand fisheries) to be prioritized in development.As the criteria for delineation was national or too broad in scope, and considering the wide variation of conditions among local government units, the reason for delineating the SAFDZ was lost in the process, and the delineated SAFDZ's were considered of little consequence. For instance, the Strategic Crop Development Sub-zone encompassed all existing cropped areas and could include marginalized grasslands. The basic concept of SAFDZ serving as the centre for agriculture and fisheries development could not be implemented; and putting into operation an integrated development plan consisting of production, processing, investment, marketing, and human resources development could not be achieved.

In the review and evaluation of the implementation of the AFMA, one main conclusion is that the SAFDZ component was not implemented. The stipulations and the implementing rules and regulations are beyond the capability of the concerned institutions and individuals to accomplish within the specified time frame. In amending this law, there is a need to clarify the budget, objectives, and targets, as well as institutional arrangements. The root cause of the non-compliance with the SAFDZ concept was concluded to be the flawed process of delineating the SAFDZ. In fact, most local governments, thinking that development funds would come in corresponding to the size of their SAFDZ's, delineated almost the whole of their NPAAAD as SAFDZ. The remaining NPAAAD was almost very small and nil. This explained why some local governments included marginalized grasslands in their SAFDZ when it is supposed to be the best of the prime agricultural lands

3.3 Soil Quality - Soil Fertility Decline

Agricultural intensification through excessive use of fertilizers and pesticides lead to polluted waters and degraded soils. The indicators are declining soil organic matter, soil acidity, micronutrient deficiency, and general nutrient imbalance.

Since the Green Revolution of the mid-1960s characterized by government investments in irrigation systems and modernization of agriculture through the use of high yielding varieties, inorganic fertilizers, chemical pesticides, and other synthetic chemical inputs like the use of antibiotics and growth hormones in the livestock sector, the Philippine agriculture has become predominantly conventional by the 1980s. The general trend based on soil analysis covering the period 1970s to 1990s indicated very active soil mining resulting in increased fertilizer inputs to sustain farm productivity. The period 1960-1970 is characterized by the need to use nitrogen fertilizers only. The succeeding decade of 1970-1980 requires higher phosphorus fertilizer inputs in addition to nitrogen to maintain yield. The years 1980-1990 requires not only nitrogen and phosphorus fertilizers but also increased potassium plus micronutrients such as zinc for rice and magnesium for corn. The excessive use of urea fertilizers beyond the normal ratio of 3N:1P contributed to the stagnation of rice and corn yields and nutrient imbalance in the soil.

Table 5 The yearly trend and ratio of N, P, and K utilization (tons/year)(Source BSWM)

Year	N	P	K	Ratio (N/P)
1980	224,866	53,784	55,782	4.18
1981	209,875	51,163	60,620	4.10
1982	232,840	56,139	57,435	4.10
1983	244,179	54,784	64,496	4.46
1984	180,569	45,372	38,617	3.99
1985	205,364	42,822	35,060	4.80
1986	298,323	42,771	46,267	6.97
1987	371,925	63,340	48,661	5.87
1988	372,118	77,471	54,934	4.80
1989	375,940	84,101	77,260	4.47
1990	394,767	46,188	68,512	8.55
1991	292,483	30,397	54,197	9.62
1992	331,537	36,025	61,628	9.20
1993	395,183	42,473	93,331	9.30
1994	396,751	46,920	38,944	8.46
1995	389,295	56,817	59,098	6.85
1996	462,776	65,055	90,346	7.11
1997	541,112	65,253	93,331	8.29
1998	408,778	53,299	81,740	7.67

By 2005, there has been a major shift in government policies owing to accelerated increases in the prices of farm inputs beyond the reach of ordinary farmers and a host of other issues like land degradation, climate change and biodiversity decline. Executive Order 481 was issued by President Gloria Macapagal Arroyo in December 27, 2005 to promote and develop organic agriculture as a farming scheme and to regulate the organic certification procedures. In 2010, the Philippine legislature enacted RA 10068 also known as the Organic Agriculture Act. This is a significant milestone in the Philippine agricultural production policy as we refocus on our natural resources than on our external resources with which to establish our agricultural production systems. The national government recognizes that farming methods which neglect the ecology of the soil, crops, and nature damage the farming environment and inimical to our national interest.

3.4 Soil Quality - Soil Losses through Erosion

Hilly land and mountain agriculture contribute to soil loss. The estimated soil loss for land uses and slopes in tons per year is as follows:

Table 6 Estimated soil loss for land uses and slopes (tons/year) (Source: Coxhead and Shively, 1998)

Land Use	Slope category (%)		
	18-30	**>30**	**Total**
Rice	15,750,000	5,250,000	21,000,000
Corn with fallow	217,250,000	240,190,000	457,340,000
Other agriculture	14,800,000	4,812,500	19,612,000
Non-agriculture (forest)	-	-	7,900,000
All uses	-	-	505,852,500

4 PARTICIPATORY APPROACHES ON SUSTAINABLE LAND MANAGEMENT

As per FAO brochure (undated), sustainable land management (SLM) is crucial to minimizing land degradation, rehabilitating degraded areas, and ensuring the optimal use of land resources for the benefit of the present and future generations. SLM is based on four common principles:

- Land use driven and participatory approaches.
- Integrated use of natural resources at ecosystem and farming system levels.
- Multi-level and multi-stakeholder involvement.
- Targeted policy and institutional support, including development of incentive mechanisms for SLM adoption and income generation at the local level.

Muchena and Bliek (1997) discussed that land use planning aims to improve sustainable use and management of resources and this implies that those who use and manage the resources are the key players in the planning process. It is thus important that all the stakeholders are involved and the participatory approach to land use planning is introduced and developed. SLM, improved technologies, and improved economic performance are central to the goals of sustainable agriculture.

Muchena and Bliek (1997) further discussed that in the natural resource planning, resource inventories provided basic information but are often not understood by the local non-technical staff who are not familiar with the resource classification. The need for more participatory approach to land use planning is premised on the fact that the land users will be the final decision makers and implementers of land sue changes. There is a need to consider different spatial and temporal dimensions while analyzing resource issues and searching for solutions. The individual user needs cannot be considered in isolation, especially in more fragile areas, or with types of resource uses that have impacts on larger areas.

Intensification of land use, hand-in-hand with sustainable resource management increases agro-ecosystem efficiency and reduces the pressure on rapid land degradation processes. Efforts on participatory approaches are geared towards preserving and enhancing the productive capabilities of the land in the cropped areas; and implement actions to minimize if not reverse land degradation. de Campos Guimaraes (2009), quoting Cohen and Uphof, stressed participation as a process of empowerment of the deprived and the excluded, in this case, the hilly land and mountain land migrants consisting basically of landless subsistence farmers whose unsustainable farming practices exacerbate their marginal economic conditions.He further quoted OECD that participation is built upon dialogue among the various actors during which the agenda is jointly set, rather than having an externally set project agenda dominating. de Campos Guimaraes (2009) described the ladder of participation typology to range from passive participation to functional participation to interactive participation, and to self-mobilization at the highest level. This means that in a participatory approach to SLM, the extension worker aims to empower the stakeholders to take decisions independently of external institutions. This is quite a long process that starts from dependency to "liberation" stage and attained through recognition by the farmers themselves that they are part of the solution.

5 BEST PRACTICES OF LAND MANAGEMENT/CASE STUDIES

BSWM promotes the Soil Conservation Guided Farm for upland farming system. With the Local Government Code vesting agricultural extension function to the Local Government Units, the Guided Farms are collaborated with the local government who usually provide the funding requirements in terms of the required inputs while BSWM provides the technical expertise.

5.1 The Project

The San Roque Soil Conservation Guided Farm was established in 2008 by the Soil Conservation Division, BSWM in San Jose Del Monte City, Bulacan Province. The area stood in what was once a logged over area on the foot slopes of the Sierra Madre mountain range. But because the soil is classified as low fertility acid soil, it could not regenerate into secondary forest and the area remained grassland with continuing human intrusions. It was reported during rapid rural appraisal of the area that insurgents used to hide into these once-forested areas even as late as the 1970's. But by the time BSWM started the Soil Conservation Guided Farm in 2008, a community was already established, and the grasslands that emerged from the logged-over area was already privately titled and tenanted. It would not be surprising that the farmer-beneficiaries were former insurgents themselves who returned to the fold of the law. This is an advantage to the project because SLM requires value formation and we have farmer cooperators who are not at dependency stage but are fast moving towards self-mobilization stage.

Population increase as well as the basic need to satisfy their economic well-being pushed marginal and subsistence farmers to cultivate the fragile ecosystem. Nutrient mining and erosion due to cultivation of slopes greater than 18 percent contribute to the pressures on the productive capacity of the land already hindered by being inherently a low fertility acid soil. Loss of biodiversity, observed crop yield decline, disturbances in the water cycle with increasing length of seasonal aridity or dry period were among the impacts observed. Interestingly, community response recognized the need to be trained on natural resource conservation and management and the farmer leaders themselves initiated contact with BSWM to avail of technical assistance in the establishment of Soil Conservation Guided Farms. Initially started with three farmer cooperators, the program now involves about two-thirds of the farmers in the community, and their number is still growing.

5.2 The Project Components

5.2.1 Participatory Rural Appraisal (PRA): PRA is the process of understanding people, their resources, their socio-economic conditions, and a process of exploring their problems, their aspirations and potentials,and the PRA is considered an integral part of the Soil Conservation Guided Farms development framework. Crucial is not only the availability of the information to the upland farmers but we have to develop their ability to analyze this information and act accordingly. Usually, a final output is for farmers to map their current farm land use so that they will be able to contrast with their final land use plan.

5.2.2 Topographic Mapping: Since existing topographic maps are available from our national mapping agency at 1:50,000 scale, the Soil Conservation Staff complemented a more detailed farm topographic map with field topographic survey conducted at map scale of 1:20,000. This provides a base map with which to indicate current land use and with which to put into a map plan the envisioned Soil Conservation Guided Farm.

5.2.3 Land Use Planning and Capacity Building: Two forms of institutional building are vital to capacitate the farmers on soil conservation and management practices: (1) farmer groups for knowledge sharing; and (2) a consortium/council of stake holders for decision making. This means also involving the extension staff of the City Agriculturist Office and the *barangay* officials where the farming community belongs. The *barangay* is the lowest political unit and consists of several *sitios*. This is easier said than done as it involves community immersion for the BSWM Soil Conservation staff handling the project. The fundamental soil conservation extension philosophy is that we could not come to a community educating them on the solutions to their problems when they do not know that they have a problem in the first place. Community immersion involves eating with the farmers, drinking with the farmers, sleeping with the farmers, talking with the farmers on their agricultural production concerns and issues. Soil conservation extension work involves huge investment in time with the farmers since we are working with value formation and behavioral change, not just technical and social issues relating to land degradation and SLM. When the farmer recognizes his problem concerning productivity decline and that he is part of the solution by changing his ways through SLM practices, can soil conservation efforts can move forward to its desired goal.

5.2.4 Soil Fertility Management and Erosion Control: A major part of farm-level land use planning is development of fertility enriching as well as soil conservation practices. Generally, a mix of organic fertilization, crop rotation and diversification, terracing and strip cropping, mulching, zero or minimum tillage, etc., are incorporated into the BSWM-guided farm plan. The crop choices are dependent on land suitability, farmer's choices and familiarity, market demand, climatic risks and vulnerabilities, etc. The Local Government Unit provides the seeds and seedlings and other forms of material assistance. Each farm plan is unique except for the soil conservation technologies and SLM principles espoused.

5.2.5 Water Resources Management: Eventually, as the number of farmers practicing SLM grew, they became more organized and coherent to initiate solutions to the land degradation issues they faced. Recognizing climate change and prolonged dry season, the farmers themselves initiated to negotiate with the local government unit and with BSWM for water resources development in the area. Thus, they were able to put up a solar-powered small water impounding project and a hydraulic ram pump irrigation system with funding and technical assistance from the said government agencies. A hydraulic ram pump uses the energy of a small stream falling into a small height to lift a small amount of that water, usually about 20 percent of the water that flows, to a much greater height.

5.3 Challenges and Key to Success

(1) Local community participation in all aspects of the program; and in-fact, the infrastructure components were locally initiated based on their felt needs.

(2) Local government unit support in the soil and water conservation.

(3) Capacity building by BSWM on land use planning and principles of soil conservation.

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Land Resource Utilization in the Philippines: A Paradigm Shift Towards Food Security

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ABSTRACT: Land use planning is the practice of accounting and allocation of land resources in order to meet national requirement for food, feed, energy including sites for the needed infrastructure of the community as well as additional space to accommodate wildlife habitat. Critical to the planning process is the evaluation of land resource potential towards sustainable land utilization. With identified major soil constraints to food production for instance water availability, low CEC, aluminium toxicity, vertic properties, high P fixation, shallowness and erosion risk Philippines has barely 9.323 M hectares of arable land with a potential of supporting the grain requirements of a population of 22.909 M, 41.559 M and 76.295 M under low, medium, and high technology input levels, respectively. The estimate does not even take into account the negative impact of climate change, extent of land degradation due to mismanagement and neglect which can exacerbate the productivity of available arable lands for particular agricultural crops.

Government planners in the Philippines saw the need to re-examine its existing policies and programs purposely designed to raise agricultural productivity as the national measure to address food security. Farming in the Philippines is now generally undertaken on small farms, owned and managed by single families ranging from subsistence to commercial production. Real growth of agriculture in the Philippines of 1% from 1980-1990 lagged behind the world average and middle-income countries with average of 2.8% and 3.5%, respectively.

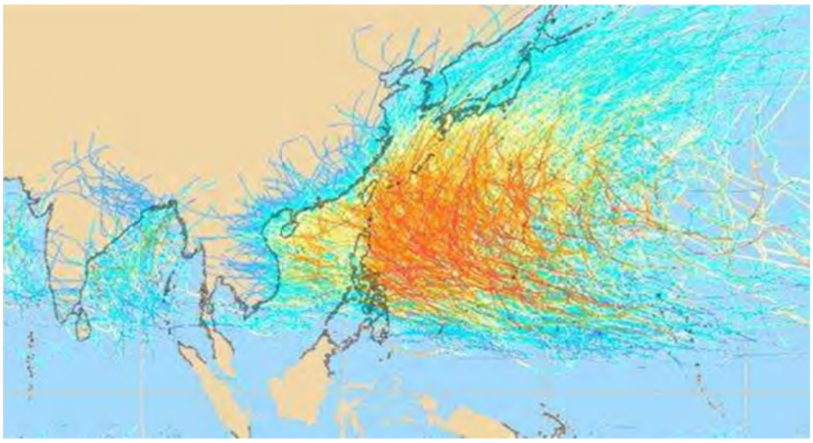
In a globalized system according to Chantalakhana and Falvey (2010), where rich and poor are assumed to have free and equal access to the use of available resources to enhance their wealth, generally the rich group including multi-national corporations have the advantage in such a competitive world. On the other hand the poor especially marginalized farmers become poorer.

KEYWORDS: arable land, food security, problem soils, natural calamities, land degradation, land use, agrarian reform

1 INTRODUCTION

At the onset of the second millennium, it has been reported that the estimated arable land of the Philippines can no longer support the food requirements of the more than 80 M Filipinos (Beinroth et al., 2001). The problem of limited available arable land for food production is exacerbated by the high vulnerability of the major islands of the Philippines to natural calamities especially typhoon and drought occurrences (Figure 1). At the shadow of the problem of limited arable land, the Philippine Government has signed the World Food Summit in 1996 and indicated its commitment to keep Filipino people food secure and free from hunger.

Figure 1 Typhoon tracks in the Asia-Pacific Region



Source: ttp://en.wikipedia.org/wiki/File:Tropical_cyclones_1945_2006_wikicolor.png

Ironically, given the current state of the Philippine economy, agricultural and rural development is being relied upon as the major key factor towards achieving sustainable food security in the Philippines. It is therefore imperative that the government needs to put up policies and programs that can help alleviate predicament of insufficiency of food supply by way of raising farm productivity or through other means to insure that every Filipino will be food secure. It may no longer be safe to say however, that opening new areas for crop production would solve the problem of food security.

The performance of agriculture in the Philippines has continued to lag behind its neighboring countries in Asia. Dismal performance of Philippine agriculture already recognized the problem of limited productive land resources, exacerbated by the long period of mismanagement and neglect (Table 1). Assessment of Philippine land resources is no longer encouraging considering their high vulnerability to land degradation and related constraints to intensive arable use (Table 2). The vast forest of the Philippines has already dwindled to its lowest level, affecting wildlife habitat, as well as significantly limiting the forest watershed function (Figure 2). The Swedish Space Corporation has shown that as of 1987, Philippine has only 7.1 M hectares of forest land and with 21.9 M hectares of cultivated land (Table 3) (SOLNA, Sweden, 1988). The miscellaneous areas (eroded areas, quarries, riverbeds, built-up areas, marshy area, lakes) cover 0.5 M hectares, for a total classified areas of 29,537,500 hectares with unclassified area amounting to only 462,500 hectares.

It was estimated that in 1930, 60% of the Philippines was still covered by primary forest. Between 1969 and 1988, an average of 2,000 square kilometers is logged annually. Today, only 6 - 8 % of the original primary forest remains (Philippines Environmental Profile, 2005).

Table 1. Land degradation: severity of human-induced degradation in selected countries of Asia and Pacific.

Economy	Total area '000 km2	Land degradation					
		Severe		Very severe		Cause	Type
		'000 km2	%	'000 km2	%		
Bangladesh	138	39	27	0	0	A,D	C,W
China	9,369	2,347	25	948	10	D,A	W,N
India	3,062	1,352	43	494	16	D,A	W,C
Indonesia	1,898	607	32	108	6	D,A	W,C
Japan	373	0	0	0	0	A	W
Myanmar	668	237	35	6	1	D,A	W,C
Philippines	295	227	3	10	3	D	W
Thailand	516	144	28	258	50	D,A	W,C
Viet Nam	330	97	29	162	49	D,A	W,C

Derived from: FAO Statistics Asia and Pacific Legend: Cause: A-agriculture; O – overgrazing; D – deforestation; I – industrialization; V – over exploitation of vegetation; Type: W – water erosion; N – wind erosion; C – chemical deterioration; P – physical deterioration

Table 2. Major Soils of the Philippines

SOIL ORDER	AREA (HA)	% TOTAL	SUBORDERS AND COMMON INTERNATIONAL NAMES
ENTISOL	740,013	2.47	Aquents, Arents, Fluvents, Orthents, Psamments, Aquepts, Tropepts (Cambic Arenosols, Eutric Fluvisols, Eutric Regosols, Thionic Fluvisols, Dystric Cambisols, Eutric Cambisols, Eutric Gleysols, Gleyic Cambisols, Vertic Cambisols)
INCEPTISOL	4,114,591	13.72	
ALFISOL	2,963,085	9.88	Udalfs, Ustalfs, Humults, Udults, Ustults, Ustox, Udox (Dystric Nitosols, Eutric Nitosols, Humic Acrisols, Humic Luvisols, Orthic Acrisols, Orthic Luvisols, Vertic Luvisols
ULTISOL	12,432,352	41.47	
OXISOL	78,470	0.26	
MT. SOILS	8,570,069	28.58	
OTHERS	1,084,079	3.62	Udands, Fibrist, Aquolls, Rendolls, Udolls, Ustolls, Uderts, Usterts (Haplic Kastanozems, Haplic Phaeozems, Ochric Andosols)
TOTAL	29,982,659	100	

Source: Badayos,R.B. 1997

Figure 2. Philippine forest cover in hectares (ha) over time (Source: R. K. Suarez, P. E. Sajise 2010)

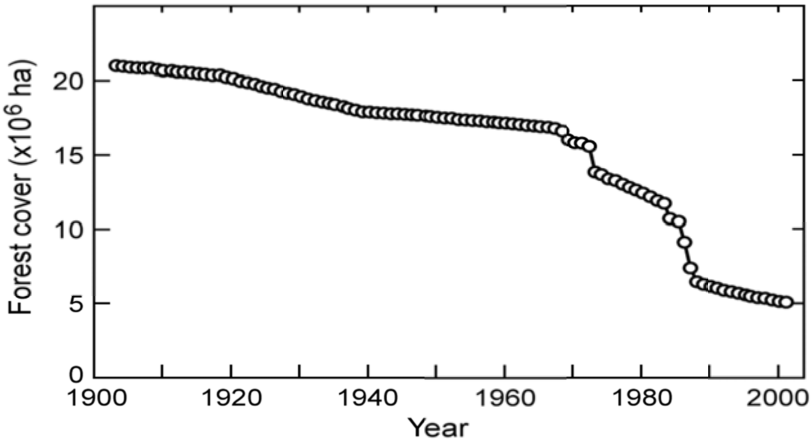


Table 3. Land uses in the Philippines, by category, area in thousand hectares, 1987

CATEGORY	AREA ('000 ha.)
FOREST LAND EXTENSIVELY CULTIVATED LAND INTENSIVELY CULTIVATED LAND OTHER LAND USES	7,104.20 11,957.60 9,934.00 541.70
TOTAL CLASSIFIED LAND AREA	29,537.50
UNCLASSIFIED LAND AREA	462.50

Source: Swedish Space Corporation. Mapping of the Natural Conditions of the Philippines (SOLNA,Sweden: 1988) in Cabrido and Samar (1994).

Philippines is known for its rich and diverse natural resources. However, these resources are being rapidly depleted due to a variety of reasons: i) high population pressure with the majority of the poor deriving their income from natural ecosystems; ii) advancing industrialization/ conflicts of interest between long term environmental concerns and short term profit motives in particular regarding logging and mining; and iii) absence of political will (and therefore of allocation of resources) to enforce effective implementation of a relatively comprehensive legal and regulatory regime; and ii)lack of clearly defined mandates and responsibilities among the various layers of central and local authorities (Philippines Environmental Profile, 2005).

2 LAND RESOURCE UTILIZATION IN THE PHILIPPINES

The Statistical Yearbook of 2006 indicated that given an annual per capita poverty threshold of PhP15, 057 or US $342 (exchange rate of US $1 = PhP 44), 4.7 million Filipinos belong to poor families. It was estimated also that 35% of the national population earn less than US$2.00 a day.

With reference to the 6.6 T pesos gross domestic product (GDP) of the Philippines in 2007, it was reported that agriculture contribute 14% of the GDP for 2007 with rice and corn as the main drivers for agriculture (Table 4). The industry sector accounted for 31% of the Philippines' GDP for 2007, with mining and quarrying posted the biggest growth in the industry sector with 43.2% from the previous year contributing to around PhP108 M pesos at current prices. The manufacturing sector contributes to around 70% to the industry sector. Meanwhile the service sector contributed 54% to GDP in 2007. Of the Service Sector, Agriculture-related services will be most affected by climate change. Occurrence of typhoons and flooding, a yearly natural disaster event affecting the Philippines will impact heavily the volume of products in the low lying prime agriculture areas devoted intensively for rice and corn thus affecting considerably the business activities of this sector.

Table 4. 2007 Philippine GDP (in million pesos).

Industry	2007(at current prices)	% of GDP	2007 (at constant prices)	% of GDP
Agriculture, Fishery and Forestry	936,415	14%	251,272	18%
Industry Sector	2,107,287	31%	445,486	33%
Service Sector	3,604,542	54%	671,883	49%
GDP	6,648,245		1,368,641	

(Source: National Statistical Coordination Board (NSCB) as of May 2008)

Philippines have an estimated arable land area of only 9.323 M hectares out of the total land area of 29.817 M hectares (Table 5). Based on the potential productivity and quality of available arable land, by 2025, Philippines will only have an estimated population-carrying capacity of: 22.909 M, 41.559 M and 76.295 M under low, low, medium, and high technology input levels, respectively (Beinroth et al., 2001).

Table 5 . Actual and potential available arable land

Economy	Total area	Potential arable land	Equiv. Potential arable land	Equiv. Potential arable land as % of total land	Actual arable land 1994	% of potential arable land actually in use	Total populatio n in 1994	Agric population in 1994
	'000 km2	'000 ha	'000 ha	%	'000 ha	%	'000	'000
Bangladesh	138	9,401	7,388	53	9,694	103.1	114,980	73,310
China	9,369	201,649	137,626	15	95,782	47.5	1,208,842	863,988
India	3,062	206,327	168,961	55	169,650	82.2	918,570	534,549
Indonesia	1,898	71,233	49,481	26	30,171	42.4	194,615	96,331
Japan	373	12,861	8,277	22	37,178	289.1	124,960	6,961
Myanmar	668	24,487	16,919	25	10,076	41.1	45,555	32,949
Philippines	295	9,342	6,716	23	9,190	98.4	66,188	28,221
Thailand	516	32,198	23,435	45	20,800	64.6	58,183	32,901
Viet Nam	330	11,594	7,817	23	6,985	60.2	72,931	50,828

Derived from: FAO Statistics Asia and Pacific

A. National Issues and Concerns

1.Politics of Land Use Regulations
In the Philippines, efforts on sound land use have been undertaken by the government since the 70s. Various laws have been passed such as The Forestry Reform Code (1975), Comprehensive Agrarian Reform Law (1988), Indigenous Peoples Rights Act (1997) and the Agriculture and Fisheries Modernization Act (1997) to ensure that land is utilized properly (Guiang, 2004). However, the multi-stakeholder nature of land utilization and the lack of a comprehensive land use policy framework have resulted in the following problems: i) confusion due to inconsistent laws on land utilization; ii) continued negative environmental effect on land; and iii) unabated conflicts among different sectors due to competing land use.

2. Agrarian Issues/Conversion of Agricultural Lands
The Philippines has long been known for its high inequality in distribution of wealth and income; unlike many of its Asian neighbors characterized by relatively less inequality by international standards, the Philippine economy has often been compared to Latin American countries which are characterized by high inequality in land distribution. Partly due to its historically high inequality there has long been intermittent incidence of peasant unrest and rural insurgencies in the Philippines. As a result, the issue of land reform (or 'agrarian reform' as more commonly called in the Philippines, of which land reform constitutes the major part) has continuously been on political agenda at least since the early part of the 20th century; nevertheless land reform in the Philippines has been, and still is, an unfinished business.

According to Lanfer (2006) many aspects of the Philippine socio-economic structure and politics have their roots in the Spanish and American colonial periods. Such historical background helps understand how long-standing and deeply rooted the today's political dynamics are and at the same time would warn us against easy optimism for the prospects for rapid and sweeping land reform and against an idea of transplanting other countries' policy prescriptions without enough consideration of historical contexts within the respective societies (Lanfer, 2006) . He cited that the major legacies of the Philippine colonial history include: i) the patterns of highly concentrated land ownership throughout the archipelago; ii) the patterns of paternalistic (patron-client based) tenancy in some parts of the Philippines (such as in the coastal Luzon), of haciendas which dominate other parts (such as the inner Central Luzon), and of plantations on the island of Negros and others; iii) the dominance of landowning families in both local and national politics; iv) the prominence, in particular, of a small number of land-owning families (landed oligarchy) in both economic and political spheres; v)(arguably) a relatively fragmented society with weak state apparatus (which is not capable, for example, of administrating substantial land redistribution policy) and with weak collective action capacities among the peasantry; and vi) the dubious legitimacy of the system of private property rights on land in the views among the rural poor.

3. Fragmentation of Agricultural Lands
There are two major economic issues involved in the Philippine land reform: one has to do with the conversion of share tenancy into fixed-rent leasehold, and the other is about the economic rationale for land redistribution in terms of improving the efficiency of agricultural production.

Various potential sources of economies of scale in agricultural production were cited and included the following: i) lumpy inputs, such as machinery, farm animals and 'management skills'; ii) processing and marketing; iii) credit access and risk diffusion; and iv) occupational choice among farmers. In plantation crops, such as sugarcane, banana, oil palm and tea, economies of scale seem to arise in processing or marketing stage. Sugarcane for example, needs to be crushed within a short period of time after harvest and such processing of sugarcane is a heavily capital intensive operation with strong scale economies. Bananas need to be placed into a cold boat within 24 hours after harvest, posing a major challenge of careful coordination, including coordination of harvest timing, arrangement of boats arriving timely and ensuring transportation between harvest point and shipment, which is very difficult to do for a large number of independent small farmers.

Finally, the process of occupational choice among farmers could also lead to a tendency of larger farms being more productive than smaller farms. That is, more productive/talented/ technologically-savvy farmers would want to work with more land than would less productive farmers (Banerjee 1999). Thus larger farms may tend to be cultivated by more productive farmers.

4. Changing Livelihoods and Survival Strategies

Poverty remains a serious problem in the Philippines, which is the only populous economy in East Asia in which the absolute number of people living on less than US $1 a day remained constant over the 1981-1995 period according to figures compiled by the World Bank.

Economic policies from the 1960s to 1980s focused on a capital-intensive, import-substituting strategy, which bred inefficient industries and contributed to the neglect of the agricultural sector. Policies promoting industrialization favored the development of urban areas to the detriment of rural areas, most of which remained underdeveloped. Starting in the mid-1980s, policies adopted by the government moved toward a more open, market-friendly economy.

Among the poorest Filipinos, most of the family income is derived from entrepreneurial activities such as selling food on street corners or collecting recyclable materials to sell at the junkyards. Those belonging to the higher income strata obtain a bigger share of their incomes from wages and salaries. Most of the poor are lowland landless agricultural workers, lowland small farm owners and cultivators, industrial wage laborers, hawkers, micro-entrepreneurs, and scavengers. Most poor Filipinos live in rural areas, where they are subject to the low productivity of agricultural employment. Urban poverty is caused by low household incomes and the internal migration of poor rural families to urban areas. Overseas employment represents an important outlet for excess labor, and is a major source of income for Philippine households.

5. Agro-industrial Production and Territorial Restructuring

The unpredicted energy condition of the world has forced the Philippines to look at biofuel as an alternative energy source in solving the Philippines' fuel instability. The enactment of Republic Act 9367, otherwise known as the Biofuels Act of 2006, mandates the use of biofuel as a measure to ensure availability of alternative and renewable clean energy without any detriment to the natural ecosystem, biodiversity and food reserves of the Philippines. The law mandates that all liquid fuels for motors and engines sold in the Philippines shall contain locally-sourced biofuel components to reduce dependence on imported fuels with due regard to the protection of public health, the environment, and natural ecosystems consistent with the Philippines' sustainable economic growth that would expand opportunities for livelihood.

To meet the future energy demand, the government is aggressively pushing for the cultivation of first and second generation energy crops. The policy makers and the general citizenry, however, have raised the issue that biofuel crops if grown in large-scale may pose a threat to food security, land, forest and biodiversity. This was in anticipation that areas to be devoted for biofuel feedstock production may expand into traditional food production areas.

In consideration with the food security program of the government at the same time responding the call of the national government to engage in biofuel, first it is necessary to reserve the prime agricultural areas for the production of food and feed crops, and second to limit the production of biofuel feedstock in marginal lands.

The Food and Agriculture Organization (FAO) of the United Nations called on the Philippine government to review biofuel policies to ensure food security. "The emergence of biofuels as a new and significant source of demand for some agricultural commodities contributes to higher prices for agricultural commodities in general," the FAO warned in its annual report entitled, "The State of Food and Agriculture." "Higher food prices could threaten the food security of the world's poorest people, many of whom spend more than half of their household incomes on food."

For the poorest households, food accounts for a major part of their expenditures, and food prices directly affect their food security. As a commonly accepted definition, food insecurity exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active, healthy life.

Land is a primary input in the conduct of economic and productive activities for the Filipinos' general welfare. Though the State has the sovereign right to control and supervise the exploration, development and utilization of the Philippines' land and other natural resources, the Constitution ensures the right of individuals to engage in legitimate business and commercial activities that are intended to increase the Philippines'wealth. The creation of special economic zones and industrial parks are mechanisms of giving a premium to the economic or commercial use of large tracts of land. However, this economic and commercial use of land may, at times, be in conflict with the food production role of land. For example, indiscriminate land conversions from agriculture to non-agricultural purposes that persist around the Philippines pose the danger of food insufficiency for the Filipinos.

Land can also be utilized for social development purposes such as shelter. At present, the growing population of the Philippines has resulted in an increasing demand for housing. Because of the limited space available for mass housing, there is now congestion particularly in urban areas, and this is where the use of land for shelter comes in conflict with other interests. Due to the rapid need of urban centers for housing and the lack of a national land use policy to guide planners, lands allocated for other purposes near these areas (such as agricultural) are utilized for housing.

The size of our forests and forestlands is critical to securing the Philippines's water resources in the future. Their denudation contributes to watershed degradation which affects the Philippines'water supply. The Philippines has the highest total water withdrawals in Southeast Asia and projections up to 2025 show that the Philippines will continue to have the highest withdrawal as a proportion of its water resources (Rola, et al., 2004).

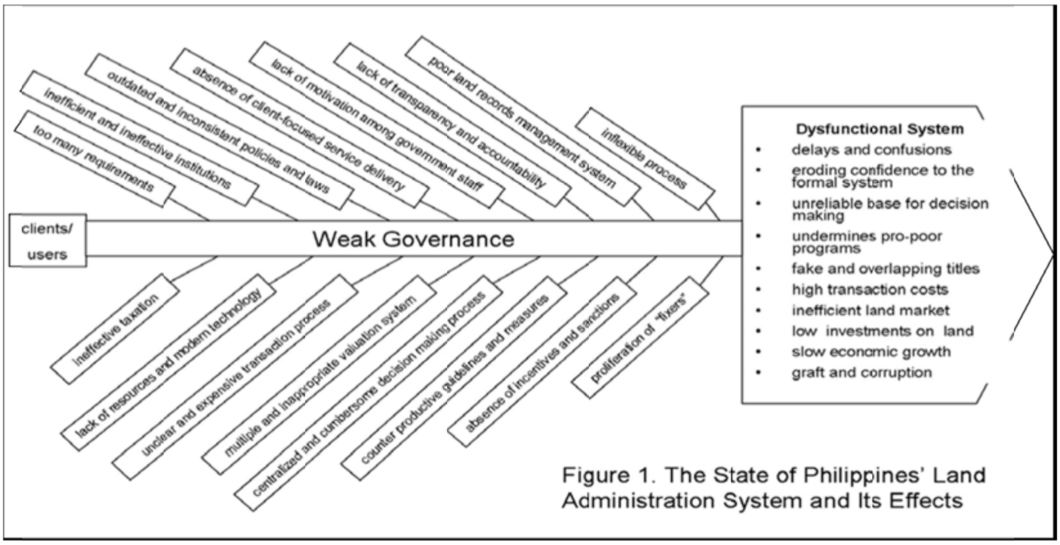
Conflicting land uses and practices, inappropriate land classification and disposition of watershed areas, and unabated encroachment and illegal occupancy within watershed areas are some of the unresolved issues that threaten watershed resources.

Given the aforementioned, it can be deduced that the lack of a national land use policy has resulted in confusion on land utilization and also has, in several instances, resulted in negative effects among stakeholders (Figure 2). It is therefore imperative that Philippine policymakers pursue moves to address the complexities of the problems that arise from land use and land related issues.

3 **BOTTLENECKS FOR SUSTAINABLE DEVELOPMENT: LRU CONTEXT**

Various Philippine government leaders have continuously changed the rules of the game when it comes to the implementation of land reform which led to mediocre accomplishment relative to land distribution. In addition the issue of productivity of fragmented land raised by local law makers adds to the resistance in the full implementation of land distribution. Furthermore, Land Reform Program of the Philippine Government remains ineffective due primarily to lack of sufficient sources of financing to pay

Figure 2. Governance Problem



Source: Danilo R. Antonio, Instituting good governance in the land administration system – the Philippines' perspective

for the landowners as well as in providing credit to land reform beneficiaries, in general there is insufficient support services available to effectively implement land reform.

Maintaining policies toward a more open, market-friendly economy has sustained the disadvantage of small farmers over big land owners. Such policy therefore, not only fails to help promote the development of small scale farming communities, but likewise sustained the highly unequal distribution of income.
Insufficient appreciation of the limited land resources available for food has resulted into an aggressive promotion of biofuel feedstocks production. It may lead to the unnecessary conversion of prime agricultural into biofuel that may exacerbate the food supply situation in the Philippines. It may also disrupt clean water supplies and even result in the loss of wildlife habitat.

Absence of clear, sound and modern framework for land allocation has resulted to conflict among competing land users. Philippines needed an appropriate framework that can guide in the proper allocation of land resources to various land uses. It may be appropriate to reconsider land use allocation strategies being currently implemented by the government. This time, land use distribution should emphasize the importance of small farmers in addressing food security.

4 PARADIGM SHIFT IN LRU: COPING STRATEGY

4.1The Current Scenario in the Agriculture Sector

Farming in the Philippines is now generally undertaken on small farms although one can still observe a mixture of small, medium and large farms. The average agricultural farm is about 2 hectares, owned and managed by single families, ranging from subsistence to commercial production. A typical farming system consists of a major crop, with rice, corn and coconut as common base crops, and a few heads of livestock and poultry. Prior to CARP, there are large plantations of rubber, coffee, oil palm, cacao, banana, pineapple, etc. Philippine agriculture still plays a vital role in the economy. This attaches the high priority of transforming agriculture into a modern, dynamic and competitive sector. A sustained expansion of the national economy requires sustained growth in the agricultural sector. The Philippines'population is predominantly rural (70% of the total) and two-thirds of this population depends on farming for their livelihood. In terms of employment, about one-half of the labor force is engaged in agricultural activities.

From 1993 to 2004, agriculture, fisheries, and forestry hardly grew at an average of 2.6%. Real growth of Philippine agriculture by 1% in the Philippines within 1980 -1990 lagged behind the world average and middle-income countries averaged of 2.8% and 3.5%, respectively.

Neighboring Asian countries such as China, Viet Nam, and Thailand posted very high growth rates during the period. Despite the sector's desire to implement reforms to increase productivity, efficiency, competitiveness, market adaptability, and sustainability of agri-based industries, these reforms were hampered by inadequate resources, limited implementing capabilities of national and local government units (LGUs), and weak coordination among implementing agencies. In addition, the occasional occurrences of natural disasters (El Niño phenomenon and La Niña phenomena) and international market crisis (e.g., 1997 financial crisis) exacerbated the real growth of the agriculture sector.

Like many developing countries in Asia, Philippines is influenced by free market capitalism with the observed benefits of national development confined to richer groups, resulting in even wider gaps between rich and poor. Chantalakhana and Falvey (2010) noted that agricultural development influenced by free-market capitalistic economies (otherwise referred to as globalization), has been associated with serious degradation of the environment as substantiated by: energy and water shortages, global warming, social and economic crises, political unrest, and even terrorism. Food security has not improved, in fact vulnerability of food supply has increased – especially where self-reliance has been replaced by reliance on fickle markets. Furthermore, while it may be true to say that total agricultural production for sale has increased, many still believed that the past adherence to a partial Western approach to agricultural development is a threat rather than a boon to smallholder farmers in developing countries. The smallholders are the world's majority of farmers and producers of food, and most are here in Asia. It is all very well to have faith in technology – even the smallholders rely on technologies that they have researched over millennia. The technology used to produce such food is not commercial factory farming alone, but that developed and still used by smallholders in developing countries. However, we orient our universities, our research and our policies to the commercial more than the smallholder sector (Chantalakhana and Falvey 2010).

In a globalized system where rich and poor are assumed to have free and equal access to the use of available resources to enhance their wealth however, we all know that rich groups including multi-national corporations have the advantage in such a world, while the poor especially marginalized farmers become poorer. According to Chantalakhana and Falvey (2010), it is not that the Western approach is necessarily wrong but that it's partial understanding and partial application in developing countries has produced unsustainable and expensive systems unsuited to Asia. Smallholder farmers now have little hope for better future; attempts to enter market-oriented and monocultural farming in fact had serious negative impacts on the sustainability of agriculture and their livelihood (Falvey, 2000).

4.2 The Desired Goals and Directions of the Agriculture Sector

In pragmatic context, the real question for the developing countries could be: What is the most sustainable path for national social and economic development?

There is no single answer to the issue; in the first place, different economy has different approaches in dealing with various problems regarding agricultural development. The mindset of the Filipino would not necessarily fit the frame of mind of people in other economies because of difference in religious belief, the prevailing political system and the aspiration of the people among others.

The Philippine government thru its related line agencies should reconsider its current economic policy when it comes to agriculture.

It is now recognized that the national government has devolved the planning and actual development decisions into the local government. This means that local government must draw up from its pool of manpower the needed expertise in the area of land resource assessment and planning. It calls for participatory identification of agricultural problems and development of technologies appropriate to specific LGUs, i.e., towards the development of dynamic, responsible and sustainable farmers and farming communities.

While each municipality under a given province is mandated to prepare Comprehensive Land Use Plan (CLUP), in most cases prepared CLUP lacks enough detail on the characteristics of land and water resources limiting establishments of a more logical options for agricultural development. In addition, farmers under various farming systems have not optimized the benefits from available technologies, such that gaps during technology generation, radiation and adoption phases should be narrowed or eliminated. Apparently, these gaps are attributed to the currently dominant top-down flow of technology, which is flawed by ineffective matching of generated technologies and the adoption or adaptation by end-users.

4.3 Strategies Toward Food Security

The Philippines must aspire to enhance competency of local communities in agricultural plan formulation and development complementation. Specifically, agencies concern i) should help assess the bio-physical, agro-climatic, agro-ecological, socio- cultural and socio-economic attributes of different farming communities to identify productivity gaps and constraints; ii) facilitate documentation, formulation and implementation of suitable practices to various field programs across the major agricultural production systems in all provinces of the Philippines; and iii) enhance the competency of LGUs/stakeholders to infuse advanced knowledge on crop and/or livestock production systems for sustainable productivity.

The aforementioned data and information will be crucial in effecting improvement on the performance of farming systems. Such data as comprehensive database on bio-physical, agro-ecological, socio-cultural, socio-economic attributes; agricultural production systems inventory and profile, particularly on technology gaps and needed interventions will be important if we want to effect changes on the state of food security in the Philippines. Improvements on the performance of farmers on crops, animals and various products will be a must as well as the capacity of LGU staff/target farmers to plan, implement and promote sustainable agricultural production systems.

There is a need for the proper identification, segregation and preservation of the prime agricultural lands for food and feed production and at the same time concentrate the utilization of the marginal lands for biofuel feedstock production, should decision to expand the production of biofuel feedstock in the Philippines would be pursued.

With the signing and accepting the provisions in the World Food Summit, the Philippine Government sees the need to revitalize its agriculture, fisheries and forestry. Such commitment has resulted to the enactment of the Agriculture and Fisheries Modernization Act (AFMA) of 1997 (AFMA, Republic Act 8435). It is a landmark Philippine legislation that aims to accelerate the pace of development in agriculture and fisheries. The law prescribes a comprehensive set of policies and programs that aim to jumpstart agriculture and fisheries modernization.

Republic Act No. 8435, otherwise known as the Agriculture and Fisheries Modernization Act (AFMA) became effective as law on February 9, 1998 and embodied the government's policies to ensure the development of the agriculture and fisheries sectors in accordance with the principles of: poverty alleviation and social security, food security, rational use of resources, global competitiveness, sustainable development, people empowerment, and protection from unfair competition. The provisions in AFMA also cited the need for the formulation of medium and long term plans aimed at the reduced use of agro-chemicals that are harmful to health and the environment. There is so much expectation in the passing into law of AFMA among Filipino people.

5 CONCLUSION

Philippines is now at the threshold of being aligned with Afghanistan, Bangladesh, or Pakistan, countries which likely will not be able to produce sufficient food now or in the near future, and wherein the Malthusian prophesy has already become a reality. We cannot be complacent with the reported insufficiency of supply of food grains relative to the current demand of population even if we have non-agricultural industry, commerce, and servicing functions to earn the money to import food this time. While we can afford importing food this time, importing food from elsewhere may not be a sustainable solution. Globally, the financial crises affecting many countries including developed countries has raised doubts about the future.

To confront the food security issue, massive infusion of capital are needed to support the following: 1) agricultural research and development, particularly in biotechnology and other cutting edge technologies; ii) development of policies and practices conducive to sustainable land management; iii) development of indices of land quality and their monitoring; and iv) elaboration of early warning indicators of land degradation.

For the Philippines to survive the impending crises of food security, it needs to accomplish the following: i) to strictly enforce/implement laws; ii) to set aside considerable investments for infrastructure, technology and support services to fuel the new direction; iii) to redirect strategy towards strengthening productivity of small farmers and use farmers as indicator of food security; iv) to streamline function/TORs and flagship activities of government institutions, academe, NGOs, POs, LGUs; and v) protracted reorientation of social and individual values (participatory—among stakeholders).

To realize its object to attain food security, the Philippine government pass into law Republic Act No. 8435, otherwise known as the Agriculture and Fisheries Modernization Act (AFMA). AFMA embodied the government's policies to ensure the development of the agriculture and fisheries sectors in accordance with the principles of: poverty alleviation and social security, food security, rational use of resources, global competitiveness, sustainable development, people empowerment, and protection from unfair competition.

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Land Resources of Russia: Current State and Ecological Threats

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ABSTRACT: In this paper, a review of current status of land resources in Russia is presented using data of State Reports of 2001-2010. The area of land fund in Russia accounts 1,7010 mln ha, being located on four climate belts: polar, boreal, sub-boreal and sub-tropical and accounting 76 soil types. Lands in RussiaF are distinguished into 7 main categories: forest, agricultural, water, industry, dwelling, nature protection and reserve. Forest fund occupies about 65% of lands (1116 mln ha) and 23% belong to agricultural fund (394 mln ha); the area of agricultural lands within the lands of agricultural designation is 196.1 mln ha. Among the most dangerous land degradation processes are erosion, deflation, salinization, desertification, deterioration of agricultural lands and contamination. The total area of eroded and deflated agricultural lands is estimated in 130 mln ha (18%), including 84.8 mln ha (12%) of arable lands and 28.7 mln ha of pastures. Soil salinization predominantly occurs in the southern parts of Russia, and countrywide saline soils make about 3% of total land fund (44-54 mln ha) and 8-13% (22-28 mln ha) of agricultural lands. The total area of soils subject to desertification varies from 50 up to 100 million ha. Deterioration of chemical soil properties takes place: 36.4 mln ha (31%) of arable lands have high acidity; 54.5 mln ha (46%) – low humus content; 25 mln ha (22%) – low phosphorus content; and 11.5 mln ha (10%) - low potassium content. Technogenic degradation of land due to contamination by chemicals mostly takes place on the territories close to industrial enterprises, roads and oil pipelines. To prevent land degradation the new strategic direction in agriculture has been developed in RF during the last years and The Federal Target Program "Conservation and restoration of soil fertility of agricultural lands and landscapes as a national heritage of Russia for 2006-2010 and for the period till 2013“provides using adaptive-landscape systems of agriculture, in the maximum degree considering land condition, soil and vegetative cover, and bioclimatic potential of the territories.

KEYWORDS: Land degradation, erosion, deflation, waterlogging, salinization, desertification, acidification, dehumification, contamination.

1LAND RESOURCES OF THE RUSSIAN FEDERATION

Accordingto Federal Agency for the Cadaster of Real Properties the area of land fund in Russian Federation (RF) on January 1, 2011 composed 1,709.8 mln ha without internal sea and territorial waters. This is about 13% of terrestrial land with the dimensions about 3,000 km from north to south and 7,000 km from west to east. The territory is characterized by high heterogeneity of climatic and litho-geomorphological conditions, diversity of vegetation and soil cover and consequently by the diversity of soil and land resources. It is located on four climate belts: polar, boreal, sub-boreal and subtropical and account 76 soil types (Land Resources of Russia, 2002).Soils of polar belt occupy more than 6% of territory, boreal – about 55%, sub-boreal – 15% and subtropical – about 0.05%. Mountain soils are located mostly in Siberia and Far East and occupy more than 31% of the territory (State Report, 1997). More than 70% of the territories of Russia are hardly suitable for dwelling or agriculture.

Polar and boreal soil formation is most typical of the territory of the Russian Federation (the arctic, subarctic and taiga zones). Forming tundra, frozen taiga, podsolic and peatbog soils of these regions cover almost 40% of flat territories of RF.Forest zones of the sub-boreal belt occupying about 14% of flat territories of Russia are characterized by different kinds of podsolic, sod-podsolic soils, lesser by brown and grey forest ones. The subzones of southern taiga and mixed forests lands are most agriculturally

‘Countrywide’ refers to Russia

developed among all taiga territories. Agricultural lands occupy here 17.3% of total area including about 10% of arable lands (Natural Resources, 2001).

The most productive are the soils of forest-steppes and steppes of Russia. They cover more than 12% of all flat areas of Russia. Famous Russian black soils (chernozem) are distributed in this region.Favorable soil and climatic conditions of the black earth zone predetermined intensive use of these lands. With the exception of ravines and swamp territories there is no natural vegetation in this region. Today agricultural lands occupy more than 57% of forest-steppes (including arable lands - about 40%) and 73% of the steppe zone (arable lands - about 47%). The European part of Russia has even higher percentage of agricultural lands, being a principle grain-producing area of Russia (Natural Resources,2001).

The zone of semi-deserts and deserts (0.9% of the Russian Federation) mainly consists of light chestnut and brown desert-steppe soils, mostly solonetzic, meadow-chestnut soils, saline lands and tracts of sand. Agriculture is possible only applying artificial irrigation. These soils are characterized by a low content of humus and almost universal salinity. The summary of the above data is given in Table 1.

Table1. Distribution of Land Resources among Natural Zones of Russia (Romanenko et al., 1996)

Nature zone	Area		Forests,%	Agricultural lands, % from zone area		
	mln ha	% from RF		Total	Arable	Forage
Polar tundra	197.8	11.6	-	-	-	-
Northern taiga	233.6	13.7	37.7	0.03	-	-
Taiga	222.8	13.0	76.4	0.5	-	-
Southern taiga	245.4	14.3	57.6	17.3	10.4	6.9
Forest steppe	127.7	7.5	27.5	57.2	40.6	16.6
Steppe	79.9	4.7	-	73.3	47.3	26.0
Dry steppe	22.2	1.3	-	85.5	51.8	33.7
Semi desert	14.7	0.9	-	75.9	13.5	62.4
Mountains	565.7	33	62.7	7.6	1.5	6.1

Forthe designated use landsinthe RFaredistinguishedinto 7 maincategories (LandCode, s.7) as showed at Fig.1. About 65% of lands forest fundoccupies and 23% belong to agricultural fund. According to State Report (2010), on January 1, 2011 the area of lands of agricultural designation was 393.4 mln ha, which is on 6.6 mln ha less than it was previous year.

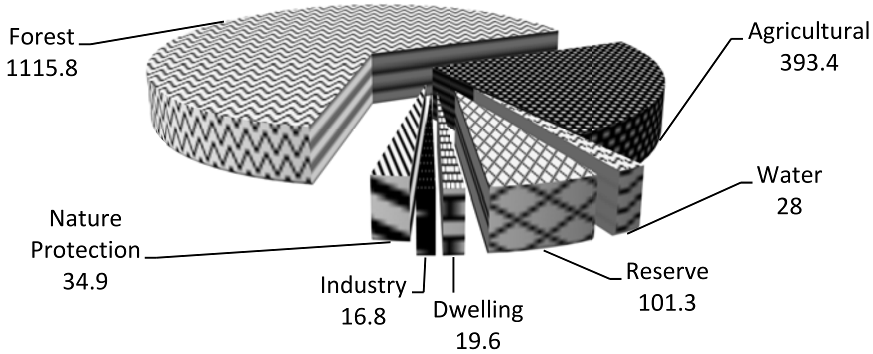

Figure 1: Land fund structure: land categories, mln ha

On January 1, 2011 the area of agricultural lands within the lands of agricultural designation was 196. 1 mln ha, composing more than 90% in 24 federal subjects of the RF (State Report, 2010). Within all the land categories the area of agricultural lands was 220.5 mln ha, or 12.9% of the total land fund, whether the share of non-agricultural lands composed 1489.4 mln ha (87.1%). Among the lands of agricultural designationprecisely the agricultural lands have the priority in use and subjected to a special protection. The structure of agricultural lands in RF is presented at Fig.2. About 55% are under arable lands, and 42% are under forage lands including both pasture and grasslands. The rest is occupied by fallow lands and perennial plantings.

During last 15 years in RF an annual decrease of agricultural lands area was observed; for the period from 1990 to 2010 it decreased on 2012.9 thousands ha (Fig 3; Gordeev and Romanenko, 2008). Results of statistical data for 2010 support this trend: the decrease of area was 65.3 thousand ha and observed in 52 subjects of RF. The decrease in area of agricultural lands is mostly connected with the extraction of lands for industrial, storage and other construction. Although in certain federal subjects of RF an increase in area of agricultural lands was also recorded.

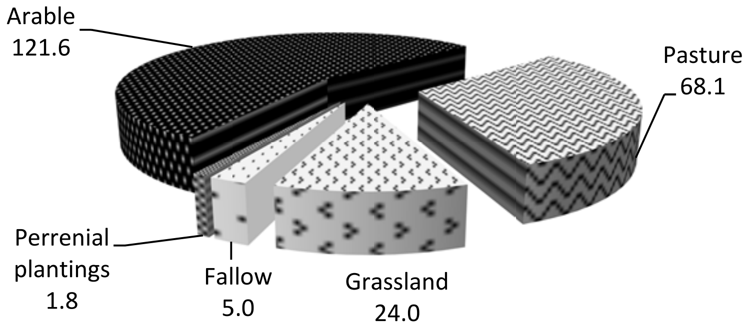

Figure 2: Structure of agricultural lands, mln ha

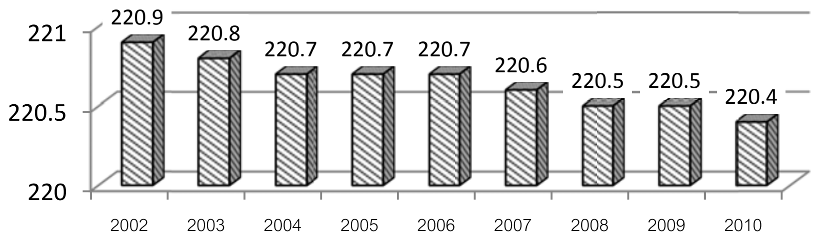

Figure 3: Dynamics of agricultural lands, mln ha

For the arable lands the decrease in area was also observed during last 21 years and accounted to 10.9 mln ha. Dynamics in areas of arable and forage lands for the period of 2002-2010 is given at Fig.4-5. In 2010 the area of arable lands decreased on 214.8 thousands ha. Although in certain regions an increase of arable lands was observed due to tilled bare land, but generally there is a trend of decrease. The main reasons for that are insufficient financial and technical possibilities to keep the lands in a proper status. In contrast, the area of forage lands in 2010 increased on 6.5 thousands ha all over Russia. Among them area of pastures increased on 18.8 thousands ha, whether area of grasslands decreased on 12.3 thousands ha.

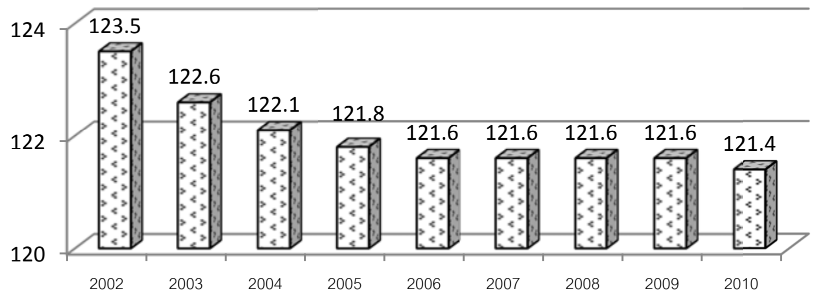

Figure 4: Dynamics of arable lands, mln ha

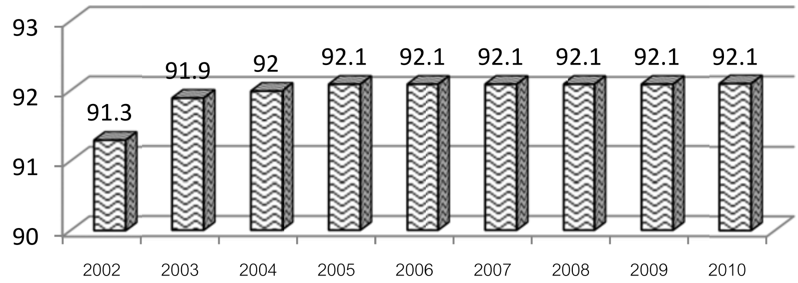

Figure 5: Dynamics of forage lands, mln ha

2 LAND DEGRADATION

Land degradation is a worldwide problem of the modern civilization. According to the Commission of the European Communities, the main treats to soil in the European Union include decline in soil organic matter, erosion, compaction, floods and landslides, contamination, salinization and decline in biodiversity.

In Russia land degradation is also one of the most important socio-economic problem, which causes threats to ecological, economical and finally national security of RF. Analyses of land monitoring data shows that almost in all federal subjects of the RF a trend to land deterioration occurs. Among the most dangerous processes are erosion, deflation, mire formation, salinization, desertification, bushing of agricultural lands and contamination. These processes lead to loss of soil fertility and extraction of lands from agricultural use, bringing a huge disbenefit to the land fund productivity in Russia. Scales of land degradation and distribution of degraded lands countrywide are presented in Table 2.

Table 2 Quality of Agricultural Lands in RF (State Report 2001)

Degradation	**Agricultural lands**		**Including arable**	
	Mln ha	**% from total area**	**Mln ha**	**% from total area**
Saline	16.3	8.9	4.5	3.7
Alkaline	22.9	12.5	9.9	8.2
Acid	51.5	28.1	41.6	34.4
Over- wetted	16.1	8.8	6.8	5.6
Waterlogged	9.6	5.2	2.2	1.8
Stony	12.2	6.6	3.9	3.2

On January 1, 2011 the area of degraded lads was estimated in 1000.3 thousands ha, what is 5.3 thousands ha higher comparably to previous year (State Report, 2010). The distribution of degraded lands is demonstrated at Fig.6. Land degradation processes are worsening by unfavorable socio-economic situation in agriculture as a whole. State support of agro-industrial complex was 19-fold reduced, investment volume was 7-fold decreased, wages for rural workers do not exceed 35% from average in industry (Gordeev and Romanenko, 2008).

3 SOIL EROSION AND DEFLATION

Soil erosion and deflation are one of the most dangerous processes, because they are the result of not only lithological and climatic conditions, but they reflect also the negative impacts of other degradation processes, which destroy soil structure, give conditions for soil wash-off and blow-off.

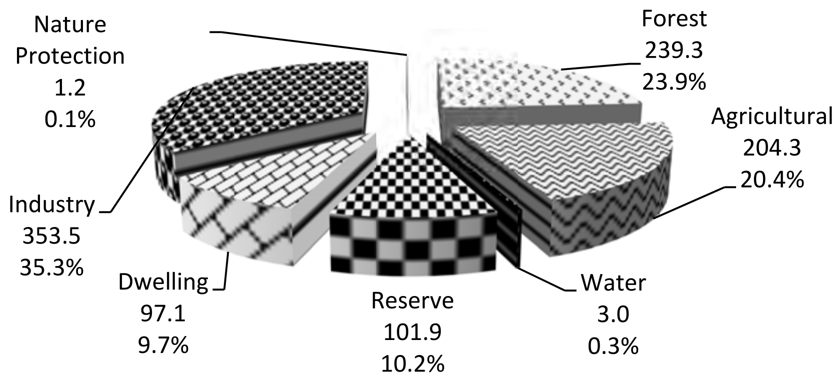

Figure 6: Distribution of degraded lands within land categories

According to data of the State Recording,the total area oferoded and deflated agricultural lands was 130 mln ha (18%), including 84.8 mln ha (12%) of arable lands and 28.7 mln ha of pastures. Countrywide eroded lands occupy about 26%, including arable lands (14.9%), grasslands (1.2%) and pastures (9.3%) (Gogmachadze, 2011).

Ravines and gullies increase their areas from year to year (80-100 thousand hectares annually). They are distributed in many regions of Russia, especially in mountain and foothill territories. In flat regions their fast formation is registered mostly in Southern and Central federal districts (Fig. 7; State Report, 2006). The areas adjoining to the valleys of large rivers in the Volga federal district, are also characterized by high activity of gullies formation.

Percent of eroded soils is going up: during last 20 years the rate of increase achieved 6-7% each 5 years or up to 1.5 mln ha per year. As a result of erosion and deflation a shortfall in agricultural production in Russia achieves 36-47%.

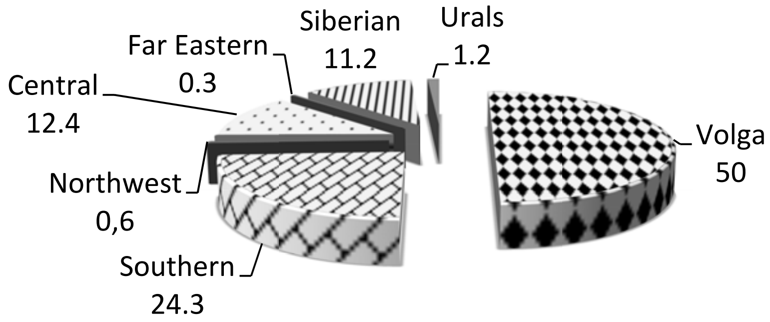

Figure 7: Share of eroded lands in federal districts of RF, %

More than a half of eroded lands (52%) are also subjected to deflation. The most active deflation processes occur in Southern, Siberian and Volga federal districts (Fig.8).

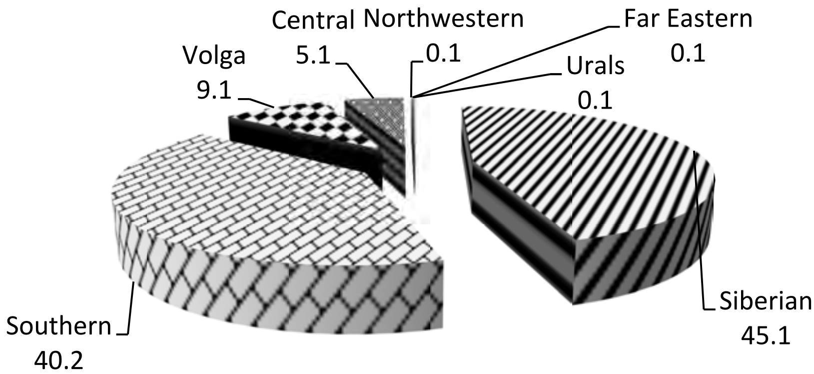

Figure 8: Share of deflated lands in federal districts of RF, %

4 SECONDARY HYDROMORPHISM

Countrywide wetlands occupy 12.3% of agricultural land areas, including 6.8% of arable lands. Water logging processes are the most active on the territories of Central and Siberianfederal districts (23-32% of water-logged lands), although all other districts also got 5-10% of wetlands (Fig.9).

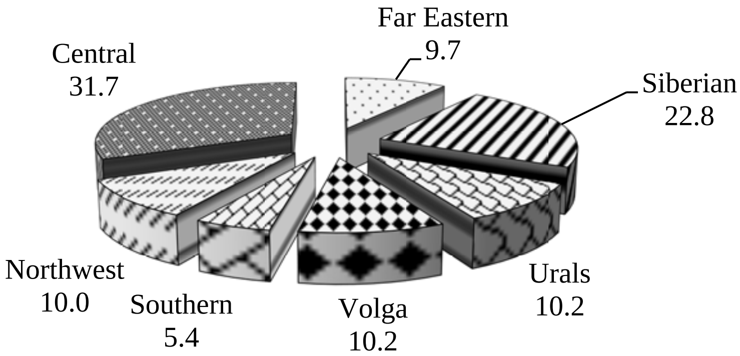

Figure 9: Share of water-logged lands on federal districts of RF,%

5 RECLAIMED LANDS

According to statistical data, within all the land categories there are 9.1 mln ha of reclaimed lands in RF, including 9.0 mln ha of agricultural lands. Among them there are 4.3 mln ha of irrigated and 4.8 mln ha of drainage lands. The dynamics of land area subjected to reclamation is given in Table 3. Over years not only areas, but also shares of reclaimed agricultural lands are going down – from 5.5 to 4.6%. In 2007 areas in 2.3 mln ha (including 0.87 mln ha of irrigated and 1.47 mln ha of drained lands) belonged to the category of lands with unsatisfactory agro-ecological conditions (Gordeev and Romanenko, 2008)

Table 3 Dynamics in Area of Reclaimed Lands in RF

Area	1985	1990	1995	2000	2005	2010
Total, thouthandsha	10602	11539	9786	9100	9346	9109
Including:						
Iirrigation	5802	6159	5002	4466	4546	4339
Drainage	4800	5380	4784	4634	4800	4770

According to expert estimations the area of drained lands in RF must be not less than 7-8 mln ha. Realization of the Program of Complex Land and Water Reclamation would allow solving the problem onfood and ecological security in Russia.

6 SOIL SALINIZATION AND ALKALINIZATION

Soil salinization is one of the most widespread processes of soil degradation decreasing the fertility of agricultural lands. In Russia it predominantly occurs in the southern parts, on the territories of steppes and semi-deserts and involve both auto-morphic and hydro-morphic soils.

Countrywide saline soils of various genesis, their complexes and combinations make about 3% of total land fund (44-54 mln ha) and 8-13% (22-28 mln ha) of agricultural lands. Area of alkaline soils in complexes with other steppe soils composes 24-30 mln ha which is about 11-13% of agricultural lands or 8-9% of arable lands (Gordeev and Romanenko, 2008)
Thus, together saline and alkaline lands occupy 20.1% of agricultural lands’ area, including 6.8% of arable lands.

On the territory of RF saline and alkaline soils are located irregularly. The biggest areas of saline soils occur in Southern, Siberian, Volga and Urals federal districts of RF (Fig.10; State Report 2006).
For these territories soil salinization and alkalinization are the main degradation processes leading to the loss of soil fertility.

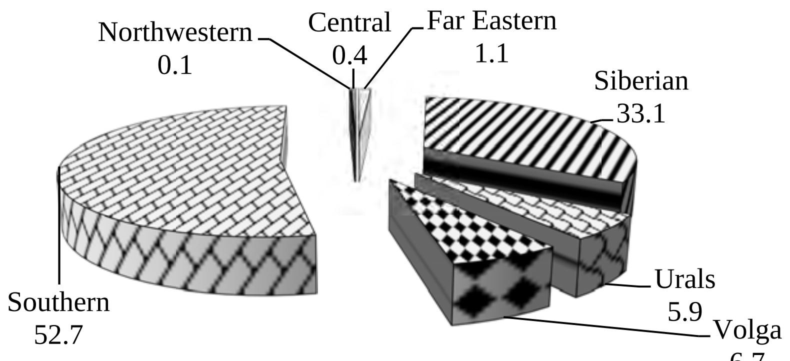

Figure 10: Share of saline soils in federal districts of RF,%

Agricultural development of saline and alkaline soils request high expenses for the removal of salts, restoration ofsoils' physical and chemical properties and other reclamation activity, as well as following constant maintaining of soil condition which allows keeping these soils for agricultural use. That is why these soils are not so deeply involved in agriculture, although in the south of Russia their areas are so big that they cannot but used for agriculture (Gordeev and Romanenko, 2008; Gogmachadze, 2011).

7 DESERTIFICATION

The total area of Russian soils subject to processes of desertification or potentially dangerous in this respect by various estimations varies from 50 up to 100 million ha. They locate in the Volga Region, Ciscaucasia, Transbaikalia and in other southern regions of the Russian Federation and involve 27 federal subjects (State Report, 2010).

Desertification and correspondingdecrease of biological productivity are especially dangerous on arid territories of RF, where it is worsen by droughts. Forage lands there experience overgrazing with following erosion and soil compaction leading to decrease their originally low soil fertility. Agricultural activity on these territories (mostly crop farming, husbandry and sheep husbandry) is going down. Rates of decrease in agricultural land use depend on geography and the degree of desertification. Thus, in the center of desertification of arid belt (Kalmykia and Dagestan), where pastures occupy about 80% of agricultural lands, currently oasis agriculture takes place. According to expert estimations (State Report, 2006) today 50-70% of degraded arid lands are involved into agricultural turnover and the annual loss of productivity achieve about 7 mln tons in grain equivalent, including 3 mln tons in Southern Federal district.

On the territories experiencing desertification the socio-economic situation is also getting more complicated. Demographic situation is getting worse; population growth is going down, mortality rate and human migration increase. Problems with drinking water (high mineralization, content of iron, silica and nitrates) cause an increase of diseases.

International organizations put a high priority to combat desertification. In 2003 Russia joined the United Nations Convention to Combat Desertification, and in 2010 Ministry of Natural Resources and Environment of the RF developed the Package of Measures to Combat Desertification. The strategy includes the detailed evaluation of conditions and scales of desertification, including forecasts as well as practical measures including adaptive-landscape type of land use, advanced hydrotechnics, lands reclamation, and forestation.

8 DETERIORATION OF SOIL PROPERTIES: ACIDIFICATION AND DEHUMIFICATION

Deterioration of chemical soil properties decreases plant nutrition, soil fertility and finally the land productivity. Currently in RF 36.4 mln ha (31%) of arable lands have high acidity; 54.5 mln ha (46%) – low humus content; 25 mln ha (22%) – low phosphorus content; and 11.5 mln ha (10%) - low potassium content. The shift of acid soils boundary toward south was observed. Decrease in volumes of soil liming resulted in increase of acid soils on 0.5-1.3% comparably to 1990. Losses in agricultural production due to acidification are estimated in 15-16 mln tons of agricultural production per year in grain equivalent (Gordeev and Romanenko, 2008; State Report, 2010).
Volumes of fertilization drastically decreased over years, and the results of long-term agricultural soil survey indicate land degradation due to deterioration of chemical soil properties (Table 4).

Table 4 Dynamic of fertilization rates in RF, average per year (Gordeev and Romanenko, 2008)

Fertilization	1965	1986-1990	2010
Organic fertilizers, t/ha	1.4	3.7	0.9
Mineral fertilizers, kg/ha	20	99	33
Liming, th ha	1430	5340	279
Phosphorous, th ha	nd	1939	32

Soil dehumification is one more dangerous degradation process, observed for arable soils in all the federal districts. Thehighest degree of dehumification was recorded for famous Russian chernozem soils. The cropping pattern on these lands includes crops which require intensive soil treatments (corn, sugar beet, and sun-flower). Intensive tillage and irrigation lead to enhanced soil aeration and mineralization of soil organic matter, which provide high productivity. But at the same time the removal of nutrients from soil goes up and in combination with insufficient fertilization, removal of organic residues and exclusion of perennial grasses from crop rotation it results in accelerated dehumification. For the last 15-25 years an annual decrease of humus supplies in chernozem soils was estimated in 0.62 t/ha.

9 TECHNOGENIC DEGRADATION

Technogenic degradation of land due to contamination by chemicals mostly takes place on the territories close to industrial enterprises, roads and oil pipelines.

Contamination by Heavy Metals(HM): HM is documented for all the federal districts. State survey mainly includes examination of the territories next to source sites of technogenic emissions of hazardous substances. In soils contents of total and available species of Al, V, Fe, Cd, Co, Mn, Cu, Mo, Ni, Sn, Pb, Hg, Cr and Zn are determined. Estimation the degree of contamination is fulfilled for each element according to values of top allowed concentrations. In cases when values of top limits are not developed, concentrations are compared to the background content of element.

Thus, more than 250 thousands ha of agricultural lands have the pollution in 10-100 times above the background level. Technogenic emissions cover 18 mln ha, HM-contamination was recorded for 3.6 mln ha (Gordeev and Romanenko, 2008; State Report 2006). Results of survey in 2001-2010 report that 4.7% of investigated area belong to category “dangerous”, and 9.4% are moderate dangerous, whether soils of 85.9% of settlements in average stay within the allowed category (Table 5; State Report, 2010).

Table 5 Contamination of agricultural lands by heavy metals

Element	Investigated area		With content of HM above top limits	
	thousands ha	% from total area	thousands ha	% from total area
Pb	16380.7	12.9	273.0	1.7
Cd	14257.7	11.3	27.7	0.2
Hg	7037.2	5.6	-	-
Ni	8667.5	6.8	56.0	0.7
Cr	5957.5	4.7	33.3	0.6
Zn	24783.5	19.6	54.0	0.2
Co	9256.7	7.3	94.3	1.0
Cu	22326.0	17.6	449.2	2.0

Oil Contamination: Monitoring of content and dynamics of oil content in soils is obligatory carried out on the territories of most probable sites of impact pollution (near sites of oil extraction, transportation and development) and in settlements. High pollution levels, 10-100 times above the background level are recorded for certain territories.

In 2006 the highest pollution was documented in Irkutsk region as a result of accidental oil spill when the concentration of oil is soil 69-533 times increased the background level (State report,2006). In 2010 oil pollution above 4 background levels was observed in certain urban territories and in Ural, Volga, Southern and North-Western federal districts (State Report, 2010).

Pesticides: In 2010 in RF more than 900 pesticides were registeredand 32.8 thouthands ha were examined for the pesticide bound residues. Contamination above the required limit concentrations were recorded for 3.4% of investigated territory in spring and 2.5% in autumn on the territories of 11 from 40 investigated subjects of RF. Monitoring results show that during last 16 years a trend of decrease of pesticide-polluted lands in Russia is observed (State Report, 2010).

10 CONCLUSION

The agricultural science has effective tools to protect lands from degradation. The new strategic direction in agriculture has been developed during the last years using adaptive-landscape systems of agriculture, in the maximum degree considering land condition, soil and vegetative cover, and bioclimatic potential of the territories. The soil-protective systems of agriculture are developed for the areas subject to water and wind erosion. The special state standard regulating the requirements to agricultural technic is created to prevent soil compaction. State monitoring of contaminated lands and obligatory remediation of polluted lands helps to prevent land degradation.

For practical realization of achievements in the field of land protection it is necessaryto take the measures of nation-wide character providing full and timely financing of land protection activity. The federal law from December29, 2006 «About Agriculture Development» creates conditions for «realization of statepolicy focused on maintenance of ecological equilibrium, protection of agricultural lands, increase of their fertility … »(article 13).

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Inventory and Classification of Agricultural Land Resources in Chinese Taipei

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ABSTRACT: For the sake of protecting agricultural land resource to ensure foodsecurity and stability, Chinese Taipei has conducted agricultural land resource inventory in 2011.This task is not to survey the crops onthe farmland, but to investigate the location that deserves for cultivation. According the location and characteristic, agriculture land isdefined as the three kinds of land, production, conservation and non-production agricultural land. Besides, the classification of agricultural area has been conducted. Four types of agricultural productive areas are categorized to map out the high-quality agricultural production area. These results will be used to make the policy and management of the agricultural land.

Keywords: Foodsecurity and stability, production, conservation, high-quality agricultural production

1INTRODUCTION

The land of Chinese Taipei is about 36,000 sq.km., approximately 70% belong to the hillside, and only 30% belong to the plain area that is suitable for agriculture, urban or rural uses. Due to the rapid urbanization, industrialization and the competition of land for other uses, agricultural land is decreasing. Besides, the fragmentation, pollution and deterioration of farmland influence the sustainability of agricultural land resources and also affect the food sanitary. The issues of environmental impact, food production, resource conservation and food security matters are important in Chinese Taipei’s agriculture land. For the sake of improving the agriculture land use and food security matters, nationwide agricultural land use and food security conferences have been held in January and May 2011. Their conclusions and suggestions such as to promote self-sufficiency ratio of food, to conserve and protect good agriculture zone for agricultural use, etc., have been set up as the agricultural policy to be carry out. After the conferences cited above, a nationwide farmland inventory is planned to be held in late 2011 in order to comprehend the present use of farmland as a basic data for land use planning and management.

2 AGRICULTURAL LAND RESOURCES INVENTORY

The purpose of the inventory is to know the status and distribution of current agricultural land resource for the consideration of food security. The inventory is not only statistic of the area of agricultural land, but also to understand the farmland where there is over reconstruction for agriculture facilities, farmhouse or other buildings, or where there it is reserved for cultivation. In addition, the work is not to identify whether or not the farmland is legal use, but to grasp the area of superior farmland.

To understand the land use situation, the Ministry of the Interior conducted the first and second national land use inventories, which were carried out at 1993 and 2006. The results just revealed the existing status of land use nationwide. It did not analyze or classify the character of agricultural land resource comprehensively.

The other agencies in Chinese Taipei also have made some surveys for their official needs. The geographic information system (GIS) technology has become more popularized in the field of land use planning for special datum analysis. For the sake of making full use of existing data that were surveyed by other agencies in Chinese Taipei, in order to reduce expenditure and improve the effectiveness of inventory, the Council of Agriculture (COA) collects relevant maps from other agencies firstly, and applies the GIS technique to analyses the data. Three kinds of agricultural land are defined as production, conservation and non-production land. The preliminary result also has been double checked by field investigation and aerial photographs.

In 2011, the framework of inventory job has been figured out first, and all of the relevant maps have been lumped together. The job for the most part in2012 is to differentiate the discrepancy between the mapping data and the latest aerial photographs. Any site that is doubted about its discrepancy has to be checked on the spot.

2.1 Working flow chart

The overall procedure is divided into three phases: planning, inventory and analysis. Figure 1 shows the flow of those phases.

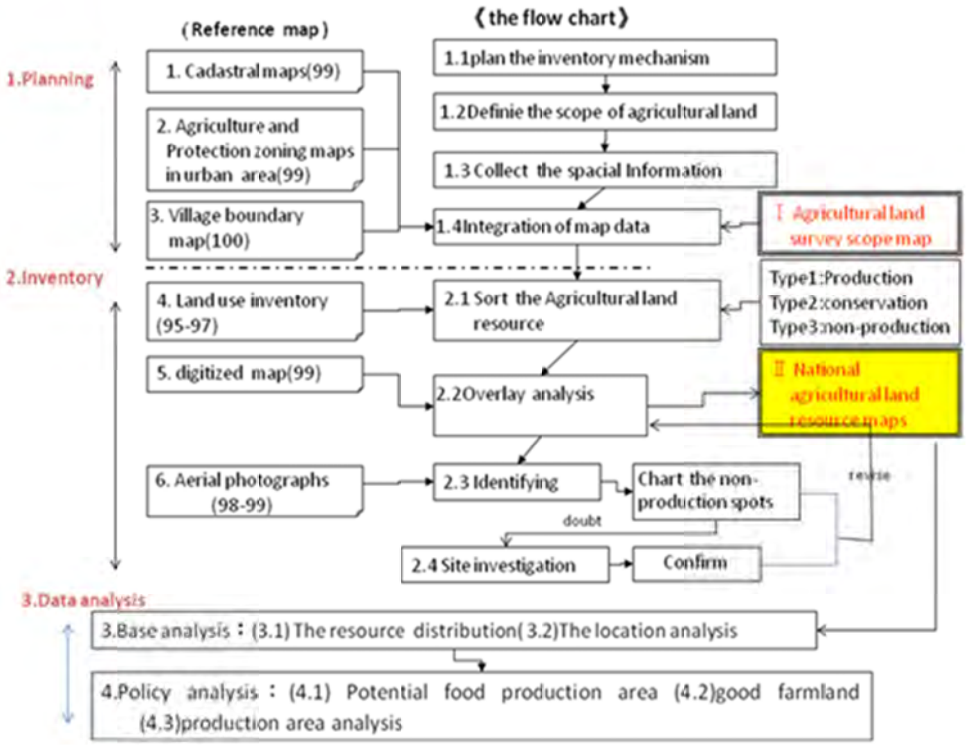

Figure 1: The inventoryprocedure of the agricultural land resources

2.1.1 Planning Stage (Preliminary Analysis): This is a stage of preparations. The work in this stage includes planning the overall schedules, defining the scope of the inventory, collecting the relevant maps which were made by other agencies. These data embrace the cadastral maps, agriculture and protected zones of urban planning area, municipalities (counties) boundary maps, land use map, digitized map and aerial photographs.

2.1.2 Inventory Stage:

2.1.2.1. Classification of the Agricultural Land Resource: In accordance with the cadastral map, land use map and the urban planning map, the boundary of agricultural land can be drafted. Based on the results of the 2nd national land use inventory the agricultural land resource is classified into production, conservation, and non-production land.

Considering 3-4 years time lag of the 2nd national land use inventory, the digitized map, which was done in 2010, is used to identify the non-production spots, and then the map of the agricultural land resources is accomplished. Production land can be subdivided into farming, pasturage and fishery.Conservation land can be subdivided into the forests, wetlands, shrubs and dis use. The non-production land is the location of buildings or facilities, such as agriculture facilities, farmhouse, or other illegal buildings.

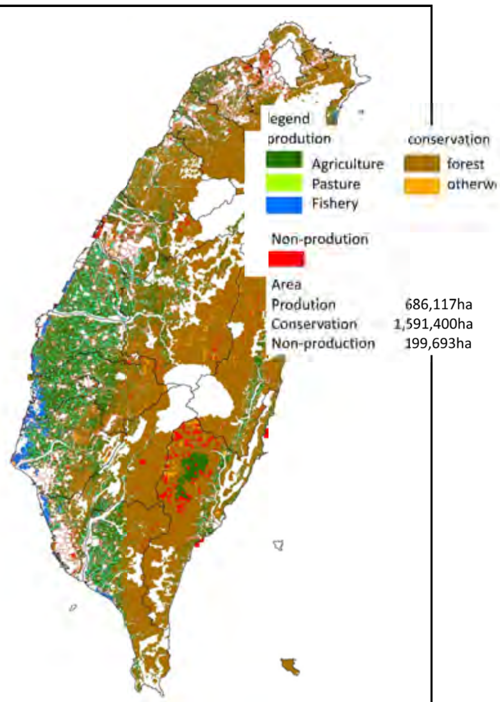

Figure2:The distribution map of the agricultural land resources

2.1.2.2Interpretation of the Aerial Photograph:

In order to improve the accuracy of the result, the latest aerial photograph has been used to distinguish the differences with the digitized map and identify the new location of non-agricultural use. In this stage, the satellite image data is not used to analyze the variation, mainly due to the lack of precision of the satellite images for spatial analysis. The job of interpretation of the orthophoto consumes more manpower and time, but the accuracy is relatively well. In order to conduct the work, we also establish the principle of plotting the variations and matter of pay attention to.

2.1.2.3 On-site Checking: If the case isdifficult to judge the status of production or non-production, on-site checking is necessary. The on-site checking is done by the official in the local government. In order to check actual status, the COA has set up the working procedures, held the training courses, edited the handbook,and prepared aerial photomap for their reference. The on-site checking is carried out by the township official, and then the official from county government makes a spot check randomly. The spot check also has to check its documents and confirm its legitimacy.

2.1.3 Data Analysis Stage: The results of the agricultural land resource inventory are used to do some basic statistical analysis, in order to understand the existing area of the agricultural land and its situated location. It has been used to make some policy analysis, such as potential food production areas, the boundary of the good agricultural land and agriculturalproduction location.

Preliminary Results

Around 2.48 million ha of agricultural land have been surveyed. Within the area of this inventory, the production agricultural land (e.g. cultivation, pasture and fishery) is estimated about 686,000 ha, the conservation agricultural land (e.g. forests, wetlands, etc.) accounted for 1.591 million ha, and non-production agricultural land (e.g. water conservancy facilities, agricultural facilities, farmhouses, roads, public facilities and other buildings, etc.) accounted for 199,000 ha.

The result shows that agricultural land surrounding the metropolitan areas or close to the main roads or large development areas, its fragmented or abandoned situation is more serious than in other regions. In the future, for the case of converting agricultural land to urban development or other uses deemed necessary, the location should be considered whether or not it will cause fragmentation of agricultural land resources.

3 CLASSIFICATION OF AGRICULTURAL DEVELOPMENT AREA

Agricultural land resource in Chinese Taipei is scattering over plains, hillsides and alpines. It supports all kinds of agriculture, such as farming, forestry, fisheries, pastures, etc. It not only provides food products for our demand, but also supplies the open space, landscape features, maintenance of the ecological environment and other multi-functions. The classification of agricultural land is for the purpose of ensuring food security; therefore, only the land in the main agricultural area has been classified. Forest or environmental sensitive areas, e.g. disasters sensitive areas, wildlife protected areas, etc. are not involved. Besides, the classification is based on the conditions of the productivity and location land, in order to map out the high quality of production land and the suitable way of agriculture land use.

3.1 Classification Principle

The classification of agricultural area is evaluated basedon the production and location of the agricultural land. To avoid too crushing ofgradingcausing problems of integrationof land use and beingadvantageous to policy analysis,four types of agricultural productive areas are categorized. The definition and characteristics of each type is described as follows:

3.1.1 Class I: With good agricultural production environment and has invested the constructions of major agriculturalfacilities.

3.1.2 Class II: Still suitable for cultivation, and has the function of food production.

3.1.3 Class III: Still suitable for cultivation, but is affected by the external factors, such as neighboring the industrial zone, science park, or the highways and interchanges.

3.1.4 Class IV: Located at the hillside for cultivation, but not in the environmental sensitive areas.

3.2Process of Classification

3.2.1 Defined Boundary of Farmland: Only the land within the agricultural area are for evaluation and classification, not including the areas of eco-resources conservation, landscape conservation, water conservation, and potential hazard etc.

3.2.2 Collect Maps: Collecting related mapping data is the primary work for farmland classification. Some of those data have already been collected via agricultural land resources inventory. Some were completed by other agencies, e.g. productivity map, irrigation/drainage map, important crop production areas, etc.

3.2.3 Develop theClassification Criteria: Criteria for classification are discussed through many times of the expert consultation.

3.2.4Grading Principle: By definition of grading and the results of the expert meeting, the sequence of grading is first Class I, while the second order is Class III and Class IV, the last order is Class II.The grid system has been introduced into this analysis according to the road or river boundary to define the smallest partition unit. Those partition units have been integrated into polygon format and been analyzed via spatial data overlap techniques.

3.2.5 Results Review: According to the above-mentioned methods of classification and the application of geographic information system techniques, the classification of agricultural development areas has completed. In order to make the results more useful, the check mechanisms has been set up, which includes to check the results with the aerial photographs and on-site checking by townships official.

3.3 Classification Criteria and Designation of Agricultural Areas

3.3.1 Criteria: The criteria are given in Table 2.

Table 2 The classification indicators of agricultural areas

Class	Characteristics	Mapping Criteria
Class I	• With good production environment	• Important agricultural development area
	■ Maintain food security	•Rice suitability Class I or Class II areas •Hillside classification criteria is Class I to Class II
	• Has invested in major improvements in agriculture facilities	•Irrigation area •Important agricultural operations area or agricultural production areas
	• Large-scale and full of agricultural land	•analysis unit within the area of agricultural land greater than 25 ha and % of agricultural use is ratio greater than 70%
Class II	• Still has good agricultural production environment	• The same with Class I
	■ Not reach a certain size or the situation is scattered	•Agricultural land less than 25 ha or agricultural use less than 70%
Class III	• can produce the food of agricultural land	•Agriculture use
	• Vulnerable to external factors interfere with agricultural land	•Neighboring the specific area of the high-speed rail, interchange, industrial zone, science park, urban development areas, and the use of agriculture is less 30%.
Class IV	• Located in hillside and does not belong to the conservation areas	•Hillside classification criteria is Class III to Class VI and not in the conservation area.

3.3.2 Analytical Methods: Many methods of land use suitability analysis techniques can be used to grade the agricultural development area, such as Point Method, Factor Combination Method, and Land Evaluation and Site Assessment (LESA). The Factor Combination Method is adopted in this analysis. The evaluation criteria have been organized according to their characteristics, resulting in a variety of combinations, to define different classes of agriculture areas. In addition, the software of ArcGIS is used to analyze the spatial data.

The Example of Classification

In order to confirm that the classification method is useful and suitable for the nationwide, Yunlin County was selected as a pilot project. Yunlin County is one of Chinese Taipei's major food production county, with 20 townships and 130,000 ha of land. The 78% of the land is located at plain area, and the other 22% at sloping area. The area of agriculture land is about 93,000 ha, for growing rice, grains, vegetables and other crops.

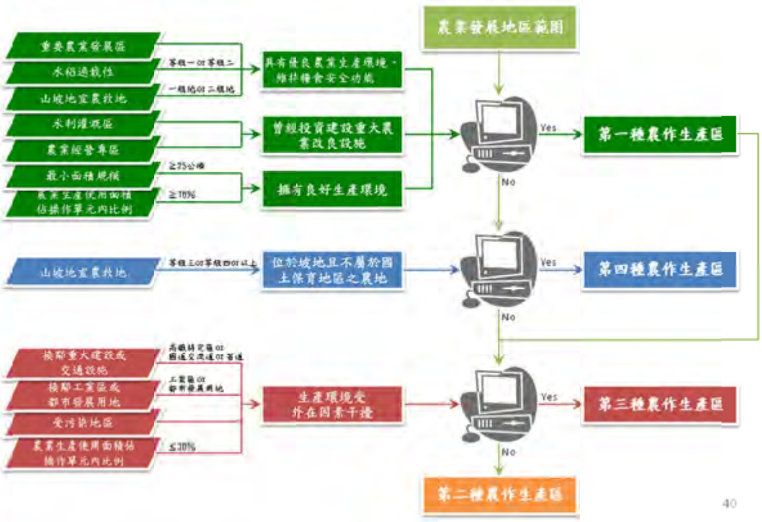

Figure 3: The flow chart of the classification of agriculture area

The main or subordinate agriculture area — The slope map = The main-road interchange area

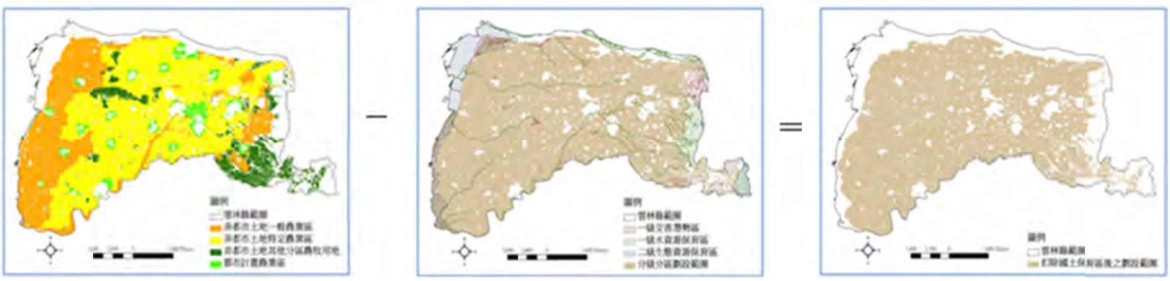

Figure 4: The agriculture area of Yinglun County

The suitable area for rice map — The irrigation map — Urban or industry area map

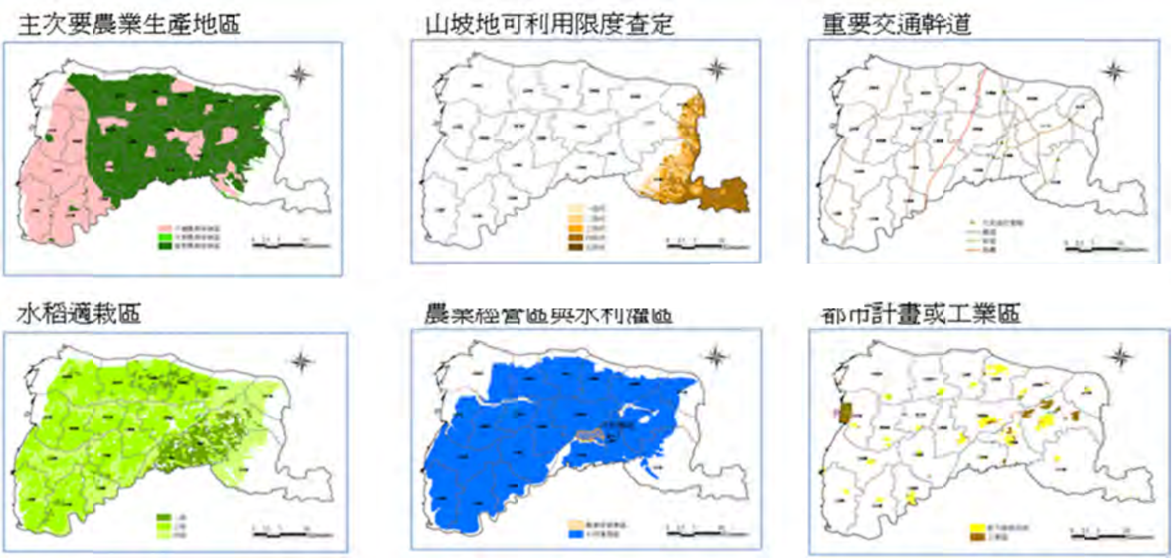

Figure 5: The analysis reference of classification in Yunlin County

In accordance with the processes mentioned above, the result of classification of Yunlin County is as follows:

Class I area in Yunlin County is about 54,000 ha, approximately 58% of the agriculture area of . Class III is about 24,000 hectares, approximately of 26% , Class IIis about 12,000 hectares, accounting for 13%, and Class IVis 3,000 ha, approximately of 3% of agriculture area.

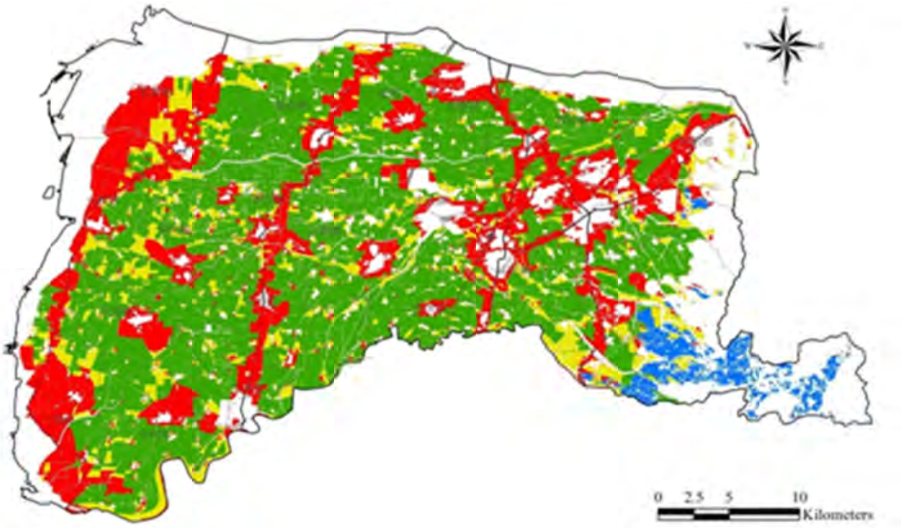

Figure 6: The classification results of Yunlin county agriculturearea

In order to check the reasonableness of this analysis, some sentinel points has been chosen for spot checking, including the Google map and on-site inspection. Through this inspection, it is confirmed that the analysis is good for the farmland classification in Chinese Taipei.

Figure7:The result is checked with the google map

4 MANAGEMENT STRATEGY OF AGRICULTURAL LAND

In order to achieve the policies of maintaining agricultural production environment and implementing agricultural land for agriculture use, four types of agricultural zone are as follows:

4.1 Class I: The agricultural land in this class is primarily for food production. It is the main agricultural production areas in Chinese Taipei. These areas are also the primary areas need to be actively engaged in public facilities for agricultural production by the Government, e.g. subsidies of production and marketing facilities, farmers counseling measures etc. in order to maintain agricultural production environment. Furthermore, not only the fallow land in this class has to be limited, but also prohibit the conversion of agriculture land in this class to other uses. In case the conversion is inevitable, the buffer zone between the converted area and the agricultural area has to be set up to protect the agricultural production environment.

4.2 Class II: This area is maintained for agriculture use as well. Some agriculture resourceswill also be invested to improve the agriculture environment, but mostlyto support non- production use, such as leisure agriculture. When it is inevitable to alter the agriculture land for non-agricultureuse, the feedback mechanism and the buffer zone for conserving the agriculture land have to be designed and built up.

4.3 Class III: The current situation is for agricultural use, but the region is suitable for large-scale agricultural marketing or processing facilities. The place can be allowed for converting to another use.

4.4 Class IV: The region is located on the hillside but still good for agricultural use. Soil and water conservation are the firstpriority consideration. The agricultural practicein this area should not affect the eco-environment.

5 CONCLUSION

Chinese Taipei had never conducted a comprehensive survey or land evaluation for agricultural land resource. Thistask compiled basic spatial data of agricultural land, and the distribution of agriculture area.The mechanism of correction and adjustment data will be established, and the results can be applied into the agriculture policy making.The principle of designating agricultural areas is based on the conditions of production and the location of the agricultural land. The results of this task can be used for choosing the land which is suitable for fishery, pasture or other uses. Follow-up, the outcomes of space analysis will guide the input of the resources intospecialized production areas, and the rational use of the agricultural land. In the future, continuing inter-ministerial communication and improvingthe laws of agricultural land management are important works for maintain the agriculture resources. Besides, in order to avoid improper conversion of agricultural land, itis necessary to check its necessity, reasonableness and irreplaceable into consideration, and review carefully.

Community Participatory Network on Sustainable Land Management: A Case Study on Saline Soil in Northeastern Part of Thailand

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ABSTRACT: Saline soils in the northeastern part of Thailand cover an area of 1.841m ha, which causes reduction of crop growth and yield. There are three land management schemes depending on salinity levels; (1) improvement of slightly and moderately saline soil for better crop cultivation, (2) rehabilitation of severely saline soil, and (3) prevention from saline soil distribution. The best management practices were selected for each affected area in order to get more saline soil management efficiency.

The project on "Community participatory network on sustainable land management: A case study on saline soil" was carried out at Nakhon Ratchasima and Khon Kaen provinces in 2011. The building network was under taken as followings. The first step was to collaborate all organizations that involved in salt affected area for building network relied on Landcare (Australia) concept. The second step was to gather all stakeholders from two provinces in the meeting to achieve the action plan in the community and household levels. The third step was to manage the workshops at two effective communities; Ban Nong Suang and Ban Pundung, Nakhon Ratchasima Province for their action plan. The finally action was to establish the community action plan.

KEYWORDS: Land management schemes, stakeholder, salt affected area, saline soil management, Landcare concept, community action plan.

1 INTRODUCTION

Salinity problem in the northeastern part of Thailand is an important issue, which covers an area of 1.841m ha and classified as slightly, moderately or severely salt-affected soils (Soil Survey and Land Use Planning, 2006). Salinity adversely influences plant growth, dramatically decreases yield and degrades agricultural productivity by impeding water uptake, imbalance of plant nutrients and accumulation of toxic ions (Luttge et al., 1984; Sharma, 1984). There are three land managements depend on salinity levels; (1) improvement of slightly and moderately saline soil for better crop cultivation, (2) rehabilitation of severely saline soil, and (3) prevention from saline soil distribution (Arunin, 1996). The best management practices were selected for each affected area in order to get more saline soil management efficiency and to achieve more sustainable resource use. However, the soil problem situation cannot solve by one agency alone. So stakeholder participation on sustainable land management should be concerned. Stakeholder is an important part and has many benefits in natural resource management such as making a better decision, increasing public understanding and helping agency to reduce the misunderstanding in existing management strategies (NOAA, 2007). Citizens have a chance to comment before decisions are made. There are many methods and techniques for gathering stakeholder input on a topic, creating dialogue and making decisions, such as advisory group, field trip, focus group, interview, large group/small group meeting, public meeting and workshop (Creighton, 2005). The perspective of public participation provides appropriate process, selection techniques, making a general agreement and evaluating the process. Furthermore, the participation efficiency depends on information that community received. Reid (2000) summarized that community participation is one of the key factor that empowered community success. These activities are similar to the

Landcare System in Australia. Curtis and De Lacy (1996) summarized that Landcare group activity will produce more awareness and informed, skilled and adaptive resource managers with a stronger stewardship ethic will gradually increase the adoption of sustainable resource management.
Thus the objective of this project was to find out the initiation community participatory network for management salinity problem in the northeastern part of Thailand.

2 METHODOLOGY

The project was carried out at Nakhon Ratchasima and Khon Kaen Provinces in 2011. The building network was undertaken as follows:

(1) The first step was to collaborate all organizations that involved in salt affected area for initiation network based on Landcare (Australia) concept. The Office of Research and Development for Land Management (ORDLM) of the Land Development Department collaborated with the LandDevelopmentRegional Office 3 in Nakhon Ratchasima Province, LandDevelopmentRegional Office 5 in Khon Kaen Province and Sukhothai Thammathirat Open University (STOU). They work together for setting up the project, selecting study area, assigning responsibility and planning initiation the network.

(2) The second step was to gather all stakeholders from two provinces to create an action plan. The ORDLM informed about the importance of salinity problem and how to manage the problem, while STOU explained how to design participatory process. Then all the stakeholders were divided into small groups having 10-12 persons per groups. Focus group technique was used to define the problem and how to manage. Several focus groups were set up and participants could be chosen randomly from the communities. The officers played role as facilitator. Brainstorm was used to find out the agreement of the action plan and then action plan was presented by the group leader.

(3) The third step, i.e. the workshop technique, was initiated. The two effective communities - Ban Nong Suang and Ban Pundung, Kham Tha-le So District, Nakhon Ratchasima Province - were selected for setting up the action plans. Staff of LandDevelopmentRegional Office 3 (Nakhon Ratchasima Province) informed valuable information about land resource, land use, water resource, land holding, salinity problem and management. The STOU lecturers explained the participation process. Then stakeholder would brainstorm to find out the best practice for their communities.

(4) The final step was to establish the community action plan.

3 RESULTS

From the first meeting, Nakhon Ratchasima and Khon Kaen Provinces were selected as study areas for initiation network as these two provinces have a large area of saline soil, 0.616 and 0.329 million ha, respectively. The staff was assigned responsibility and work plan was designed.

3.1 To Create the Action Plan

Stakeholders from the two provinces were invited to the workshop, which was held during 16-17 August 2011 at the LandDevelopmentRegional Office 3 in Nakhon Ratchasima Province. In this process, the ORDLM informed about salinity problem and how to manage, while STOU lecturers explained participation process. All stakeholders were divided into 10-12 persons per groups. Focus group technique was used to define their problem and how to manage it. Stakeholders were active and significantly involved in a consideration. Their ideas were useful for final decision based on complete information. The best management practices were selected. Then the group leader presented the results. The stakeholders created two action plans, community and household levels, which are shown in Tables 1 and 2.

(a) (b) (c) (d)

Figure 1: (a) ORDLM officer informed about salinity problem, (b) STOU lecturers explained the participation process, (c) group discussion, and (d) presentation of the action plan

Table 1Action plan for saline soil management in community levels

Activities	Process
.1To better understanding about saline soil management.	1. Setting up the meeting for better understanding of all landholders, coordinating with related organizations.
.2 To reshape the land.	2. Setting up the meeting for better understanding of all landholders, coordinating with related organizations.
.3To set up the compost and bio-extract user groups.	3. Assembling all farmers that produce and use compost and bio-extract for group setting and learning from the successful communities.
4. To set up the Khao Duak Mali 105 rice producer group.	4. Selecting all farmers that produce Khao Duak Mali 105 rice for group setting. Appropriate cultivation practices, such as suitable land preparation, using pure seed, etc. are employed.
5. To promote reforestation.	5. Planting communityforest, reforestation on levee for conservation of soil moisture content, mitigation global warming problem, making firewood and controlling groundwater level.

Table 2 Action plan for saline soil management in household levels

Activities	Process
1. To reclaim land by using organic fertilizer	.1Employing organic amendments such as farmyard manure, compost, green manure, rice husk, incorporation of stubble will be used for agricultural production.
2. To reshape the land	.2 Levelling the land, construct drainage system and farm road, grow perennial trees on levee.
3. To grow salt tolerant crops	3. Selecting salt tolerant crops for planting in saline soil, such as Khao Duak Mali 105 rice; *Sesbania rostrata* is used as green manure.
4. To look for alternative land use.	4. Changing land to aquaculture for severely saline soil where cash crops cannot grow.
5. To plant alternative crops after rice	5. Growing vegetable crops, such as lettuce, parsley and shallot.
6. To provide water resource for agriculture	6. Community leader contacts Land Development Department for providing water resource in the community.

3.2 To Find Out the Best Practices

Workshops for initiation network were held at the two effective communities. The first was held at Ban Nong Suang on 19 September 2011 while the second at Ban Pandung on 20 September 2011**.** The results are described below:

3.2.1 At Ban Nong Suang: This site has a total area of 2,453 ha, while saline soil covers an area of 958 ha. The main crops are rice and cassava. The results from the brainstorm of 39 participants showed that suitable action plan for salinity management depended on salinity level, which is classified as slightly, moderately and severely saline soils (Table 3).

Table 3 Best practices for sustainable salinity management at Ban Nong Suang

Slightly saline soil	Moderatelysaline soil	Severely saline soil
.1To reclaim land by using organic fertilizer. .2To provide water resource. .3To reshape the land. .4To produce Khao Duak Mali 105 rice variety. .5To grow salt tolerant cash crops. .6To select the salt tolerant trees for growing.	.1To set up the meeting for better understanding about salinity problem and management. .2To reclaim land by using organic fertilizer. .3 To reshape the land and make drainage system. .4To provide water resource. .5To select the salt tolerant trees for growing.	.1To set up the meeting for better understanding about salinity problem and management. .2To reshape the land. .3To reclaim land by using organic fertilizer and gypsum. .4To select the salt tolerant trees for growing.

3.2.2 At Ban Pandung: This site has a total area of 3,948 ha, while the saline soil covers area of 2,251 ha. The main crops are rice, cassava, corn and water melon. The results from the brainstorm of 38 participants showed that the suitable action plan for salinity management depended on salinity level, which was classified as moderately and severely saline soils (Table 4).

Table 4 Best practices for sustainable salinity management at Ban Pandung

Moderatelysaline soil	Severely saline soil
.1To set up the meeting for better understanding about salinity problem and management. .2To reclaim land by using organic fertilizer. .3To reshape the land. .4To provide water resource .5To grow salt tolerant trees	.1To set up the meeting for better understanding about salinity problem and management. .2To reshape the land. .3To reclaim land by using organic fertilizer. .4To look for alternative land use.

(a) (b) (c) (d)

Figure 2: (a) Land Development Regional Office 3 officer informed land resource, (b) STOU lecturers explained the participation process, (c) group discussion, and (d) presentation the action plan.

The results from the two workshops indicated that sustainable land management depended upon salinity level, location, socio-economic and public agreement.

The project evaluation is an important step after the workshop. The participants should be evaluated in both the process and outcome by using a questionnaire. This will ensure not only a process achievement but also long-term objectives and outcomes as well (NOAA, 2007).

Lastly, when the community action plan was established, the action plans would emphasize on community participation. The selected practices should include prevention of saline soil distribution, reclamation of slightly and moderately saline soil for better crop cultivation, developing the use of underground water in recharge areas for reduction the water table and reducing distribution of saline soils in the discharge area. The evaluation of influence factors such as salinity, groundwater level and socio-economic background should be concerned.
The participatory concept was recently implemented in 2012. The farmer network using underground water in recharge areas are launched in both Nakhon Ratchasima and Khon Kaen

Provinces**,** which mainly aim is to increase efficiency of groundwater utilization. This implementation project would lower the groundwater level which results in salinity control.

(a)

(b)

Figure 3: Initiation network at (a) Nakhon Ratchasima Province, (b) Khon Kaen Province

4 CONCLUSION

The salinity in the northeastern part of Thailand is an important problem, which cannot solve by any agency alone. The community participation is the key factor for salinity management success. All stakeholder participation together with the possibility of useful information that obtained will be determined the suitable method. The community participatory network would be the appropriate approach not only for fulfilling the goals but also salinity solving as well.

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Food Security and Land Management in Viet Nam

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1 INTRODUCTION

Food security is the matter concerned by most countries in the world, especially after the global food scarcity at the end of 2007 and at the beginning of 2008, which had negative impacts on political and economic situation in many countries in Asia, Africa and Latin America.

In the 21st century, there are rising elements of food insecurity such as rapid increase of population, decreasing agricultural land, global climate change, natural disasters, cattle and plant diseases, financial crisis, etc. So countries in the region and in the world have to strengthen cooperation to find out solutions.

In Viet Nam, for the industrial development, land of agricultural production is shrunk. On the other hand, because of rapid increase in industries and services, the ratio of agriculture in GDP continues to reduce. However, the role of agriculture, especially of food, has never been discounted. Its role is more and more important, i.e. the creation of 26 million jobs, main source of income for 62 million rural people, material supply for processing industries, increase of foreign currency for Viet Nam from 4.2 billion US$ in 2000 up to 16.47 billion US$ in 2008, and especially ensure the national food security and improvement of rice export.

Therefore, the analysis of reality, shortcomings and challenges in food production in order to design the policies plays an important role to the national food security.

2 FOOD PRODUCTION IN VIET NAM

For five years during 1996-2000, the food production in Viet Nam (rice, corn, sweet potato, cassava) continuously increased 1.3 million tons per year (from 31.7 to 38.1 million tons). The average increase is 4.7 percent per year (three times more than the population increase). For food such as rice and corn, it was increased from 27.93 to 34.53 million tons with the average increase of 1.32 million tons (5.5 percent) per year while the average population increase was 1.5 percent per year.

From 2000 to 2008, the food output (rice, corn, sweet potato, cassava) has continued to increase from 38.1 million tons in 2000 to 52.4 million tons in 2008. It is an increase of 14.2 million tons and the average increase is 1.8 million tons per year. For food crops such as rice and corn, there is a slow trend of increase compared to the previous five years. It increased from 34.5 million tons in 2000 to 42.9 million tons in 2008. It was an increase of 8.4 million tons and the average increase was 1.05 million tons equal to 2.75 percent per year and 2.2 times more than the population increase.

In food production, rice is the main crop in Viet Nam. Its plantation covers more than 70 percent food output and more than 90 percent grain output. For the last eight years (2000-2007), because of rapid urbanization and industrialization, the rice area decreased quickly from 4,337 million ha by the end of 2001 down to 4,13 million ha in the beginning of 2007. It was a decrease of 206,800 ha. Thanks to scientific and technical application, especially in seedlings and hydraulic system investment, the average rice yield in Viet Nam is among the highest ones in Southeast Asian countries and 17 percent higher than average yield in Asian countries. However, it is only 75-77 percent of the yield in China, Korea and Japan.

Thanks to the increasing yield, the average rice output in 2000-2008 was 35.11 million tons per year, an increase of 5.71 million tons than that in the period 1996-2000. In 2008, regardless of natural disasters and insects, it was the year of the highest output of 38.73 million tons.

After rice, corn is the considered for the food demand. There is a big demand of corn for animal husbandry. The area of corn plantation continuously increased since 2000. It was 730,000 ha in 2000 and 1,076 million ha in 2008. It was an increase of 346,000 ha. For the last decade, there was the application of many breeds of hybrid corn with high yield and quality. The percentage of hybrid corn in Viet Nam increased from 45% in 1997 to 90% in 2007. In 2008, the corn output in Viet Nam was 4.4 million tons equal 2.2 times increase more than that in 2000.

Thanks to production output increase, the food grain per capita increased from 370 kg per year to 444.9 kg per year (4.75 % per year increase) in the period 1996-2000. In 2008, the grain output was 42.996 million tons, an average of 500 kg per capital and an increase of 55kg per capita more than in 2000. Most of population got sufficient food for consumption. Since 1989, Viet Nam became rice exporter. In 1989-1995, it exported on the average 1.849 million tons of rice a year earning 359 million USD. In 1996-2000, this number was 3.67 million tons of rice per year worth 900 million US$. In 2001-2008, it amounts to 4.27 million tons worth 1.2 billion US$, which were 16.3% of exports and 33.3% of the value higher than in the period 1996-2000.

3 SHORTCOMINGS AND CHALLENGES

3.1 Rice Production Decrease

According to the Statistics Bureau, in 2000-2005, there were 366,400 ha of agricultural land (about 73.290 ha/year) were turned into land of non-agricultural purposes, including of industrial parks as 39,560 ha (11%), urbanization as 70,320 ha (19%), infrastructure as 136,170 (37%), administration office as 23,269 ha (6%) and other purpose as 89,504 ha (27%). The decrease of agricultural land, especially of rice cultivated land affected the development of agriculture and food production. The capacity of food supply was affected such as the rice average output per capita in 2005 was 431 kg per capita per year while it was 426 kg per capita per year in 2006 and 421 kg per capita per year in 2007.

3.2 Rice Producer Low Income

According to statistics in the Rural Survey in 2006 by the Statistics Office, the profit after production was 3.141 million VND per ha (equal 150.3 USD per ha).

Now, the profit after production is not more than 2 million VND. If including their own labour (accounting for 16.64% of the cost), the profit was about 3 million VND per ha (equal 143.6 US$ per ha).

The area of agricultural land, especially rice land per household is small so the farmer household income is much lower than the urban household. In addition, the rural households have to pay about 2.5% of their income for many things, such as irrigation, infrastructure fees. Thus, rice producers are very difficult to invest in production, accumulation and living demand.

3.3 Increasing Demand of Food and Foodstuff

In 2007, population was more than 85.1 million. It is forecast that population continues to increase in two ways. Firstly, for rapid increase of population as 1.5 % in the period 2000-2010 and 1.3% in the period 2011-2020, the population will be 100.5 million in 2020. Secondly, for the average increase, the percentage is 1.4 and 1.2%, respectively, and population will be 98.7 million in 2020.

To be certain in the food security plan, if the population will be about 100 million in 2020 and stable as 120 million after 2030, the food demand of Viet Nam will be 53.2 million tons in 2020 and 58.3 million tons in 2030.

As population increases, food and foodstuff demand increase in both quantity and quality. While the rice demand decreases, demand for meat, fish, eggs and vegetables will increase. Therefore, food for animal husbandry will increase. Part of rice cultivated land will be used for planting vegetables and food for animal husbandry as well as aquatic farming to meet the food and food stuff demand.

3.4 Decreasing Land of Agriculture

According to Land Laws 2003, land users shall be permitted to use land for planting annual crops, for aquaculture and for salt production are 20 years and to use for planting perennial crops and forests are 50 years to family households and individuals. More over, the law said that the quota on allocation to each family household or individual of land for planting annual crops, land for aquaculture and land for salt production shall be no more than three hectares of each type of land.

However, the number of households which gets fewer than 0.5 ha of land per household account for 61.2%. There are some places in Red River Delta and the central region where the cultivated land is as small as 0.3 ha per household.

For the last five years, the wet rice area decreased 41,000 ha per year for non-agricultural purposes or turned into aquaculture or other plants.

To achieve the goal of being an industrialized economy in 2020, the land demand for infrastructure, industries, services and urbanization is very big. It is estimated that the demand is about 400,000 ha in 2009-2020, out of which there are at least 270,000 ha of rice. From 2020 to 2030, the demand will be about 100,000 ha, out of which there are 55,000 ha of rice land.

On the other hand, in order to meet the food and foodstuff demand and increase of land use, some land area in wet land, suburbs or sea coastal areas will be turned into aquacultural land or planting other trees for higher economic returns. These lands will be about 130,000 ha in 2020

Table 1 Estimate of rice land turned into other purposes (in 1,000 ha)

Period	Total area	Non-agricultural purposes	Other plants
2008-2010	80	50	30
2011-2015	150	100	50
2016-2020	170	120	50
2021-2030	100	55	45
Total	500	325	175

3.5 Climate Change Impact

According to the Viet Nam Institute of Meteorology, Hydrology and Environment (IMHEN), in term of ten years (2000-2010), the annual average temperature in Viet Nam increases about 0.1^{o}C and sea level increase about 2.5-3.0 cm/year. It means that there were from 10,000 to 15,000 ha per year be lost by salinity infection in the Mekong River Delta.

Intergovernmental Panel on Climate Change (IPPC) forecast that Viet Nam is one of five countries in the world that could face impact of sea level increasing by climate change. Suppose that the temperatures increase 20^{o}C, sea level would increase by a meter. It was forecasted that 100 years ago, the land could be lost from 1.5 to 2.0 million ha in Mekong River Delta and from 0.3 to 0.5 million ha in Red River Delta by salinity infection or inundated.

4 SOLUTIONS FOR FOOD SECURITY AND LAND MANAGEMENT

4.1 Develop Food Production and Keep the Cultivated Land

Development of rice cultivation is based on the stable land area in Mekong River Delta and Red River Delta, protection of current land area at 3.8 million ha. Select the high yield breed and expansion of effective intensive agricultural methods, completion of irrigation system for intensified agriculture and reduction of losses after harvest for the ultimate purpose of national food security at the stable population of 120-130 million people.

At the mountainous and remote areas, it is the investment in small irrigation system together with terraced fields. Strengthen agricultural extension promotion and farmers' support to meet local food demand and enhance the national food security.

There are 18 provinces and cities which have the food per capita below 300 kg. 6 out of these provinces and cities have small area of rice land and the trend of turning rice land into urban land. The solution is to increase production in other provinces. For other 12 provinces, continue the investment in small irrigation systems, terraced fields, support of new varieties and techniques to meet the local food demand.

According to calculation by MARD, total demand is 40,1 million tons of rice for domestic consumption and export in 2010. Similarly, total demand is 41.1 million tons of rice in 2015, 43 million tons of rice in 2020 and 45.3 million tons of rice in 2030.

According to calculation, the land area for rice cultivation needs to be maintained at 4.05 million ha in 2010, 3.85 million ha in 2015, 3.8 million ha in 2020 and stable at least 3.6 ha after 2020 out of which the rice land is 3.2 million ha. Then the rice output will be 38.6 million tons in 2010, 39.6 million tons in 2015, 41.3 million tons in 2020 and 42.2 million tons after 2020.

Table 2 Plan of rice production in Viet Nam to 2020-2030

Year	Rice land (million ha)	Land where rice is cultivated (million ha)	Yield (quintal/ha)	Output (million tons)
2007	4.10	7.20	49.8	35.8
2010	4.05	7.30	52.9	38.6
2015	3.85	7.05	56.2	39.6
2020	3.70	7.00	59.0	41.3
2030	3.50	6.80	62.0	42.2

To harmonize the development in different sectors in the trend of industrialization and urbanization, the minimum method is to keep the rice land at 3.6 million ha. For selected methods, land of two crops must be 3.2 million ha.

4.2 Prevent and Mitigation of Climate Change Issues

Recommended solutions to prevent and mitigate climate change issues to relate with food security are the following:

- Establishing networks to monitor and warn disasters (flood, storm, etc.); for the people living in the dangerous areas.

- Investing infrastructures to prevent and mitigate natural disasters; for example forest planting in highland and coastal areas, breakwater building.

- Encouraging the scientists to research on new seedling, breeding and advance cultivated practices and processed technology system adapted with climate change; for example new rice variety can grow in drought, salinity, and floodland areas.

4.3 Policy of Agricultural Land Management and Protection

For sustainable agricultural land management, the concern of the Viet Nam government is to amend some contents in Land Laws 2003 related to agricultural land, especially rice cultivated land as follow:

- The government should manage land through strategy, land use plan and allocate to households for long term use.

- Transfer and rent of land use rights and encourage users in land movement, land accumulation for scale production to be applied according to the market system. Implement integrated administrative and economic solutions to protect rice land area.

- To make policies for expanding appropriate land quota on allocation, transparent in land users and procedures for rent or transfers or change of land use purposes.

- To have policies to support people changing their occupations, land accumulation for experienced land users or whose get capital for investment in plantation, agricultural businesses in rural areas.

- To assign functional agencies to do research on land expansion in specific regions, expansion of rice land rent to expand the scale of production. The expanding scale will be easier to apply advanced science and technology, disease prevention, intensive cultivation for more effective and sustainable food production.

- Clearly regulate responsibility and liability for authorities at different levels in agricultural land management, especially rice land. Rice land collection must be decided by the Prime Minister. Assign the land management agency to manage and plan the production together with land use, cultivation methods and land reform.

- Regulate principles of changing land use purposes to encourage development of industrial parks, urban areas in coastal and hilly areas.

- Adjust the land collection policies to harmonize benefits among the state, investors and affected land users; regulate mechanism so that farmers can contribute shares in companies by the land use right value.

- There are policies limiting the use of rice land, especially rice land of two crops for non-agricultural purposes, except for special purposes of defence and security; increase the compensation price of the agricultural land or rice land for changing to other purposes.

- Simplify and clarify administrative procedures so that farming households can contribute the value of their rice land right use into enterprises for profits or become employees of enterprises. Some households contribute rice land in order to establish groups or agricultural enterprises and directly produce as well as to get their profits from their contribution shares as land use right.

5 CONCLUSION

As for last year, thanks to reforming policies by the Viet Nam Government, the production of food output in Viet Nam has achieved impressive results. From Viet Nam faced with hunger, Viet Nam has ensured national food security and become one of the biggest exporters of rice in the world.

For sustainable development and food security in the following years, Viet Nam has to develop food production by maintaining land for food crops at least at 3.6 million ha (out of which 3.2 million ha is wet rice land) after 2020. In order to reach this goal, Viet Nam must implement policies of managing and protecting the agricultural land by amending Land Laws 2003 related to agricultural land, especially rice land.

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Session 3: Technology and Approach

Australian Landcare Facilitation: Making the Most of the Volunteer Ethic

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ABSTRACT: Landcare is a powerful community-based non-for profit organisation, which was established in 1986 in the State of Victoria, to assist landholders with management of the fragile Australian landscape. Landcare is now managed at various scales; local, network, regional, state and national. In the State of Victoria Landcare involves more than 1,188 Landcare groups, including 62 Landcare networks, operating with a membership of 25,294 for networks and for Landcare groups 60,107 individuals, working together to shape the future of Australia's land, biodiversity and waterways. The proven success of Landcare is based largely on the utilisation of volunteer time – motivated by their sense of stewardship, enduring commitment and deep appreciation for Australia's sustainable environment. Landcare exists and continues to be resilient today because it recognises that people are its greatest asset and are drivers of the movement.The mix of individual volunteerism, facilitator support and government funding opportunities is required to ensure that Landcare delivers broad regional, state and national objectives. Monitoring and evaluating projects are essential for a long lasting project and future successes of project which is mostly the responsibility of the Landcare facilitator.

This paper discusses the successes and challenges of Landcare, the importance of facilitators and partnerships that assist with the community achieving their outcomes and state and national natural resource management aims.

Keywords: Networks, community, sustainability, communication, biodiversity, waterways

1 INTRODUCTION

The Australian Government recognises the important role Landcare and collective community action plays in management of Australia's environment and natural resources suitability. Refer to Appendix 1. The Australian Framework for Landcare identifies that the Landcare approach comprises:

- a philosophy, influencing the way people live in the landscape while caring for the land – the Landcare ethic,
- local community action putting the philosophy into practice – the Landcaremovement founded on stewardship and volunteers,
- a range of knowledge generation, sharing and support mechanisms including groups, networks from district to national levels, facilitators and coordinators, government and non-government programs and partnerships – the Landcare model.

Landcare has been funded on different levels since its initial formal establishment in Victoria in 1986. The movement was developed by Joan Kirner (former Minister of Conservation Forests and Lands) and Heather Mitchell (former Victorian Farmers Federation President) to help with issues arising from land degradation, in particular erosion, salinity and soil management. From this time Landcare groups have grown from 200 nationally to 5000 (De Hayr, 2012).In Australia, groups have grown from one in 1986 to 1,188 including 62 networks, operating with a membership of 25,294 for networks and for Landcare groups 60,107 individuals (Curtis and Sample, 2010).

Landcare groups have demonstrated its success by engaging around 40% of rural property owners as Landcare members (Curtis and Sample, 2010). At this scale, it is possible to make local scale changes, educate people in better land management (e.g. weed control, erosion and water quality) and create a sense of community.

At the Landcare network scale, Landcare groups can work together to achieve landscape scale outcomes.

Example: *The Gecko CLaN, a Victorian Landcare Network of 23 groups, who sought to conserve native pastures. Native pastures are an important component of Victorian grazing enterprises, are perennial and summer growing, and therefore are also important in sustainable production and maintaining biodiversity. However, many farmers replace native grasses with exotic species to improve productivity, as generally native grasses have less calorific value. A farmer recognised the importance of native pastures for other values, but also wanted to increase productivity. The Gecko CLaN facilitator was able to initiate trials of 'Pasture Cropping' where native pastures are retained and over sown with more productive, annual grasses. Pasture cropping has now grown in popularity and uptake, and national trials have begun. The design, promotion and success of this project would have been less likely if a Landcare Network Facilitator was not involved. The paid facilitator had the time and expertise to explore the pasture cropping idea, promote it and gain support through trials.*

For the broader community, school education programs have proven to be an effective means of educating the next generation. Projects such as 'Bugs in a Bus', 'Waterwatch' and 'Survivor' (targeting threatened species) are all examples of successful Landcare school education programs. These programs have educated 1000's of children and their parents through positive take home messages.
Nationally, the Junior Landcare program, through Landcare Australia Ltd, has provided useful information and challenges to educate students about biodiversity conservation, such as: the importance of native vegetation in providing habitat for wildlife; highlighting the importance of food security by growing vegetable gardens, and even teaching the students how to cook the seasonal vegetables grown in their school garden.

Because Landcare is supported nationally, there are many resources available to all groups and networks. This includes access to support information, technical advice, scientific knowledge, and other resources. The internet has proven valuable, as a good resource to keep the Landcare groups and Networks connected and informed. In Victoria, most of the Landcare resources are kept on the 'Victorian Landcare Gateway' <http://www.landcarevic.net.au> and groups and Networks are able to have their own pages and advertise their own events on this site.

Similarly, 'Landcare Online' <http://www.landcareonline.com> is a national Landcare directory which is managed by Landcare Australia Ltd. and has great resources that are aimed at Australia wide programs. The site holds a directory of Landcare groups, information on Junior Landcare, Coastcare, volunteer opportunities and funding opportunities.

Successful and popular, State and National Landcare Forums and conferences are held biannually or annually and are a great way to make connections with likeminded people, create networks and learn from each other and natural resource management experts.

2 LANDCARE FACILITATORS

Originally Landcare groups were formed in isolation of each other, however through time the need for collaboration on larger sub-catchment and regional scale projects was recognised. This has resulted in the formation of 62 Landcare networks across Victoria. Landcare networks are collectives of Landcare groups within a particular area (usually 10 or more Landcare groups) which have paid part/full time facilitator(s). Individual groups remain autonomous and can be involved in their Network to varying degrees. Networks provide the opportunity for efficiencies in the delivery of projects (e.g. wider reach of weed control and water quality management), provide a wider application of activities and deliver projects with landscape scale outputs, within a framework of regional, state and federal policies and strategies.

Although many volunteer hours are given to Landcare, the role of a facilitator is important in achieving landscape scale changes. Like many groups, however, funding for facilitators can be difficult to obtain. Funding is gained mostly through two sources: (1) grants for projects where facilitation can usually be

15% of the overall project budget, and/or (2) Government support. Currently the Victorian Government support for facilitators is high. For example, in Victoria the Department of Sustainability and Environment is funding 68 Landcare Facilitators. However, for the facilitator positions to be sustainable in the long term, the development of alternative funding options is required. The Landcare Corporate Partnership Facilitator assists with finding alternative funding for projects and facilitation costs.

The Landcare Corporate Partnership role has added value to Landcare across Victoria. This role has resulted in businesses supporting Landcare with in-kind, skills based and monetary support. For example, Bunnings, a large hardware chain, has been supporting the building of nest boxes, using materials supplied by the store and volunteer labor, often school groups. The nest boxes are then erected within a Landcare Group area, providing important nesting hollows for Australia’s animals.

Example:*Includes thousands of dollars being donated by BikeTREES to Landcare groups to plant native trees for an on-going project. BikeTREES is an organisation that was established to create a green image for bike events and participants. Encouraging people to buy a tree to cover the carbon foot print of a person’s travel to a bike event.*

3 RESPONSIBILITIES AND AIMS OF A LANDCARE FACILITATOR

The Landcare Facilitator’s role is to make life easier for landholders to get involved in and take ownership of the issues affecting the way landholders manage the land, and to carefully lead landholders on a journey of up skilling and advancement in their chosen field. Communication is a valuable education method which can take many forms such as face to face discussions, group workshops and meetings, community newsletters, radio interviews, brochures, workshops, field days, farm walks, forums, newspaper articles, and letter box drops, etc. All methods aim to educate the broader community about the natural resource management issues in their local area and show broader impacts on the surrounding district.

Certain skills are required for a facilitator to be successful. A good facilitator has skills in personal communication; (observing, speaking, listening, questioning and probing, summarising, conversing and presenting), group development; (team work, participation, conflict resolution, balancing discussions, identifying group dynamics, teasing out the real issues and sharing of knowledge) and knowledge of natural resource management issues, strategies and policies at various levels.
The Landcare facilitator is responsible for:

- assisting the community with the formation, or reinvigoration, of Landcare groups
- building the knowledge, skills and self-sufficiency of Landcare groups and Networks
- networking and communicating with all Landcare groups and the general community
- communicating with partners and developing new partnerships
- establishing links with service providers and funding agencies
- monitoring and evaluating their projects
- reporting to funding agencies on project delivery, and
- selling success stories to the broader community.

The aim of the Landcare facilitator is to:

- empower landholders, groups and institutions to create and to respond to change
- create an environment for sharing and learning, using principles of adult learning
- support group/network activities and projects
- build up activities slowly and ‘drip feed’ information in line with the landholders learning pace so as not to overwhelm people with too much technology or too much information at any one time
- share different technologies from which the landholders themselves can choose those appropriate to their need, rather than providing a technology package for landholders to rigidly follow step by step; the facilitator need to source and gain access to a range of appropriate technologies, often in areas where they have little expertise

- balance the process and the technical content, while paying attention to both; the process side requiring a mix of social and interpersonal skills, while the content side requires a mix of technical knowledge and the ability to effectively source outside technical support. (Landcare Foundation of the Philippines, 2009).

Many Landcare groups and networks have never directly employed staff previously creating some challenges within the Landcare groups and networks. There are many different ways employment is managed within each region.

For example*:Some Landcare Facilitators are employed by their Catchment Management Authority where employment is management through the HR officers and is ideal employment of Landcare Facilitators. Others are employed by the local Landcare group or network which can be a challenge for some groups as workcover, insurance, superannuation, training and OH&S are items that need to be addressed to make sure facilitators are adequately and safely employed but some groups are unsure how to go about carrying out effective employment. This has been a learning curve for all concerned and training has been necessary to address some of the issues.*

4 LESSONS LEARNT

4.1 Communication

Education is one of the most common communication methods Landcare uses to get messages out to the broad community; it is also one of the hardest areas to evaluate change and to get funding for. Education takes many forms community newsletters, radio interviews, brochures, workshops, field days, farm walks, forums, newspaper articles, letter box drops and many more. They vary from expensive TV ads to the cheapest community newsletter but they are all trying to do the same thing, educate the community about the issues they see as important. With so many communication methods at Landcare’s disposal it is important to tailor your delivery messages and method to your desired audience.

The Landcare ‘brand’ is well known, and often the major group for individual participation, for old and new landholders alike. 68% of Australians aged between 14 years and over had heard of Landcare (Morgan, 2011). This level of awareness is extremely positive considering the changing landscape of non-government offices in the environmental sector and the proliferation of social media use in the non-profit sector (Landcare Australia Ltd, 2011).

4.2 Resources

Information and other resources are important for Landcare groups / networks to be able to have access to at all times and the internet is the best way to do this for most of Australia. However, internet access is a limiting factor in some areas of Australia; the size of documents needs to be kept in mind when dealing with remote areas. Resource information is readily available on State and National Landcare websites that are identified in the Introduction of this paper.

4.3 Challenges

Volunteers directing paid facilitators can be an issue if the volunteers are not prepared to manage facilitators or when they try to over manage facilitators. There is a fine line of directing facilitators and letting them run with project ideas of the group. There is an expectation by facilitators that employers have employment requirements under control, which sometimes in not the case. Dealing with conflict or issues that arise can also be difficult for volunteers to deal with, for these reasons the Regional Landcare Coordinators play a lead role with advice and support to the volunteer groups.

OH&S is an issue that needs to be addressed by Landcare at all levels. The safety of volunteers and staff is extremely important and every effort should be taken to have a safe working / volunteering environment. Information has been developed by Department of Sustainability and Environment Landcare staff to help Landcare work through these concerns.

Communication across Australia can be a challenge if the group operates remotely. Mobile phone service may not exist in some areas so UHF radio or satellite phones need to be used. Property sizes and distance travelled is a time issue with the average size of properties, Victoria has an average property size of 500-600 acres but in Western Queensland the average property is 300,000 acresand can take two days driving to inspect the property. All issues that need to be taken into consideration when employing a facilitator to carry out Landcare on-ground works.

4.4 Partnerships

Partnerships are a valuable resource and help develop connectivity to the community for government, corporate and community organisations. In cases where a strong partnership has been developed Landcare projects have been very successful and have generally involved the broader community. Partnerships can be on various levels involving local community groups, Parks Victoria, Local, State or Commonwealth Governments all which are equally important.

Partnerships improve networking and result in strategic outcomes based on efficient and effective project development and implementation. Efficiencies are gained through partnerships from community groups cost sharing, carrying out works in adjacent areas (e.g. spraying weeds has more value the larger the area that is involved); and working with agencies ensures a higher level of strategic priorities.

Example: *A fox baiting project in northern Victoria to protect a threatened species, the Bush-stone Curlew started by one community group identifying the threat to the Bush-stone Curlew. The Project was managed by the facilitator linking in with other land managers such as Parks Victoria. The facilitator talked to around 250 landholders individually to gain support for a large scale program and funding was applied for on behalf of the community by the facilitator. The application was successful and the coordinated baiting program was funded. A partnership was developed with the local sporting shooters group through the facilitator and monitoring was undertaken estimating the number of foxes prior to and after the baiting program. Landholders updated their Chemical User's Certificates through the running of a facilitated course run in conjunction with the Department of Primary Industry. A "beer and baits" day was organised by the facilitators for landholders to come and pick up their baits and then the baiting began over a one month period.*

5 STRATEGIES / POLICIES

Because Landcare is an individual entity, it is important to show some consistency of delivery to political bodies. Government needs this information for efficiency however it is not a priority to the average Landcare group and is generally managed by the Department of Sustainability and Environment Community Engagement and Landcare team.
The relevant strategies and polices that Landcare has worked towards in the past are:

- the Victorian Landcare Program Strategic Plan 2012
- the Victorian Action Plan for Second Generation Landcare: Healthy Landscapes – Sustainable Communities 2005 - 2009
- the Australian Framework for Landcare 2010 -2020

Facilitators can understand and use these strategies and policies to aim for strong alignment of Landcare projects with federal, state and regional strategies and policies.

HOW LANDCARE LOOKS IN AUSTRALIA

Based in which Region	Position title	Role of position
Nationally	National Landcare Facilitator	There is one person in this role that advocates the Landcare ethos and supports community Landcare through an advisory role. (Landcare Australia Ltd website 2012)
Nationally	Landcare Australia Ltd.	A national, not for profit, non-political bipartisan origination which raises awareness and corporate sponsorship for Landcare.
State/Territory	Eight State / Territory Landcare bodies	Victoria, New South Wales, Queensland, Northern Territory, Western Australia, South Australia, Tasmania, Australian Capital Territory
Regional	Regional Landcare Facilitators	52 employed in each Natural Resource Management or Catchment Management Authority region. To facilitate climate change issues and improved agriculture practices.
State based in Victoria	Regional Land-careCoordinators	These 10 positions coordinate Landcare programs and supports Landcare groups in their region.
State based in Victoria	Landcare Facilitators themed based roles	These two positions, the Indigenous and corporate engagement facilitators engage specific areas of concern to the Landcare community and work across all 10 Catchment Management Authorities.
Landcare Networks in Victoria	Landcare Facilitators	68 people assist local Landcare groups / networks to facilitate funding, project development and general support.

6 CONCLUSION

Landcare is an influential and successful community driven movement working towards a sustainable future. Landcare relies on the volunteers working on the ground in local regions and are supported by state and federal roles which are aligned to national, state and regional policies and strategies. The facilitators support helps Landcare groups and networks achieve their aims and build the capacity of their Landcare groups, networks and the broader community. Communication at a range of levels is a critical skill for Landcare facilitators. Partnerships at various scales need to be strong and adaptable to achieve local, regional and state goals. The state and federal governments in Australia continue to support this nationally, successful, community-driven network.

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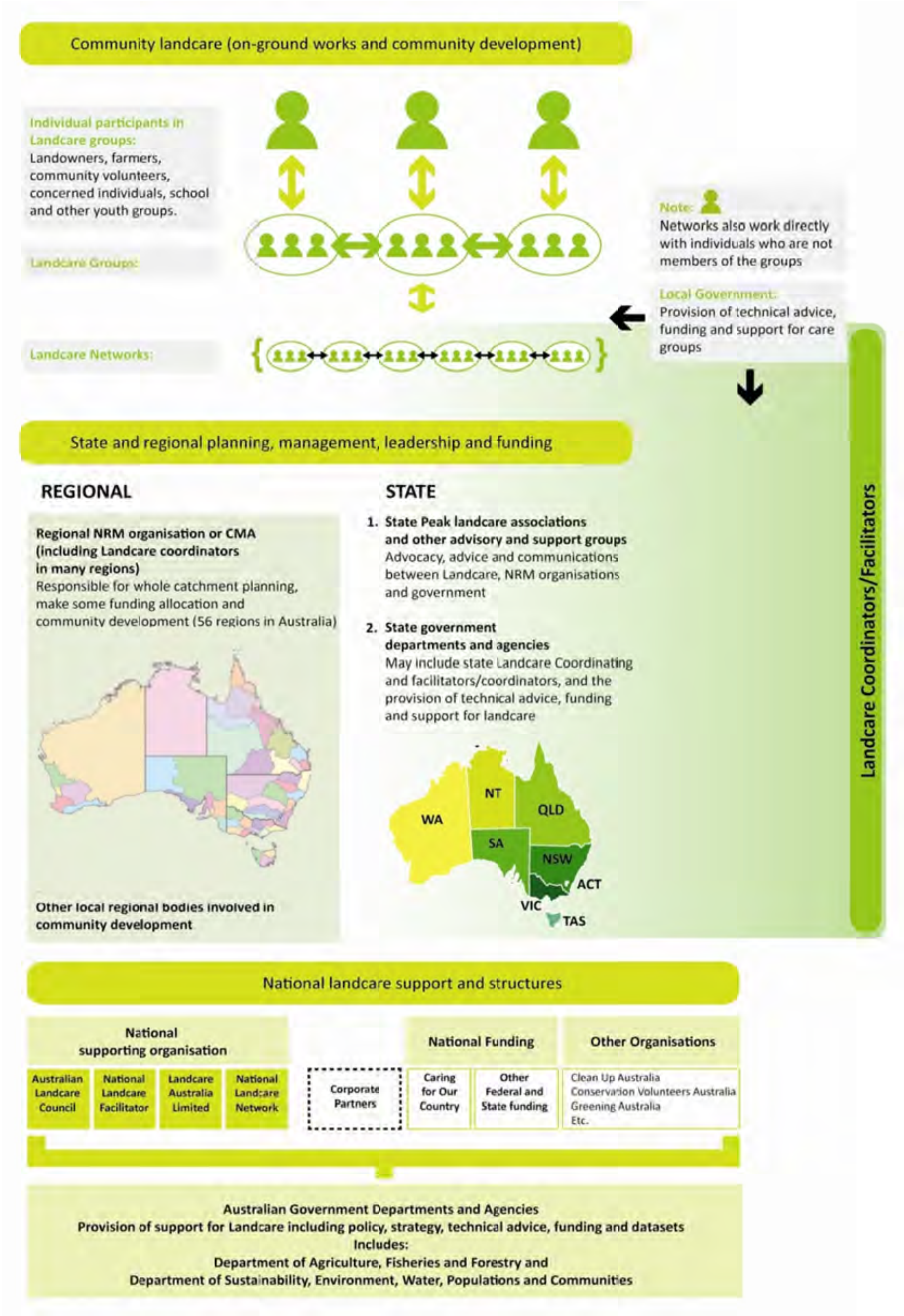

Figure 1: A schematic diagram of Landcare scales of management: from the group, network, region, state and federal Landcare.

Mapping Soil Depth Characteristics Using Digital Soil Mapping Techniques to Monitor Land Degradation

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ABSTRACT : Soil erosion is the main cause of land degradation in Indonesia. Extensive sloping land and high intensity of rainfall and unwise land management have accelerated soil erosion. Soil depth and the thickness of A-horizon are the two basic soil data required for the assessment of land degradation status in Indonesia i.e. erosion hazard evaluation and critical land assessment. Nevertheless, both data are rarely readily available in the existing soil maps. Meanwhile, Indonesia has voluminous legacy soil data in the form of legacy soil observation and legacy soil map. Using these legacy data, the digital soil mapping approach can be used to create a quantitative, soil property map. This study aims to create quantitative soil depth and A-horizon thicknessmap using soil-landscape models in the digital soil mapping framework. The study was performed in Upper Cisadane Watershed in Java, Indonesia. Soil depth map, map of A-horizon thickness, and reliability maps were created using environmental covariates and existing soil-landscape models. By comparing to the existing soil observation, 103 of 151 selected sites have the soil depth difference of 25 cm or less and 125 of 151 selected sites show the difference of 5 cm or less for A-horizon thickness data. The integration these soil property maps into national system of land degradation monitoring is then discussed.

KEYWORDS: soil depth mapping, soil erosion hazard, digital soil mapping, land degradation

1 INTRODUCTION

Land degradation is the process of declining land productivity, either temporary or permanently (Dariah *et al.* 2004). In Indonesia, land degradation is mainly due to soil erosion. Indonesia has extensive sloping land and high intensity of rainfall. Even, this erosion still takes place in the dry climate due to high intensity of rainfall notwithstanding low annual rainfall (Abdurahman and Sutono 2002; Kurnia *et al*. 2002).

In Indonesia, about 77% of total land havethe slope of 3% or more (Hidayat and Mulyani, 2002), or about 60% of total land have the slope of 8% or more (Subagyo *et al.* 2004). From total sloping land, about26 Mha is on the elevation of 700-2500 m above sea level (Kurnia *et al.* 2004) and 58 Mha is on the elevation of 700 m above sea level or less (Hidayat *et al.* 2004) of which about 86% is found in wet climate (i.e. Sumatera, Borneo, western part of Java, and Papua) and the rest is found in dry climate (i.e. some part of Moluccas, Celebes, and eastern part of java, Bali, and Nusa Tenggara).

The erosion rate in Indonesia varies with soil type, climate, slope gradient, and landuse type. Suwardjo (1981) found the erosion rate of 25 mm/year in Citayam Oxisols (West Java) on the slope of 14%and 3 mm/year in Lampung Ultisols on the slope of 3.5%. Abdurachman *et al.* (1985) reported the erosion rate of 14 mm/year in Punung Alfisol (East Java). PUSLITTANAK (1997) reported that 10.94 Mha of agricultural land (in 11 provinces) was classified as critical land due to soil erosion. In Indonesia, the term of degraded land is interchangeable with the term of critical land. Hence, land degradation becomes a national issue. Efforts are planned and performed to reduce and monitor this land degradation.

Soil depth and A-horizon thickness are key, basic soil properties being required for land degradation assessment in Indonesia. Soil depth is a basic data for erosion hazard evaluation (Hardjowigeno and Sukmana 1995). Also, soil depth and A-horizon thickness are soil properties being required for critical land assessment (Tim Puslittanak 1993). Nevertheless, both data are not readily available. The existing soil map does not provide both data in its legend. The map legend covers only landform group, parent material, slope class and relief, and soil subgroup. Thus, new soil survey and mapping must be conducted to measure these characteristics, but it consumes much time and costly. New approach in providing these data must be explored and developed continually.

The digital soil mapping approach (McBratney *et al.* 2003; Minasny *et al.* 2008) offer techniques to create a quantitative soil property map using either legacy soil data or new soil observations as data source. Indonesia has voluminous legacy soil data in form of legacy soil observation and legacy soil map. Using the combination of this legacy and auxiliary information (e.g. digital elevation model, geology map, agroclimate map, etc), soil-landscape model can be developed. Recently, Gastaldi *et al.* (2012) developed soil-landscape regression model to describe and predict the occurrence and thickness of soil horizon in Australia.

Previous study (Sulaeman 2012) has resulted soil-landscape models to predict spatial distribution of several soil properties in Java including soil depth and A-horizon thickness. This study aims to create quantitative soil depth and A-horizon thickness map using soil-landscape models in digital soil mapping framework. Information stored in these maps will be compared to the existing soil observation. Finally, the significance of these quantitative soil property maps in land degradation assessment and monitoring will be discussed.

2 METHODOLOGY

2.1Study area

The study area is the upper Cisadane watershed (106° 28' 03.38" E-106° 57' 06.19" Eand6° 27' 17.01" S-6° 47' 43.23" S) located in eastern part of Java island covering an area about 96221 ha (Figure 1). The watershed consists of moderate to very steep slopes with elevation ranging from 71 to 2607 m above sea level. The main rock types found in this area are volcanic intermediary and sedimentary coarse felsic, exposed since Holocene, Pleistocene, and Middle Miocene. The predominant soils in the watershed are Brown Latosols (Inceptisols) followed by reddish brown Latosols (Ultisols), and yellowish brown Andisols (Andisols) (BAKOSURTANAL 1987). The climate of the region is classified as tropical moist. The mean annual rainfall is 2700 to 5948 mm, with the highest monthly rainfall of 580 mm in January and the minimum of 167 mm in August. The watershed area can be broadly divided into four land use categories of rice field, mix garden, upland agriculture, and forest. The forests in the steep area are well protected.

2.2 Soil-landscape model

The soil-landscape model used for this study is model developed by Sulaeman (2012), where soil depth and thickness of A-horizon are predicted by environmental covariates. The models are as following:

$$SD = 112.18-0.000245\ SP + 0.012\ SL-1.585\ MRRTF -53.531CS +0.353CI \quad (1)$$

$$AT= 9.03 + 0.252MRVBF + 0.069FW +0.0031Elev -12.906CS \quad (2)$$

where: SD= soil depth (in cm), AT= thick of A horizon, SP= stream power index, SL=slope length (in meter), MRRTF=multiresolusion index of ridgetop flatness, MRVBF=multiresolution index of valley bottom flatness, CS=catchment slope (in degree), CI=convergence index, Elev=elevation (in meter above sea level), FW=flow width (in meter).

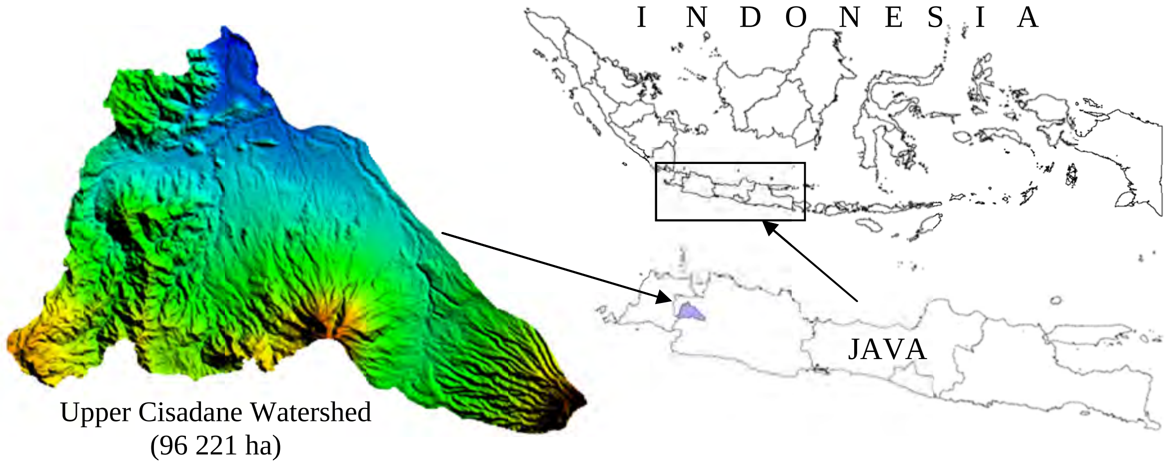

Fig.1 The location of study

2.3 Soil map creation and verification

Environmental covariates being required as input to model can be provided easily and cheaply.
The Equation 1 and Equation 2 require covariates than can be derived only from digital elevation model (DEM). So, firstly we downloaded SRTM DEM and clipped based on watershed boundary. Then, the covariates were derived from DEN using SAGA GIS. Once the covariatesare available, soil depth map and A-horizon thickness map are created using SAGA GIS. The resulted maps then compared with 151 existing soil observationstaken from previous soil survey.

3 result and discussion

3.1 Spatial variation of covariate to predict soil depth

Figure 2 show examples of covariates to predict soil depth distribution in the study area. The convergence index and stream power representflow characteristics and erosion characteristics. The convergence index shows flow characteristics either divergence for positive value or convergence into its cell for negative value. Higher positive value, more distribute the water and its solute and higher negative value convergence the water and it solute. On the site with positive value, flow bring removed from that site. Conversely, on the site with negative value, soil material is deposited in that area.
The potency for erosion is strengthened by stream power (SP), wherestream is apparently strong around river channel and decrease with the distance from river channel. Combined with convergence index, stream power index determines the erodibility of stream. The erodibility itself controls land surface stability. Lower soil erodibility, more stabile land surface are and higher the possibility to find deep soil is.
The MRRTF represent slope position. Multi resolution index of ridge top flatness is an index showing site position in slope extending from ridge top to valley bottom. Site having high value index is found in valley part where colluviation occur. On the other hand, small value index denote that site in ridge part where erosion is taken place.

Slope length represents slope characteristics and catchment slope represent watershed characteristics. The catchment slope (CS) indicate mean watershed slope. Slope is important in distributing energy for erosion and soil development. Soil erodibility increases with high slope. Meanwhile slope length related to potential erosion where high slope length high energy and higher erosion may occur.

The five covariates to predict soil depth can explain the capability of soil to erosion and deposition. Soil depth is the balance between soil formation and soil erosion. Soil erosion tends to shallow solum especially if soil erosion is accelerated by unwise human activity. Considering the erosion and deposition, soil can be differentiated into stabile soil where no erosion and deposition occur. It can be found in wide interfluves. In this area soil formation occurs and deep soil is commonly found. Instable soil is found in erosion surface, as in sloping land where erosion tend to shallow soil as upper part is loosed.

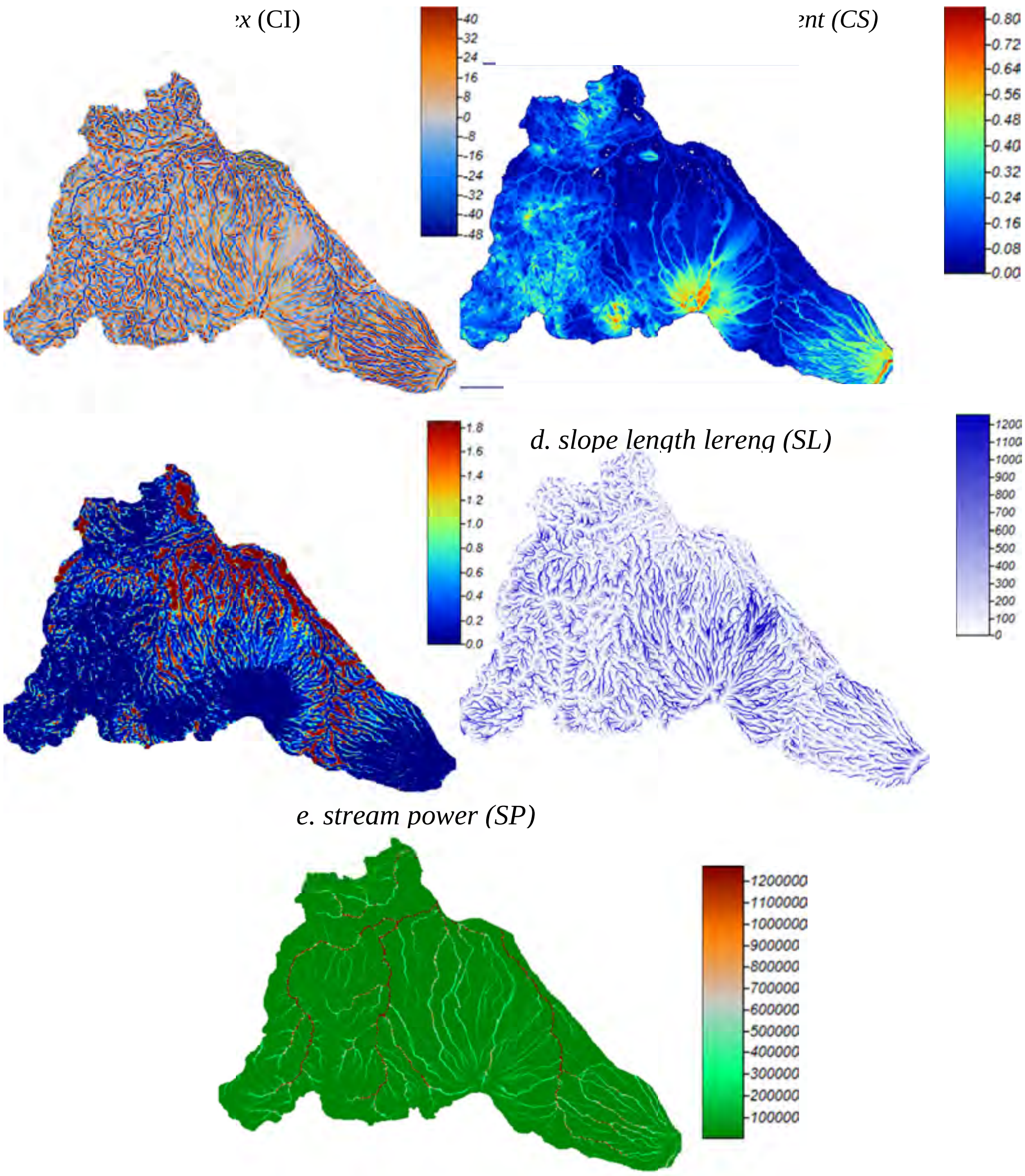

Fig. 2 Examples of covariate to predict soil depth characteristics

3.2 Soil depth map and its reliability

Figure 3 show predicted soil depth map. Different from conventional soil map being presented in polygon map, the digital maps are presented in grid map. The grid size (called resolution) controls the detail of presented data. The resolution of Figure 3 is 90 meter following the resolution of SRTM DEM as data source. It means that each value of soil depth represents the area of 8100 m^2 in the field. However, the resolution of resulted map may be less than 90 m depending upon the resolution of exercised DEM.
The maximum soil depth presented in Figure 3 is 220 cm. In fact the soil depth of 7 m or more still can be found in the field. The volcanic parent material in humid climate may cause soil depth occur due to intensive soil formation. However, the maximum value of the map is determined by maximum value of soil depth in the training dataset as soil-landscape model was built using this training dataset. Soil surveyor measure soil depth up to 200 cm or less as it is a requirement to name soil. This is the reason why the maximum value is 200 cm. thus, one must be careful in interpreting this predicted soil depth map.

In Indonesia, soil depth information is needed for 3 assessments and usually it is classed according to a given rule. Firstly in mapping critical land, soil depth is grouped into <25 cm, 25-50 cm, and 50-100 cm (Tim Puslittanak 1993). Land having soil depth of 100 cm or less has high possibility to be critic. This suggests that the land needs rehabilitation immediately depending upon total soil loss, and soil coverage. Secondly in erosion hazard evaluation, soil depth is differentiated into <30 cm, 30-60 cm, 60-90 cm, and >90 cm (Hardjowigeno and Sukmana 1995). Land having soil depth of 60 cm or less potentially has very heavy erosion hazard. Thirdly, soil depth combined with maximum soil loss and erosion hazard are based to select conservation measure (Hardjowigeno and Sukmana, 1995). In this assessment, soil depth is grouped into <30 cm, 30-60 cm, 60-90 cm, and >90 cm. With quantitative soil depth map, grouping and re-grouping can be easier. Thus, this soil depth map can be helpful in land degradation assessment.

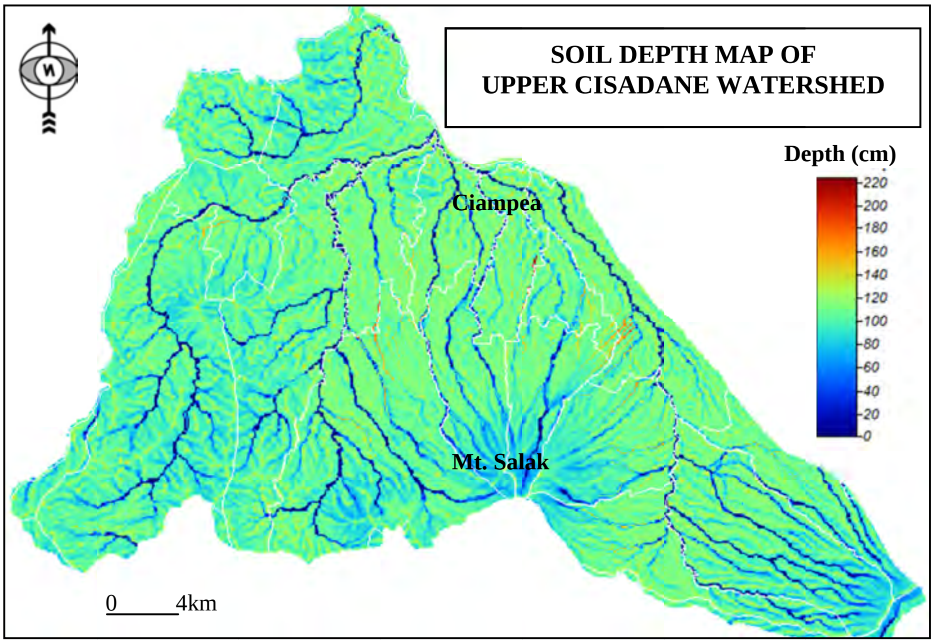

Fig. 3 The spatial distribution of predicted soil depth in Upper Cisadane Watershed

Figure 4 show predicted thick of A-horizon in Upper Cisadane Watershed. A-horizon is surface layer showing an accumulation of humified organic matter intimately mixed with the mineral fraction or properties resulting from cultivation, pasturing or similar kinds of disturbance (Soil Survey Division

Staff, 1981). By definition, the identification of A-horizon thickness is subjective depending surveyor's experience and tools as is directly observed in the field. The steep slope show lower A-horizon thickness than the relatively flat one.

A-horizon thickness is another soil property used in determining critical land (Tim Puslittanak 1993), where the thickness is grouped into < 5 cm, 5-10 cm, 10-15 cm, 15-25 cm and > 25 cm. Thicker A-horizon, higher the critical level of respective land. This information is also rarely available in common soil map in Indonesia as soil mapping activity is to support land development, not land degradation. The quantitative A-horizon thickness map can be helpful in the assessment of critical land. Grouping and re-grouping soil thickness can be easier.

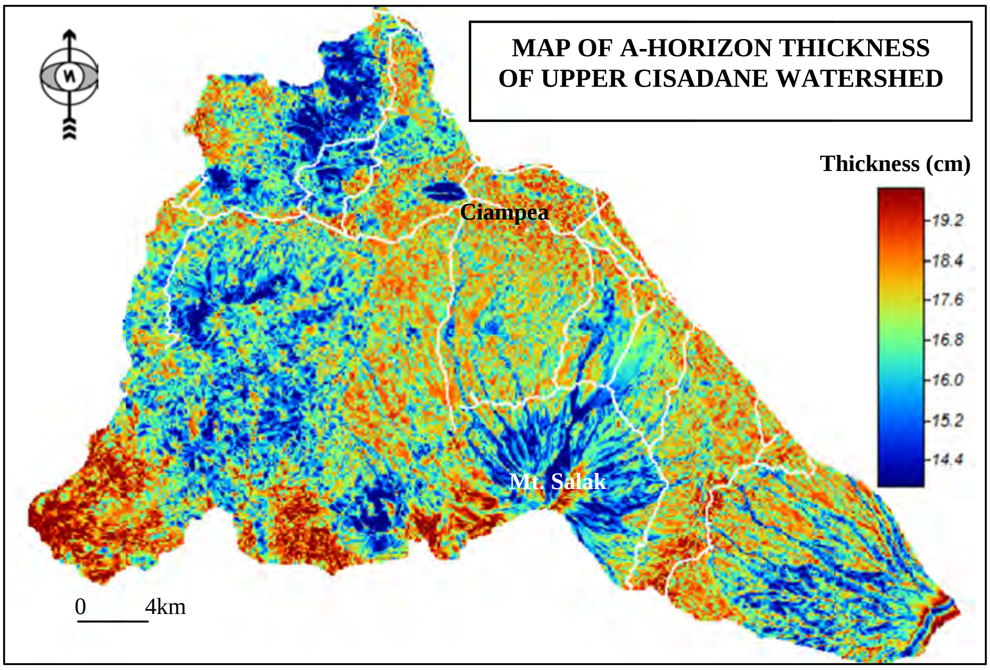

Fig. 4 The spatial distribution of A-horizon thick in Upper Cisadane Watershed

3.3 Map Validation

Figure 3 and 4 is predicted map with full of uncertainty. Although map is available and may be used to identify critical land, these maps need further validation to assess the error of data presented. In this study we validated soil map using existing observation. The absolute difference between observed soil data and predicted one is presented in Table 1.

From 151 sites, the soil depth difference that is frequently found is 27.5 cm. We think that this figure iss still accepted considering the high variation of soil depth data in the field. Meanwhile, the frequent difference is 2.4 cm for thick of A-horizon. From 151 sites, the soil depth difference of less than 25 cm is found in 103 sites, while the difference in A-horizon thickness of 5 cm is found in 125 sites. Considering these figure, additional soil observation should be collected to validate and improve the respective soil-landscape models. Hence, field visit is still required to improve soil depth and A-horizon thickness map.

Table 1 The absolute difference between observed and predicted data

	Soil depth	Thick of A horizon
Mean, cm	26.0	3.6
Median, cm	21.4	3.2
Mode, cm	27.5	2.4
Maximum, cm	93.6	12.4
Minimum, cm	0.68	0.2
Difference:		
Less than 5 cm	12 site	125 site
Less than 25 cm	103 site	

*for 151 validating site

3.4 Where new soil observations should be taken?

Digital soil mapping also create reliability map beside predicted map. The accuracy map or the reliability map informs usersabout the uncertainty soil depth value or A-horizon thickness in the predicted maps. The information accuracy is expressed in two ways, i.e.: (i) upper value and lower value of prediction in the significance level 95%, and ((ii) range value as the difference between upper value and lower value of predicted soil property. However, eachhas its significance. Figure 5 show the example of upper limit and lower limit value of predicted soil depth map in Figure 3.

Upper limit and lower limit value of predicted map are more suitable to measure accuracy when users verify the information in the field. More sites having soil depth value between these two limits, more accurate the soil depth map is. Up to now, in Indonesia such reliability map is not available yet. In conventional mapping approach, the accuracy of soil map is not determined. As a result, information accuracy of a given map is debatable, due to no established reference.

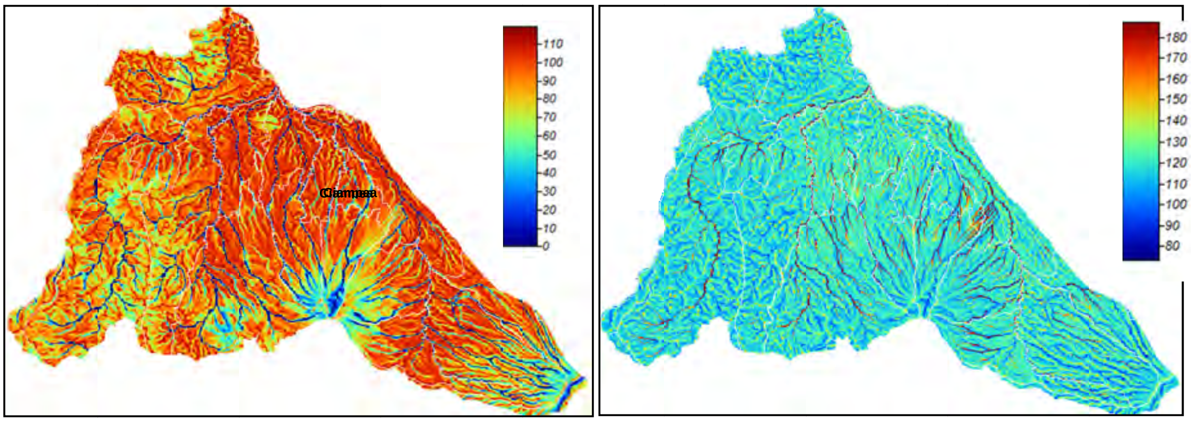

Fig. 5 Upper limit (right) and lower limit (left) of predicted soil depth (in m) at 95% confidence interval

The range value is more suitable for planning next soil observation, where one should select soil observation site that represent regional variation. Up to now, the site is selected based on landscape variability in the field. Higher landscape variability, more sites must be observed. Assisted by the reliability map over layered with existing soil observation, observation site can be better selected and the number can be optimum.

Figure 6 presents the reliability map of soil depth map in the study area. In this map, accuracy is expressed as range value that is the difference between upper value and lower value in 95% confidence interval. Higher range value, higher uncertainty of predicted value or lower the reliability of predicted value in the map. Figure 6 suggest that the reliability of soil depth value in the peak of Mt. Salak is low, yet reliability of soil depth value in Ciampea is high.

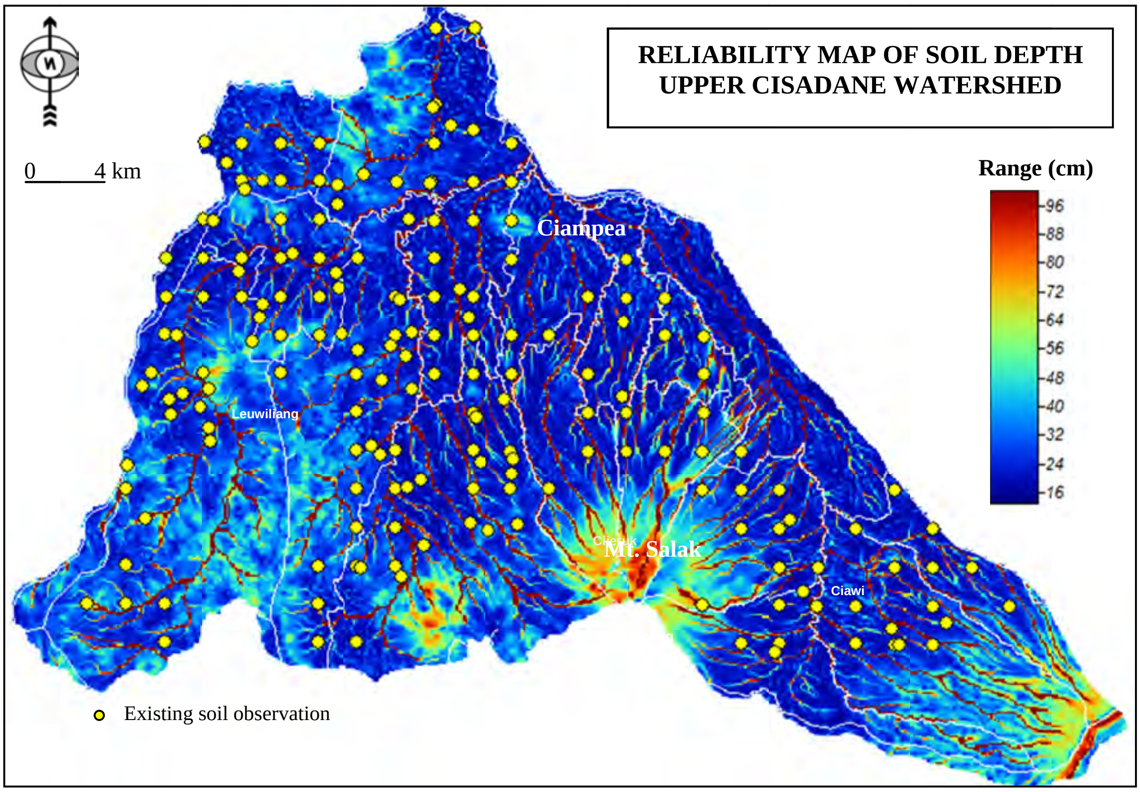

Fig. 6 Spatial distribution of range over layered with 151 existing soil observations

Figure 6 also show existing soil observation taken from previous soil survey activity. Overlying between existing soil observation map with reliability map may help in prioritizing next soil observation and soil sampling. The next soil observation can be directed to location that low reliability and no soil observation yet. If planned soil observation cannot be observed due to several reasons, then soil observation may be selected based on a priority level. The high priority to observe is given to sites with low soil depth information reliability and not yet observed. This sampling technique is called stepwise soil sampling in digital soil mapping approach.

3.5 Toward a dynamic land degradation monitoring system

Currently, no monitoring system is available to dynamically monitor land degradation. Recent effort coordinated by Indonesian Ministry of Environment is just to establish a critical land database in "one map" initiative framework. This is the first step to monitor land degradation. Yet, the monitoring system requires time series observation of land degradation. As land degradation involves spatial context as well as temporal one, the spatio-temporal land degradation monitoring system should be prepared at watershed level, regencial level, and provincial level. Of this system, land degradation assessment must be performed regularly.

Historically, Indonesia has used two frameworks to asses land degradation i.e. erosion hazard evaluation and critical land assessment. Critical land assessment mapping has been conducted for 17 provinces in 1990's at regional scale. Critical land mapping will be conducted for other provinces and regencial level. The administration boundary is selected since each government has its own funding and program.

Table 2 provides criteria to determine the critical level of given land based on land management level and land status. Based on this criteria, given land can be grouped as not critical, potentially critical, weakly critical, critical, and strongly critical and mapped as the critical land map. In fact, this map is considerably useful for planning and prioritizing land rehabilitation program. The strongly critical land and the critical land are the first priority for land rehabilitation to conserve soil and water. The Potential critical land is the second priority for land rehabilitation to prevent further damage, and weakly critical is the third priority for land rehabilitation.

Table 2. Criteria to determine the critical level of land

Land status (see Table 4)	Management level (*see* Table 3)			
	I	II	III	IV
Very low	Not Critical	Not Critical	WeaklyCritical	Weakly critical
Low	Not Critical	Not Critical	Weakly Critical	Weakly critical
Medium	Potentially Critical	Potentially Critical	Critical	Critical
High	Potentially Critical	Weakly critical	Critical	Strongly critical
Very high	Weakly Critical/Critical	Weakly Critical / Critical	Strongly critical	Strongly critical

After Tim Puslittanak 1993

Table 3 show criteria for determining land status. The land status is determined by 4 parameters including slope gradient, soil depth, A-horizon thickness, and soil loss due to erosion. These parameters are selected because they are easily, cheaply measured or estimated in the field. Even, with current digital soil mapping technology, these parameters can be provided quantitatively based on DEM and legacy soil data.

Table 3 Criteria to determine land status for critical land assessment

Parameter	Status					Note
	Very low	Low	Medium	high	Very high	
Slope (%)	< 8	8-15	15-25	25-45	>45	Digital soil mapping, DEM
Soil depth (cm)		>100	50-100	25-50	<25	Digital soil mapping, legacy soil data
A-horizon thickness (cm)	>25	15-25	10-15	5-10	<5	Digital soil mapping, legacy soil data
Erosion (ton/ha/year)	<10	10-20	21-30	31-50	>50	Drained density, DEM

After Tim Puslittanak (1993)

Table 4 show criteria for classifying management level for critical land assessment. Here, three parameters are evaluated i.e. the percentage of land coverage, land condition in term of applied conservation measure, and input level such as fertilizer application and ameliorant addition to the land. Land coverage percentage can be determined by interpreting satellite imagery followed by ground trusting. Other parameter can be verified by field visit.

Table 4 Criteria to determine management level for critical land assessment

Parameter	Management level				Note
	I	II	III	IV	
Land coverage (%)	75-100	50-75	25-50	<25	Identified from satellite imagery
Land condition	Good	medium	bad	Very bad	The application of conservation measure
Input level	High	medium	low	No input	Fertilizer and ameliorant application

After Tim Puslittanak (1993)

Erosion hazard evaluation mapping had been conducted for several watersheds in 1987 following criteria in Table 5. Two parameters are considered i.e. maximum erosion and soil depth. Maximum erosion is calculated by Universal Soil Loss Equation, and soil depth ii verified by field visit or soil map. In this framework, soil depth is differentiated into 4 classes, where the used class limit differs from those of land status (Table 3).

Table 5 The criteria to determine the level of erosion hazard

Soil depth (cm)	Maximum erosion (ton/ha/year)				
	< 15	15-60	60-180	180-480	>480
>90	Very weak	weak	medium	heavy	Very heavy
60-90	weak	heavy	heavy	Very heavy	Very heavy
30-60	medium	Very heavy	Very heavy	Very heavy	Very heavy
<30	heavy	Very heavy	Very heavy	Very heavy	Very heavy

After Hardjowigeno and Sukamana (1995)

Regular assessment of land degradation (e.g. every five year or ten year) using the above frameworks may provide spatio-temporal data. From this time series data, trend analysis may be performed to get insight about land degradation change spatially or temporally. Also, by regular assessment, the effectiveness of rehabilitation measure can be evaluated. In this context, the quantitative soil property maps produced by the digital soil mapping technology will be found helpful in the assessment.

4 CONCLUSION

Land degradation is due to soil erosion need effective assessment, re-assessment and monitoring. Soil depth and the thickness are A-horizon is key soil properties for that purposes, but they are rarely available in existing soil map in Indonesia. We have demonstrated how digital soil mapping techniques assist in preparing quantitative soil depth characteristics at watershed scale. In similar way, other soil properties-related to land degradation may be prepared. Digital soil mapping products were helpful potentially in monitoring land degradation and re-assessment land management. The integration of this spatial information with national model for land degradation monitoring is suggested.

5 ACKNOWLEDGEMENTS

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Assessing the Effectiveness of Long-term Application of Soil Conservation Measures at the Novosil Study Site, Central Russia, Using Different Methods

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ABSTRACT: The findings are presented of a detailed study about the long term (75-80 years) effectiveness of soil conservation measures, which was conducted at the Novosil study site located in the Orel region of the Central Russian Plain. At the Novosil Experimental station, two pairs of transects of different morphology were selected on relatively steep arable farmland. One transect in each pair underwent introduction of soil conservation measures in the past, while the other was kept under traditional cultivation. On both transects under soil conservation practices artificial terraces were installed in combination with forest belts located parallel to the topography contour lines and spaced at approximately 100 m from each other. The construction of terraces and tree planting was initiated in 1932. Simultaneously radionuclide technique, soil profile morphology method and empirically based erosion modelling were used for quantitative assessment of long term soil conservation effectiveness within each pair of transects. The results, based on soil profile morphology and ^{137}Cs based methods, concluded that slopes with soil-protective measures are characterized by a reduction of the average annual soil redistribution rates by 25-80%. High coincidence of the spatial patterns of soil redistribution rates provided by these two techniques suggests general reliability of the results. Observed discrepancies in values obtained can be attributed to differences in temporal resolution of methods as well as to possible influence of individual extreme events on results yielded by the ^{137}Cs method. More significant decrease of average soil degradation rates on slopes under soil conservation practices (up to 70-75% for each pair of slopes) was predicted by empirically based modelling. This substantial differences between predicted and directly measured values is attributed to a high degree of soil degradation prior to the introduction of protective measures (reflected by the soil-morphological method).

KEYWORDS: soil redistribution, soil conservation measures, Central Russia, effectiveness

1 INTRODUCTION

Since the early intensification of the agricultural sector in the 19th century, soil degradation has been an important threat for the agricultural land in Russia. The central part of European Russia is one of the agricultural regions with the longest history of intensive cultivation. The most intensive expansion of arable lands in this region took place during the second part of 19th century after the land ownership reform was introduced in 1861, resulting in severe sheet, rill and gully erosion. Some of cultivated land was abandoned because of severe soil degradation and slope dissection by very intensive rill and gully erosion. In the beginning of the 20th century the famous Russian scientist Dokuchaev elaborated a national program of conservation measures for protecting soil from water and wind erosion. Several experimental stations were established in different landscape zones of Russia during the first decades of the 20th century to study the effectiveness of different conservation measures.

The present study focused on the evaluation of the effectiveness of long-term conservation measures initiated 70-80 years ago at the Novosil study site located in the Orel region of the Central Russian Plain. Fallout radionuclide-based tracer techniques were used in combination with more traditional methods and approaches for the quantitative assessment of soil redistribution on cultivated slopes.

2 STUDY SITE

The study area is located in the Zusha River basin at the centre of the Orel oblast (Fig.1). The Orel oblast is the main agricultural region of the European Russia within the forest-steppe agroecological zone. Area of agricultural land within the Orel oblast is 87%. The average annual water erosion rate for the region is estimated as 4.5 t ha^{-1} yr^{-1} (Fig.2), which is also the average value considering all regions of the Central European Russia (Fig.2). However, percentage of eroded arable land from the total area is highest in the Orel oblast (Fig.2).

Figure 1. Location of study site within the Central European Russia.

Legend: study site, Novosil experimental station

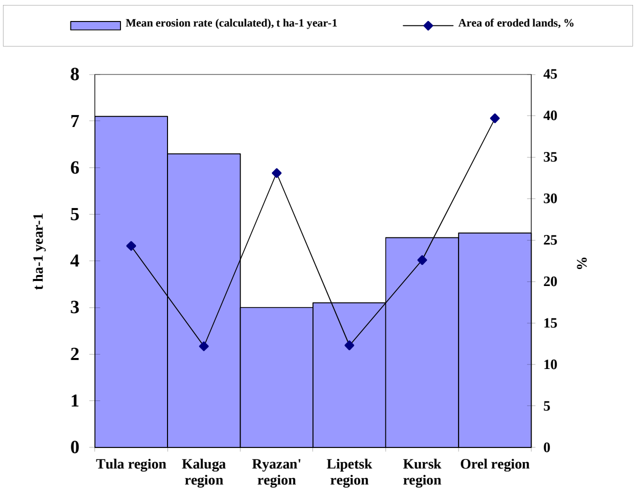

Figure 2. Mean erosion rate (calculated by empirical-based model) and percentage of eroded arable land from the total cultivated area for some main regions (oblast) of the Central European Russia.

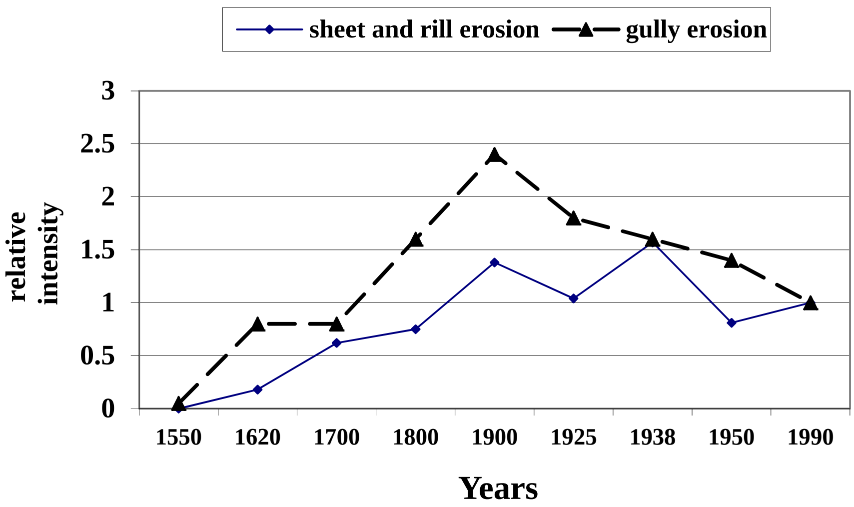

Figure 3. Relative intensity of surface (sheet and rill) and gully erosion for the 1550-1990 year period within the Zusha River basin (the intensity in 1990 is equal to 1).

The Zusha River basin is a territory with a well-known history of intensive cultivation. Farmland area increased especially significantly in the second half of 19^{th} century and reached its maximum after the collectivization in 1938. Preliminary assessment of gully erosion rates using historical maps shows that maximum numbers of gullies were formed after the land ownership reform in 1861 (Fig.3). During this period even very steep slopes became cultivated in many places, which enhanced the development of new gullies. The maximum surface (sheet and rill) erosion was observed in 1930-1940 immediately after collectivization (Fig.3). That was a period of arable field enlargement because of transformation of individual parcels into large collective fields.

The study site is located at the Novosil agro-forestry and land-improvement research station situated in the central part of the Zusha River basin (Fig.1). The Novosil experimental station was founded in 1923 with the main objective to study processes of soil and gully erosion and to develop effective and economically sound soil conservation measures. The main focus has been put on the improved spatial organization of agricultural land use, crop rotations, use of slope terracing and forest belts for optimal soil protection. At the site analyzed in the present study construction of terraces and tree planting (forest belts) was initiated in 1932. Terraces and forest belts were located parallel to the contour lines and spaced at approximately 100 m from each other. In addition, water retention ditches were dug within the central parts of some of forest belts in the 1960s. Also some other conservation measures were tested on the lands belonging to the Novosil experimental station. The list of conservation measures is presented in Table 1.

There is no detailed information available on the soil cover conditions prior to the foundation of the Novosil experimental station and introduction of soil conservation measures. However, it is generally known that large part of the present experimental station’s landownership was characterized

by moderately to severely degraded subtypes of the Grey forest soils (Phaeozems according to the World Reference Base on Soil resources) (Kozmenko, 1954). In addition, extreme soil degradation occurred on the steepest parts at the lower slope position above the adjacent valley slope upper breaks. In many cases these parts of the slopes were completely devoid of productive topsoil as a result of severe sheet and rill erosion. Degradation of lower parts of slopes by erosion was often so severe that their surfaces could be characterized as a “mini-badland” (Kozmenko, 1954). Agricultural productiveness of the degraded soil was completely lost. It must be noted that such most severely degraded zones were first selected for soil conservation and counter-erosion measures application, as this fact has important implications for the analysis of the soil recovery and present state.

The study area is underlain by the Devonian limestones and marls mantled by the Middle-Late Pleistocene sands and loams on which the present soils have been formed. The most typical soils are the Grey forest soils (Phaeozems according to the WRB) (about 80%) and Podzolized chernozems (Luvic chernozems according to the WRB) (about 20%) with a heavy loamy texture. The permeability of soils is very low. A soil surface crust appears very quickly after the first spring rains.

Table 1 Types of conservation measures tested at the Novosil experimental station for the period of 1923-2000

Conservation measures			
Agronomic/ soil management	**Vegetative**	**Structural**	**Overall management**
a/ mulching; b/ deep tillage; c/minimum tillage; d/ deep ripping; e/ counter cultivation; f/ contour ridging.	a/ windbreaks; b/ zero grazing; c/ relay cropping; d/ hedge barrier; e/ planting forest; f/ reseeding trees along field boundary.	a/ retention ditch; b/ forward sloping terraces; c/ dam; d/ level banks; e/ waterway (convey water at the gully top and gully bottom); f/ level banks with level ditch g/ stone concrete over-falls.	a/ exclusion of natural waterways; b/ change from cropping to grassland; c/ better soil cover by vegetation.

The main crops are winter and spring cereals, maize, sugar beans and perennial grasses (forage). According to the local meteorological record the annual average temperature is +5.2°C (the monthly average minimum temperature is reported for February and is -9.7°C; the monthly average maximum temperature is measured in July and is +19.6°C). The annual average precipitation for the period observed (1959-2003) is 536 mm (range of 350-800 mm), with about 30% of the precipitation falling as snow. Rainfall events with maximum intensity mainly occur during the period of June to August. The mean water equivalent of the snow before the spring snowmelt is 170 mm (Pronin, 1973).

In the current study two pairs of slope transects were selected with possibly minimal differences in aspect, length, gradient and morphology between transects in each pair. One transect in each pair was conventionally cultivated, while another had soil conservation measures introduced. All the four transects studied generally have convex long profiles typical for this part of the Central European Russia. Between pairs of slopes there are differences in aspect, length and morphology. In addition to slope aspect, major differences are found in length of the gentle upper parts and gradients of the steeper bottom parts of slopes. The length of cultivated parts of the studied pairs of transects varies from <500 m for transects 1 and 2 up to ca. 800 m for transects 3 and 4 (Table 2)

.

Table 2. General characteristics of the studied slope transects

Pairs of slopes	Slope transects	Documented cultivation period, years	Orientation	Relative height, m	Length, m (entire transect / upper gentle part)	Gradient, degrees (upper part/ average/ lower part)
1	Transect 1[1)]	300	West	17	460/110	0.8/2.2/3.2
	Transect 2[2)]	300	West	18	490/100	0.8/2.2/3.2
2	Transect 3[1)]	300	South	25	800/230	1.0/1.7/2.3
	Transect 4[2)]	100	South	30	770/250	1.3/2.2/3.0

[1)] Slope transects with contour terraces and forest belts;
[2)] Conventionally cultivated slope transects.

The duration of intensive cultivation could not be established exactly. However, three out of the four transects studied are shown as arable on the State Landownership Survey maps dating back to 1784. Based on this information and the archive data stating that the major expansion of arable land before 1861 in the region occurred between 1620 and 1696 (Tsvetkov, 1957). the authors took a figure of 300 years as the cultivation period for slope transects 1-3. The only exception is the transect 4, for which a 100-year period of intensive cultivation was established from comparison of topographic maps from 1861 and the early 20th century.

3 METHODS

Three independent methods were applied for evaluation of soil erosion rates for studied transects. The ^{137}Cs method can in most cases be used to derive an average soil redistribution rate for the period since the commencement of the global fallout (1954 for the Northern hemisphere). However, for the Novosil experimental station it was only possible to calculate average soil redistribution rates since the Chernobyl fallout (1986), as it represents more than 90% of the total isotope amount contained in the studied soil profiles. The ^{137}Cs method cannot distinguish between the effects of different soil redistribution processes (mainly those including erosion by wind and water as well as tillage translocation), but gives an integral assessment of their combined action (Walling, Quine, 1990). It has also been argued that the technique is limited to sites where sheet and shallow rill erosion predominates, as development of deep rills and gullies involves redistribution of subsoil material having no ^{137}Cs content, in proportions increasing with depth of incision (Walling, Quine, 1990). Nevertheless, it has been demonstrated that not only total soil losses, but also the relative contributions to it from different erosion processes can be obtained when ^{137}Cs data and other field-based and modeling techniques are combined (Belyaev et al., 2005).

The field sampling for radionuclide analysis involved three phases. Firstly, 5 reference sites were selected across the study area. Depth-incremental sampling was undertaken at some of these reference sites for assessing the vertical distribution of ^{137}Cs. It was established based on the radionuclide vertical distributions that both ^{137}Cs are kept within the upper 30 cm of the soil profile. Secondly, 9 to 12 bulk cores were collected using an 8.0 cm diameter cylindrical metal corer from the 0-30 cm topsoil layer at each reference site. Thirdly, soil sampling was carried out along all six transects by the same corer. Two individual bulk core samples were combined for each single sampling point at transects. Distance between the sampling points depended on slope morphology and location of forest belts. All soil samples were subsequently dried, disaggregated and passed through a 2 mm sieve.

Measurements of the ^{137}Cs activity of the <2 mm fraction were undertaken by gamma-ray spectrometry using an ORTEC HpGe detector. The analytical precision at the 95% level of confidence was typically 4%.

Soil profile morphology method involves comparing the thickness and horizon composition of the upper productive topsoil in areas affected by various soil redistribution processes to that in locations where the soil profile can be regarded as undisturbed. The decrease or increase of the topsoil thickness within a cultivated field can be used to estimate the total soil loss or gain for the entire period of cultivation, although it is not possible to determine the particular process or processes responsible for that (Larionov et al., 1973). Application of the empirical model in this particular study aimed to show the comparability and possible discrepancies between regional erosion estimations commonly based on such models and detailed small-scale case studies employing the field-based techniques. To achieve this, model estimations of erosion were carried out along the same transects the field-based techniques were applied for. The empirical model employed in this study utilizes a combination of the USLE-based approach for estimating rainfall-induced erosion and the model developed in the Russian State Hydrological Institute for estimating erosion from snowmelt runoff. It was put together and developed by Larionov (Larionov, 1993) especially for the application in Russia and is supported with a large spatially distributed dataset of input coefficients. Modifications from the initial USLE model include an improved set of equations for determining topographic factors (Larionov et al., 1998) a novel approach calculating and mapping a rainfall erosivity index for European Russia (Krasnov et al., 2001), as well as adaptation of land use factors and soil protection techniques specific to the Russian agricultural system. The model yields estimates of sheet erosion rates from both rainfall- and snowmelt-generated overland flow. Data required for the model inputs include detailed topography of slope transects oriented along the surface runoff flow lines, local soil properties, precipitation records and land use information. The output is generated as a series of points with values of soil loss, which can then be exported to various GIS tools for visual presentation and manipulation with other spatial data. Available information about crop rotations and their changes during the period of cultivation was collected. The most correct data about crop rotations and cultivation practices at different arable fields of the study area were available for the last 20 years. Information about local soil properties (local distribution of soil subtypes, typical soil profile structures, texture and humus content) was available (Surmach, 1956). Information obtained from detailed description of soil pits along the case study transects as well as from grain size and humus content analysis of samples was also taken into account. In addition meteorological information was collected from the local meteorological stations.

4 RESULTS AND DISCUSSION

The results of the present study have shown that slopes with soil-protective measures are characterized by a substantial reduction of average soil redistribution rates, as shown by soil-morphological and ^{137}Cs methods (Table 3). The maximum relative decrease of average net erosion rate was reported for transects 3 and 4 (more than 80% by the ^{137}Cs method and up to 70% by the soil-morphological method). Intermediate values were observed for transects 1 and 2 (about 50% by thesoil-morphological method and about 25% by the ^{137}Cs method).

The reasonably good coincidence of the spatial soil redistribution pattern provided by the soil-morphological and ^{137}Cs methods (Fig. 4) suggests generally good reliability of the obtained results. However, at the same time, large discrepancies in soil redistribution rates obtained by the two field based methods require more detailed consideration. Soil redistribution rates estimated by the ^{137}Cs method are extremely high if compared with the typical average values for the general study region (4.5 t ha^{-1} a^{-1}) (Litvin, 2002) while soil-morphological method and empirical model provide more comparable results. The most extreme soil redistribution rates are yielded by the ^{137}Cs method for the studied transects 1, 2 and 4 (Table 3). However, even relatively low values for transect 3 (Table 3) seem to be overestimated if one takes into account the fact that both fields after the year 1986 have been mainly used for growing annual or perennial grasses. As very low soil redistribution rates are normally expected for fields under such crop rotations, values of net erosion rates obtained by ^{137}Cs method for these two transects may roughly represent a range of overestimation by this method in our case.

With regards to the reasons for such a substantial degree of overestimation, two main explanations can be proposed. First of all, extremely high soil redistribution rates yielded by the ^{137}Cs method for many sampling points can be attributed to possible influence of individual extreme runoff events on ^{137}Cs redistribution prior to soil mixing by tillage operation. It is known from the available precipitation data that 5-10 rainfall events, potentially able to generate overland flow (>10 mm), took place during the summer period of the year 1986. Especially heavy rainstorm was reported on August 26 (25-35 mm at different meteorological stations). At that time, the fields of transects 1 and 2 were sown partly with maize and partly with barley, while the fields of transect 4 was used partly for oats, and partly left under bare fallow. Very severe erosion could have occurred on these slopes, along transect 4 because of the presence of fields under bare fallow, and transects 1 and 2, as maize and barley at site of those transects were likely already harvested to the date when the rainstorm occurred. If this was the case, substantial proportion of the Chernobyl^{137}Cs fallout could have been eroded from the topsoil before its incorporation into the plough layer, as the isotope initially has an exponential depth distribution with peak located at the soil surface (Walling, Quine, 1990). The authors believe that this erosion event (or a few events) in 1986 unaccounted for by calibration models is the most reasonable explanation for overestimating soil redistribution rates obtained from the ^{137}Cs data.

A more significant decrease of average soil degradation rates on slopes with soil conservation measures (60-75%) was predicted by the empirical model (Table 3, 4). It is important to notice for comparison with the other techniques that the erosion model calculates only potential rates of gross erosion, without accounting for any within-slope redeposition (Table 4). It is obvious from comparison of the model estimates with the field based method results (Table 3, 4) that the real observed effectiveness of soil conservation measures is lower than the potential one. This can be explained firstly by insufficient time for a complete soil recovery passed since the terrace construction and forest belts planting, and secondly by improper maintenance of the terraces and forest belts because of a lack of funding since 1991.

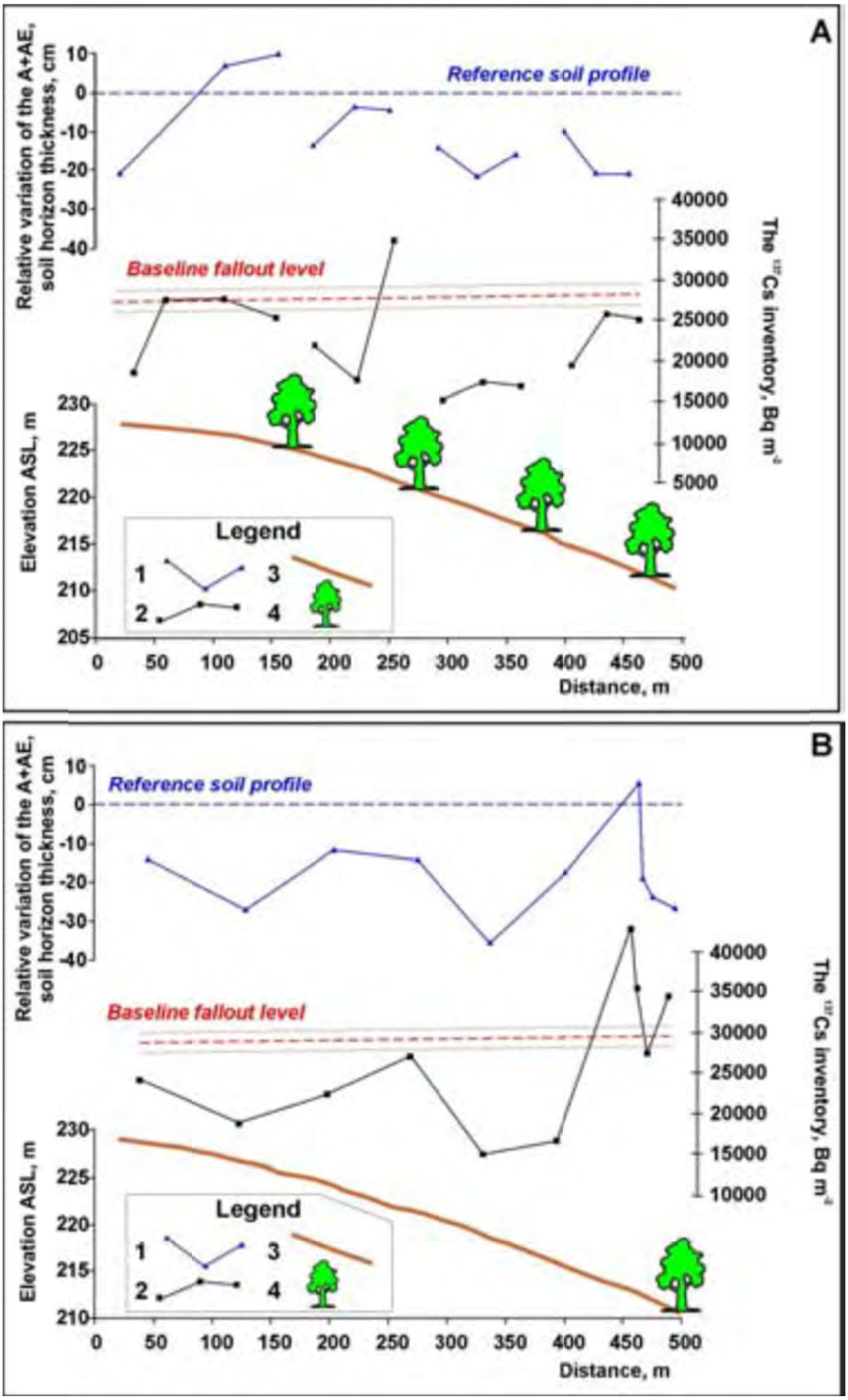

Figure 4. Distribution of relative soil horizon (A+AE) thickness (1) and ^{137}Cs inventories (2) along slope transects (3) 1 (A) and 2 (B). Tree signs (4) designate forest belts.

Table 3. Comparison of soil redistribution rates calculated for the studied transects by different techniques

Pairs of slopes	Slope transects	Soil redistribution rates (t ha^{-1} yr^{-1}) (gross erosion/gross deposition/net erosion)		[3] Potential soil loss estimated by empirical model (t ha^{-1} yr^{-1})
		^{137}Cs (proportional model) ^{137}Cs (simple mass balance model)	Soil profile morphology	Without forest belts With forest belts
1	[1] Transect 1	43.5/3.6/39.9	5.1/0.4/4.7	23.9
		52.8/4.1/48.7		6.0
	[2] Transect 2	54.9/3.7/51.2	9.0/0.1/8.9	19.9
		67.6/4.5/63.1		-
2	[1] Transect 3	14.2/1.9/12.3	4.7/0.0/4.7	24.0
		15.8/2.0/13.8		9.2
	[2] Transect 4	59.3/2.4/56.9	16.3/1.6/14.7	21.6
		78.9/3.1/75.8		-

[1] Slope transects with contour terraces and forest belts;
[2] Conventionally cultivated slope transects;

Table 4. Percentage difference of soil redistribution rates between transects without and with forest belts within each pair of transects calculated by different techniques

Slope transects	^{137}Cs technique		Soil profile morphology		Empirical model
	Gross erosion	Net Erosion	Gross erosion	Net Erosion	Gross erosion
-1	21-22%	22-23%	43%	47%	75%
4-3	76-80%	78-82%	71%	68%	62%

5 CONCLUSION

The study based on soil profile morphology and ^{137}Cs-based methods concluded that slopes with soil-protective measures are characterized by a reduction of the average annual soil redistribution rates by 25-80%. Good coincidence of the spatial patterns of soil redistribution rates provided by these two techniques suggests general reliability of the results. Observed discrepancies in values obtained can be attributed to differences in temporal resolution of methods as well as to possible influence of individual extreme events on results yielded by the ^{137}Cs method. However, more significant decrease of average soil degradation rates on slopes under soil conservation practices (up to 70-75% for each pair of slopes) was predicted by empirically-based modelling. This substantial differences between predicted and directly measured values is attributed to a high degree of soil degradation prior to the introduction of protective measures (reflected by the soil-morphological method) and lack of funding for maintaining the appropriate conditions of terraces and forest belts after collapse of the former Soviet Union (reflected by the ^{137}Cs technique).

6 ACKNOWLEDGEMENTS

This research work has been made possible by the financial support the International Atomic Energy Agency grant (RUS /12329). Authors gratefully acknowledge the cooperation of the Novosil experimental station director A.I Petelko in providing access to the study sites, research information and consultations. Assistance of a number of the MoscowStateUniversity researchers and students involved in fieldwork activities is gratefully acknowledged.

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Session 4: Poster Abstracts

Study on Soil Management by Using Different Kinds of Compost Combinations

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ABSTRACT

The objectives of this study were to compare the use of bio-fertilizers LDD 12, in combination with compost, between LDD recommendation and farmers use, which affects some soil chemical properties, rice (Khao Dauk Mali 105 variety) yield and the economic internal return. The study site was located at Ban Khu Phra Khona, Suwannaphum District, Roi Et Province, Thailand during May 2010 - December 2011. Soil was in the soil series group No.17 (Renu soil series). An RCBD design with 7 treatments and 3 replications was employed. It was found that soil pH in all treatments was increased (ranged from 5.67-6.53) as compared to the control treatment. Soil organic matter was increased (ranged from 0.44-0.66%). Available phosphorus had highly significant different in all treatments as compared to the control. The use of compost produced by farmer alone, compost produced by farmer with chemical fertilizer at the rate 1/2 and compost produced by farmer with chemical fertilizer at the rate ¾, led to the highest available phosphorus in both years (ranged from 11-18 mg kg^{-1}) and potassium in year 2 (7.7-11 mg kg^{-1}). In addition, the soil treated with compost produced by farmer alone had the highest calcium in year 2 (458.67 mg kg^{-1}), while the use of compost produced by farmer with chemical fertilizer at the rate ¾ had the highest magnesium contents (47.33 mg kg^{-1}).

This soil management led to increase in the rice growth and yield composition (such as stem per tiller, panicle per tiller, 100-seed weight) in all treatments, especially in soil treated with compost and chemical fertilizer. This management led to an increase in whole kernels (95%). The soil applied with compost produced by farmer with bio-fertilizers LDD 12 and chemical fertilizer at the rate ¾ (treatment No.7) showed highest average rice yield in two years (626.5 kg rai^{-1}). Moreover, the average economic internal return in two years was the highest (5,726.75 baht rai^{-1}) in the treated with compost produced by LDD with bio-fertilizers LDD 12 and chemical fertilizer at the rate ¾ (treatment No.6), followed by the use of compost produced by LDD with bio-fertilizers LDD 12 and chemical fertilizer at the rate ½ (treatment No.4, 5,509 baht rai^{-1}).

The result indicated that the use of compost produced by LDD with bio-fertilizers LDD 12 and chemical fertilizer at the rate ½ was the suitable soil management, resulting in increase in rice yield and economic internal return.

KEYWORDS: Bio-fertilizer,chemical fertilizer, economic internal return, Khao Dauk Mali 105 rice, Renu series.

Contents and Storage Locations of Soil Carbon and Nitrogen Under the Different Land Uses

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ABSTRACT

The objective of this study (started in 2011) was to investigate some soil properties, content and storage locations of carbon (C) and nitrogen (N) under different land uses. Study site was at the Land Development Research and Technology Transfer Division, Pak Chong District, Nakhon Ratchasima Province, Thailand. It was found that soil the ECEC ranged from 15.57-24.99 cmol kg^{-1}. The highest ECEC was found in agroforestry system (24.99 cmol kg^{-1}). The agroforestry had the highest soil C (1.37%) and N (0.17%) contents, followed by the soil in the orchard plantation (C=1.17% and N = 0.13%). The C content was positively correlated with soil ECEC (R^2= 0.97). The quantity of soil macro-aggregate (74.5-81.3%, highest in agroforestry) was higher than soil micro-aggregate (18.7-25.5%, highest in vetiver grass). In addition, it was also found that the soil C and N contents were sequestered in the soil macro-aggregate (0.25-2.0 mm), which were highest in the agroforestry system (C= 93% and N= 95.8%). Additionally, C (R^2= 0.61**) and N (R^2= 0.71*) contents in soil aggregate were highly positively correlated with the quantity of soil aggregate, especially in the soil macro-aggregate. This result indicated that agroforestry led to increasing the soil C and N accumulation, in which the main storage location was located in soil macro-aggregate (0.25-2.0 mm). It was found that soil C and N play an important role on soil aggregation.

KEYWORDS: Soil properties, agroforestry, orchard plantation, soil aggregate, vetiver grass, soil macro-aggregate, soil ECEC.

The Recovery of Farmlands in the Area of Acid Sulfate Soils: 2011 Big Flooding

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ABSTRACT

The "2011 Big Flooding" has a great impact on the sustainability of agriculture, where the farmers gather to feed themselves with their own crops. Around 1.4 million farmers have been affected by flash floods that devastated over 30 provinces from July to December 2011. The Thai government helped them to become strong and healthy again after this problem, taking into account their production and income to balance their lives and to ensure long-term socio-economic sustainability and food security. The Ministry of Agriculture and Cooperatives reported that around 7.3% of crop production in the first half of the year was the lost of rice crop in flooded rice fields (1.44 million ha.), with 1.6 billion $US dollars in damage. This worst flooding has also taken away the opportunity for farmers to benefit from rising farm prices.

The Department of Land Development realized the agricultural area subjected to flooding, which is mostly in the central plain of Thailand, will have to be secured and recovered. Acid sulfate soil is one of the problem soils in Thailand (966,462.8 ha) where rice and other crops are grown. To recover the post-flooding situation of farm lands, land development working group has worked closely with the farmers and proposed several agricultural practices to manage their own crops. The results showed that not only can they recover their lands but also they can realize how to integrate the use of natural resources in the ecosystem and farming system for sustainable land use.

KEYWORDS: Sustainable land use, farming system, long-term socio-economic sustainability, food security, rising farm prices, post-flooding situation.

Study on the Trend of Plow-pan Soil under the Intensive Tillage in Nakhon Ratchasima, Thailand

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ABSTRACT

The objectives of this study were to investigate the potential of plow-pan by application of Small Multi-Mission Satellite(SMMS)imagery and to study relationships between plow-pan with other factors (such as soil texture and soil color). The study site was the upland soil under cassava plantation in Nakhon Ratchasima Province, Thailand. The upland soils were sandy, coarse loamy, fine loamy and clayey. It was found that the bulk density (1.93 mg m^{-3}) and soil resistivity (ranged from 3.75-4.50 kg cm^{-2}) were highest at the 30-40 cm depth. Soil bulk density was related to soil resistivity. The plow-pan as indicated by soil bulk density and soil resistivity occurred at the 30-40 cm depth, especially in the loamy soil condition. The plow-pan in this study was not found in clayey soil condition. In addition, soil color was a part of factor that affected plow-pan by that the most of plow-pan occurred in the brown soil followed by yellow soil. On the other hand, the plow-pan was not found in the red soil color (classified as the oxisols). The result of this study indicated that the soil planted with cassava led to be plow-pan. We found that 29% of total area in Nakhon Ratchasima had potential to be plow-pan, especially in loamy-textured soil and brown color. The potential of plow-pan in the upland cassava plantation was divided into three groups, namely; (1) highly potential of plow-pan, and (2) moderately potential of plow-pan and (3) low potential of plow-pan.

KEYWORDS: Small Multi-Mission Satellite(SMMS) imagery, upland soil, soil resistivity, soil color, soil texture, bulk density, loamy soil.

The Study on Compost, Chemical Fertilizer and Soil Amendment Combination in Chinese Cabbage - Michilli Production Using Farmer Participatory Approach: The Case of Nong Hoi Royal Project Development Center

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ABSTRACT

The project was studied at Nong Hoi Royal Project Development Center in Chiang Mai Province, Thailand, in 2011 with the objective of investigating soil management technology on the highland area for appropriate and sustainable vegetable growing using farmer's participation that was more acceptable to them. The experimental design was RCBDwith 6 treatments and 4 replications. There were: (1) without dolomite and without fertilizer application (control method), (2) chicken dung in combination with chemical fertilizer at farmer's rate (farmer practice), (3) dolomite in combination with chicken dung and chemical fertilizer at farmer's rate, (4) dolomite and compost, (5) dolomite in combination with compost and chemical fertilizer at half of farmer's rate, and (6) dolomite in combination with compost and chemical fertilizer at farmer's rate. The result showed that planting of vegetables using dolomite in combination with chicken dung and chemical fertilizer at farmer's rate (Tr. 3) gave the highest yield and thus the highest economic return. Farmers were most satisfied with this treatment. They paid much interest and accepted the method for soil improvement on the highland. Furthermore, soil analysis revealed that soil density, organic matter content, phosphorus and potassium decreased in all treatments, while pH, calcium and magnesium increased.

KEYWORDS: Soil management technology, soil improvement, farmer participatory approach, dolomite, chicken dung, chemical fertilizer, compost.

Land Use Plan of Lam Se Bok Sub-Watershed

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ABSTRACT

The interest for the enhancement of the socio-economic condition for the stakeholders in Lam Se Bok Sub-Watershed, together with the concern for the environment requires the collection of relevant data on biophysical, socio-economic, as well as related laws and policies governing the use of the land resources in the said watershed. As part of the major activity in the planning process, all relevant data and information were analyzed using GIS allowing the overlaying of all the data and maps, together with relevant laws and policies for purposes of making rational decision during the preparation of the land use plan.

The project area, the Lam Se Bok sub-watershed, straddles between two provinces - Amnat Charoen and Ubon Ratchathani - having a combined land area of 359,441 ha. The watershed is currently under paddy rice and field crops cultivation, particularly cassava. Cultivated areas were currently surrounded partly with forest. Analysis of land unit based on soil group data showed 100 land units.

It was established that the use of land resources in the watershed for crop production is limited by the sandy soil texture and the shallow soil depth in both lowland and upland areas. Likewise, the assessment of soil erosion using Universal Soil Loss Equation (USLE) revealed five soil erosion classes: low, moderate, severe, very severe and extremely severe. In terms of physical suitability for rain-fed crop production, the assessment made showed that there was no highly suitable (S1) land area for all the crops tested, only moderately suitable (S2) and marginally suitable areas could be found. For the irrigated area, only moderately suitable areas were found. In terms of economic assessment, the results revealed that only cassava was highly suitable while for the other crops, they were either moderately suitable (S2) or marginally suitable (S3).

For purposes of proper allocation on the use of soil resources in the watershed, Lam Se Bok Sub-watershed was classified into seven zones - forest, agricultural, urban, industrial, livestock development and aquaculture development zones.

KEYWORDS: GIS, land resources, paddy rice, cassava, Universal Soil Loss Equation, industrial zone, livestock development zone, aquaculture development zone.

A Study on the Type and Rate of Biochar to Increase Lettuce Yield in Sandy Soil

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ABSTRACT

The experiment on the type and rate of biochar to increase lettuce yield on sandy soil was conducted at the farmer's field of Nong Khai Province in the Northeast of Thailand. Soil amendments consisted of wood charcoal, rice-husk ash from biomass power plant and carbonized rice husk. Biochar of bio-extract waste produced by slow pyrolysis at the rate of 125 and 250 kg/ha was tested with control in order to verify its effects on the number of leaf and leaf fresh weight of lettuce. The experiment was laid out by RCB design with 3 replications. It was conducted during June to November 2011. The results indicated that soil amendments produced from biomass could improve the yield of lettuce at the highest application rate. The choice for type of soil amendments depends on the availability of biomass in the local area. The incorporation of soil amendment with stable C is one approach of carbon sequestration into the soil. It could be used as a mitigation measure for global warming.

KEYWORDS: Soil amendment**,** wood charcoal, rice-husk ash, biomass power plant, carbonized rice husk,bio-extract waste, pyrolysis, carbon sequestration.

A Study on Vegetable Cultivation in the Thai Royal Project's Plantation Area Using Biotechnology Products from the Land Development Department

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ABSTRACT

The objective of this study was to investigate the effect of utilizing biotechnology products developed by the Land Development Department, on the production yield in the Royal Project's plantation area. Three types of vegetables, namely: pointed cabbage, Cossalad and lettuce, were selected to be grown in the study area. The control plantation area was designed to be 2×5 factorial in CRD with 3 replications. The first control factor was with and without the mulching of vetiver grass on the top of the soil surface. The second control factor was soil management methods: 1st - farmer's practice, 2nd - farmer's practice with lime, 3rd- LDD-1 with lime practice, 4th - LDD-1 and LDD-2 with lime practice and 5th-LDD-1, LDD-2 and LDD-1,2 with liming in the controlled production areas. The 1st and 2nd methods were considered as chemical practice, while the 3rd, 4th and 5th methods were the organic ones. The results indicated that the 1st and 2nd practices gave a higher yield than the organic method. Cos salad and lettuce gained a higher yield with the 3rd, 4th and 5th practices. Yield of Cos salad with mulching was insignificantly different from without mulching. Nevertheless, the result was different in pointed cabbage and lettuce. Withoutmulching, lettuce gained a higheryield while pointed cabbage gained a lower yield. Economically, the returns of organic practice (3rd, 4th and 5th methods) were relatively high in comparison with normal farmer's practice for all three products. This is due to higher selling prices of organic product, which were 2-4 times higher than the price of normal products.

KEYWORDS: Pointed cabbage, Cos salad, lettuce, vetiver grass, soil management methods, organic product, mulching.

Web-Based GIS Application for Disseminating Geospatial Information over the Internet: Mae Ngon Watershed Management and Development Project, Mae Ngon Sub-district, Fang District, Chiang Mai Province, Thailand

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ABSTRACT

Distributing geographic information on the internet is an enforcing factor for information services. Internet allows all levels of social network to access geospatial information, and provide a media for geo-processing related information with no location restrictions. Web-based GIS is evolved from different web maps and client-server architecture to distributed ones. As such, internetreshapes all functions of information systems including: gathering, storing, retrieving, analyzing, and visualizing data. The high cost of GIS, the release of system specific databases, and the enormous software developer efforts on upgrading the system are fading with the introduction of web-based GIS. Moreover, disseminating spatial information on the internet improves the decision making process.

This study examined the current web GIS technologies with emphasis on architecture. It was proposed that a web GIS development strategies starting from requirement analysis, and ending in GIS uses and maintenance. Disseminating the Mae Ngon Watershed Management Information over the internet has been implemented successfully.

It is concluded that the internet-based information delivery adds the margin of profitability of the people and government/organization involved. The proposed strategy has been implemented successfully. Staff can get to their destinations faster and more effective.

KEYWORDS: Geographic information, social network, geo-processing, client-server architecture, internet-based information delivery.

Summary Report
of
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Imperial Mae Ping Hotel, Chiang Mai, Thailand

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1. Scientific Workshop on Sustainable Land Management to Enhance Food Production of APEC Members was held during November 28-30, 2012 at the Imperial Mae Ping Hotel, Chiang Mai, Thailand. There were 122 participants attending the Workshop, 19 of which came from 13 members of APEC economies, namely Australia, Chile, China, Chinese Taipei, Indonesia, Malaysia, Mexico, Papua New Guinea, Peru, Philippines, Russia, and Viet Nam. The remaining 103 participants were from the host economy– Thailand.

2.Mr. Kriangsak Hongto, Director-General of the Land Development Department, delivered the opening speech. He is of opinion that APEC economies are among the world largest food exporters as well as importers. They generate more than half of the global cereal production. The impacts on food production could be even worse when combined with impacts from other factors, such as rising food prices, financial crisis, higher energy consumption, and extreme climate events. It causes the loss of capability to promote regional productivity vulnerable to food security risks. In order to handle those challenges, soil must be first secured in a sustainable manner. Therefore, SLM approach has been implemented to minimize and rehabilitate degraded areas. Nonetheless, the concept of SLM is broad, the particular issues need to be proposed by the APEC member economies to screen and find solution options to manage soil sustainability in response to their interests and economies. This workshop is the most appropriate platform for sharing and exchanging ideas to achieve our common goals of encouraging collaboration among APEC members. Most importantly, we are here with high ambitions to conserve natural resources and do not cause an irreversible damage to the environment. This is to ensure that future generations have healthy natural resources available to them to obtain enough food.

3. Prof. Dr. Peter Motavalli, University of Missouri, Columbia, Missouri, USA, discussed the global achievements on SLM. He stressed the importance of identification and development of SLM because of widespread resource degradation from poor land use practices. Moreover, the world will need to increase food production to meet the nutritional needs of a growing population without major environmental contamination. In addition, the climate change and its impacts on the environment should be considered in identifying and developing sustainable land use practices. Some common components of this type of management are: 1) understanding the ecology of land management, 2) maintenance of soil quality, 3) increased diversity for higher stability and resilience, and 4) provision of economic and ecosystem service benefits for communities. Several examples of SLM systems were discussed to illustrate the wide range of systems that have been developed around the world including agroforestry, conservation agriculture, and precision agricultural systems.

4. Prof. Dr. Robert J. Gilkes of the School of Earth and Environment, University of Western Australia, Crawley, Australia, studied the landcare facilitation and found that most problem soils are readily recognized and treated but adoption of remediation and prevention measures remains inadequate. However prevention and remediation of soil salinity remains problematic. Subsoil constraints to root function in terms of water nutrients are commonly unknown and need to be identified and ameliorated to achieve potential yields. Land managers/ advisers/farmers should do a “22 point soil evaluation” to identify constraints.

5. Ms. Karen Brisbanefrom Broken Catchment Management Authority, Shepparton, Victoria, Australia discussed the issue of Australian landcare facilitation. Landcare is driven from the ground up, and is a volunteer organization consisting of people concerned about sustainable agriculture and natural resource management in their regions. Each community has a separate issue of concern and for landcare to be successful, the community is the key driver of the program. The mix of individual volunteerism, facilitator support and government funding opportunities is required to ensure that landcare delivers broad regional, state and national objectives. Monitoring and evaluating projects are essential for a long lasting project and future successes of project, which is mostly the responsibility of the Landcare Facilitator.

6. Mr.Pablo Cortés Tiradoof theOffice of Agricultural Policies, Trade and Information, Ministry of Agriculture in Santiago, Chile stated that several international and Chilean organizations agreed that soil erosion must be controlled in order to maintain a sustainable food production. The Government of Chile has developed several programmes to achieve this goal like the Soil Recovery Programme. WTO categorizes the programme as a “minimis programme”. This kind of programmes is characterized by not distorted prices and therefore is allowed by WTO. It aims to recover the former productive potential of agricultural soils and maintain the upgraded levels achieved in order to obtain sustainable Chilean soils. It is based in five sub-programmes which includeestablishment of vegetative cover, incorporation of essential chemical elements, elimination, cleaning or destruction of physical or chemical impairments, use of soil intervention methods for conservation and incorporation of phosphorus based fertilizers.

7. Mr. Chencho Norbu, Director, Department of Agriculture,Ministry of Agriculture and Forests,Thimphu, Bhutanpresented the paper entitled, “Sustainable land management responding to food security and climate change challenges”. He stated that production of rice, maize, and wheat in the past few decades has declined in many parts of Asia due to increasing water stress arising mainly from increasing temperature, increasing frequency of El Nino and reduction in the number of rainy days.SLM can contribute to food security, climate change adaptation and mitigation measures. SLM practices reduce loss of top soils from farming land. The farmers in Bhutan adopted SLM to increase crop and fodder production, reduce surface soil erosion and increase vegetation of local landscape. The important factors to consider for the adoption of SLM technology are policy support, awareness and education of stakeholders, understanding local culture, farming system, and physical limitation of landscape.

8. Dr. Julian C. Prior, School of Environmental and Rural Science, University of New England, Armidale, NSW, Australiastated that participatory sustainable land management that attempts to build social capital among groups of resource users, can explicitly target over-utilisation and under maintenance, while also internalising formally external costs and benefits, through sustainable landscape management. He canvased the lessons that can be learned regarding the reported benefits of PSLM, as well as potential strategies for fostering this process. Criticisms of inappropriate participation are highlighted. The relevance to SLM of building social capital among resource users is discussed, and strategies for building social capital identified. Lessons learned from the experience of countries involved in international landcare are utilised to inform the discussion on how APEC economies might address the issue of scale in SLM, and build or strengthen national PLSM programs.

9. Dr. Zhongming Wen of the Institute of Soil and Water Conservation in Yangling, China stated that expansion of farmland is the main cause of soil erosion in China’s Loess Plateau. The increase of land productivity can greatly reduce the pressure on the expansion of farmland and make more land for ecological restoration. With the implementation of “green for green” programme, urbanisation and decrease of labour in countryside, land use has changed greatly since 2000. The vegetation cover had increased to 60-70% in many areas on Loess Plateau. Soil erosion has been greatly reduced and the sediment transported into Yellow River has decreased from 1.6 billion tons per year to around 0.3 billion tons per year in recent years.

10. Dr. Syaiful Anwar of the Ministry of Forestry, Indonesia who studies the agro-sylvopasture as sustainable and management to enhance food production in dry sub-humid areas in Indonesia. It was found that one hectare of agrosylvopasture system using multirows of *Sesbania* for fodder mixed with livestocks and food crops had provided enough food for family with 3-5 members. After three years, these

‘Countryside’ refers to China

systems had increased farmers' income from almost nothing to US$ 258 per month. In 2011 these systems have been adopted by more than 1500 farmers. It is believed that these systems will also be effective to increase biodiversity in this area as well as carbon sequestration.

11. Dr. Yiyi Sulaeman of the Indonesian Center for Agricultural Land Resource Research and Development, Agency for Agricultural Research and Development, in Bogor, Indonesia studied mapping soil depth using digital soil mapping technique to monitor land degradation. Soil depth and the thickness of A-horizon are the two basic soil data required for the assessment of land degradation status in Indonesia. Both data are rarely readily available in the existing soil maps. Meanwhile, Indonesia has voluminous legacy soil data in the form of legacy soil observation and legacy soil map. Using these legacy data, the digital soil mapping approach can be used to create a quantitative, soil property map. Soil depth map, map of A-horizon thickness, and reliability maps were created using environmental covariates and existing soil-landscape models. By comparing to the existing soil observation, 103 of 151 selected sites had the soil depth difference of 25 cm or less and 125 of 151 selected sites showed the difference of 5 cm or less for A-horizon thickness data.

12. Assoc. Prof. Dr.Ainul Jaria Binti Maidin of the International Islamic University Malaysia conducted a study on developing rural land for sustaining agricultural activities. Through a case study of the customary land development in the State of Negeri Sembilan, she found that the Malaysian government has identified various strategies to help alleviate rural poverty since the early days of independence. Various strategies were formulated and implemented. However, despite the efforts undertaken by the government, the major problem posed to the government agencies is the increasing rate of idle agricultural land. There are various policies and measures undertaken by the government to cultivate idle land. However, research identified that there are certain factors impacting adversely on the successful implementation of the government's plans to develop idle agricultural lands. This problem if left unattended will lead impact on the supply of agriculture land available for development.

13. Prof. Dr. Diana Gabriela Casro Frontana of the National Polytecnic Institute, School of Biological Sciences in Mexico studied the role of Mexican territory ordinance in assuring land management for food production. It was found that economic recession, population growth and social inequality are international problems that are causing environmental degradation and natural resources depletion to an extent that cannot be continued. This situation has encouraged the Mexican Government to make territory planning a national priority. To address this concern the Mexican Government has created the Programme for General Ecological Ordinance of the Territory (POEGT), which has been found to possess an important political instrument that can help assure territory for land production for present and future generations. Furthermore, the Mexican Natural Resources Protection Ministry is using Web-GIS to disseminate information about the Ecological Territorial Ordinance to the general population so that better decisions regarding land use are made.

14. Dr. Raghunath Ghodake of the National Agricultural Research Institute, in Port Morseby, Papua New Guinea, studied the soil management for SLM. It was found that small mound slash and burn and compost performed highly, and mulching reduced yield. In particular, Engan mound was found to have the highest yield in Simbu, outperformed in the high altitude environment and no single treatment performed best, but improved compost could increase yield if soil fertility is poor.

15. Dr. Apichart Jongskul, Director of the Office of Agricultural Economics, Ministry of Agriculture and Cooperatives, Thailand delivered an invited paper on agricultural economics crop zoning on Thailand. Economic crop zoning is an important strategy for efficient agricultural production both for physical and economic situation. The goal is how to encourage farmers to produce agricultural products in an appropriate area zoning in order to get reasonable price and income. Currently, economic crops zoning for 13 commodities has been recommended by Office of Agricultural Economics. However, encouraging farmers to follow those recommendations was limited due to the lack of incentive measures. In 2012, the Thai government has attempted to promote zoning system again with new approach and incentive measures. The new approach has focused on different purposes, including zoning for promoting

agricultural products in which the farmers can get high returns, zoning for protection from the transmission of pest and diseases and zoning for matching between supply and demand. Examples of economic crops zoning for Jasmine rice in Thung Kula Rong Hai in the Northeast and location-zoning for oil palm in the South have been presented. This is the one of the key strategies to reduce production costs for farmers and encourage public-private participation.

16. Mr. Rodelio B. Carating, Senior Science Research Specialist of the Bureau of Soils and Water Management of the Philippine Government discussed sustainable land management in the Philippines. He stated that some recommendations on writing for a worldwide readership are offered and suggested the concerned officers to review this document to learn about the formatting of text, table captions, references, and the method to include the indexing information.

17. Prof. Dr. Rrodrigo B. Badayos of the Agricultural Systems Cluster, College of Agriculture in Los Banos, the Philippines discussed the land resource utilization in the Philippines, by emphasizing on a paradigm shift towards food security. Land use planning is the practice of accounting and allocation of land resources to meet requirement for food, feed, energy including sites for the needed infra-structure of the community as well as additional space to accommodate wildlife habitat. Critical to the planning process is the evaluation of land resource potential towards sustainable land utilization. Water availability, low CEC, aluminum toxicity, vertic properties, high P fixation, shallowness and erosion risk were identified as major soil constraints to food production in the Philippines. There is a need to re-examine its existing policies and programs purposely designed to raise agricultural productivity as the measure to address food security.

18. Prof. Dr. Valentin Golosov of the Laboratory for Soil Erosion and Fluvial Processes, Faculty of Geography, Moscow State University, Moscow, Russia assessed the effectiveness of long-term application of soil conservation measures using different methods. It was showed that combined application of three independent techniques allows acquiring much more detailed information on temporal and spatial variability of soil redistribution rates than single method-based studies do. Integrated approach also enables researchers to highlight possible shortcomings and errors of the individual techniques employed by cross-comparison and validation of results between those. It was suggested that wider use of such approach in studying soil redistribution on cultivated land would help to make outcomes of studies carried out by different research groups more comparable, thus giving broader knowledge of the global extent and variability of soil erosion and associated environmental problems.

19. Dr. Olga Yakimenko of Moscow State University in Moscow, Russia discussed the land resources federation emphasizing current state and ecological threats, using data of State Reports of 2001-2010. Scales of Russia land degradation processes (erosion, deflation, waterlogging, salinization, desertification, acidification, dehumification and contamination) were described in facts and figures.

20. Hsiu-WanTsai, Agriculture Land Resources Planning Section, Department of Planning, Council of Agriculture, Chinese Taipei investigated the location that deserves for cultivation. According the location and characteristic, the agriculture land is defined the three kinds of land, production, conservation and non-production agricultural land. Four types of agricultural productive areas are categorized to map out the high-quality agricultural production area. These results will be used to make the policy and management of the agricultural land.

21. Dr. Somchai Anusornpornperm of Kasetsart University in Bangkok, Thailand discussed soil degradation in Thailand emphasizing the obstacles to soil management sustainability. Degraded soils in Thailand have become a major problem for soil management, particularly in the context of trying to improve yield of economic crops. Such problem has been addressed nationwide and the attempts of reclamation have been made. However, outcomes hardly show any sign of successfulness, considering the low average yield of most major plants. Funding support for the research in the case of alleviation the problem must be heavily invested to achieve the goal, i.e. soil management sustainability. Priority of reclaiming these degraded lands must be carefully placed on a specific approach. Soil conservation should be placed more emphasis first. In addition, under the tropical condition where most soils have low ability

to efficiently retain plant nutrients, rehabilitation of degraded soils has to come before fertilization, especially the substantial one. Soil physical or biological properties in some degraded soils might be in more urgent need to be improved rather than soil chemical property or actually in the other way round.

22. Prof. Dr. Kolf Kappelof the Swiss Federal Technology of Science in Zurich, Switzerland presented an invited paper on howcan foreign direct investment (FDI) in agriculture contribute to more sustainable land management and improved food security. It was found that FDI in agriculture contradicting principles of sustainable land use have been observed in many cases. These negative effects must be reduced as much as possible. Various organisations have proposed codes of conduct for investors and host governments. A priori there is no reason why foreign investments in agriculture should be less sustainable than domestic investments. Despite the risks, FDI can have positive impacts on agricultural production, productivity, employment, infrastructure, income, poverty and food security. Additional FDI to the tune of 5, 10 and 15 million ha between 2011 and 2020 can have discernible impacts on world market prices for cereals. Given that the majority of the poor are net food buyers, such FDI-induced price declines would be a welcome contribution to reducing hunger and poverty and to strengthening food security.

23. Ms. Pasinee Napombejra of the Office of Agricultural Economics, Ministry of Agriculture and Cooperatives in Bangkok, Thailand discussed the strategic framework on Thailand food security which became an important issue for the global society. APEC Members gave priority on this issue by organizing the first APEC Food Security Ministerial Meeting in 2010 in Niigata, Japan and the second time this year in Kazan, Russia. Thailand shares the awareness of the seriousness of this issue by developing a strategic framework on food security 2013-2016, which aims to ensure the sustainability of food security. The strategic framework has focused on four strategies, namely to 1) produce adequate food for sustainable domestic demand, 2) encourage all Thai people at all time to access good quality and nutritious food, 3) enhance good quality and safety food production, reduce food waste and promote appropriate food utilization, and 4) sustainably use natural resources for food production. The new theory practice under sufficient economy concept initiated by H.M. King of Thailand was one of best practices for farmer to achieve the food security at the household level that can lead to national food security.

24. Dr. Tong Anh Tuan, Personnel and Organization Department, Ministry of Agriculture and Rural Development of Viet Nam, discussed the food security and land management in Viet Nam. He stated that output of food production in Viet Nam has achieved impressive results, Viet Nam has ensured national food security and become one of the biggest of exporters of rice in the world. For sustainable development and food security in the following years, Viet Nam must implement policies of managing and protecting the agricultural land by amending land, especially rice land and give out other solutions to increase food production capacity and to decrease and mitigate climate change issues

25. On November 29, a study tour was arranged to visit the Royal Project Foundation at Ang Khang, Fang District of Chiang Mai. The participants had a good chance to see the organic vegetable production and GAP strawberry production by the hilltribers, and the package house.

26. On behalf of the Director-General of the Land Development Department, Mr. Anusorn Chantanaroj, the Chairman of the Organizing Committee,delivered the Closing Address by stating that he was well aware of the high recognition of the importance of the sustainable land management approach in contributing to the health and fertility of our soil resources in order to increase productivity and food security worldwide. Having proceeded through this scientific workshop for three days, he was confident that the deliberation and contributions based on the valuable knowledge from all distinguished participants have marked the achievement towards our goals. What we have learned during the past three days has showed that there are indeed enough mechanisms and approaches to make the management of soil resources sustainable. Nonetheless, the intensification of networking activities and collaboration among APEC economies and within each individual economy is required to initiate the processes and mechanisms in a long-term effort to develop effective solutions for enhancing and sustaining agricultural productivity. At the end he added that Thailand would also play an active role in raising the awareness of the important roles of soil towards its sustaina , food production related ecosystem services, and global food security.

CLOSING REMARK

His Excellency Mr. Kriangsak Hongto

Director General of Land Development Department

at

Scientific Workshop on Sustainable Land Management

to Enhance Food Production of APEC Members.

Bangkok, Thailand

14.45-15.15 hrs. November 30, 2012

Distinguished delegates

Ladies and Gentlemen,

It is indeed my great pleasure to deliver to you the closing remark of the highly successful scientific workshop on Sustainable Land Management to Enhance Food Production of APEC Members. I would like to state that we have been very pleased to have all of you with us here in Chiang Mai, a beautiful and heritage province of Thailand.

I am well aware of the high recognition of the importance of sustainable land management approach in contributing to the healthy and fertility of soil resources towards the productiveness and food security worldwide.

Having proceeded through this scientific workshop for three days, I am confident that the deliberation and contributions based on the valuable knowledge from all distinguished participants have marked the achievement to our goals.

What we have learned during the past three days has showed that there are indeed enough mechanism, enough approaches to make management of soil resources sustainable. Nonetheless, the intensification of networking activities and collaboration among APEC economies and within each economy are required to assure the processes and mechanisms in a long-term effort to develop effective solutions for enhancing and sustaining agricultural productivity. I would like to say that Thailand will also play an active role in raising the awareness of important roles of soil towards its sustainable management, as of fundamental for food production system, the related ecosystem services, and global food security.

On behalf of the Ministry of Agricultural and Cooperatives and the organization committee, I would once again express my deeply appreciation to all of you for the kind interest and contribution to the scientific workshop on Sustainable Land Management to Enhance Food Production of APEC Members. Also, I would like to complement all staff of the hosted organization for their hard work in making this workshop successful.

Ladies and gentlemen,

I thank you all once again and wish you a safe journey back home. I hereby declare “the scientific workshop on Sustainable Land Management to Enhance Food Production of APEC Members” closed.

Thank you.

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