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Diploma Thesis

Agricultural Innovation and Development from the Perspective of Capacity Building in North Sumatra.

Master Thesis

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Declaration

I hereby declare that this thesis entitled "Agricultural Innovation and Development from the Perspective of Capacity Building in North Sumatra**"** is my own work and all the sources have been quoted and acknowledged by means of complete references.

In Prague, 18.4.2014

….....

Gabriela Kubátová

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Abstract

The innovation process is currently promoted in emerging market economies as a means to achieve sustainable economic, social and environmental development. In this study conducted in the North Sumatra region from June to August 2013, the current situation of the small-scale farmers was identified and evaluated. A holistic approach of capacity building assessment was utilized to stress the main triggers and constraints of agricultural development in the Republic of Indonesia. This study makes a major contribution to the analysis of the significance of formal education as well as a currently evolving new approach, labelled as „*permaculture*". The study was conducted in the form of a survey, with data being gathered via participatory research methods; rapid rural appraisal. This set of methods includes semi-structured questionnaires, informal conversational interviews as well as participatory observation. The survey revealed that the main constraints which need to be overcome by small-scale farmers are (i) climate blips related to natural hazards, (ii) expensive fertilizers, (iii) lack of governmental support for agricultural initiatives, and (iv) unstable market prices of crops. The interest in adoption of innovative technologies does not stem from formal education systems. Other indicators such as age or desire to reduce crop failures were found. However, no increase in annual agricultural income was detected in relation with a higher number of diversified crops grown. The study implied other beneficial aspects of permaculture, such as increased food security and ensured a steady nutritional intake. Due to the fact that farmers´ agricultural production is more likely to be semi-subsistence, there is a potential for change in more variable composition of crops. Thus the vulnerability of farmers caused by mutable prices could be partially solved as well as harvest losses (some crops are less susceptible to climate blips.) In addition extension services which could deepen the farmers´ knowledge about innovative technologies could notably improve the livelihoods of small-scale farmers as well.

Key worlds: *Innovative agricultural technologies, North Sumatra - Indonesia, sustainable development, permaculture, education*

Abstrakt

Inovační proces je v současné době chápán, v rozvíjejících se tržních ekonomikách, jako prostředek k dosažení udržitelného hospodářského, sociálního a environmentálního rozvoje. V této studii, uskutečněné v období od června do srpna 2013 v regionu Severní Sumatry, byla sledovaná současná situace malých zemědělců a následně pak zhodnocena. "Capacity builing", volně přeloženo jako potenciál rozvoje, představuje holistický přístup k posuzování stavu dané lokality. Tato studie přispívá k analýze vztahu formálního vzdělávání a míry zájmu o inovativní technologie. Dále se zaměřuje na inovativní přístup v zemědělství tzv. *permakultury"*. Primární data byla sesbírána během terénního výzkumu v provincii Severní Sumatra, v regenstvích Toba Samosir a Samosir, prostřednictvím participačních metod výzkumu jako jsou strukturované dotazníky, neformální konverzační rozhovory, a pozorování. Studie identifikovala hlavní překážky místních farmářů, které jsou (i) klimatické výkyvy, (ii) drahá hnojiva, (iii) nedostatek státní podpory zemědělským iniciativám, a (iv) nestabilní tržní ceny plodin. Bylo zjištěno, že zájem o přijetí inovativních technologií nepramení pouze z formálního vzdělávacího systému. Záleží také na věku respondenta. S každým dalším rokem, klesá zájem o inovativní technologie o 7.9%. Bohužel nebyl nalezen vztah v souvislosti s pěstováním většího počtu různorodých plodin a zvýšení příjmů ze zemědělských aktivit. Avšak studie popisuje i jiné pozitivní aspekty, jako je stabilní příjem různorodé stravy či lepší ochrana proti klimatickým změnám. Vzhledem k tomu, že zemědělská produkce dotazovaných farmářů je určena jak k prodeji, tak k vlastní obživě, je zde potenciál pro kompoziční změnu pěstovaných plodin. Díky této změně, by se mohla snížit zranitelnost drobných zemědělců jak z pohledu nestálých tržních cen zemědělských produktů, tak i snížená úroda v důsledku klimatických výkyvů. Těchto cílů se dá dosáhnout pomocí vzdělávacích kurzů se zaměřením na inovativní přístupy a názorné ukázky přímo v terénu.

Klíčové slova: *inovační zemědělské technologie, Severní Sumatra – Indonésie, udržitelný rozvoj, permakultura, vzdělání*

Content

Declaration i
Acknowledgement ii
Abstract iii
Abstrakt iv
List of Acronyms 2
List of Tables 4
List of Figures 5
1 Introduction 6
2 Literature review 7
2.1. Innovation concept 7
2.2. Dimension of innovation 8
2.3. Procurement for innovation system 9
2.3.1. Policy instruments of sustainable development 11
2.4. Capacity building in South-East Asia 12
2.4.1. Characteristics of the Region 12
2.4.2. Capacity building background of selected attributes of Indonesia 14
2.5. Permaculture as an innovative technology 19
2.5.1. Key components of permaculture 20
2.5.2. Permaculture design 21
2.5.3. Benefits of permaculture 23
2.5.4. Permaculture projects 24
3 Objectives 26
4 Methodology 27
4.1 Study of secondary data 28
4.2. Description of study area 28
4.3. Primary data collection 29
4.3.1. Questionnaire design 30
4.3.2. Observation 30
4.4. Data Analysis 31
4.5. Study Limitations 31
5 Results and discussion 32
5.1. Socio-demographic indicators of target groups 32
5.1.1. Agriculture characteristics 37
5.2. Innovation capacity building assessment of selected attributes 41
6 Conclusion and Recommendation 47
6.1. Conclusion 47
6.2. Recommendation 48
7 References 49

List of Acronyms

3R	Recycle, Reuse, Reduce
ASEAN	Association of Southeast Asian Nations
BAPPENAS	State Ministry of National Development Planning
BKPM	Indonesia Investment Coordinating Board
BPS	Badan Pusat Statistik
BRICS	Emerging national economies (Brazil, Russia, India, China, South Africa)
DALY	Disability-adjusted life year
CA	Conservation Agriculture
EAP	Ecoagriculture Partners
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
HACCP	Hazard Analysis and Critical Control Points
HDI	Human Development Index
HDR	Human Development Report
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
ISCU	International Council for Science
ISFD	Institute for Strategic Funding Development
IPRCC	International Poverty Reduction Center in China
LEAF	Learning Environmental Adaptations for Food Security
MOA	Ministry of Agriculture

MOAC	Ministry of Agriculture and Cooperatives
MOF	Ministry of Forestry
MMAF	Ministry of Marine Affairs and Fisheries
NFS	National Science Foundation
NGO	Non-governmental Organization
NMTPF	National Medium-Term Priority Framework
OECD	Organization for Economic Co-operation and Development
PIDEL	Politeknik Informatika Del
R&D	Research and Development
SARDI	South Australian Research and Development Institute
SEA	Southeast Asia
SMA	Sekolah Menengah Atas
SMK	Sekolah Menangah Kejuruan
SMP	Sekolah Menangah Pertama
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USPTO	United States Patent and Trademark Office
WB	World Bank

List of Tables

Table 1. Changes in various determinants in different zone
(Adapted from Mollison, 2012; Tropical Permaculture, 2013; FAO 2013)…….22
Table 2. Descriptive statistic of target group……..33
Table 3. Water sources grouped by regencies…….....35
Table 4. Proportion of growing crops grouped by respondent preference…….39
Table 5. Descriptive statistics of variables used in regression analysis……44

List of Figures

Figure 1. Sustainability (Global Reporting Initiative, 2008)……9

Figure 2. Creating favourable Conditions for Innovation (Mytelka, 2000)……..…..11

Figure 3**.** Agricultural research intensity ratios (Raitzer and Meridia, 2012)……..13

Figure 4. Utility patents by country (Author´s based on USPTO, 2012)……14

Figure 5. Public Expenditure on Education, 2001-2010
(WB staff estimates based on MoF, APBD, and BPS data)……17

Figure 6. Research design……27

Figure 7. Map of study area (Adjusted according Badan Pusat Statistik, 2013)…….29

Figure 8. Type of school enrolment grouped by regencies……..36

Figure 9. Land size grouped by Regency…….37

Figure 10. Types of fertilizers used in Toba Samosir and Samosir regencies……..38

Figure 11: Main agricultural problems arranged by importance……..40

1 Introduction

The Republic of Indonesia is the largest economy in Southeast Asia region. The main sector of its economy is industry; nonetheless the agriculture represents basic pillar of Indonesian economy as well as it employs approximately 40% of population. Taking in consideration the annual population growth of just about 1% the high demand for food is expected. Thus the agricultural development becomes essential question as seen in National Medium-Term Priority Framework for 2010-2014 created with the assistance from Food and Agricultural Organization of the United Nations.

Nowadays, many challenges lay on governments especially those with emerging market economy. To support process of rapid growth and equal distribution of wealth among the population broad network of actors have to be involved as well as vast different polices need to be launched. Innovation process overlaps many fields of activities aiming to, so called “wicked problems“. Thus the creation of favourable environment for applying an innovation processes is inevitable pace for sustainable development.

The growing interest in addressing food security while maintaining sustainable development focuses on ecological farming. Ecological farming widely recognized as organic farming relies on crop rotation, green manure, compost and biological pest control. Such an approach still does not cover entire farming system. Permaculture strives to include all aspects of elements or systems (water management, pest control, biodiversity, labour, energy source and demand as well as environmental impact) into designing most efficient, and sustainable livelihood.

In order to investigate economic significance of permaculture, firstly innovation environment has to be described whether the local conditions favours adoption of new technologies. Then the examination of the contribution of higher biodiversity (growing different crops) to agricultural annual income of small-scale farmers will be presented.

2 Literature review

Meeting the goals of sustainable growth of food production and reducing rural poverty requires assisting family farmers to develop more productive, profitable, resource efficient and environmentally friendly farms (Dogliotti et al., 2014). To support such a growth cooperation of many national and international players is necessary. However, without either the national policy framework or long-term development strategy desirable results can be hardly achieved. So, in the following section the comprehensive review along with a framework of the agricultural development will be presented.

2.1. Innovation concept

Innovation and the innovation process is an extensively debated issue across today´s world, the inception of innovation occurred between the 1940s and the late 1960s, labelled under the term "Green Revolution". The term "Green Revolution" originally described developments for rice and wheat, high-yielding varieties to increase food crop production, especially in India (Kitchin, 2009). Since that, other major food crops as; sorghum, millet, maize, cassava and beans have been developed. The aforementioned term is mainly associated with Norman Borlaug, who is seen as father of Green Revolution, later awarded the Nobel Peace Prize. The trigger of innovation process was entailed by hunger and malnutrition, especially in Asia in mid-1960s. The U.S. President's Science Advisory Committee in 1967 report stated that: "the scale, severity and duration of the world food problem are so great that a massive, long-range, innovative effort unprecedented in human history will be required to master it. "

Thus the social and agricultural impact of the "Green Revolution" has had both positive and negative aspects. Without the yield increases a great number of poor people would experience hunger and poverty, greater degradation of forests for agricultural purposes would also occur. On the other hand low-potential rain fed areas has improved little, thus the inequalities between those who adopted 'Green Revolution' technologies worsened (IFPRI, 2003).

Today´s societies face a number of serious obstacles and challenges, many of them global in scope. The development of new technologies alone will not solve any of these problems, for some at least, the creation and adoption of more effective and appropriate

technologies is a necessary part of any solution (Foray et al., 2012). The broad approach for a change needs to be applied. Even in agriculture the adoption of new technologies cannot ultimately and comprehensively be the solution of these problems. Agricultural development depends to a great extant on how successfully knowledge is generated and applied (WB, 2006). It should be clear that the concept of „innovation“ encompasses not only “technological innovation“, i.e. the diffusion of new product and services of a technological nature into the economy, but equally it includes not-technological forms of new innovation, such as: „organization“ innovations (WB, 2004). According to Pradhan (2010) innovation means technologies or practices that are new to a given society. They are not necessarily new in absolute terms. A bearer of innovation process is mainly government and society (Aubert, 2004; WB, 2006; WB, 2007). Nonetheless Borrás et al. (2013) claimed that the innovation is primarily carried out by firms.

2.2. Dimension of innovation

The concept of innovation reflects extensively with the notion that its process can mitigate grand challenges of today´s world such as: global warming, water and food security, public health, pandemics and tightening energy supplies. Policy instruments do not allow the solving of grand challenges as whole. It is not possible for one policy to work at such levels. Innovation process focuses on more limited goals for example research and development (R&D) funding, tax credits, environmentally motivated regulations and standards (e.g. mileage standards for automobiles), creation of markets for innovative ideas, support for education and training or enhancing capacities for knowledge exchange (OECD, 2011; Edquist et al., 2012). Hence it supports to create a network of organizations, enterprises, and individuals focused on bringing new products new processes, new forms of organization into economic use, together with the institutions and policies that affect their behaviour and performance (WB, 2006, FAO 2009). The innovation process is involved in many fields and endeavours, always striving to be sustainable and feasible. Especially the innovation process aims to solve so-called „wicked problems„ and moves towards sustainable development which require the involvement of a broad network of collaborators: not only research institutions, but also businesses, government and non-governmental organizations in the process of social learning and knowledge co-creation between scientists and other stakeholders (Röling and Wagemakers,

1998; Leeuwis and Pyburn, 2002; Van Bueren et al., 2003; Hermans et al., 2013).

Unprecedented challenges require novel and rapid innovative responses (ISCU, 2010). These responses have to overcome not only precisely defined problems, moreover once created and applied need to maintain sustainability and minimal environmental impact. Without a paradigmatic shift in how natural resources are valued and managed, inequality and instability will deepen, and human development in current and future generation will be at least hindered, perhaps even reversed (UNDP, 2013). Figure 1 shows what have to be taken in consideration while creating responses to global/regional/local issues.

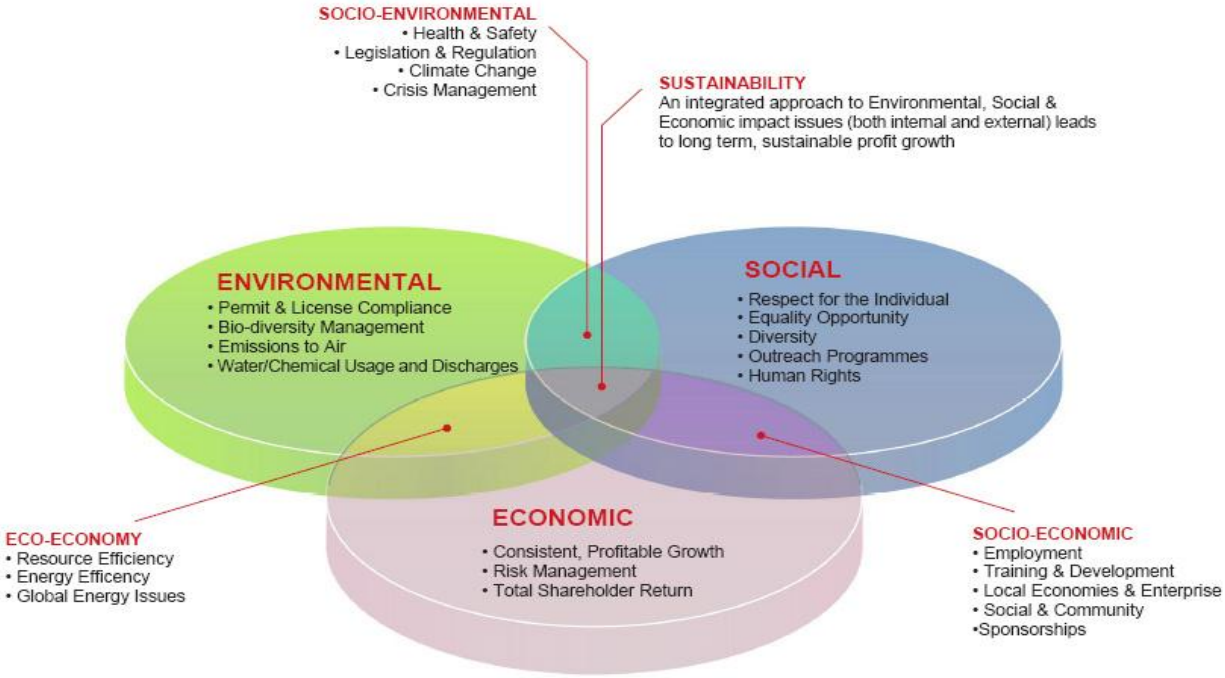


Figure 1: Sustainability (Source: Global Reporting Initiative, 2008)

2.3. Procurement for innovation system

Global development challenges become more complex and trans-boundary in nature, coordinated action on the most pressing challenges of our era, whether they be; poverty eradication, managing climate change or ensuring peace and food security, is essential (HDR, 2013). To secure further development Weber (2013) claims that fundamental changes in our models for production and consumption are needed if major threats to our

societies are to be prevented or significant new opportunities are to be seized. Economic growth is one of the fundamental indicators of development. To overcome Grand challenges three aspects of sustainability (i.e., people, planet, and profit) have to be taken into account (Alkemede et al., 2011) for stimulating the innovation process that is beneficial for society at large.

The linear model of innovation is replaced by multidimensional innovation system that can appropriately react on current challenges. To keep pace with today´s technology, social and economic demand, modern states have to abandon early linear innovation model based on three phases of the process; from Invention to Innovation to Diffusion. As noted above; to facilitate sustainable development more bodies, as Universities, Advanced laboratories, Private companies, Government etc. (Convey et al., 2009) have to be involved to established desirable and supportive environment.

Many governments realize importance of sustainable development and its instrument to spur innovation processes are policies and direct financial support of R&D. The broad innovation system is shown in Figure 2 to emphasis main involved bodies and to stress fundamental synergies within the system itself.

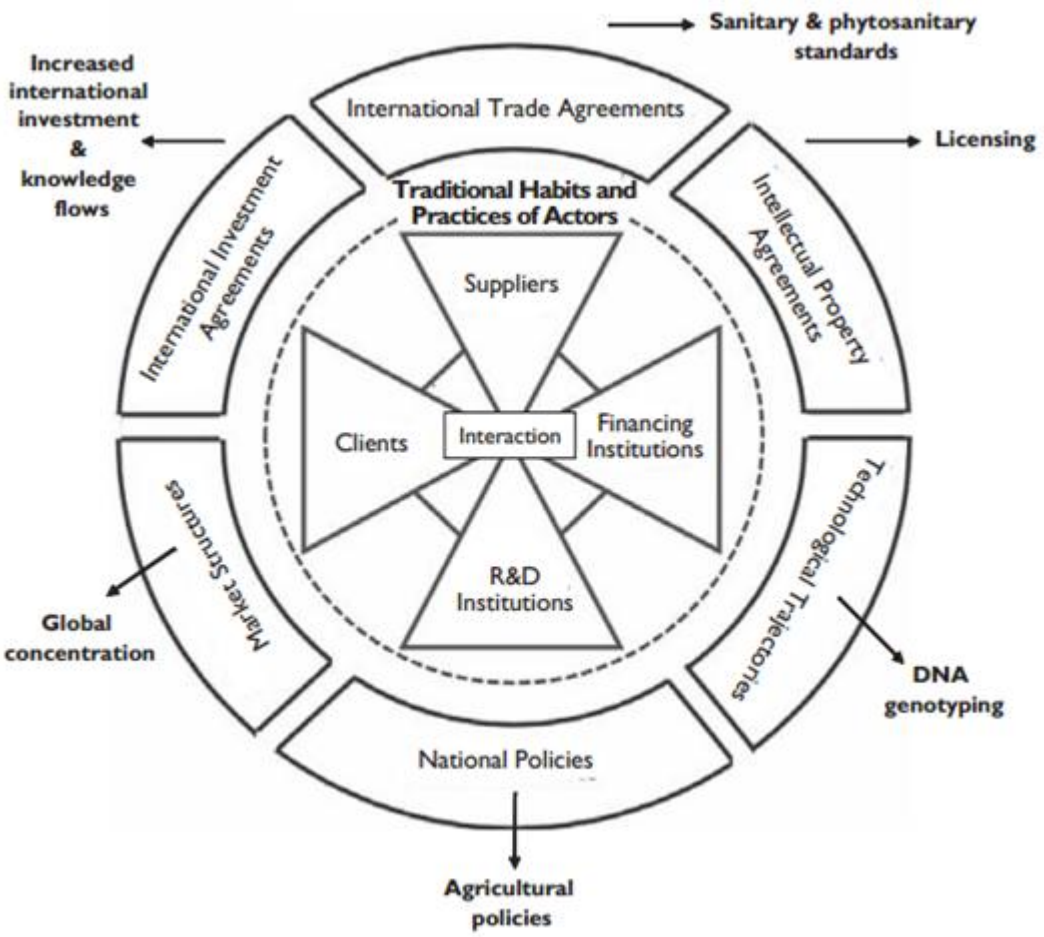


Figure 2: Creating Favorable Conditions for Innovation (Source: Mytelka, 2000)

Expend scientific and technical innovation, break through the core technologies concerning new materials, energy and products such as biodegradable plastic film, biomass energy conservation, etc., from the high-tech products with independent intellectual property rights, cultivates new economic growth points and emerging industries so as to promote the development of the modern agriculture (IPRCC, 2010).

2.3.1. Policy instruments of sustainable development

The government policies can play a large role in whether these potential benefits of population of growth are realized (Pender, 1998). A proactive developmental state is one of the three drivers of transformation recognized by UNDP in 2013, followed by (ii) tapping of global markets (package that involves the interaction of reforms in trade, and fiscal,

monetary and institutional policies), and as last to successfully (iii) determine social policy which has to be accompanied with substantial public investment. Public procurement represents one of the powerful tools encouraging investments into R&D that have been fundamental to long-term economic growth worldwide (Wright et al., 2007). R&D spurred by public procurement is recently seen as an attractive and feasible instrument for furthering the goals of innovation policy (Georghiou et al., 2013) and to satisfy human needs and/or to solve societal problems (Edquist and Zabala-Iturriagagoitia, 2012).

2.4. Capacity building in South-East Asia

Aforementioned definitions of an innovation system adhere to the holistic perception of innovation environment where more organizational bodies have to be involved. Thus the term capacity building refers to capacity development. To evaluate strengths, limits and opportunities at such level, a wide-spectrum of criteria was developed.

In the following chapters, an innovation environment in South-East Asia, will be described especially in Indonesia. Due to lack of data for Republic of Indonesia, we may refer to the entire sub region of South-East Asia as it shapes Indonesia.

2.4.1. Characteristics of the Region

Despite the fact of notable development growth (especially China, India, Indonesia), South-East Asia (SEA) still fights with poverty. According to IFAD (2011) 1.4 billion people living on less than US$1.25 a day, and there remains close to 1 billion people suffering from hunger. At least 62% (IFAD, 2011) of people are still involved in agriculture, meaning SEA countries contain mainly rural population. As mentioned above; in spite of the economic growth of country, economic benefits are heavily biased in favour of urban population (FAO, 2001). Thus regional economies remain agrarian.

On the other side R&D spending has risen rapidly in Asia (Veugelers, 2013). Further adds that private R&D investment is also increasing worldwide, and is growing more rapidly outside the previous dominant centres of North America, Europe and Japan.

Nonetheless SEA has one of the world´s lowest agricultural research intensity ratios, or ratios of agricultural research expenditures to values of agricultural production (Beintema and Stads, 2008) as seen in Figure 3. On the other hand experimental trials with genetically engineered organism are permitted in Thailand, Indonesia and Vietna

Furthermore, several SEA countries permit the import of genetically engineered foods as Indonesia, Vietnam, Malaysia, Thailand, Philippines, Myanmar, Laos, and Cambodia.

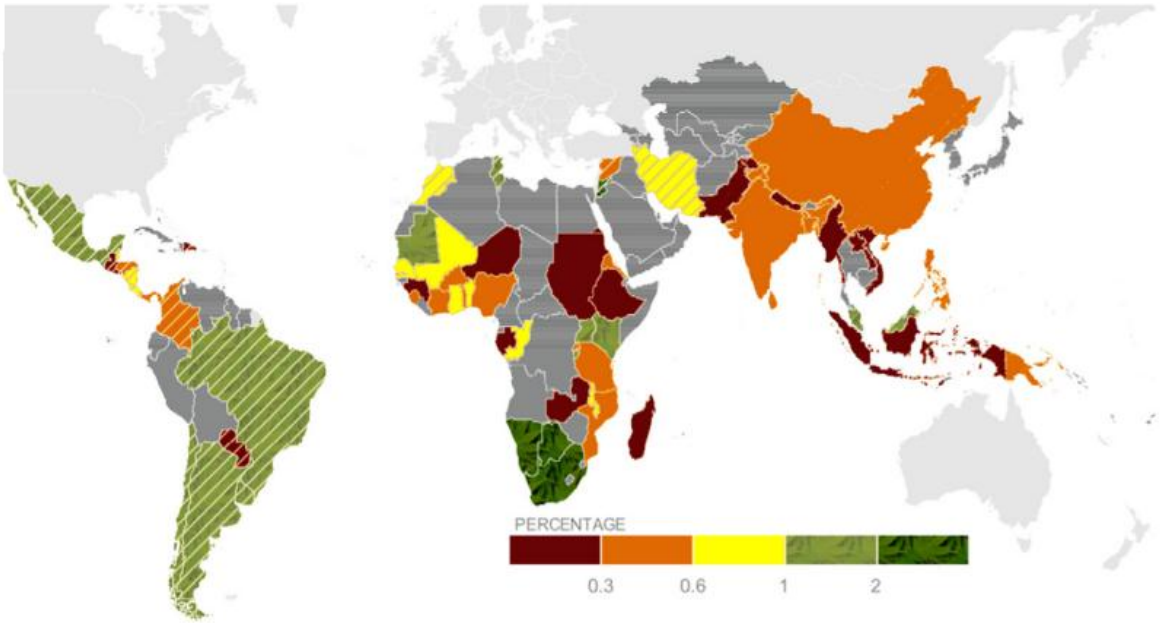


Figure 3: Agricultural research intensity ratios (percentage of agricultural Gross Domestic Product spent on agricultural research) for developing countries during the most recent years with available data from Asti 2012. (Source: Raitzer and Meridia, 2012)

Overall data does not support the notion that the rise of Asian R&D is driven by the direct government spending (Veugelers, 2013). However the sectors targeted by government-funded R&D are (i) industry products and technology, (ii) energy and environment and (iii) great share of governmental spending is concentrated on transport, telecommunications, agriculture, education, culture, and political systems (Bruegel based on NSF, 2012 in Veugelers, 2013). To support the innovative environment it is important to go beyond sector boundaries (agriculture, services, local development, regional branding

etc.), bring various competencies and visions together and invent new solutions moreover, sometimes distant networks may help to overcome pressure of competition on regional level (Knickel et al., 2009).

Another indicator of research activity is patent improvement. Figure 4 shows selected countries in SEA regions with significant differences in approved patents but still with growing HDI in recent years. Thus the innovation and developmental activities are not necessarily connected with economic growth.

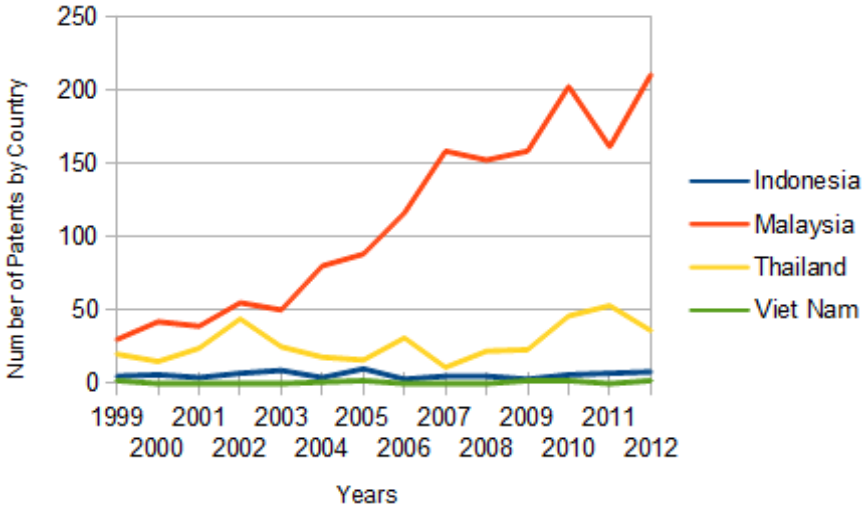


Figure 4: Utility patents by country.
Source: Author´s based on USPTO, 2012.

2.4.2. Capacity building background of selected attributes of Indonesia

Indonesia as the 4th largest population in the world with 240 million of inhabitants (Research and Market, 2013). The country gives a rank of 121 out of 187 countries in Human Development Index (HDI; Anonymous author, 2013). It is one of the country that was able to increase its share of world exports of goods and services from 0.624 to 0.803 (between years 1985-2010) and mutually increase HDI to 0.629 (BPS, 2012).

It is expected that Gross Domestic Product (GDP) of Indonesia will get to 1 trillion USD in 2013 as the biggest economy in the Southeast Asia. Indonesia is, after Singapore which doesn`t have any governmental debt, country with the lowest debt among ASEAN

countries (BKPM, 2013). The Standard Chartered Bank sees Indonesia to be the 10th largest economy country in 2020 and 5th in 2030 (BKPM, 2013).

The poverty was set at 1.25 USD per day per capita by the World Bank (Ravallion and Chen, 2013). Indonesian multidimensional index of poverty is 0,095% (HDR, 2013).

The poverty of whole Indonesia is about 11.37% (urban and rural areas) according National Socio-Economic Survey from March 2013. Of course greater poverty can be find in rural areas at around 14.32% compared to urban figure of about 8.39%. If we focus to Sumatera, there is the total poverty a little bit comparatively higher to Indonesia overall with about 11.51%. The poverty in rural areas is around 12.72% and in urban areas around 9.64%. In the region of Sumatera Utara the total poverty reaches to 10.06%, urban areas reach to 9.98% and rural areas reaching 10.13% (BPS, 2013).

The farming systems used in North Sumatra region, according to FAO (2001), are mostly, (i) tree cropped mixed, (ii) pastoral, and (iii) upland intensive mix farming. All these systems are used in the studied area. Farmers focus mainly on staple crops as rice, maize, and chili with some exception of vegetable, cocoa or fruits. However Raitzel et al., (2012) claimed that oil palm is the agricultural system with the highest production value. Strip intercropping advantages include: better use of growing area, plant diversity, increased yields per area grown as well as pest control. Undermentioned permaculture systems also use intercropping for additional benefits in incorporate household, horticulture, water capture and soil erosion. As the target group is located around Lake Toba they supplement their daily diet with fish. Regardless relevant food diversity, Indonesia reports the highest losses of DALYs as a result of micronutrient deficiency (Raitzel et al., 2012).

School Enrolment

One of the tools according Millennium Development Goals of alleviation of poverty is education. Moreover UNDP acknowledges education as one of the key indicators of dimension of development. Thus, the education is the fundamental attribute to empower people with knowledge from which to make informed choices (Hollins and Robb, 2013) and to give equal weighting to the personal growth of each individual side-by-side with human resource development in lifelong perspective (OECD, 1993 in Hollins and Robb, 2013). Cremin and Nakabugo (2012) also state that the benefits of investing in education

has great contribution on poverty reduction.

The educational system in Indonesia is divided into different levels. Every child is required to be enrolled in a minimum of 9 years of schooling. First degree is attended in *Sekolah Dasar* (SD) lasting for 6 years. To finish "junior high school", consecutive 3 years study cycle in *Sekolah Manengah Pertama* (SMP) is necessary. Subsequently it depends on family/child whether to continue to study or not. In the second case child starts to attend *Sekolah Menengah Atas* (SMA) which is consecutively divided into mechanical specialization at *Sekolah Menangah Kejuruan* (SMK) which can be understood as vocational apprentice training center. During following tertiary education you can get Associate Degree (*Profesional Ahli Pretama* - S1, *Profesional Ahli Muda* - S2, *Profesional Ahli Madya* – S3) depending on years of studying. Bachelor Degree is outlined to S4 (*Sarjana Sains Terapan)* and *Sarjana* D1. *Sarjana* (D2) represents Master degree and D3 Doctoral degree.

Meeting rapidly rising demand for more and better education (OECD, 2008) pushes government to increase educational expenditures (OECD, 2008; Cheung and Chan, 2008; Tang and Yin M, 2012; HDR 2013; Hollins and Robb, 2013; OECD, 2013). Unlikely reverse phenomena are monitored via the choice of young people in specialized technologies at the tertiary education level, especially in agriculture studies (BPS, 2013). Nonetheless a promising educational environment, as wide range of job opportunities as well as appropriate wage, is being created to support students´ choice of study area.

This trend can be observed in Figure 3 where from 2001 and until 2010 it was measured approximately a 10% increase in governmental expenditure on education. The share of GDP on public education account only for 1.0% in 2009 (most recent data available from WB).

In addition, personnel working in R&D is predominantly individuals with tertiary education acquired. According to a R&D survey in Higher Education from 2009 58% of R&D personnel have Master Degree, 26% Doctor Degree, 13% Bachelor and Diploma Degree and only 3% have no higher education. The total number of R&D personnel accounts for 42 083 people in all the Republic of Indonesia.

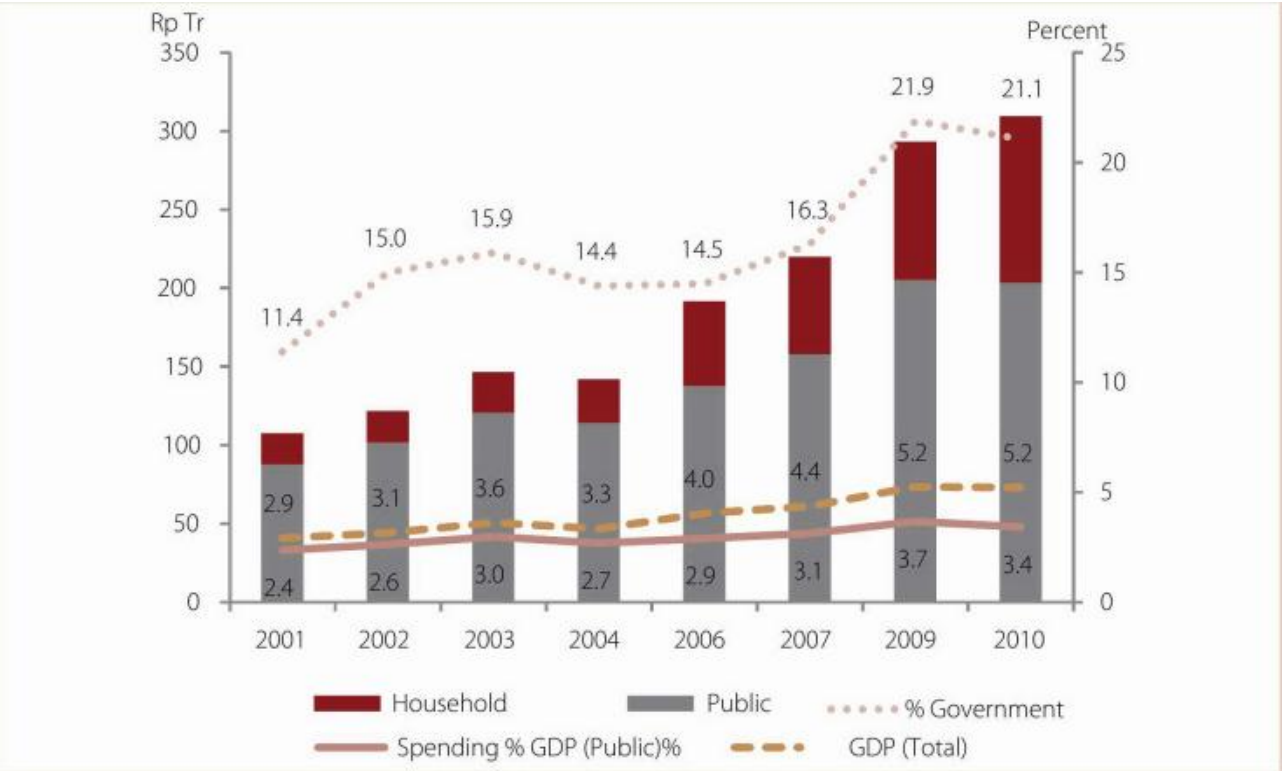


Figure 5: Public Expenditure on Education, 2001-2010
Source: World Bank staff estimates based on Ministry of Forestry (MoF), and BPS data.
Notes: Realized expenditure data are unavailable after 2009 as sub-national realized data after that year are unavailable. Planned education expenditures reflect calculation of the budget including central government and regional transfers in the planned revised budget laws.

Agricultural research and development

Southeast Asia can provide favourable economic background at the farm-level thus the adoption of specific practices can be rapid and extensive (Pannel, 2013). Most recent available data on R&D expenditure are from year 2009 when it accounted for 0.1% from GDP (WB). According to the UNESCO data report this 0.1% represents PPP$ 731,220 in constant price 2005. Further note; the average percentage of GDP on R&D expenditure in developed countries is 2.24% compared to developing countries (excl. least developed countries) 0.99%. This ration is lower than the world average which constitutes 1.7%. According to Simamora (2011) the university R&D expenditure accounts for Rp.1, 740 Billion ($148.268 Mill. for actual price). Moreover from this amount 56.7% was used in applied research, 22.9% in basic research and 20.4% in experimental development.

The Republic of Indonesia managed to boost its economy and the premise for upcoming years is more than positive. One of the indicator for expected economic

development is candidacy for membership in the BRICS (Indonesia Investments, 2014). Accurate stimulation of such an economy may attract foreign investors not only in industrial and economic sectors but also in agriculture, and R&D.

In Indonesia there are 3 013 companies performing R&D activities and their expenditure was estimated for $68 million (Simamora, 2011).

To support development in the country, the Indonesia government launched the National Medium-Term Priority Framework (NMTPF) 2010-2014. The NMTPF was developed with Ministry of Agriculture (MoA), MoF, Government of Indonesia (GoF), Ministry of Marine Affairs and Fisheries (MMAF), and State Ministry of National Development Planning (BAPPENAS) with assistance of FAO. The ultimate goal of NMTPF is to *Increase Agriculture Competitiveness and Contribution to GDP.* Thus NMTPF embodies three main practices (i) PUS – Priority Ultimate Strategy, PCS – Priority Core Strategy, PSS – Priority Support Strategy which altogether represent cross-structural change of current system of Indonesia. NMTPF strives to gain cross-sectorial change which leads to poverty reduction, increased economy growth and quality of human development. For this paper it is not necessarily to thoroughly describe all the aspects of NMTPF therefore we stressed only the most important strategies for innovation and agriculture of small-scale farmers.

Additionally New Zealand´s development partnership – Indonesia Strategic Framework for Development (2012-2016) with Indonesia is embedded in NMTPF 2010-2014, New Zealand´s International development policy, the Jakarta commitment, Busan Partnership etc. Focal areas are renewable energy, disaster risk management, agriculture, human resources development, and Eastern Indonesia. Thus foci commitment in agriculture will be dairy sector and quarantine services especially HACCP on fresh food product biosecurity services to entry/exit points (NMTPF, 2010; ISFD, 2012).

To enhance farmers´ livelihood there is a necessity of increased capacity development of human resources and local institution that are involved in the agricultural sector alongside improved governance, transparency and accountability and change in the national policy framework in a land tenure system. Furthermore, there is a great demand for research institutions, especially in production and use of bio-energy (bio-fuel, bio-gas) and sustainable and environmentally-friendly programs as well as endeavour to re-empower agricultural field extension (partly achieved by promulgation of Law no. 16/2006). Moreover, by increasing food supply from animal products, fruits & vegetable,

and adjusting the consumption pattern of the population towards a better quality, more-balanced, nutritious and healthy diet. One of the tools how to diversify food with environmentally-friendly systems is permaculture which will be discussed in following chapters.

2.5. Permaculture as an innovative technology

To begin, a definition and understanding of the term of permaculture is essential. Bill Mollison coined the word permaculture and David Holmgren in the mid-1970's described it as an integrated, evolving system of perennial or self-perpetuating plant and animal species useful to man (Mollison and Holmgren, 1978). It may be argued that the intercropping agriculture system is the same concept, especially in reference to mixed intercropping which is defined as: "growing two or more crop together in no distinct row arrangement" (Wolfwinkel, 2007). To pinpoint the differences we need to look to current definition of permaculture which is stated in accordance with the former definition of permaculture Holmgren (2004) as: "consciously designed landscapes which mimic the patterns and relationships found in nature, while yielding and abundance of food, fibre and energy for provision of local needs". The aforementioned definition points out the holistic spectrum of permaculture agriculture compared to a mixed intercropping system.

It should be mentioned that some permaculture aspects are incorporated in Ecological Farming, Conservation Agriculture (CA) or Eco agriculture (recognized by FAO) that is still understood as landscape management approach that achieves three goals at a landscape scale: conservation and sustainable use of biodiversity and ecosystem services, sufficient food production, improved rural livelihoods (EAP, 2014) including, but not limited by; agriculture, water management, waste management, green building and efficient use of energy (Kusamala, 2014) furthermore, increased profits and food security while preserving and enhancing the resource base and the environment (FAO, 2014). In addition, the permaculture systems stress traditional knowledge, local food chain and full exploitation of neighbouring ecological system with the principles of sustainable development and minimal intervention in the nature design. Overall, the permaculture design is an innovative tool for households and communities to use towards a sustainable future.

2.5.1. Key components of permaculture

In response to concerns about food security, farm profitability, and land degradation in agriculture around the world, a range of practices have been developed and promoted to farmers (Pannell et al., 2013). Typically small holder farmers perform subsistence agriculture characterized by limited application of inputs, distorted markets, deteriorating soil conditions, and recently uncertain weather patterns (Christensen et al., 2007 in Johansen et al., 2012).The permaculture operates with continuous minimum mechanical soil disturbance (zero tillage), permanent soil cover (mulching), and diversification of crop species grown in sequences and/or associations (intercropping) (Kassam et al., 2009; FAO, 2014) to contribute for cross-sectorial improvement of livelihoods´ of small-scale farmers.

As international organizations are focusing on solution of food security with associated improvements of living conditions and poverty alleviation, many manuals of the conservation agriculture and its principles were launched (ADRA, 2013; FAO, 2014). The following points summarise fundamental principles and ethics of permaculture developed by Bill Mollisson[1] (2012)

- Relative location
- Each element perform various function
- Each important (fundamental) function is ensured by many elements
- Energy-efficient planning of building and farmsteads
- Preference of renewable sources rather than fossil one
- The energetic circle is performed on the spot (human as well as energetic)
- The development of land and soil by using natural plant succession
- Productive system uses polyculture (cooperating systems of mutual beneficial species)
- Land design is taken from natural patterns.

[1] The following principles were translated by author from the Czech original. Therefore the difference with other publications can be found.

Relative location is one of the fundamental elements. The location of any buildings is crucial to the location of livestock, greenhouses and water reservoirs. The meaning of Principle 1 is to efficiently use the location to support effectiveness i.e. water reservoirs located in higher location so gravity can be used. In greater detail, location and zoning will be discussed in chapter 2.6.2. Permaculture design. The system fits also to small home gardens where works with small intensive systems mostly maintained by hand tools. Compared to classical conception of gardens (all in rows) permaculture utilizes primarily 'no strict borders' philosophy. On the other side borders, especially where two different ecosystems meet and create new third ecosystems, are the most productive and complete areas, due to high diversity of plants, animals and insects interacting within each other. Thus the creation of terraces, swales or vegetable gardens along edges of livestock land are excellent examples of full recognition and exploitation of edge effects in the permaculture.

Furthermore, smart energy cycling is crucial to reduce labour power used as well as reduction of inputs costs. Successful soil nutrient management in organic farming can only be the results of long-term integrated approach, where interactions of components of an organic system are accounted for (Chaoui and Sørensen, 2008). For instance, instead of burning maize husks and stalks we can include them in compost or mulch for others parts of the garden (ADRA2013). An equal distribution of residue provide homogenous temperature and humidity conditions (FAO, 2014) thus the minimal tillage can be applied, in order to reduce agricultural losses (Fan et al., 2013). Interpreted by Erenstein (2002) the incorporated amount of residue should be limited, since the specific amounts required for local conditions are often not clear (Paul et al., 2013). Valbuena et al. (2012) identified usual use of crop residue as animal feed, mulch and for trading. Thus the challenge for many small farmers is to produce and retain enough residues to permit these changes to occur (Boudron et al., 2012 in Boudron et al., 2014).

2.5.2. Permaculture design

The fundamental part of permaculture design is zoning, which allocates each element according its functions and necessity of attendance/maintenance within the year. The correct permaculture zoning saves time and energy by reducing necessary travel (Tropical

Permaculture, 2013). Therefore in creation of sustainable livelihood (farm, community) it is crucial to design what we need, and how often we frequent any particular place. In most cases the actual permaculture practice/design has to be developed locally, to be relevant to the specific farming situation and agro-ecological conditions (Friedrich and Kassam, 2009).

To design a permaculture garden it is essential to follow the aforementioned principles and collect accurate information about the farm position. Efficient designing can be done only with a comprehensive knowledge of slopes, wind direction: its variation throughout the year, direction of sunlight, water catchment, access road, what is grown at the borders, existing buildings, rocks, future buildings plans etc. This information is implemented into the zone diagram. Zones are numbered from the inside out starting with Zone 0 which is represented by the house. Zone 0 should be energetically and environmentally sustainable as well as comfortable and easy to manage. Following zones and their functions are described in Table 1. Zoning is frequently displayed by expanding circles from the centre (Zone 0), as seen in Annex 1. In the case of situating more distant zones closer to the centre permaculture utilizes sectors as visualized in Annex 2.

Table 1: Changes in various determinants in different zones (Adapted from Mollison, 2012; Tropical Permaculture, 2013; FAO 2013)

Determinants	**Zone I**	**Zone II**	**Zone III**	**Zone IV**
Place	Intensive zone – garden for subsistence	Small domestic animals, food forest and orchard	Main crop – staple production, Fodder Storage	Woodlots, Pasture, Collection of feed
Crop Management	Full cover (mulching)	Spot mulching, tree protection	Soil management – permanent bed system	Soil management
Structure	House, Greenhouse and integrated storage	Greenhouses, henhouses etc.	Storage for feed	Deer-stand

The map gives relevant features of the land to incorporate element analysis. This analysis covers functions and requirements of each element. Thus, the allocation of elements will be favourable for other accompanied elements. Moreover the better

allocation of component parts, the less labour is required. Therefore to design a sustainable zone map respecting natural patterns are inevitable.

2.5.3. Benefits of permaculture

Even if the permaculture is seen as universal approach for poverty alleviation it has to be adapted for each agro-ecological zone respectively. What is clear is that agro-ecological conditions play a major role in determining the benefits (Pannel, 2013) depending on the ability of farmers to adapt its components to the unique environment of their farms. Because of the permaculture; contribution to local and regional improvement is achieved through economic, agronomic, environmental and social redistribution of human resources as well as implementation of innovative agricultural techniques (Kusamala, 2014). In the following part we present some of the techniques or beneficial elements which are created within the permaculture.

The first discussed benefit is trap cropping and the use of other preventive measures (herbicide-tolerant cultivars, companion planting, mulches, competitive crop cultivars) prevention of invasive and alien weeds in fields is usually easier and less costly then eradicating them after severe infestation, as it is difficult to control weeds once they are established (Chauhan et al., 2012). Therefore FAO (2014) states that mulching provide weed suppression moreover has a positive effect on soil moisture, soil temperature, and improves soil chemical, physical and biological soil fertility. Wszelaki (2012) distinguishes two primary techniques utilized in trap cropping (i) selection of a more preferred plant species or cultivar grown at the same time as the main crop, (ii) planting of the same species and cultivar as the main crop timed to be at the most preferred stage of development before the main crop. Both of the techniques enable to control pest location in desirable way and so reduce damage to crops.

Another weed control technique is mulching as was discussed earlier in chapter 2.5.1. Key components of permaculture. Mulching can provide an additional positive effect in addition to weed control. The loss of organic matter brings new challenges for small-scale farmers and their permanent bed systems. The adequate residue management and its distribution can increase organic matter in soil, buffer the pH of the soil and facilitate the

availability of nutrients - especially NPK and other trace elements (Tropical Permaculture, 2013), in addition to protecting the soil from being eroded (FAO, 2014). The study by Rogers et al., (2009) confirms that the retention of an organic mulch on the soil surface and a reduction in cultivation results in an increase in organic matter within the soil.

Moreover, s permaculture system elaborates on diversification of food gaining more stable, various nutrient rich food dietary. Agricultural policies, including R&D, can be used to make the food supply more diverse, but unfortunately few countries have made diversification of food a specific policy objective. (FAO, 2013). Herfoth (2012) claims that projects aimed at promoting the production, marketing and consumption of traditional vegetables among smallholders found that increasing crop diversity as associated with increased dietary diversity. Furthermore in the study by Powel (2012) it was proved that food obtained on farm and crop diversity were positively associated with of dietary adequacy, while percent of food purchased was negatively associated. Thus permaculture system enable higher food security for rural poor as well as semi-subsistence or subsistence farmers accompanied by preventing micronutrient deficiency.

2.5.4. Permaculture projects

As mentioned before permaculture is one approach that is being adopted by rural farmers to both decrease reliance of outside inputs and increase biological diversity (Carlton and Lewin, 2013). The Agroecology Extension in Mountainous Areas of the Vietnam project (ADAM) was launched in 2009 to intensify agricultural production on sloping lands in the North Vietnam, through building and the extension of innovation based conservation agriculture. Another project facilitated the sustainable development of marginalized communities through mobilization of their capabilities for self-reliance is EMPOWER (Enabling entrepreneurs to build self-reliant communities) in Malawi and Sri Lanka. The project was launched in 2013 with a 5 year operational horizon. The development priorities for 614 residents in Puthumunmarchicholai are (i) repair of irrigation channels, (ii) developing a dairy farming cooperative, (iii) building a pre-school.

After the devastating Tsunami of 2009 which mostly hit the Aceh region, IDEP non-governmental organization (NGO) - Helping Aceh Victims Rebuilt Their Lives was founded. Their work covers four areas (i) sustainable development – permaculture, (ii)

disaster preparedness, (iii) emergency response and last, (iv) community recovery, and is altogether called the Cycle of Resilience. To increase awareness of the importance of sustainability training and consultation team was established. Training is held in Pengosekan Ubud, Bali. The permaculture section covers six issues:

1. Introduction to Permaculture
2. Introduction to Sustainable Agriculture
3. Community Permaculture Facilitation
4. Composting and Soil Rehabilitation
5. Integrated Pest Management
6. Seed Saving

These training sessions are mainly for community leaders and NGO workers, in order to disseminate the acquired knowledge among local communities and thus increase reliance and effective resource management. So far IDEP and IDEP Partners´ delivered their training to 16 locations across central and western Indonesia.

3 Objectives

Capacity building encompasses wide spectrum of actors which shape rural development in different levels. It can identify problems and gaps which can facilitate further successful project implementation. The main aim of this thesis was to analyse the current situation of small-scale farmers with their respective problems and challenges. Furthermore, the first specific objective of this study is to assess the level formal education of the farmers as a part of capacity building. Therefore, one of the key research questions was thus whether or not education significantly influences interest in adoption of innovative technologies. The second specific objective was to examine the role of number of crops grown on household income, as the higher diversification of crops is the main attribute of permaculture. Thus, the hypothesis that was tested as follows:

Hypothesis 1:

H_0: With higher diversity of crops grown, higher financial revenue is expected depending on arable land, irrigation, and the number of harvests.

4 Methodology

The starting point for this study undertaken in South-East Asia was the study of secondary data from reliable sources (see in chapter 4.1.).

The literature review outlines the conceptual framework, and existing articles about the capacity building focusing on agricultural innovation and development, alongside sustainable agriculture and permaculture related issues.

The assembled secondary data, reports, and studies were examined to deepen knowledge about the studied topic as well as to facilitate compiling questionnaires. Figure 5 shows basic steps of the entire research of this study in North Sumatra, Indonesia.

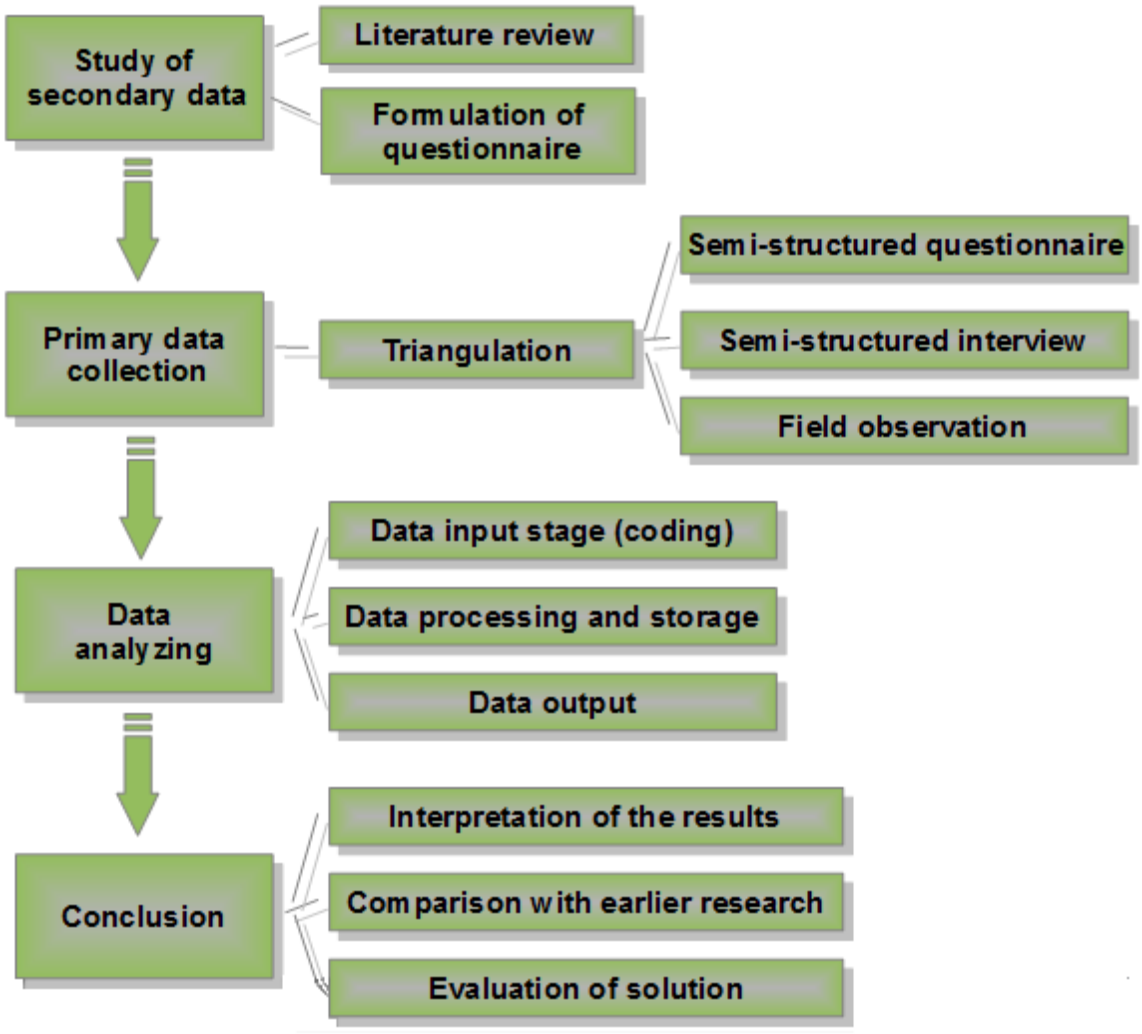


Figure 6: Research design

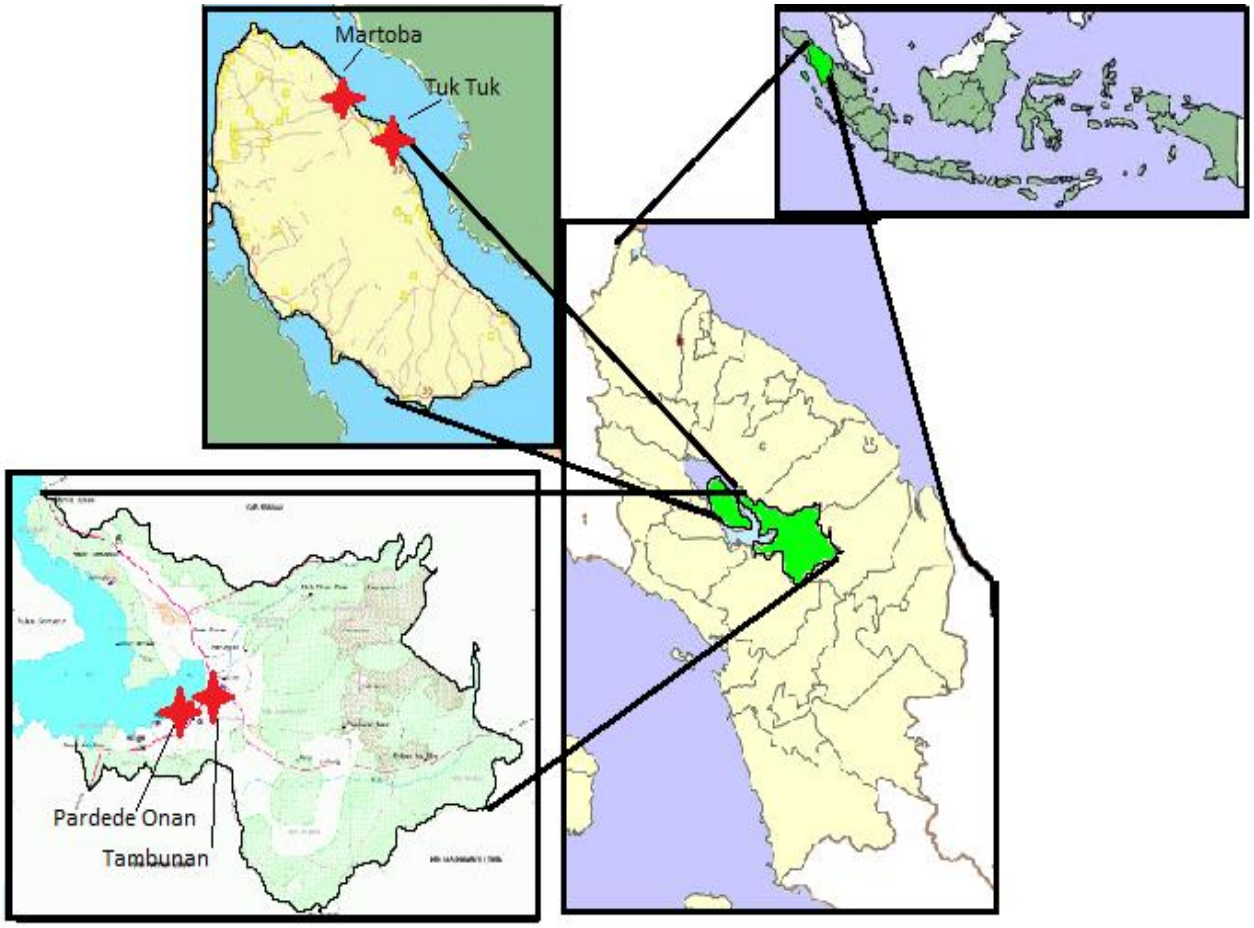
4.1 Study of secondary data

Study of the data from secondary resources report on innovation policy, capacity building as well as permaculture. Collection of data contributes to a comprehensive overview on the main attributes of the studied topic. Data were obtained primarily from scientific databases as *Science Direct, Web of Knowledge, World Bank, Faostat* or *Badan Pusat Statistic* as well as publications from specialist in given field of study as *Bill Mollison, Reinhilde Veugelers* and many others.

4.2. Description of study area

The research was conducted in the province Sumatera Utara (North Sumatra) precisely in the regencies of Toba Samosir and Samosir. Geographically the location of North Sumatra is 1º- 4º north latitude and 98º-100º east longitude. The altitude of North Sumatra varies from zero at sea shores to more than 2,000 meters above sea level at the central part of the province. Due to this fact there is a great variety of cultivated crop such as rice, corn, sweet potatoes, manga, and cocoa. In hilly zones there are mandarins, pomegranates, kaki, mangroves etc. The volcanic basin entails significant levels of organic carbon in inceptisols and oxisols soils (Rizatus et al., 2010). As a tropical region North Sumatra is influenced by two seasons. Dry season lasts usually from June to September and dry season from October until March. The studied area has an average temperature approximately between 22-30 degrees Celsius with maximum temperature 32.7ºC and minimum 15.4ºC. Precipitation is around 1,000-2,000mm/year (Acquastat, 2013).

The Toba Samosir regency is mostly situated on the Samosir Island surrounded by Lake Toba, one of the largest volcanic lakes worldwide. The Samosir regency lies in a south-easterly direction from the Toba Samosir regency. The total area of the Toba Samosir regency represents 3.22% of the total province´s total surface area. For the Samosir regency it accounts for 3.33% of North Sumatra region. The precise location of target villages is shown at the Map 1.



Map 1: Study area (adjusted according Badan Pusat Statistik, 2013)

4.3. Primary data collection

To get more accuracy, the Rapid Rural Appraisal was used for the data collection. From this set of the methods three of them were used: semi-structured questionnaires, direct observation, and informal interviews (Fig. 6). To avoid both misleading and bias questions a pilot testing was undertaken. Subsequently two informal interviews based on questionnaires were done to fine-tune any drawbacks. The translation of achieved questionnaires was done on the spot by Indonesian interpreters.

The field survey was conducted from June to August of the year 2013 at the regencies of Toba Samosir and Samosir in the cooperation of institute Politeknik Informatika Del in Balige (PIDEL).

To avoid commercially-oriented farmers, the criteria of maximum rented/owned land size was set up, up to 5 hectares (Johansen et al. 2012). Based on background

provided by PIDEL, four villages were selected. Tuk Tuk, and Martoba from the Samosir regency and Pardede Onan and Tambunan from the Toba Samosir regency.

Thanks to the cooperation with students from PIDEL University the snowball method was used as sampling method. During the elaboration of the research design approximately 100 questionnaires were set up to be completed. After reaching target location as well as farmers only 83 fully questionnaires was gathered. For Martoba village it was 21 respondents (F 6/M 15), Tuk Tuk gave 20 respondents (F 10/M 10). In the Samosir regency in Tambunan gave 21 respondents (F 9/M 12) and for Pardede Onan there were 21 respondents (F 16/M 5), too.

4.3.1. Questionnaire design

The questionnaire had four parts altogether comprising 32 questions (Annexes 3, 4). The first part concerns the general information of the farmers and his household. The second part focused on crop production and livestock. The penultimate series was dedicated to the climate situation that can highly influence farmers´ lives. The last section was aimed to find farmers´ perception of crucial problems in the agricultural sector as well as attitude to innovative technologies.

Within the questionnaire different types of questions were used such as dichotomous, closed-ended, rating scale, multiple-choice as well as open-ended which were especially aimed to define problems or special agricultural techniques.

4.3.2. Observation

Observation is one of the methods of data collection which has a great impact on final results. It helps the researcher get familiar with an area of study and target group. So, during making questionnaires the researcher can directly rise questions to adjust to real situations based on the responses of farmers. As a result the researcher can avoid inaccurate data. Moreover, through observation researcher can get en entire picture of management of life for farmers to thus reveal some issue which may not have been discovered by questionnaires.

4.4. Data Analysis

After first row preparation, data were transcribed into the statistical program IBM SPSS Statistics 21.0 where they have been subsequently cleaned. Secondly, the data set was categorized, coded and organized for further processing and analyses. At the beginning basic descriptive statistic of the sample together with frequencies analyses and related tables were executed (Valbuena et al., 2012). The results are presented in the form of graphs and figures in chapter 5 Results.

To investigate whether and how strongly are related education and the interest in adoption of innovative technologies Spearman´s rank correlation was used. In addition, to determine if two data sets are significantly different from each other *t*-test was used. Moreover, through the Analysis of Variance we sought the differences between the age and the attitude to adoption of innovative technologies. To testify the alternative hypothesis the linear regression was used as it models the relationship between a dependent *financial revenue* and an explanatory variables (in this case: *number of crops grown, land size, irrigation, and number of harvests*). Furthermore, according the study of Mohri et al., (2013) we indicate environmental and livelihood benefits provided by the permaculture.

4.5. Study Limitations

Certain study limitations have to be mentioned. Undeniably there was a significant language barrier. Although the interpreters were used to fill out the questionnaires there was still a chance of misunderstanding of questions, unwillingness of communicate truly or lack of openness from the side of farmers.

5 Results and discussion

This chapter presents the results of data concerning the selected issue. Results of the survey are divided into two fundamental sections. The first one describes general socio-demographic information of the target group, the second one focuses on main issues which are influencing small-scale farmers, and subsequently local innovation within capacity building assessment.

5.1. Socio-demographic indicators of target groups

The conducted survey included 83 small-scale farmers, of whom 49.4% (41) were female and 50.6% (42) were male. So, whilst men are traditionally the heads of the families, there is no significant prevalence within the survey. The average age of respondents was 40.82 (SD 13.23) years even if the mode was only 23 years. The average number of family members is approximately six persons, and the mode accounted for 4 household members (21.7%). Valbuena et al. (2012) in their study indicate average numbers of household member respectively 5.5; 5.8; 6.1 for African countries where the highest proxy was presented by Niger with an average number of 11. Usually all family members actively participated in agricultural activities except pre-school children. Hence the seasonal workers who were paid are therefore not so common among small-scale farmers in studied region. Only two cases were registered, the rest of farmers mainly rely on neighbourly help.

Men are more likely to stay in their place of birth 37.3% compared to women 21.7%. Moreover men are more likely to move from their place of birth up until 35 years, whereas for women this figure is 35-50. There is no statistical evidence of differences among both regencies. Few studies have been done on this issue although Nooteboom et al. (2008) revealed the main reasons for migration in East Kalimantan were lack of natural resources and labour opportunities, overpopulation, and the widespread belief that economic success can be achieved only by migration. Further, some of the respondents indicate a lack of available land as a problem for their farming.

The summary of socio-economic characteristic is shown in Table 2 where the association between ownership and regencies appears relatively weak even though in the regency of Samosir 66% of respondents are owners compared to 43% in the Toba Samosir regency. In the study of Valbuena et al. (2012) it was identified that in 8 cases (of 10) the percentage of ownership surpassed 70% mostly in medium and low density areas. In an earlier presented study it was observed that only Kenya (high density area) exceeded the limit of 70% of ownership, whereas in two other cases it accounted for 51%, 69% for India and Bangladesh respectively (Valbuena et al., 2012). Thus in the case of the Toba Samosir regency the low share of ownership can be explained by the location of villages close to Balige town. So, the possibility of achieving of new land is harder than in the Samosir regency, where the slash-and-burn approach is still common practice for gaining/enlarging of available land.

Table 2: Descriptive statistics of the target group

	Toba Samosir regency		Samosir regency	
	(%)	N	(%)	N
Gender				
Female	60	25	40	16
Male	40	17	60	25
Status				
Owner	43	18	66	27
Rented	57	24	32	13
Other			2	1
Irrigation	12	10	25	21
Av. land size (ha)	0.3		0.3	
Av. income*	706.6 ($)		619. 9 ($)	

* Average Annual Agricultural Household Income

Among the annual income from agricultural activities (Table 2), there was no statistically significant difference between the Samosir regency (M=606.38, SD=529.30) and the Toba Samosir regency (M=1023.16, SD=1263.67); with *p-value* 0.056 at the 0.05 significance level. To increase economic stability via a broad spectrum of sources of income, livestock is the main commodity. Even if the contribution of agriculture to the Gross Domestic Product (GDP) is only 14.5% (NMTPF, 2010) it employs approximately 40% of the population and that makes the agricultural sector crucial part of the Indonesian economy. Livestock contributes up to 12.7% (NMTPF, 2010) of the agricultural GDP. Hence small-scale, resource-poor farmers own about 95% of the livestock (Devendra and Thomas, 2002). In this study the highest animal populations were presented by poultry

25.3%, 31.3%; pigs 25.3%, 19.3% and subsequently by duck 14.5% and 6% for the Toba Samosir and the Samosir regency respectively. Similar data sets were interpreted in the study by Baguma et al. (2013) from Uganda where poultry 24.3% is the most commonly reared livestock for each household, followed by pigs 15.9%. In the Toba Samosir regency up to 67.7% of respondents produce up to 50% of animal feed by themselves. In the Samosir regency the situation distorts so, that approximately 40% of respondents purchased everything or produce up to 50% themselves as an animal feed. In both regencies nearly 60% of respondents indicated that they do not have enough (optimal) feed for the animals. In a follow-up question only 21.8% of farmers reported lack of feed as a complication for breeding. Most cited problem for rearing of animals was disease. Unfortunately little evidence is available on current diseases among the animal population in Indonesia. Therefore Brioudes et al. (2014) concluded that a systemic review of papers compiling information on any diseases affecting domestic animals is warranted for the tropical environment of Pacific Island Countries and Territories.

Water situation analysis

Of growing interest to the enhancement of both livelihoods and agriculture is water collection and its various sources. The water for industrial purposes is essential for rural development. Unfortunately, especially rural population in certain parts of the year face water scarcity. Moreover, the majority of respondents are reliant on their own sources of water collection (Table 3), as the country lacks major facilities of a public network.

In urban areas the main supply is from unsafe water sources. In both regencies the main water source is provided by unsafe but easily available mean. Similarly, as recently as 2004, 44% of unsafe water in Ethiopia originate from unprotected springs, in addition river and ponds accounted for 39% (UNESCO, 2004). The population of the Toba Samosir regency mainly use private wells (33.7%) and Samosir regency utilize Lake Toba (18%). Despite the fact that 66.2% of water is easily available (i.e. river, lake and collection of rain water) only 37.35% respondents have an irrigation system. The irrigation system is one of the essential mean how to improve farming system. It is evident (Table 2) that in the Samosir regency are more likely to use irrigation. We found out the statistical significant difference between the Samosir regency (M=.50, SD=.506) and the Toba Samosir regency (M=.24, SD=.435), $t(81) = 2.48$; where *p-value* accounts for 0.015 at the 0.05 significance

level. These differences can be explained in part by the proximity of lake Toba (Martoba and Tuk Tuk villages) and therefore, easier establishment of irrigation systems.

Table 3: Water sources grouped by regencies

	Village				Total
	Samosir regency		Toba Samosir regency		
	%	N	%	N	
River (lake)	2.4	2	18.0	15	20.4
Public network	1.2	1	1.2	1	2.4
Cooperative network	1.2	1	0.0	0	1.2
My own private well	33.7	28	8.4	7	42.2
Community well	7.2	6	6.2	5	13.3
Protected tank	0.0	0	2.4	2	2.4
Unprotected tank	1.2	1	0.0	0	1.2
Collection of rain water	3.6	3	13.2	11	16.9

N = 83

Sri Lanka National Water Development Report (2006) reported rain collection only in 1.3% of cases compared with 3.6% and 13.2% for the Samosir, and the Toba Samosir regency, respectively. Therefore one of the main indicators of rural agricultural development is characterized by water use efficiency. In many areas, availability of water is the major limitation for new horticultural development although there is sufficient land available in reasonable proximity to the river (SARDI, 2011). It can therefore be assumed that either the water scarcity (see chapter 5.2. Innovation capacity building) during long period of recurring droughts or poor irrigation system cause agricultural losses, subsequently decreased agricultural income from sold crops.

School Enrolment

The average statistical value of schooling in the Samosir regency accounts for 9

years as it is compulsory among all Asian countries (WB, 2012). Slightly longer school enrolment is seen in the Toba Samosir regency where it accounts for 11 years. HDR (2013) shows that the average statistical value of schooling for East Asia and the Pacific accounts only for 7.2 years. Similar data sets are collected in study by Rasouliazar (2011) with average value of schooling of 7 years. The study by Mariano et al. (2012) revealed mean schooling to be 7 years, as well. Hence both regencies embodies a higher educational ratio comparing SEA countries. Figure 8 summarises school enrolment grouped by regencies.

Figure 8 shows that in the Toba Samosir regency there is a prevalence of Senior High School enrolment which represents 12 years of schooling. However in the same regency we can observe respondents with no kind of formal education enrolment. On the other hand in the Samosir regency tertiary education accounts for 7.5% of all surveyed farmers compared to Toba Samosir where it is only 2.43%. The aforementioned findings would suggest that either the environment for implementation of innovative technologies (i.e. extensions services, farmer field schools; FFS) or the interest in new practices from the side of farmers, would provide favourable environment for capacity building of these regencies. However, further investigation (chapter 5.2. Innovation capacity building) revealed that the formal education is not the only factor influencing probability of adoption of innovative technologies.

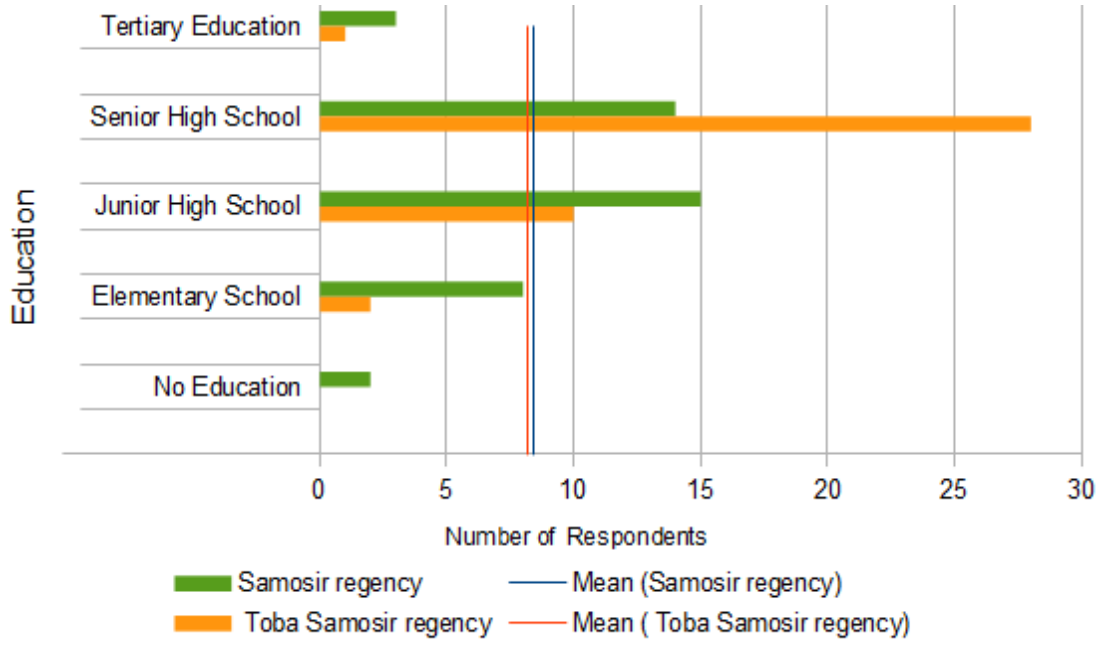


Figure 8: Type of school enrolment grouped by regencies

5.1.1. Agriculture characteristics

As shown in Table 2 small-scale farmers living in the Toba Samosir regency are more likely to be owners of their farms. They do not mention any special duties in relation to ownership. On the other hand land tenants in both regencies indicated the annual payment of rent mainly in the form of payments in kind. The same practice was described by Macours (2014) in Guatemala where land tenants pay the rent in kind or by providing labour services on landlords´ fields. In both the Toba Samosir and the Samosir regencies is a payment ratio of 1/3 of yield from harvest was observed.

All of the farms hold agriculture using predominantly family labour or rely on neighbourly help as well, as agriculture is one of the main sources of income. Thus these farmers are defined as semi-subsistence farmers.

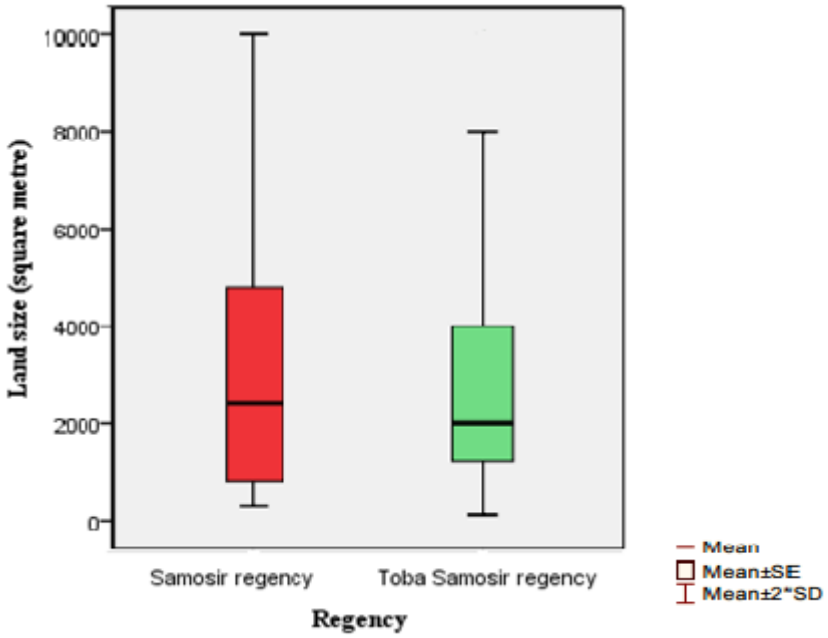


Figure 9: Land size grouped by Regency

Another characteristic of smallholder farms is considered to be land size that is less than 3 ha (Johansen et al. 2012) which is the same for the Indonesian case as seen in Figure 9. Also in the study by Valbuena et al. (2012) the range of farm size did not exceed 2.9 hectares. The smallest land size was measured in Kenya which accounted for 0.5 hectares. In both regencies the average size of land is approximately 0.2 hectares (Fig. 9).

The available means for resource poor farmers to increase agricultural yield is mainly by irrigation or by using fertilizers. As cited before only half of the respondents are using irrigation therefore the application of fertilizers is observed in 89.2% (72). Comprehensive reports on microbial control usage and product sale in SEA are difficult, if not impossible to obtain (Skovmand, 2007). Nonetheless farmers noted that the essential problems of getting fertilizers is their price (Fig.10) followed by availability and choice. This phenomenon was observed in the study of Skovmand (2007) where impoverished farmers frequently could not afford even the cheapest generic (off-patent) chemicals. The cases in which farmers get financial support thanks to membership of Kelompok (local agricultural association) appears to be statistically irrelevant. In the Samosir regency was registered the usage of chemicals against vermin (birds, rats), therefore it revealed the presence of pests is more likely to happen closer to areas with higher population density. The farmers most commonly use nitrogen fertilizers as indicated in Figure 10. The presence of nitrogen in urea is 46%, for NPK the composition account for N: 15%; P_2O_5: 15%; K_2O: 15%. Zeta, also known under the name of Ammonium Sulphate - $(NH_4)_2SO_4$ is commonly used as soil fertilizer. It contains N: 21%; Sulfur: 24%. The KCL is not so widely used it is mainly for vegetable and legumes; where K_2O accounts for 60%.

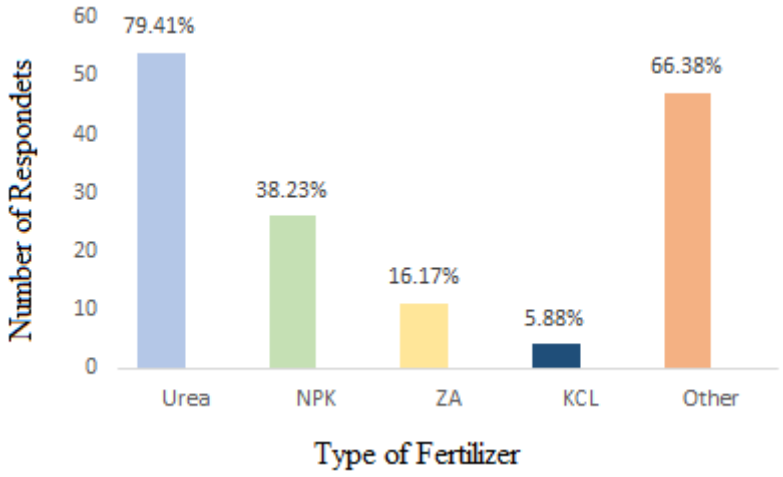


Figure 10: Types of fertilizers used in Toba Samosir and Samosir regencies.

SEA sub region consumption patterns are provided mainly by rice (IRRI, 2013). Many studies (Mertz et al., 2008; Raitzel et al., 2011; Maredia and Raitzer, 2012; Pasuquin et al., 2014; Shamshuddin et al., 2014) not only conducted by IRRI or CGIAR focused its research on enhancing either rice varieties or production to alleviate poverty. The results

represented in Table 4 express the percentage of farmers who are growing rice accompanied by other various crops.

The 73.5% of farmers grew rice followed by maize and chili (Table 4). However the resulting first choice of crops named by farmers compared to total responses, is rice then corn and cocoa. On the other hand the second choices mentioned by farmers were maize (25.8%) followed by vegetable and onion (11.8% respectively). In accordance with the present results, previous study from Uruguay by Dogliotti et al., (2014) have demonstrated that vegetable production is the main economic activity of all surveyed farms. Thus there is a quite high possibility of the introduction of sustainable crop management i.e.) permaculture.

Raizel and Maredia (2012) claim that expected benefits such as reduced food expenditure and dietary composition, caused by improving management of vegetable production would be 19.8% in 2020. This study revealed that the most beneficial impact featured would be by rice by both its cultivation and selling. Contrary in the study by Herforth et al. (2012) was elaborated that projects to increase the productivity of a single crop, can however, also reduce crop diversity and subsequently reduce the diversity of foods available in the local market and thus reduce dietary diversity for net food buyers.

Table 4: Proportion of growing crops grouped by respondent preference

Proportion of growing crops						
Crop	Responses Total		First Crop		Second Crop	
	No. of cases (%)	Rank Total	No. of cases (%)	Rank 1	No. of cases (%)	Rank 2
Rice	73.5	1	66.3	1	7.8	6
Maize	45.8	2	16.9	2	25.5	1
Chili	20.5	3	3.6	5	11.8	3
Vegetable	16.9	4	0	0	11.8	2
Onion	14.5	5	1.2	6	7.8	7
Sweet Potato	14.5	6	0	0	9.8	4
Cocoa	10.8	7	0	3	2.0	10
Nuts	9.6	8	2.4	0	3.9	9
Coffee	8.4	9	1.2	7	9.8	5
Mango	7.2	10	0	0	5.9	8
Ginger	6.0	11	3.6	4	2.0	11
Others	4.8	12	0	0	2.0	12

n=83

Similar preliminary results, which were presented at the Conservation Agriculture symposium (2012, Hanoi), showed that, on average, permaculture farmers planted nearly twice the number of vegetables and fruits and thus ranked higher in the measure of food security and diet diversity. This included the consumption of micronutrient rich fruits and vegetables (Carlton and Lewin, 2013). Hence small-scale home gardens are promising interventions (FAO, 2013) to avoid micronutrient deficiencies which were registered also in Indonesia (Raitzer and Maredia, 2012).

Much recent research focuses on climate change and its impact on small scale farmers (MOAC, 2011). The increase of climate blips especially droughts, torrential rains or strong winds affect, in the main, already vulnerable resource poor farmers in the form of reduced agricultural harvest and thus reduced food security.

The Figure 11 illustrates the main problems impeding agricultural production are arranged according to the importance as perceive by farmers. The main problem of farmers is the pest presence rather than recurring period of droughts followed by the lack of water, and torrential rains. Only a small number of respondents indicated that venture capital as a considerable issue in agriculture. All aforementioned factors (except pest and venture capital) are caused by climate change. In the report of MOAC (2011) similar data sets were found that the greatest agricultural losses are caused by droughts, floods, and hail storms. In addition, we illustrated the farmers´ perceptions on problematic issues worsening during five years in their region are demonstrated in Annex 5 and will be discussed in chapter 5.2.

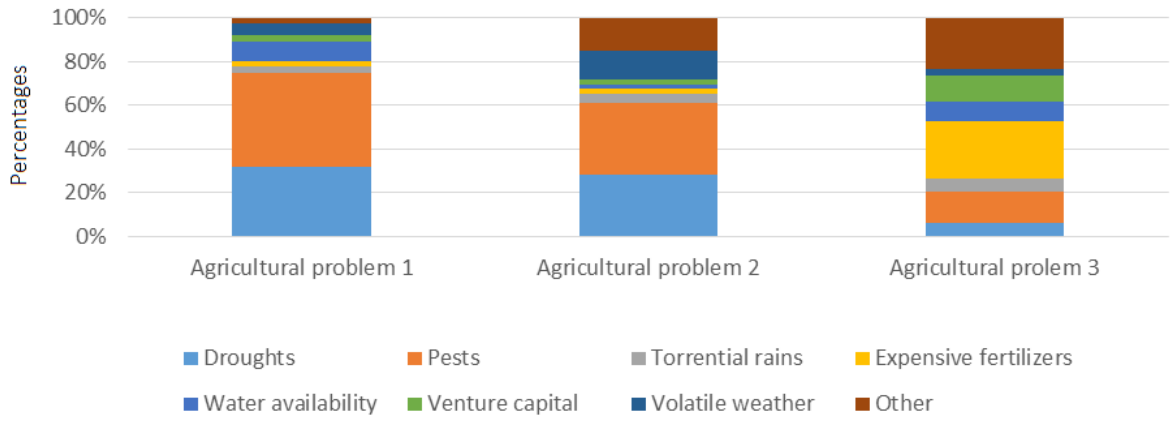


Figure 11: Main problems impeding agricultural production as perceived by farmers (include both regencies).

This vulnerability to climate change and related natural hazards is often attributed to insufficient farmers´ awareness, lack of coordination among governmental agencies and the support of informal education focusing on climate change. Similar stressors to climate change, such as lack of chemicals due to limited access to credit, droughts, information of weather forecast, and livestock diseases (chapter 5.2. Innovation capacity building assessment) of farming and livelihood were indicated in the study of Chipo et al. (2012) from Zimbabwe and Zambia. Thus safety measures should be incorporated into the national agenda to decrease the vulnerability of small-scale farmers.

5.2. Innovation capacity building assessment of selected attributes

Capacity building in agricultural development represents more than governmental support and R&D. Such a process is long term and continuous, requiring lasting financial support, cross-sectorial cooperation, demand-driven research, (including educational system transformation) in order to support individual commitment to continued self-development.

The following sections summarise contribution of the formal education in relation to the adoption of innovative technologies as well as diversity of crops grown to financial income.

School enrolment

Few studies have been done to investigate the relation between formal education and interest in applying innovative technologies. The positive results are consistent with those of Mariano et al. (2012). Even though, the correlation is positive, only 8.8% of the variation of *the interest in adoption of innovative technologies* is explained by the variation of the *years of schooling*. However, with a small sample size, caution must be applied, as the findings might not be relevant due to *p-value* of 0.198. Nonetheless Mariano et al. (2012) claimed that the probability of adopting innovative technologies increases by 1.32% for a one year increase in formal education. Contrary to this, the study by Davis et al. (2010) discussed the adoption of new practices in relation to education and revealed that increased productivity was recorded among farmers with no formal education.

Another aspect which highly influence the percentage of the interest in adoption of innovative technology is age. The odds ratio in the study in North Sumatra is 0.921 for every additional year in age. Thus for the additional year in age, the odds of interest is lower by 7.9%. The results of Davis et al., (2010) and Syrovátková (2013) indicated that the willingness of learning new knowledge is explained by the age only by 9%. In addition, the structural model of aging of Hong et al. (2013) confirmed that the influence of age on technology acceptance with regard to other indicators as perceived usefulness, perceived ease of use and behavioural intention. So, the adoption of innovative technologies is not only reliant on education. Individual and social capacity play a major part in applying new technologies (Pattillo et al., 2010; Merino and Carmenado, 2012; Mohamad et al., 2013; Schönfeldt and Hall, 2013) as discussed below.

Another trigger for innovation was tested in the Malaysian study by Zain et al. (2012) where as a result of a research and strategic action grant (UKM-PTS-096-2010) a 3R ecological centre was established to support ecological and sustainable education. This additionally created job opportunities and this discovery of opportunities in entrepreneurship respectively, Zain et al. (2012). As a result of the earlier mentioned study the average percentage of recyclables increased by 4% within one year of operation (Zain et al. 2012). The study proved that the extension services and additional educational services may increase awareness in selected issues. Consequently, education is a key element in any response to environmental change (Qvortrup, 2009). In particular, the participation of farmers in on-farm demonstration and rice production training sessions are important preconditions for adopting improved practices, since these extension activities will enhance farmers´ capacity to apply innovative technologies (Mariano, 2012).

Educational change stems from transformative learning which includes the capacity to become more critically aware of one´s own assumptions, expectations and their context, as well as those of others, when making interpretations of their opinions (O´Brien et al., 2013). This problematic within the capacity of a critical but objective perception can be observed in the study of Dalton et al., (2013) where 96.60% of respondents systematically updated themselves on current farming practices. Moreover, 63.60% are willing to try out promising new practices. In comparison to this study in the North Sumatra regency, 79% of respondents were interested in applying new technologies, and 64.2% stated their intension to apply modern technologies. However new technologies mainly implied usage of a tractor. On the other hand 89.8% of farmers are cautious to try out new farming practices,

and 21.20% still find traditional farming the best system (Dalton et al., 2013). Therefore the high interest in innovative technologies does not secure the higher uptake of new practices. Furthermore, a relation between education and awareness of full exploitation of their arable land was not found. The decision making process of either adopting innovative technologies or new practices depends on individual confidence that the returns will be worth it (Scoones, 2001; BPS, 2013).

Permaculture

In this section we present the findings related to permaculture as a part of capacity building. We focused on four main indicators (i) number of crops, (ii) land size, (iii) irrigation, and (iv) the number of harvests (Table 5). At the same time, we analyse the contribution of aforementioned predictors to annual household income from agricultural activities, moreover the interactions within each other.

As stated before (see p.33-35) there is no statistical difference between the annual household incomes from agricultural activities of studied regencies. However, the irrigation system occurred to be higher in the Samosir regency rather than in Toba Samosir, due to the further distance of target villages from a water source. The higher *number of harvests* is observed (M= 4.95, SD= 3.62) in the Toba Samosir regency; where *p-value* is 0.012≤ 0.05 significance level. So how come that when the farmers from the Samosir regency have better access to water, they apparently harvest not that often is in the Toba Samosir regency. One of the explanation can be either the inappropriate maintenance/usage of water or inaccurate setting/positioning of irrigation system as also discovered in report of SARDI (2011). Another interesting finding is that *number of crops* grown is significantly different (t= -2.927, p= 0.005) between the two studied regencies. The results is significant at the p= 0.05 level. Surprisingly, in the Toba Samosir regency they grow one crop more in average compared with Samosir as it is a touristic place (Ecotourism, 2014). Therefore, the demand for exotic fruits could be a trigger for growing various agricultural products. This assumption is supported by Mohri et al., (2013) who claim that agricultural structure can be affected by population density, proximity to the market, and other socioeconomics.

Together, these results provide important insights into agricultural linkages between ecosystems and human capacity building in target villages. So, we can conclude that the Toba Samosir regency is more likely to be dependent on agriculture as a main source of income rather the farmers from Samosir who can increase their income with off-farm activities. Especially in tourist field by selling handicrafts, providing assistance services etc.

Turning now to the null hypothesis, regression analysis was used to predict the contribution of predictors (Table 5) to annual income from agricultural activities. The significance level of the result is p= 0.05. The model describes the studied issue by 88%.

Table 5: Descriptive statistics of variables used in regression analysis

Description	Value	Type	Mean	Min.	Max.
Annual income from agricultural activities	ŷ	Continuous	8.77*	0.28*	51.89*
Number of Crops	x1	Continuous	2.33	1	5
Irrigation	x2	Binary (1 = Yes, 0 = No)	0.48	0	1
Size of the field (Ha)	x3	Continuous	0.37	0.01	2.20
Number of Harvest	x4	Continuous	2.22	1	6

n = 83

* Millions of IDR (estimated in constant Indonesian rupiah; reference August 2013)

The key indicator of annual income from agriculture is *land size* (p-value 0.000, SD 0.444) followed by; *number of harvests* (p-value 0.159, SD 2.996), *irrigation* (p-value 0.412, SD 0.487), and *number of crops* (p-value 0.604, SD 1.380). The clear benefit of *x*3 was also found in the study by Dogliotti et al., (2014) where land size was the main contributor to family income. However, it is important to bear in mind the possible bias in results as farmers do not likely calculate an annual economic balance of their farms. Similar explanation was identified by Dogliotti et al., (2014) where the evaluation of costs and benefits of different production activities was based on a general perception of costs and returns in cash and expected market prices. However, the economical aspect of permaculture is not the only indicator of its contribution to livelihood improvement. Unfortunately, recent researches focusing on sustainable agriculture mainly aimed this approach to cash crop, thus few studies have been done on overall positive aspects of diversified food crops in small farm production or home gardens (Nguyen, 1997; Pushpakumara et al., 2010; Herfort et al., 2012; FAO, 2013; Mohri et al., 2013)

In accordance with the presented results the study by Mariano et al., (2012) revealed that crop diversification is not an important factor for annual agricultural income, although it is assumed that risk-averse farmers practice crop diversification in order to reduce the risk of crop failure. Apart from the beneficial effects of decreased vulnerability to climate blips, the crops diversity ameliorate the microclimatic and macroclimate conditions, decrease carbon sequestration (Mohri et al., 2013) as well as play an important role in pest control, soil fertility, soil erosion control, and removal of excessive nutrients (MA, 2005)

By all means the considerable impact of high diversity food crops was verified by Herfort et al., (2012) and Raizel and Maridia (2012) to increase food security. In these studies (Ochse and Terra, 1937 in Mohri et al., 2013) is shown that rice fields provide higher yields of protein and calories, while home gardens provide more calcium and vitamins and a portion of the calories and proteins consumed by an entire village. Diversification of crops decreases the vulnerability of resource poor farmers due to agricultural losses caused by climate change and related natural hazards, especially drought, and torrential rains (Annex 5).

If the ultimate goal of applying innovative technologies in agricultural development is to increase useful outputs for improving livelihoods, there is a variety approaches to do so, each with differing technological choices or farm management practices. The main factors which affect choices of farmers´ adoption of innovative technologies were described in the study by Rasouliazar (2011) where increasing crop yield is seen as the main load factor 0.780 in adoption of innovative technologies. Subsequently the highest scores are detected only in the case of (i) ability to solve possible technical defects (0.817) and (ii) training courses and classes (0.794) (Rasouliazar, 2011). Therefore to properly establish policy framework, formal education, and extensions services for improving the livelihoods of small scale farmers, firstly the main problem of the location has to be identified. The perception of farmers´ main problems which worsen within five years (Annex 5) are very similar with those presented in Figure 11. Excluding natural phenomena and pests the most urgent issues are volatile market prices and expensive fertilizers (as discussed in chapter 5.1.1.). The others issues which were reported include (i) lack of land, (ii) lack of agricultural tools, (iii) lack of human resources, (iv) insufficient

governmental/regional/local agricultural support. Chipo et al. (2012) revealed the same stressors in Zambia, and Zimbabwe, and in addition indicated that inadequate draught power also inhibits farmers´ capacity to maximize on crop yields.

In summary, these results show that farmers can benefit from permaculture from one or more components such as; products from single species, ecotourism, increased soil fertility, steady nutritious intake as well as increased vulnerability to climate change. However, while “win-win” opportunities for biodiversity conservation and sustainable agriculture practised by local community do exist, local communities can often achieve greater (and quicker) benefits from action that lead to biodiversity loss (MA, 2005).

6 Conclusion and Recommendation

6.1. Conclusion

The current state of socioeconomic and agricultural characteristic between the Toba Samosir and the Samosir regency differ slightly regarding irrigation, number of harvests and number of crops grown. These results indicated that small-scale farmers from the Toba Samosir regency are more reliant on agriculture production in terms of income. One of the more significant findings of this study revealed that the diversity of crops grown does not greatly contribute (*p-value* 0.604) to annual household income from agricultural activities. As the main contributor was identified land size (*p-value* 0.005). Both results are significant at the p= 0.05 level.

Main agricultural problems impeding farmers in target area are both pests (birds, rats) and natural hazards such as recurring periods of droughts, and torrential rains caused by climate change. Nonetheless decisions intended to increase farm production and desirably decrease vulnerability in food security by adoption of innovative technologies are dependent on farmers´ knowledge to make informed choices.

We investigated that the interest in adoption of innovative technologies has a low relevance related to the years of schooling. On the other hand the odds ratio in the target area is 0.921 for every additional year. Meaning that with additional year of age, the interest in adoption of innovative technologies decreased by 7.9%.

However, recent agricultural reforms and establishment of new administrative bodies supporting R&D in Indonesia provide a favourable environment to increase capacity building of the entire country. With the support of international agencies providing consulting or educational services aiming their activities to equal dissemination of knowledge amongst the Indonesian population, an increased potential of sustainable development of the Republic of Indonesia is expected.

6.2. Recommendation

Few studies took a comprehensive look at the permaculture and the resultant ecological, social, and economic benefits to human well-being. Therefore, the key to furthering adoption of innovative technologies i.e. Permaculture, is deployment of training centres and development of governmental/regional/local support. Of particular interest is a finding of continuing importance of extension services in generating higher adoption of new technologies, and practices rather than formal education. However to support overall R&D potential of the region, promotion of vocational education is desirable. Moreover, local agricultural farmer associations should endeavour to increase their cooperation with local administrative bodies, as well as among themselves. Thus, there are a number of important changes which need to be made. A key policy priority should, therefore be to plan for a long-term focus on agricultural development, especially in terms of creating new policy standards for both trading, and land tenure which have a great impact on small-scale farming. Considerably more work will need to be done to assess the entire potential of permaculture as a tool for poverty alleviation.

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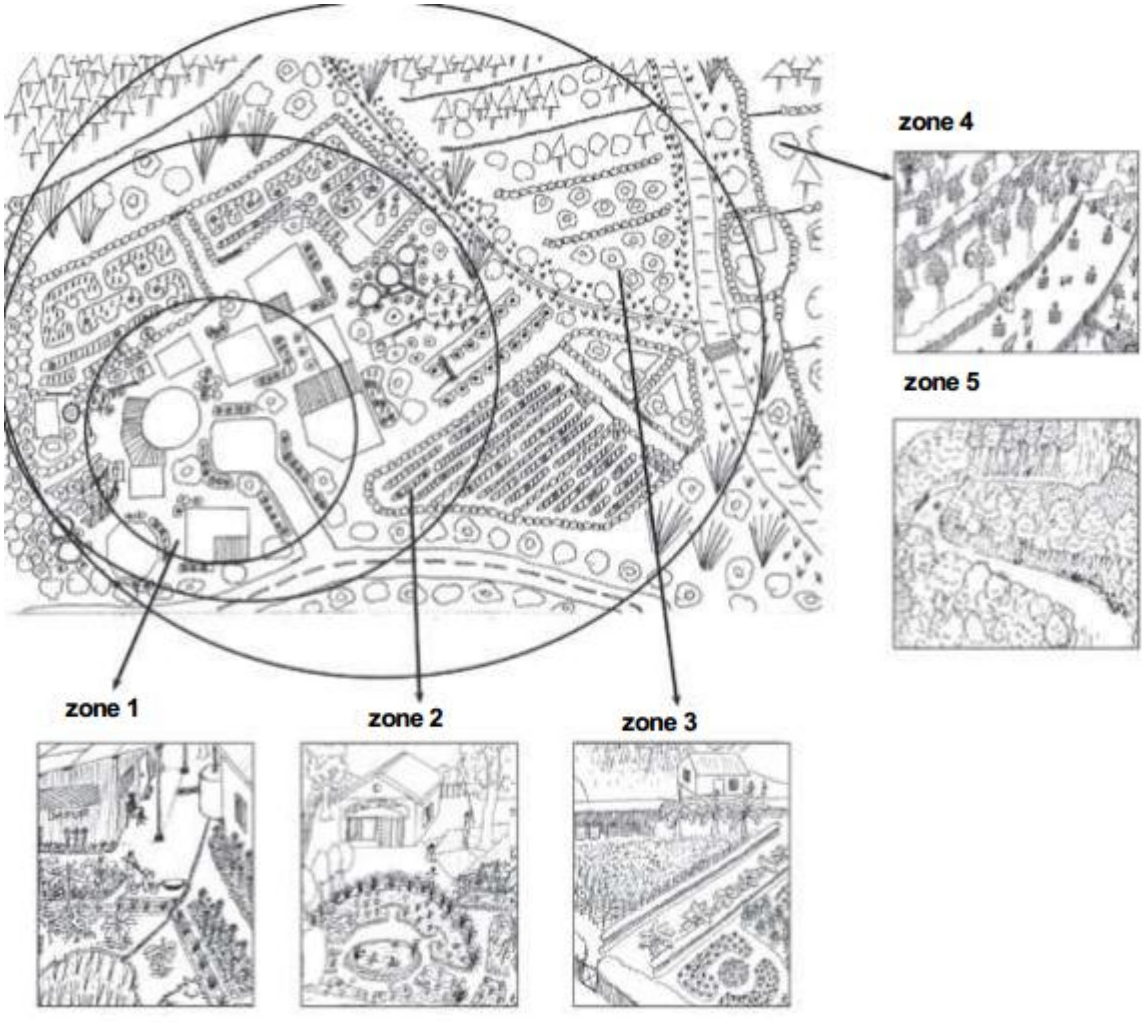
Annexes

Annex 1: Zone map
Annex 2: Zone map with sector of wildlife
Annex 3: Survey questionnaire in English language
Annex 4: Survey questionnaire in Indonesian language
Annex 5: Main agricultural problems in both regencies listed according importance
Annex 6: Photo documentary from field survey

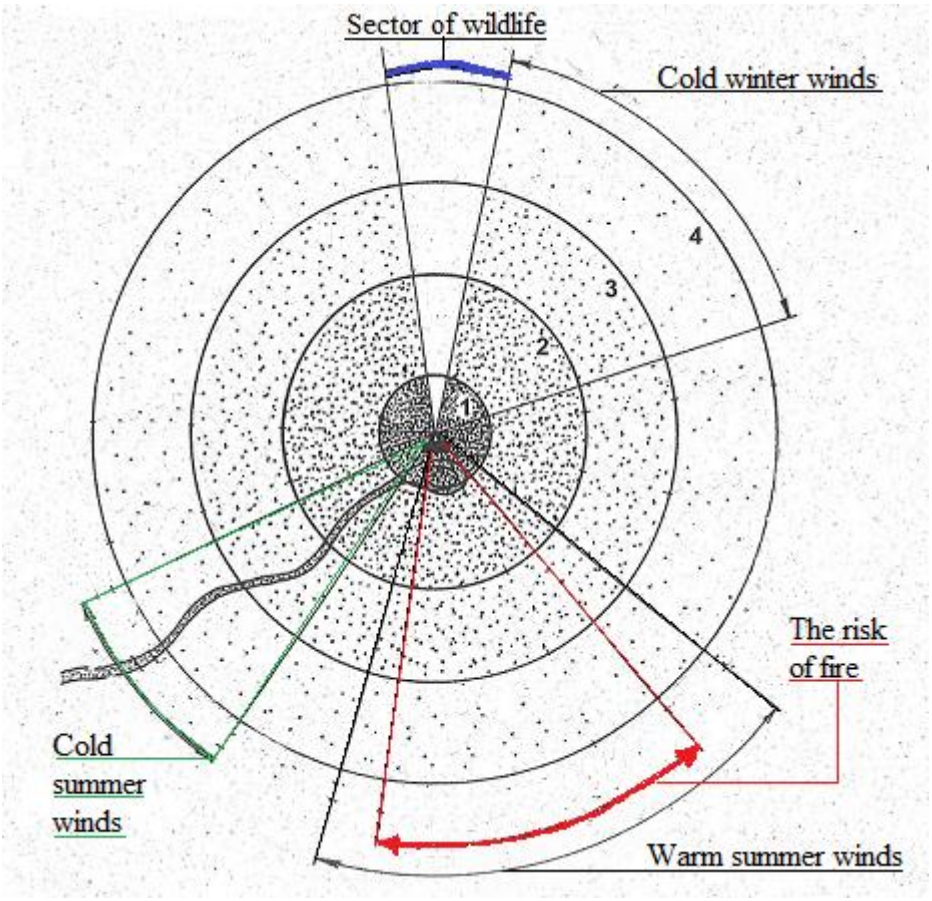
Annex I

Zone map (Source: ADRA, 2013)



Annex II

Annex 2: Zone map with sector of wildlife (Source: Mollison and Končko, 1994; Author ´s adaptation)



Annex III

Questionnaire for farmers – English language

My name is Gabriela Kubátová and I am a student of Faculty of Tropical AgriSciences at Czech University of Life Sciences Prague. This questionnaire will be used as a source of data to deenep the knowledge of traditional agricultural technologies used by farmers in Indonesia. The obtained data will be processed in my diploma thesis on Czech University of Life Sciences in Prague. I would be delighted if you could partecipate on this research and help me with collecting data.

Thank you in advance for your participation.
Bc. Gabrila Kubátová (Czech University of Life Sciences Prague, Faculty of AgriSciences)
E-mail: gabriela.kubatova@seznam.cz

Questionnaire No.:

Personal Information

Age:

Sex: a) Female b) Male

Name of the village/town:

How many years have you attended the school?

How long have you lived in a rural area?

a) since birth
b) more than 10 years
c) 6-10 years
d) less than 5 years
e) I live in an urban area

How many members live in your household?
How many people live or work on this farm?
What is your total annual agricultural income per household?

What is your status regarding farm?

a) Ownership b) Rented c) Other

What are your responsibilities/possibilities of using the cultivated area?

What is the size of your cultivated area?

General information about cultivated area and livestock

Please, answer the following questions with regard to the land you own or rent:

Use of Land	Area in ha
1. Arable land – irrigated	
2. Arable land - rainfed	
3. Land under permanent crops	
4. Natural meadows and pastures	
5. Other land (including land under water)	
Total	

Is all your land cultivated? If not, then why? (3 main reasons order according importance)

Which crops did you grow on your farm last year?

D. CROP PRODUCTION

Crop Please, fill in the name of the produced crop	**Number or harvests of the crop per year**	**Area (Ha, Rente)**	**Main use** Specify what is the percentual share of self consumption, for sale, for seeds	**Crop units sold (kg, pieces..)**	**Unit price (IDR)**	**Constrains**
	Please, specify how often do you harvest certain kind of crop.		1= self consumption 2= for sale 3= seeds			1= no constrains 2= pests 3= access credit for inputs 4= both
1.						
2.						
3.						
4.						
5.						

Did you use following chemicals to protect yours crops last year?

If NO go directly to question 2.5

If YES, which one. (Please, ask following questions)

a) Fertilizers b) Herbicides
c) Pesticides d) Insecticide

What is the name of chemicals you buy?

On which crops do you use it?

How do you use it?

Did you use manure for your crops last year?

a) From the farm b) Purchased
c) Received for free d) No
e) Produce myself up to 50% (rest is bought)

How many animals do you have in your farm and what did you do with them during the previous year?

Please, fill in in the case that your household own a livestock:

Type of animal	Number	Main use	Livestock units sold (kg, pieces..)	Unit price (IDR)	Constrains
		1= self consumption 2= for sale 3= for work 4= all of above			1= no constrains 2= diseases 3= access to animals food 4= both
Poultry					
Duck					
Pig					
Water buffalo					
Others (specify)					

Where do you get feed for your animals?

a) Produce almost everything myself b) produce myself up to 50%
c) Purchased almost everything d) Animals are feed by grazing

On the whole, do you have enough feed for you animals?

a) Not enough feed to keep animals alive
b) Just enough to keep them alive
c) Enough feed for optimal feeding
d) More than enough feed

Access to irrigation water & natural disasters

In the last growing season were you provided with sufficient quantities of water for your crops?

Enough Water	Sufficient	Neutral	Not Sufficient	Not at all
				

What water source do you use?

a) River (lake) b) Public network c) Cooperative network
d) My own private well e) Community well f) Protected tank
g) Unprotected tank h) Well owned by another farmer
i) Collection of rain water j) other

How much these natural phenomena influence your farming system?

	Yes, definitely influence a lot	More likely to influence	I do not know	Slightly influence	Not at all
Heavy rains					
Heavy hails					
Strong winds					
Recurring droughts					
Periods of excessive heat					
Periods of excessive cold					
Flooding					
Mudslides					
Other					

Innovation technologies

Please, name 5 crucial problems in agricultural sector in your region.

Please, name 5 things (according importance) which got worse in agriculture sector in 5 years:

Please, name 5 things (according importance) which got better in agriculture sector in 5 years:

Are you interested in innovative technologies?

a) Yes b) I don´t know c) No

Are you applying some innovative (modern) technologies to your field?

According to your opinion, do you fully exploit potential of your arable land?

a) Yes, definitely b) More likely yes c) I don´t know d) Rather no e) No

Annex IV

Questionnaire for farmers – Indonesian language

Faculty of Tropical AgriSciences

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Kepada Yth, Bapak/Ibu
di Tempat,

Horas!

Nama saya Gabriela Kubátová dari Republic Ceko kandidat master (Ms.c) dibidang pembangunan padesaan berkalanjutan di daerah tropics dan subtropics. Kuesioner ini akan digunakan sebagai sumber data mengenai pengalaman petani dengan pertanian. Data yang diperoleh akan digunakan untuk tesis diploma saya pada Czech University of Life Sciences di Praha. Saya sangat menghargai partisipasi anda dalam riset saya. Terima kasih.

Gabriela Kubátová
Department of Sustainable rural development in Tropics and Subtropics
E-mail: gabi.kubatova@gmail.com No.:

Informasi Pribadi

Umur(Usia):

Jenis Kelamin: a) Laki-Laki b) Perempuan

Nama Desa:

Pendidikan Therakin:

Berapa lama Anda tinggal di pedesaan?

a) Sejak Lahir b) Lebih dari ahu10 tahun

c) 6-10 tahun d) Kurang dari 5 tahun

e) Saya tinggal di kota.

Berapa orang tinggal di perumahan Anda?

Berapa orang tinggal dan Bekerja di usaha tani ini? (pekerja tambahan, musimam)

Berapa total pendapatan pertanian tahunan Anda per rumah tangga?

Bagaimana status kepemilikan lahan pertanian Anda?

a) Milik sendiri b) Sewa c)Lainnya

Apakah peraturan untuk menggunakan lahan ini? (dengan tetangga, negara..)

Berapa besar total lahan pertanian Anda?

Informasi Umum Tentang Tanah Pertaninan dan Ternak

Semis tanah	Ha/Rente
1. Tanah yang diolah – irigasi	
2. Tanah yang diolah – tadak hujan (tanpa irigasi)	
3. Tanah dengan tanaman permanent	
4. Tanah alami/padan rumput	
5. Tanah lain (termauk tanah di bawah danau/sugai/laut)	
Total	

Silahkan balas pertanya ini untuk tanah dimilik/di sewa Anda.

Semua tanah anda diguna tuk mananami. Kalau tidak, kenapa tidak?

Produksi tanaman

Tanaman Tolong dituliskan nama tanaman yang diproduksi	**Jumlah atau masa panen per tahun**	**Area (Ha/Rente)**	**Penggunaan utama** Sebutkan bagian yang tanaman yang mana untuk dikonsumsi sendiri, dijual, untuk benih	**Jumlah tanaman yang dijual (kg, pieces..)/(kg, perpotong)**	**Harga per unit (Rupiah)**	**Kendala**
	Sebutkanse berapa sering Anda panen berdasarkan jenis tanaman tersebut.		1= konsumsi sendiri 2= untuk dijual 3= untuk benih			1= ridak ada kendala 2= hama 3= mengakses kredit untuk pemasukan 4= keduanya
1.						
2.						
3.						
4.						
5.						

Apakah anda menggunakan bahan kimia di tanaman anda tahun yang lalu?

a) Ya b) Tidak

Kalau yam yang mana?

a) Pupuk b) Herbisida
c) Pestisida d) Insektisida

Apakah nama dari bahan kimia(pupuk) anda menggunakan?

Di tanaman apa anda menggunakan kimia(pupuk)?

Bagaimana caranya penggunaan?

Apakah anda menggunakan kompost di tanaman anda?

a) Dari usaka tani b) Dibeli
c) Dapat gratis d) Tidak menggunakan pupuk
e) Produksi sendirisi 50% (sisa-dibeli)

Kepemilikan Peternakan

Tolong isi tabel berikut sesual dengan peternakan yand Anda miliki:

Jenis Ternak	**Jumlah**	**Penggunaan utama**	**Jumlah ternak yang dijual (kg, ekor)**	**Harga per unit (Rupiah)**	**Kendala**
		1= konsumsi sendiri 2= untuk dijual 3= untuk bekerja 4= semuanya untuk hal di atas			1= tidak ada kendala 2= penyakit 3= akses untuk makanan ternak 4= keduanya
Ayam itik					
Bebek					
Babi					
Kerbau					
Lainnya (sebutkan)					

Dinama dopat makanan untuk ternak Anda?

a) Produksi sendiri b) Produksi sendiri 50%
c) Membeli d) Jenis k makan rumput sediri

Apakah makananya cukup tuk jenis tarnak Anda?

a) Tidak cukup b) Cukup untuk hidup
c) Cukup untuk makanan schat d) Lebin dori cupuk

Irigasi, air dan fenomen alam

Apakah anda mendapat air secukupnya tuk yang lalu?

Pas	Cupuk	Tanaman	Tidak cupuk	Tidak dapat
				

Dari mana air yang Anda menggunakan?

Sungai (danau), 2) Jaringan umun, 3) Jaringan cooperasi, 4) Sumur pribadi, 5) Sumur dari desa, 6) Tangki yang terlindungi, 7) Tangki tanpa dilingungi 8) Sumur dari petani lain, 9) Tampungan air hujan, 10) Lainnya

Berapa besar pengaruh dari fenomen alam ini?

	Sangal besar	Cukup	Saya tidak tahu	Sedikit	Tidak ada
Hujan keras					
Hujan es					
Angin kenjang					
Ke keringan					
Ke panasan					
Ke dinginan					
Panjir					
Longsor					
Lainnya					

Teknologi modern

Apakah 5 masalah paling besar untuk petani di kawasan Anda sekarang?

Tolong sebutan 5 hal yang memperburuk pertanian Anda dalam 5 tahun terakhir:

Tolong sebutkan 5 hal yang memperbaiki/membuat pertanian Anda lebih baik dalam 5 tahun terakhir:

Apakah Anda tertarik pada teknologi inovatif?

a) Ya b) Tanaman c)Tidak

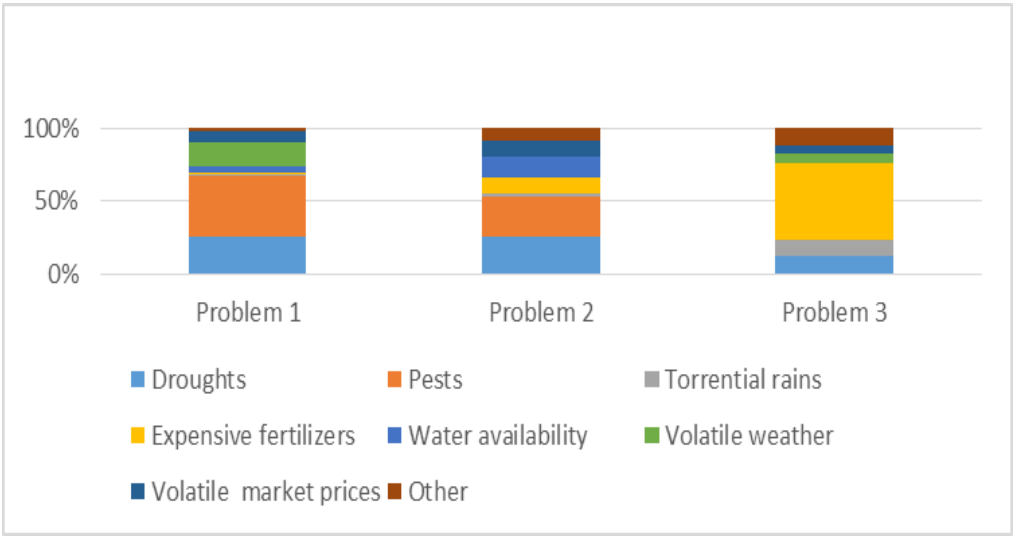
Apakah Anda menggunakan teknologi modern di tanah pertanian Anda?

Apakah menurut Anda, Anda telah menggunakan lahan ini dangan sebaik mungkin?

1) ya 2) sedikit ya 3)saya tidak tahu 4)sedikit tidak 5)tidak ada

Annex V

Main problems impeding agricultural production within five years period as perceived by farmers. Arranged according to the importance.



Annex VI

Photographic documentation of field survey (Source: Author, 2013)