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Final report

Small research and development activity

project	**Can rubber-based cropping improve productivity and income for smallholder farmers in southern Philippines?**
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SRA Report outline

1 Acknowledgments

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2 Executive summary

This Small Research Activity (SRA) on “Can rubber-based cropping system improve productivity and income for smallholder farmers in Southern Philippines?” was aimed at establishing the current situation relating to the development of a full proposal for a potential ACIAR project that aims to contribute to the reduction of poverty in marginalized upland communities of the southern Philippines. This is through developing an effective rubber-based cropping system that improves productivity and increases smallholder farmers’ income through crop diversification and improved soil nutrient management practices.

Specific activities that achieved the objectives of the scoping activity under the SRA included coordination meetings at the national government (Bureau of Soil and Water management, Department of Agriculture, Philippines, DA-BSWM, DA-PRRI, Philippines Rubber Research Institute, Department of Agriculture; Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development, Department of Science Technology, DOST-PCAARRD) and local government (Department of Agriculture - CARAGA Regional Office, Provincial Government of Agusan del Sur) levels. A whole-day Seminar-Workshop in Butuan City with local stakeholders (e.g. leaders of smallholder rubber farmers organisations, municipal government agricultural technicians, and local academe), with assistance from the Provincial Government of Agusan del Sur (PGAS). This also includes further coordination meetings and visits to other research partners [e.g. Universities in Cagayan de Oro and Misamis Oriental and The World Agroforestry Centre (ICRAF)] and research sites such as soil laboratories and demo farms.

These preliminary scoping activities introduced the project to stakeholders, ensured alignment with national and local priorities, established the necessity of the project, obtained stakeholder support at national and local levels, and gathered relevant information to further refine ACIAR project scope and details according to the Philippine’s priorities and needs at all stakeholder levels. It also ensured capacity and capability of potential research partners to carry out the research project and implement training and technology transfer as well as the suitability of various field sites. Market channels were also identified to ensure economic impacts and sustainability of the proposed ACIAR research undertaking for smallholder farmers.

Initial impacts of the SRA include soil nutrient management awareness in increasing production and quality of crops at the local level and the consequent inclusion of the Provincial government of Agusan del Sur of soil analysis as a prerequisite for funding assistance under the Upland Sustainable Agro-forestry Development Program (USAD) Program. The proposed ACIAR project will address research needs and priorities of existing Philippine government programs. More importantly, the project will address poverty and insurgency by bringing sustainable livelihood to an anticipated 22,000 households through 6300 smallholder rubber farmers in Agusan del sur and expand to 8000 smallholder rubber farmers, in the CARAGA region, and eventually the entire country due to strong partnerships with national government agencies.

The key soil and nutrient constraints to the rubber productivity have been identified, including: little information about land suitability for rubber crops; lack of knowledge and skills in the areas of soil nutrient diagnosis and management; low use of fertiliser among smallholders due to high cost of chemical fertiliser and lack of access to soil analysis services and technical support due to poor analytical capacity available in the local region. These highlighted research gaps could be addressed through science-based work, and there are clear impact pathways in terms of reducing poverty and increasing incomes of smallholder rubber farmers in Agusan del Sur.

Results of the coordination meetings, field visits and seminar-workshop confirmed that to improve productivity and income for smallholder farmers in the southern Philippines, an ACIAR project on *Rubber-based Cropping System through Effective Soil Nutrient Management* is necessary, viable, and aligns with national, and local investment, policy and research priorities. All stakeholders, including smallholder rubber farmers, supported the SRA project and the development of a full project proposal.

3 Introduction

3.1 Backgrounds

Rapid economic growth in the Philippines in the past decade has led to the reduction in national poverty incidence from 21% in 2006 to 16.5% in 2015 (Philippine Statistics Authority 2016) (https://psa.gov.ph/poverty). However, Mindanao in southern Philippines remains the poorest part of the country despite its vast natural resources and agricultural potential. Eleven out of the 20 poorest provinces are in this region, with poverty incidences ranging from 45% to 74%. To assist in addressing the poverty issue and increasing smallholder incomes, this SRA research project was to carry out a situation analysis on the potential and viability of a full ACIAR project to develop cost effective rubber-based cropping systems and to promote sustainable land management through effective soil nutrient management in the uplands in Agusan del Sur, Southern Philippines.

3.1.1 Geographical and climatic conditions of Agusan del Sur

Agusan del Sur is a province of the Caraga region in Northeastern Mindanao of the Philippines, with an land area of 8,965.50 km^2, ranking as the fourth largest in the country and the largest in Caraga region. It has a total population of 609,447 individuals, ranking the highest in Caraga Region and contributing 26.57% of the total 2.293 million population. Agusan del Sur has a tropical climate and is geographically situated below the typhoon belt, with an annual rainfall of 3190-3704 mm. The heavy rainfall starts in either Dec or Jan and slowly abates approaching Feb or Mar (De Guzman 2011). The average temperature is 26.5 ^{o}C. Agusan del Sur is an elongated basin formation with mountain ranges in the eastern and western sides forming a valley, which occupies the central longitudinal section of the land. The Agusan River, which flows from Compostela Valley in the south towards Agusan del Norte in the north, runs almost in the middle of the valley and empties at Butuan Bay.

Fig. 1 Geographic location of Agusan del Sur in Philippines

3.1.2 Land use, agriculture and economy in Agusan del Sur

In Agusan del Sur, forestland constitutes 76% of the total land area or 6,827.5 km², while agricultural, protected and undeveloped lands cover an area of 2,137.5 km^2 (24% of the total land area) (De Guzman 2011). Agricultural land occupies 13.24% of total land areas (1186.86 km^2). Forestland can be divided into production land (35.8%) and protected land (64.2%). Based on 0-18% slope, 404,936 hectares or almost half of the province's area is suited for agriculture (Agusan del Sur Provincial Commodity Investment Plan 2014-2016). Through the years, much of its forest resources has been lost because existing industries are extractive in nature.

Agriculture or faming is the major source of livelihood or economic activity of the people (Agusan del Sur Provincial Commodity Investment Plan 2014-2016). The agriculture and forestry sectors dominate the economy of Agusan del Sur. About 75% of the labour force is engaged in agriculture and forestry. Regarding agricultural production, varied crops are grown in Agusan del Sur. Rice is the largest crop, covering 243.85 km^2 of irrigated areas with an average yield of 4100 kg ha^{-1}, while rainfed rice covers an area of about 165.73 km^2 with a yield of 3000 kg ha^{-1}. However, rice insufficiency persists, especially in the upland areas (De Guzman 2011). Other agricultural crops include corn, banana, oil palm, coconut, vegetables, rootcrops, fruit, cacao, rubber and abaca etc. (Table 1, Philippine Statistics Authority 2016). The land use pattern varies with the slope. Slopes 0 – 3 are prime agricultural land, while slopes 3 - 8 are suitable for cultivated crops such as corn, vegetables, rootcrops, spices, and other cash crops and slopes 8 – 18 for plantation crops and vines. Caraga Region is the top producer of oil palm, rubber, rice and corn, and second in banana (Agusan del Sur Provincial Commodity Investment Plan 2014-2016).

A total of 118,686 hectares are devoted to cultivated and perennial crops (see Table 1). Remaining areas with potential for development reached 67,933.82 hectares. Since the province is an agricultural area, rural population accounted for 72.4% of the total population in 2007 while urban population is at 27.6%.

Table 1 Agricultural crops by planted area (ha) in Agusan del Sur (2015)

Crop	Area planted
Rice	75,430#
Corn	31,055#
Vegetables	880
Rootcrops	1567
Spices	7
Fruits	2,451.00
Banana	10,869.2
Coffee	1528
Cacao	545
Coconut	14,885
Abaca	3,266
Rubber	10,890
Mango	229
Pineapple	93
Papaya	9
Rambutan	453
Oil Palm	16,394
Total	168,170.1

#Area harvested.

As a result of the One Town, One Product (OTOP) strategy of the Department of Trade and Industry (DTI), in agricultural areas, significant increase has been observed for banana (45%), other fruits (33%), and cacao (34%) in the past few years. Tremendous growth of commercial crops in the production areas has been seen with abaca at 800%, oil palm at 101% and rubber at 48%. Other cultivated crops such as rice, corn, vegetable and root crops had minimal increase in production areas.

About 50,560 households or 46% are engaged in livestock and poultry production for livelihood in the province, while 21,932 households or 20.1% are engaged in forestry.

3.1.3 Poverty issue and rubber plantation in Agusan del Sur

Agusan del Sur is one of the poorest provinces in the country with 37.3% of households with income below the poverty threshold (NSCB, 2013). Majority of these households belong to indigenous or smallholder farmers who have poor access to technology and are totally dependent on subsistence farming on their small piece of land (ca. 3-5 hectares).

In line with the National Government's rubber program which aims to address poverty, the Provincial Government of Agusan del Sur (PGAS) is committed to increase the current rubber farm areas and production in the next few years by providing quality planting materials to smallholders who are willing to adopt the program. Around 22,000 poor households or smallholder farmers within Agusan del Sur (Community-based Monitoring System 2012) are expected to benefit from the program. More recently (March 5 2017), the Philippine Rural Development Project (PRDP) under the Department of Agriculture has approved A P20-million crumb rubber enterprise expansion project in Bayugan City, Agusan del Sur, Philippines. This project is expected to incrementally increase the income of rubber farmers, both direct beneficiaries and in the neighbouring towns. PRDP's interventions would focus on the production, processing and marketing aspects of the enterprise, specifically the production of quality rubber. Rubber is identified as one of the priority commodities for the Mindanao cluster.

3.2 Objectives

This small research activity (SRA) was aimed at establishing the current situation relating to the development of a full proposal for a potential ACIAR project that aims to contribute to the reduction of poverty in marginalized upland communities of the southern Philippines. This is through developing an effective rubber-based cropping system that improves productivity and increases smallholder farmers' income through crop diversification and improved soil nutrient management practices.

The SRA would identify the highest research priorities for the Philippines down to an implementable scale, and evaluate potential benefits of major research-led interventions, with rubber as the case study. The outputs would be an SRA report with a focus on the assessment of, viability, and justification for an ACIAR supported project, including:

- The current situation in relation to cultivation of rubber in Agusan del Sur, and the prioritisation for these systems by Philippines authorities;
- The current understanding of the extent of suitability for, and soil constraints to, rubber considering current and predicted environmental conditions;
- The factors that determine the capacity of farmers to adapt to changing conditions. What needs to be done to improve the adaptive capacity of farmers and policymakers?
- The extent and accessibility of existing soil and land management information;
- The in-country soil related analytical capacity;
- The in-country relevant soil related research capacity and enthusiasm for a project, and an evaluation of complementarity of Australian and Philippine research communities;
- Relevant research and development investments (past, present and future, inclusive of but not exclusively, ACIAR investments);
- Potential research and development partners.

4 Methodology

4.1 Research and development strategy

This SRA research aimed to evaluate the potential to increase agriculturally-derived prosperity, through developing an effective rubber-based cropping system (as an example system) that boosts household income for indigenous smallholder farmers. The following research and development strategies were adopted for this SRA project:

1) Evaluating the application of the outputs of SMCN/2009/031 "Watershed evaluation for sustainable use of sloping agricultural land", with BSWM leading landuse suitability assessment and participatory landuse planning in a new, though related area.

2) Working with key national partners, such as Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD), Bureau of Soil and Water Management (BSWM, DA), Philippine Rubber Research Institute (PRRI, DA), Department of Agriculture (DA), for planning, conceptualizing and designing required research.

a) PCAARRD: to assist in planning, conceptualizing, and designing to ensure that identified research activities were anchored on the Philippines' national research and development plans and priorities and aligned with local research capacities.

b) PRRI, DA: to assist in planning, conceptualizing and designing of research, particularly on rubber production, and ensured that research goals would support their current development initiatives for agricultural productivity.

c) BSWM, DA: to provide technical knowledge relating to local soil classification and land suitability assessment, and to be central in connecting with project beneficiaries to provide strong appreciation of needs for research and skills on soil nutrient management.

3) Involving the local partners (Provincial Government of Agusan del Sur, Agusan del Sur College of Agriculture and Technology and local farmers groups (e.g. Local Rubber Planter Associations) for the implementation of the project.

a) Provincial Government of Agusan del Sur (PGAS): to provide technical staff (e.g. agriculture technician) and resources to assist project researchers.

b) Agusan del Sur College of Agriculture and Technology (ASSCAT): to provide technical expertise in local agricultural practices.

c) Local farmers' group (Local Rubber Planter Associations): to be involved in the interactions with local farmers, and as sources of information for actual farm practices and experiences.

4.2 Research approach and activity

4.2.1 Background literature review

Relevant research and development investments (past, present and future, inclusive of but not exclusively, ACIAR investments), and all available literature on the cropping system, soil constraints and nutrient management in agricultural systems in southern Philippines, particularly in Agusan del Sur were reviewed and synthesised.

4.2.2 Meeting with federal and local government agencies and university/ research institutions, the rubber plantation associations, farmers' groups and other stakeholders

1) The SRA team (Professor Chengrong Chen, Dr Johnvie Goloran, Dr Trishah Rillorta-Goloran of Griffith University) travelled to Manila and Agusan del Sur, Philippines from 19-24 September 2016 to engage Government agencies [e.g. Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD), Bureau of Soil and Water Management (BSWM, DA), Philippine Rubber Research Institute (PRRI), DA etc.], research institutions, NGOs, local partners (Provincial Government of Agusan del Sur, Agusan del Sur College of Agriculture and Technology etc.) and community stakeholders (e.g. Local Rubber Planter Associations) through multiple meetings and visits.

Specific activities that achieved the objectives of the scoping activity under the SRA included coordination meetings at the national government (DA-BSWM, DA-PRRI, DOST-PCAARRD) and local government (DA-CARAGA Regional Office, Provincial Government of Agusan del Sur) levels. The SRA team also met with Mat Kimberley, Deputy Head of Mission; Andrew Hodges, DFAT First Secretary – Economic, Australian Embassy and briefed them about the objective of the ACIAR and the purpose of this trip to Philippines. Ms Mara Faylon, ACIAR-Philippines Assistant Manager, also attended meetings with national government agencies.

These preliminary scoping activities introduced the project to stakeholders, ensured alignment with national and local priorities, established the necessity of the project, obtained stakeholder support at national and local levels, and gathered relevant information to further refine ACIAR project scope and details according to the Philippine's priorities and needs at all stakeholder levels. The SRA team analysed partners commitments, stakeholder engagement and impact pathways, to gain confidence that the recommended research is viable and aligns with priorities.

2) Dr Johnvie Goloran visited Cagayan De Oro City and Claveria, Misamis Oriental Southern Philippines from 9 to 14th December 2017 in order to find out suitable and strong research partners and to further understand the key issues on the ground. He visited the Analytical Chemistry Laboratory of the University of Science and Technology of Southern Philippines (USTsP) in Cagayan de Oro main campus (http://www.must.edu.ph/). It was noted that the Misamis Oriental State College of Agriculture and Technology (MOSCAT), which has been a partner in previous ACIAR projects in Southern Philippines, is now under USTsP The International Council for Research in Agroforestry (ICRAF) also has a satellite office in USTsP. Dr Goloran met with Dr. Oliva P. Canencia, Research Director of USTsP and Dr Gerlie Leopoldo, Head of the Chemistry Department, USTsP to discuss about the possibility of using the chemistry laboratory for the ACIAR project.

Dr Goloran also visited Dr. Jun Mercado, ICRAF site manager in Southern Philippines. Dr Mercado gave a briefing and tour of various experimental areas where multi-cropping systems are established (Plate No. 3). This collaborative work and field visit in Southern Philippines resulted in a better understanding of the research needs and gaps.

3) Dr Johnvie Goloran of Griffith University also visited the Province of Agusan del Sur, Philippines on 29-30 March 2017 and met the head of the Upland Sustainable Agro-forestry Development Program (USAD) Manager Engr. Linda Boquir together with Dr Rodel Maglunsod head of the Provincial Economic Development Office (the marketing and business arm of the Provincial Government of Agusan del Sur) and Mr. Matt Valiente, head of Provincial Agriculture Office. Farm organisation, marketing for rubber crops, infrastructure availability, technology transfer, women engagement and private sector partners were discussed.

4.2.3 Running workshop

A whole-day Seminar-Workshop was held in on 22 Sep 2016 in Butuan City with local stakeholders (e.g. smallholder rubber farmers, municipal government agricultural technicians, and local academe), with assistance from the Provincial Government of Agusan del Sur (PGAS). Prof Chen and Dr Goloran presented a talk to introduce the

purpose of this ACIAR project and research plan. The Regional Executive Director of the Department of Agriculture Caraga Region, Renato P. Manantan, graced the activity and expressed support to the undertaking. He shared that the Oil Palm Road Map was the only commodity road map being presented in the Region, and there are on-going efforts related to the crafting of more industry roadmaps including rubber. He expressed appreciation to the Australian government through Prof. Chen and Dr. Goloran for taking steps towards the improvement of farming systems and future development in the Caraga Region particularly in the Province of Agusan del Sur.

The keynote speakers' presentations include:

a) OIC Dir. Sonia Salguero (Bureau of Soils and Water Management): Linkages between soil nutrient management and farm productivity (e.g. rubber-based cropping system) or farmers' incomes;

b) Exec. Dir. Rolando Galang (Philippine Rubber Research Institute): Challenges and Opportunities for improving productivity in rubber-based farming in the Philippines in relation to soil fertility and management;

c) Mr. Glen Garcia (Caraga State University): Local expertise and research services on soil nutrient management available in the University.

d) Mr. Armando G. Valiente (OIC, Provincial Agriculture Office, Provincial Government of Agusan del Sur): Updates on Provincial Government Initiatives on Rubber-based cropping system and need for SNM in Agusan Del Sur;

e) Esmael Elevazo (Chairman, Bayugan Rubber Producers Cooperative (BARUPCO)): Farmers' experiences in rubber-based farming in relation to soil nutrient management: Issues, Concerns and Recommendations for Research

The seminar-workshop was participated in by 56 individuals representing various stakeholders such as Farmer Leaders / Rubber Farmer Cooperatives, Municipal Agricultural Technicians, Academe, and the Provincial Government of Agusan del Sur. The seminar-workshop was highly interactive and involved speaker presentations in the morning with Q & A; the afternoon session was a simultaneous workshop with farmers to explore their views on the SRA objectives and a focus group discussion with speakers.

The participants discussed about the key issues related to the environmental constraints (soil and climate), social and economic aspects for the rubber-based cropping systems and possible option of high value perennial tree crop incorporated into this system, and assess the viability of the ACIAR project. The SRA team had developed greater understanding of the following:

- The current situation in relation to cultivation of rubber in Agusan del Sur, and the prioritisation for these systems by Philippines authorities;
- The current understanding of the extent of suitability for, and soil constraints to, rubber considering current and predicted environmental conditions;
- The factors that determine the capacity of farmers to adapt to changing conditions. What needs to be done to improve the adaptive capacity of farmers and policymakers?
- The extent and accessibility of existing soil and land management information;
- The in-country soil related analytical capacity;
- The in-country relevant soil related research capacity and enthusiasm for a project, and an evaluation of complementarity of Australian and Philippine research communities.

4.2.4 Information and data collection and synthesis

The SRA team continued to engage with key research and development partners during the project period and synthesise all the information and data collected for preparing the final report (it reviews research needs, and an analysis of the benefits associated with the main options).

5 Overview of rubber production and research in Agusan del Sur, southern Philippines

The overall aim of this SRA project was to contribute to increases in smallholder framers' incomes and reduction of poverty in marginalised upland communities of Southern Philippines through developing an effective climatic-resilient rubber-based cropping system, and nutrient management practices. This SRA project was to establish the current situation relating to the inclusion of a perennial tree crop into the rubber-based cropping system of Southern Philippines, and investigated the justification for and viability of an ACIAR supported project. In this section, based on the information and data collected through multiple meetings, visits, workshop and on-ground survey carried out by the SRA team, the rubber production in southern Philippines, land suitability and nutrient management, existing soil and land management information, soil constraints, the priority of rubber production, farmers' capacity to adopt the changes and potential research partners were assessed and reviewed.

5.1. Rubber Production in Agusan del Sur, Southern Philippines

The rubber tree was first planted in Isabela city, Basilan, in Philippines by James W Strong in 1905-1906. Now the Philippines ranks 10th in world rubber production. In terms of planted area, rubber is the 6th largest crop in Philippines after rice, corn, coconut, sugarcane, banana and cassava (Table 2, Philippine Statistics Authority 2016). The area of rubber planted increased steadily since 2011, reaching 222,600 hectares in 2015. (Table 2; Fig. 2; Philippine Statistics Authority 2016). The production volume of rubber in the Philippines is 398.1-453.1 thousand metric tonnes/ year in the past 5 years. For the period January-March 2017, the production of rubber grew by 17.9 percent, from 38.49 thousand metric tons in 2016 to 45.36 thousand metric tons this year. The growth in production resulted from more tapping activities prompted by good buying price of cuplump in SOCCSKSARGEN (North Cotabato) and Caraga (Agusan del Sur) (Philippine Statistics Authority 2016). However, the average rubber yield in the Philippines is 0.6 dry metric tonne per hectare, which is one third to half of that in Thailand and Malaysia. Rubber export increased steadily from 84.7 M pesos in 2011 to 118.4 M pesos in 2015. The rubber industry operates more than 31,000 production units, employing nearly 75,000 people; and 75% of the rubber farmers are small-holders operating from 2 to 5 hectares. Majority (>95%) of rubber plantations are distributed in southern Philippines, while more than 80,000 hectares are located in Mindanao. The current rubber production in the Philippines can supply only 40% of the domestic consumption. 75% of the rubber farmers are small-holders operating from 2 to 5

Table 2 Area of crops planted in Philippines I n 2011-2015

ITEM	2011	2012	2013	2014	2015
			('000 has)		
TOTAL	13,131.0	13,354.9	13,346.4	13,354.1R	13,229.1
Palay	4,536.6	4,690.1	4,746.1	4,739.7	4,656.2
Corn	2,544.6	2,593.9	2,563.7	2,611.4	2,561.9
Coconut	3,562.0	3,574.6	3,551.3	3,502.0	3,517.7
Sugarcane	439.7	433.3	437.1	432.0	421.3
Banana	450.1	454.3	446.0	442.8	443.4
Pineapple	58.5	58.5	60.8	61.6	62.8
Coffee	119.6	120.0	116.5	117.5	113.7
Mango	187.1	188.7	187.9	188.1	188.4
Tobacco	32.2	34.0	34.5	36.1	33.1
Abaca	139.0	138.5	138.4	134.8	134.2
Peanut	26.9	26.1	25.6	25.0	24.6
Mongo	45.3	44.4	43.6	43.0	41.4
Cassava	221.2	217.3	217.1	216.8	223.0
Camote	103.7	101.1	94.8	89.0	85.8
Tomato	17.6	17.3	17.2	16.7	16.2
Garlic	2.8	2.7	2.5	2.6	2.7
Onion	14.6	15.0	15.4	15.8	14.9
Cabbage	8.6	8.5	8.4	8.3	8.2
Eggplant	21.4	21.5	21.2	21.2	21.0
Calamansi	21.1	20.8	20.3	20.1	20.0
Rubber	161.6	176.2	185.5	217.7	222.6
Others	416.9	418.0	412.4	412.0 R	415.9

¥ Area planted for permanent crops and area harvested for temporary crops.

hectares. Mindanao supplies almost 100% of the rubber cup lump in the Philippines, and the Caraga region contributed only 2%, of which 94% is from Agusan del Sur.

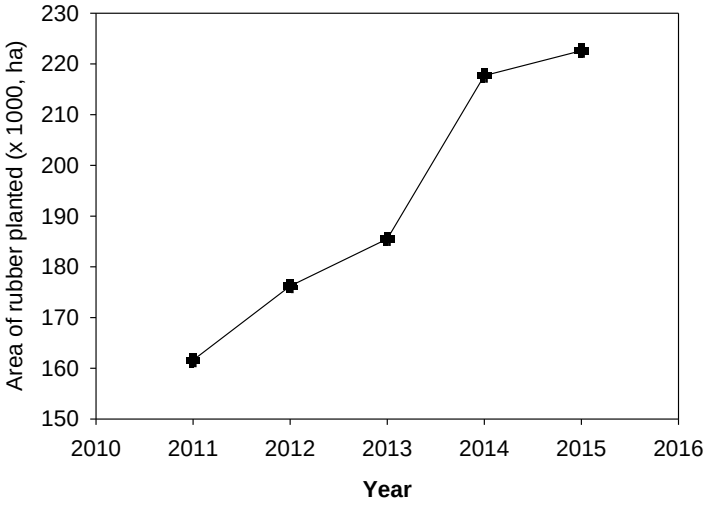

Fig. 2 Area of rubber planted in 2011-2015 in Philippines

The province of Agusan del Sur ranks 4th among the top rubber producing provinces in the Philippines with a total production area of 14,817 hectares in 2016, Its annual production is at 15,151 metric tons of raw rubber, involving 6,317 farmers. Agusan del Sur is one of the 3 provinces in Mindanao that receives national government support to boost rubber production as a priority crop in their Provincial Commodity Investment Plan (PCIP 2014-2016). In recent years, both federal and local government intend to encourage the growth of rubber and other cash crops to lift the poverty in Agusan del Sur which is one of the poorest provinces in the country (NSCB, 2013). The majority of these households belong to indigenous or smallholder farmers who have poor access to technology and are dependent on subsistence farming on their small piece of land (ca. 3-5 hectares), which contribute to the low yield of rubber crops. The Provincial Government of Agusan del Sur (PGAS) is committed to increase rubber areas and production in the next few years by providing quality planting materials to interested smallholders. Around 22,000 poor households or smallholder farmers within Agusan del Sur (Community-based Monitoring System 2012) are expected to benefit from the program.

5.2 Current issues and constraints to rubber production in Agusan del Sur and ACIAR opportunities

With an increasing demand from both domestic and international markets as predicted, the planted area of rubber crops in Agusan del sur, Southern Philippines has been increasing in the past decade. With the recent approval of a PhP20-million crumb rubber enterprise expansion project in Bayugan City, Agusan del Sur by the Philippine government, this trend is going to continue. On the other hand, a number of significant challenges and constraints are perceived that could hinder the success of the rubber program. It is essential that the new plantations are to be well-planned, implemented and managed with proper inputs and technical support in order to increase rubber productivity and maintain long-term soil sustainability and to maximise the contribution to poverty alleviation in marginalised communities. Currently the average rubber production yield is only 0.6 dry metric tonne per hectare in Philippines, much lower than that in Thailand (1.79 dry metric tonne per hectare). Through ISP intervention, the yield is targeted to increase to 1.92 dry metric tonne per hectare by 2020 through adoption of superior clones, recommended cultural management and harvesting practices.

While the major issues and constraints contributing to the low yield of rubber in the Philippines are pointed out in this SRA situation analysis, the key focuses have been placed on soil/ land suitability to rubber crops, effective rubber-based cropping systems, soil nutrient management, fertilisation and accessibility to technical support and farmers' adoptability of new changes etc. At the same time, the opportunities for research and development in improving rubber production in Southern Philippines are identified and analysed.

5.2.1 Key issues and constraints to rubber production

Low rubber yield in Agusan del Sur, Southern Philippines can be represented by the longer maturity period, and shorter economic life of rubber trees (< = 20 years in Philippines, while 21.1 year in Thailand and 25 years in Malaysia), low density of productive trees (stock density 300/ha in Philippines while 400-450 tree/ha in Thailand and Malaysia) and occurrence of pest and diseases etc. The situation analysis has shown that the following conditions have contributed to low rubber productivity and growth, and sustainability.

1) Inadequate planning, financial support and market assistance

While the national and provincial governments have some strategy plans for developing the rubber industry (e.g. Industry Strategic S & T Plan on Rubber – DOST- PCCAARRD 2014; Agusan del Sur PCIP 2014-2016 etc.), there is lack of reliable and efficient programs to develop the rubber industry.

- There are no long-term viable and affordable loan schemes and farmers have limited access to credit;
- There are inadequate planning tools for efficient plantation development and management;
- Government support for a more intensive culture of rubber is low. Only the cost of seedlings is subsidized; cost of fertilizer is high.
- Inadequate/ unreliable information/ data on rubber plantations to aid in planning and development of the industry;
- The farmers' income is greatly affected by the volatile global market price of rubber. In the Philippines, farmers' selling price is US$ 2.2.9 (50% dry) lower than those in Thailand (US$2.86) and Malaysia (US$3.08) (Industry Strategic S & T Plan on Rubber – DOST- PCCAARRD 2014). Lower price poses a great risk for upland farmers who are dependent on rubber latex production as a means of livelihood.

2) Lack of technical accessibility, training and support

- Smallholder rubber farmers do not have the technical knowledge on producing quality rubber. Their produce, the cuplump, is the lowest form of marketable rubber;
- Existing technology to enhance rubber latex production is not adopted due to poor information dissemination;
- Information on the growth and yield performance of new and current NSIC high yielding clones in various sites of the country are limited;
- Poor agronomic/agro-forestry practices due to lack of access to extension services and/or low adoption of good agronomic practices;
- Poor access to the current technology on nutrient management and cropping systems;
- Insufficient training for tappers and weak implementing capacity as well as R&D.

3) Lack of information and knowledge on soil/ land suitability

- The land suitability work has been done for cacao and coffee in Philippines, but not for rubber crops;
- Suitable sites for high yielding clones are limited and facilitated assessment of suitability will increase areas suitable for rubber and ensure high productivity;

4) Lack of proper soil and nutrient management and fertilisation

According to the Provincial Commodity Investment Plan (PCIP 2014-2016), Industry Strategic S & T Plan on Rubber – DOST- PCCAARRD 2014 and the outcomes of our workshop, the following constraints to rubber production are highlighted in Agusan del Sur:

- High cost of chemical inputs to farmers and low use of fertilizer among smallholders due to lack of understanding among farmers on cost benefits of proper and efficient use of fertilizer, risk aversion, and limited purchasing capacity. Normally, fertilizer is applied only during planting time. In the Philippines, the fertiliser input is minimum (urea 2-17 Lkg bags, much less than NPK ca. 30 Lkg bags in Thailand and 22Lkg bags murate of potash and ammonium sufate in Malaysia).

- Limited availability and commercial distribution of organic fertilizer and inputs specific for rubber.

- Limited information/knowledge support. There is lack of locally generated information on soil nutrient status in Caraga; lack of adequately trained agri-technicians from government agencies; lack of competent technicians on proper fertilizer management and application, to properly interpret and formulate fertilizer recommendations; and lack of literature that can be used as reference for formulating fertilizer recommendations.

- Lack of access to soil analysis services. There are low local capabilities and affordability of soil testing laboratories in Agusan del Sur. The provincial local government recommended assistance on the intensification of rubber research particularly on the viability of rubber-based cropping system, soil nutrient management through suitability mapping and soil nutrient index; and upgrading of the Provincial Soil Laboratory. Fees charged for soil analyses are too expensive and in some cases higher than in Australia.

- Lack of knowledge and skills in the areas of soil health and nutrient management. There is no soil nutrient (N, P, K and B etc.) diagnostic tool available for rubber and other crops. There is a lack of soil health indicators and a long-term management scheme for the sustainability of rubber plantations.

- Less input for the land preparation for rubber plantation (PhP 3,5000/ha) in Philippines compared with Thailand (PhP13,125/ha) and Malaysia (PhP11,700/ha).

5) Lack of cost-effective rubber-based cropping systems

Limited research has been carried out on the effectiveness and long-term sustainability of current rubber-other crop intercropping systems. While some examples of rubber-other crop (e.g. banana, corn cocoa etc.) intercropping systems have been practiced in some parts of the southern Philippines, nothing is known about how efficient the system is in terms of nutrient, water and sunlight resources. Through discussion with Dr. Jun Mercado, ICRAF site manager in Southern Philippines, many questions remain regarding multiple-cropping systems:

- What is the most suitable multi-cropping system that is locally adoptable (farmers choice) and can sustainably provide either food (staple food) or income (higher marketability in the local markets) for smallholder farmers?

- How can we ensure that the nutrient supplying capacity of the soils is adequate to support the most preferred multi-cropping system in a sustainable manner?

- Are smallholder farmers prepared to participate in the development of a multi-cropping system in their own farmlands?
- What are the critical interventions needed to support strong adoption of the technology among smallholder farmers and what mechanisms are needed to ensure sustainability of the introduced technology?

6) Lack of information of high yield clones of rubber

The clones that are commonly planted in Agusan del Sur is PB 260 and RRIM 600 clones which are considered as being obsolete about 10 years ago and 40 years ago, respectively. The current high yielding rubber clones (PB260/PB330) should be widely used and promoted.

7) Inadequate pest and disease management

- Higher incidence of bark and root diseases, leading to low yield;
- Low yield of existing senescent plantations developed from seedlings that are late maturing and are susceptible to pests and diseases
- Reduced/low yield of high yielding varieties due to pests and diseases

8) Poor harvesting techniques

- Reduced quantity and quality of rubber latex recovery due to poor tapping and undesirable coagulation practices;
- Spilling due to improper angle of cut. Better practice - cuplumps stored in clean concrete pavement with running water.

Majority of the above constraints as discussed above relate to soil nutrition and crop management. Nutrient improvement and designing an appropriate intercropping or multi-cropping system for rubber in particular, are both research priorities of the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARDD) and the Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD) as part of the 2020 vision for the Philippine Natural Rubber Industry.

5.2.2 ACIAR research opportunities

In the PCAARRD Rubber Industry Strategic S and T Plan, there is a roadmap for increasing rubber production and farmers' incomes in the Philippines (Fig. 3). The targeted outcomes include: a) increased national average yield by 50% to 1.92mt/ha/yr, thereby increasing farmers' income; and b) increased production of quality planting materials and addressed industry target of 50,000 hectares additional planted areas by 2020. To achieve these, modern farming methods should be promoted and adopted. The key measures include the selection of the best rubber clones, optimized rubber-based agroforestry systems, informed land suitability for rubber, species-site (land) compatibility, fertilization, improved soil and nutrient management, pest and disease control management and improved harvest techniques. Based on the information provided by the PCAARRD, nationally, there is research in place in the Philippines in the areas of developing and adopting new clones of rubber, quality planting materials, cultural management (e.g. pest and disease, new planting techniques etc.) and harvesting techniques. However, there is lack of research and development on soil and nutrient management and land suitability of rubber and cost-effective rubber-based cropping systems in the Philippines, particularly in Agusan del Sur. By adopting the above techniques and measures, it is predicted that the gross monthly income for farmers will increase from the current PhP5000 to PhP20,833 in modern rubber farming systems

(PCAARRD 2016). Therefore, there will be significant roles that ACIAR can play in filling the research gap and investing in the research of developing an optimised rubber-based cropping system and improved soil and nutrient management to enhance the yield of rubber and other crops, increasing smallholder farmers' incomes and lifting poverty in Agusan del Sur. There are some opportunities in research and development to improve rubber production and sustainability.

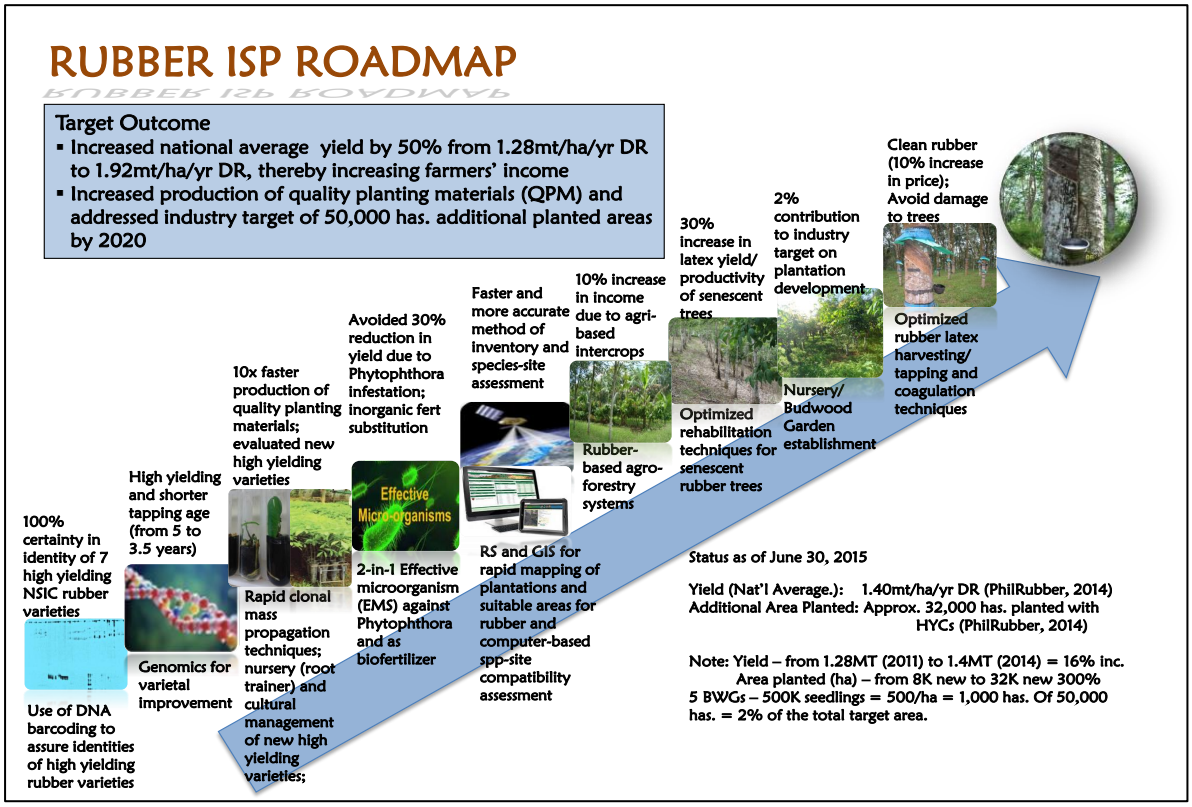

Fig. 3 Rubber Roadmap in Philippines (PCCAAD 2016)

a) Development of suitable and climate resilient rubber-based agroforestry systems

Rubber is grown either as monoculture or intercropped with other crops such as corn, banana, coconut and vegetables in Southern Philippines. The multiple intercropping systems may provide not only stable food for farmers but also high value cash crops, diversifying farmers' income and alleviating the poverty in the region. However, little is known about the effectiveness and long-term sustainability of current rubber-other crop intercropping systems in the upland areas of Agusan del Sur. Therefore, there is a research opportunity to develop model rubber-based cropping systems which adapt to local land and climatic conditions and promote proper use of nutrient, water and sunlight resources for long-term sustainable production of rubber and other high value crops (e.g. coffee, cacao etc.).

The model cropping system can promote soil health and sustainable land management, and at the same time reduce poverty in the uplands through increased rubber productivity and marketability of other farm produce. The model farm (rubber-based cropping) will be the venue of future innovations, capacity development and discussions on rubber development and cultural management practices between governments/ academes/ NGOs/ industries and rubber farmers and organisations.

Unlike other provinces, Agusan del Sur encourages intercropping for rubber which may provide smallholder farmers with other sources of income. This will add protection due to fluctuating prices of rubber cup lumps. At present, majority of the smallholder rubber farmers engage in a temporary rubber-based cropping system (i.e. planting of cash crops only during the first 3 years of rubber plantation), due to lack of technology/information showing the viability of a permanent rubber-based cropping system. The ACIAR-funded project will be unique in providing an appropriate or effective rubber-based cropping system in order to achieve sustained farm production and income which could be replicated in other areas. The former director of the International Rubber Research and Development Board, Dr. Eugenio Alcala has recommended that an ideal farming system in Philippines should have 60% of its products for commercial crops (e.g. rubber, cacao etc.), 30% for food (rice, corn, livestocks etc.) and 10% for other offerings such as medicinal product and ornamentals. This also indicated the significant role of introducing high value crops in alleviating poverty in addition to providing sufficient staple food for the smallholder farmers.

It is important to determine the most suitable multi-cropping system that is locally adoptable by farmers and can sustainably provide either food (staple food) or income (higher marketability in the local markets) for smallholder farmers. It is essential to work with local government and farmers associations to provide critical technical support and training to the farmers to participate in developing a multi-cropping system in their own farmlands. The effective cropping systems should include increased climate resiliency to climate change risks (e.g. cyclone, salinity). The rubber clones, which can withstand strong winds, should be selected for coastal areas. In addition, there is a need to benchmark the existing farms and plantations, assess its performance so that the good practices can be integrated to new or alternative technology/systems (coffee, other crops) that will work best.

The full economic analysis of the rubber-cropping systems should be carried out to understand the cost and benefits of the whole cropping system, and thus the farmers can optimize the return from the cost of inputs. It is ensured that the project on the cropping systems should fit in the entire value chain – from crop growth to marketing to achieve the goal of increasing smallholders' incomes and provide them with a safety net. The development of such rubber-based cropping systems requires collaborations with local government to make sure there is a local market and infrastructure (e.g. roads). In 2017, the Department of Agriculture's (DA) Philippine Rural Development Project (PRDP) approved A P20-million crumb rubber enterprise expansion project in Agusan del Sur, which will provide an excellent local market for smallholder rubber famers.

b) Identifying land suitability for sustainable rubber production in Agusan del Sur

Based on the Bureau of Soil and Water Management, Department of Agriculture, there is information on land suitability for coffee and cocoa at a large scale. However, little is known about the land suitability for rubber crops. The land suitability of rubber crops and rubber-based cropping systems is required for the successful establishment of rubber-based cropping systems and for the effective use of land resources and its long-term sustainability. The land suitability classification should be robust and can be used widely and at the farm level. This will deliver the effective tools for land suitability assessment to the smallholder farmers in the upland areas of Agusan del Sur. Land suitability mapping shall include soil type, nutrient status, soil and climate constraint and potential environmental impacts to ensure effective establishment of rubber-based cropping systems and diversification of crops in the region. In addition, crop species-land

compatibility and rubber clone specific land suitability should be considered to accelerate the adoption of new clones and the use of land suitability information by farmers. Therefore, there is a need to map out the rubber potential areas vis-à-vis soil fertility/land suitability and to assess the performance of different clones in different locations/types of soils. Suitable sites for high yielding clones are limited and facilitated assessment of suitability will increase areas suitable for rubber and will ensure high productivity. It should be noted that some information about land suitability for other crops may be available but the popularization and utilization of the results remained a challenge, and it was not being appreciated and utilized down to the farmer-level.

c) Developing nutrient diagnostic tools, formulating affordable (low cost) chemical fertlisers and improving nutrient management regimes to ensure sustained rubber production

Low inputs in the establishment of rubber plantations, low affordability of chemical fertiliser and lack of technical support in nutrient and fertilization contribute greatly to the current low productivity of rubber plantations in Agusan del Sur. The farmers do not have any idea if their rubber plantation is sustainable or not. Therefore research opportunities for the ACIAR in this space include:

- Developing a rapid method for assessing soil nutrient status (nitrogen, phosphorus, potassium, zinc, boron etc.) as a guide to formulating fertilizer recommendations for rubber and other crops in the rubber-based cropping systems and determining the relationship between soil and leaf nutrient status, as basis for formulating fertilizer recommendations.
- Establishing a fertilizer management system for the rubber commodity so that quality can be monitored and assured. The project will come up with a customized fertilizer grade based on specific location, in a simple computation that a farmer can follow; and there will be a specific fertilizer recommendation per commodity.
- Developing a nutrient diagnostic tool/ nutrient availability index to determine the best combination for rubber (crop-specific) that is site-specific and balanced; and will calculate nutrient balance and budget to ensure that the rubber-based cropping systems are sustainable in specific sites.
- Introducing biologically N-fixing plants (legumes) such as *Mucuna bracteata* in the early stage of rubber plantation to provide extra nitrogen to rubber crops and to reduce the fertilizer cost.
- Developing a sensitive and robust soil health indicator to ensure the long-term sustainability of rubber-based cropping systems;
- Capacity development for the Agricultural Technicians to interpret and, transfer the knowledge to farmers effectively.

Fig. 4 Rubber intercropping with legume cover plants – *Mucuna bracheata* in the research station of Department of Agriculture, Provincial Government of Agusan Del Sur

d) Capacity building, strengthening analytical capacity and empowering women

The current analytic capacity at the Department of Agriculture, Provincial Government of Agusan del Sur is very poor with only being able to analyse soil pH, EC and available phosphorus, while the BSWM, Department of Agriculture, Philippines has basic facilities which can handle most soil nutrient analyses in Manila. However, it is very inconvenient/ inefficient for the farmers / technician to send soil samples to Manila. The simple and robust analytic methods are to be developed to provide the immediate need for the analysis of nutrients locally. To work with the Philippines and Agusan del Sur provincial governments, the ACIAR can assist in setting-up a reliable Soil and Tissue Analytical Laboratory in Caraga, and/ or upgrading the soil laboratories at the local levels (in laboratories of the Provincial Agriculture Office of Agusan Del Sur or local partner universities). In addition, the following measures can be taken for strengthening capacity building:

- Provide adequate training to local extension officers with emphasis on facilitation – ensure facilitators are capacitated to help support those who need capacity – farmers;
- Educate and train local partners and farmers (e.g. ability to adopt the new cropping system and soil nutrient diagnostic tools);
- Improve farmers' accessibility to technology and soil analytical service and effective communication strategies for farmers;
- Research into gender equity and the involvement of women in various processes of research and extension to empower women to maximise the efficacy of poverty reduction. Currently, women are engaged in the farms by helping their husbands with tending to the rubber trees. They are also engaged in various alternative livelihoods such as handicrafts, and selling products from farm produce. There are also currently women-farmers, and also women who are leaders of rubber farmer organisations/ cooperatives.

5.3 Philippines Government, ACIAR and Australian Government priorities

5.3.1 Alignment with the ACIAR Research and Australia's aid investment Priorities.

This research project intended to assess the situation and viability of developing a full ACIAR proposal for increasing smallholder farmers' income by developing effective rubber-based cropping systems and promoting nutrient management to achieve high rubber productivity, soil sustainability and economic incomes. Based on the Strategy for Australia's aid investments in agriculture, fisheries and water (2015), Australia's aid investments in these areas will promote prosperity, reduce poverty and enhance stability through increasing contributions to national economic output; increase incomes of poor people; and enhance food, nutrition and water security. This project aligns well with one of three key sectoral priorities outlined in the Strategy for Australia's aid investments in agriculture, fisheries and water (2015) – 'Innovating for productivity and sustainable resource use' which aims to improve agricultural productivity, food value chains and promote more efficient and sustainable use of natural resources, using international and Australian research and expertise.

In the ACIAR Operational Plan (2016-2017), the ACIAR key activities include 'Productivity, profitability and sustainability of agricultural systems; Capability; Improving institutional effectiveness and efficiency; and Cross-cutting themes'. It is clear that this project is also in line with the key activities supported by the ACIAR, including 'Productivity, profitability

and sustainability of agricultural systems'; and 'Capacity building' (ACIAR Operational Plan 2016-17). This project also falls within the scope of the following key priorities addressed by ACIAR's program in the Philippines, particularly the 'land and water resource management for profitable and sustainable agriculture' priority.

- increased market competitiveness of horticultural products
- competitive and sustainable fisheries and aquaculture production
- land and water resource management for profitable and sustainable agriculture
- improved returns from low-input livestock production systems
- mitigating the adverse impacts of climate change on the rural poor
- improved technology adoption by poor Indigenous households in the southern Philippines through understanding and remedying adoption constraints and extension.

5.3.2 Alignment with national development priorities in the Philippines

The project supports the Philippine Development Plan (PDP 2017-2022) which aims to expand economic opportunities to address poverty and inequality, and includes Rubber as a priority sector in the CARAGA region for development into a high value added, competitive and sustainable sector. It also complements the current research interventions by the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD), which lists rubber as a priority crop. Increasing the market competitiveness of horticultural products, in a priority under-developed region of the southern Philippines.

According to PCAARRD, this project aligns with the Rubber Industry Strategic Plan (ISP) Roadmap which has a target outcome of: a) Increased national average yield by 50% from 1.28mt/ha/yr to 1.92mt/ha/yr, thereby increasing farmers' income; b) Increased production of quality planting materials (QPM); and c) Addressed industry target of 50,000 hectares additional planted areas by 2020.

The Philippines Rubber Research Institute (PRRI), Department of Agriculture has confirmed that rubber, coffee and cacao are priorities and there is some emphasis for these high-value crops to be developed together. It is expected/ anticipated that there would be an expansion in rubber plantations in the next five years due to current Department of Agriculture priorities.

The total estimated investment for three years is PhP 17.8B. This investment will focus development of prioritized commodities in municipalities within the top 5 rank taking also into consideration other municipalities which play major roles in other value chain segments.

5.3.3 Alignment with national research priorities in Philippines

This project also aligns well with the Philippines' National Research Priorities (PCAARRD, Department of Agriculture, Feb 2017). In the most recent document (Harmonized National R & D Agenda Agriculture, Aquatic and Natural Resources Sector (2017-2022)) released by the PCAARRD, the research priorities include soil health, nutrient and water management, development of biofertilisers and soil fertility enhancers, smart farming approaches, development of climate-resilient technologies, development and sustainable management practices for forests, management and rehabilitation of problem, degraded and polluted soils through remediation.

In the Research and Development, and Extension Agenda and Programs (RDEAP 2016-2022) released by Department of Agriculture, Philippines (2017), its mission is to 'attain food security and reduce poverty through technology-based agriculture and fisheries

sector'. The goals of the Department of Agriculture are to 'increase availability and affordability of food, income of famers and fisherfolk, and resilience to climate change risks'. In this, rubber, cacao and coffee are all on the priority list of plantation crops. The key goals/ strategies include increasing production, increasing employment and income and development of inclusive value chains. In the RDEAP 2016-2022, the research priority for plantation crops also include appropriate farming systems (water and nutrient management, IPM, GAP, ICM, cropping systems) and nutrient diagnostics for coffee, cacao, coconut, rubber tree, carbon footprint, water footprint and energetics.

The proposed project aligns with the following thematic programs under the Soil and Water R&D Direction 2016-2022: soil health improvement and management; conservation and management of soil biodiversity; mitigation of soil and water pollution; effective watershed management for improved agricultural productivity; soil and water conservation and management (BSWM). BSWM expressed a strong interest in this project, which is something new and adds value to current soil mapping and soil testing initiatives for the entire country, which is a priority.

5.3.4 Necessity of the ACIAR Project

The Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD), Philippine Rubber Research Institute, Department of Agriculture, Bureau of Soil and Water management (BSWM), and Provincial Government of Agusan del Sur (PGAS) have confirmed that little research has been done in developing cost-effective and climatic resilient rubber-based cropping systems and soil nutrient management to improve rubber productivity and long term sustainability.

Provincial Government of Agusan del Sur

- Under the Provincial Government of Agusan del Sur (PGAS) USAD Program, there is plantation development but no soil analysis and nutrient management due to lack of technical experts and poor analytical capacity of the provincial laboratory. There is massive support from PGAS to provide inputs (e.g planting materials) but the main issue is land suitability.

Philippine Rubber Research Institute (PRRI)

- PRRI was established in 2010 (RA 10089 or the Philippine Rubber Research Institute Act of 2010) but only became operational in 2015. They are in need of more assistance to fulfil their mandates, especially in R&D.
- According to PRRI, farmers do not know how to properly intercrop especially when the trees are big/ mature and there is poor awareness among farmers in terms of the benefits of different types of rubber plants.
- Rubber processing plants are not operating at full capacity due to low productivity or lack of local rubber supply.

Bureau of Soil and Water management (BSWM)

- There is a need to determine whether recommended farming system: 60% commercial crops (rubber, cacao, etc); 30% food crops (rice, corn, livestock); 10% others (medicinal, ornamental) is viable.
- The BSWM also expressed the need for assistance in upgrading and performing its mandates to meet the DA Secretary's plans, particularly in soil analysis and mapping.

The Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD)

- Demand interventions have been in place for rubber since 2011 so there will be a continued market/ demand for rubber. There was a supply gap of just 125,000 MT in 2015 and will increase to 1.067 M MT by 2030.
- There is a need to promote adoption of modern rubber farming methods/ practices to increase incomes (average annual gross income will be PhP20,833/ hectare compared to Php5,000 / hectare under current practices).
- PCAARRD re-confirmed that the focus on soil nutrient management on rubber is needed research to investigate why current intercropping practices are not sustainable or not working (i.e. farmers have been practicing intercropping for a long time but this still has not helped reduce poverty or increase income);
- PCAARRD suggested the need to investigate the role the legume cover plants such as Mucuna (*Mucuna bracheata)* in sustaining the fertility of the soil*, which* – make it possible to be tapped in 3.5 years instead of the normal 7 years;
- The project can assist in addressing issues of poor quality of rubber, longer maturity, low production, high incidence of diseases and wind damage through optimum cropping systems, land suitability analysis and sound nutrient management;
- There is a need to compare the performance of clones in different areas in response to nutrient management regimes;
- PCAARRD echoed BSWM and PRRI's concerns of the use of poor quality planting materials (e.g. use of wildlings instead of budded or clones)

Table 3. Comparison of incomes from traditional and modern rubber farms

Item	Traditional farm	Modern farm
Average area to get income of PhP84,000 (a)	3.5 ha	0.95 ha
Total estimated gross income per hectare in economic life (b)	PhP 1.2 M	PhP 6.6M

(a) Assuming a price of PhP 40,000 per kg dry rubber and average yield of 600 kg rubber per hectare for traditional and 2,200 kg dry per hectare for modern farm.
(b) Over 20 years for low maintenance (traditional) farm and 30 years for high maintenance (modern) farm and average price at PhP 100,00/ kg dry rubber.

5.4 Potential research and development partners and support in Philippines

5.4.1 Partnership with government agencies and academic institutions

Through extensive consultations and discussions, workshop and analysis, it is considered that the following government agencies and academic institutions have been consulted, their expertise is complementary for this project, and they are likely to be good partners for this project.

a) *Department of Science and Technology-Philippine Council for Agriculture, Aquatic and Natural Resources for Research and Development (PCAARRD)*. It will ensure that the proposed project aligns well with the national research priority of the Philippines and support the national research, development and extension program in agriculture in the Philippines. The PCAARRD has been very supportive in the past year, and based on its research project database, this proposed project on improving nutrient management and soil health and sustainability in rubber-based cropping systems has not been studied

before, but is urgently needed for boosting rubber productivity and sustainability in Southern Philippines.

b) *Philippines Rubber Research Institute (PRRI).* PRRI was established in 2010 (RA 10089 or the Philippine Rubber Research Institute Act of 2010) but only became operational in 2015. The PRRI supports the project to help fulfill its mandate on "initiating research and development projects on rubber in order to address technology and policy gaps in promoting a robust rubber industry, ensuring a standard in production and meeting demands for quality rubber in both domestic and international trade" (Republic Act 10089). There is some specific expertise in rubber production and research within the PRRI, and the PRRI has research stations and field trials across Southern Philippines. Their expertise in rubber research will complement our Australian expertise in soil nutrient management, soil health, and cropping systems. In addition, the PRRI offered/encouraged soil analysis research on their existing rubber nursery/ demo farm of rubber intercrops (cacao, coffee, banana) in Marilog, Davao City, and also in the University of Southern Mindanao, Kabakan. This will certainly provide support for this ACIAR-funded project. At the same time, it is a new agency and in need of more assistance to fulfil their mandates, especially in research and development.

c) *Department of Agriculture.* Bureau of Soil and Water Management (BSWM), Bureau of Agricultural Research (BAR), and the Department of Agriculture- Caraga Regional Office, under DA can also be partnered for this project. The BSWM is the nationally mandated authority on soils and water management for agriculture (Executive Order 116). It has good technical capacity for basic soil analyses in the Philippines, and has some land suitability and soil fertility information in the Southern Philippines, which are useful for the project. The BSWM provides continuing assessment of the sustainability of the country's agricultural production systems, particularly the soil and water resources as vital agricultural resources. It sustains Philippine agriculture through the promotion of sustainable agricultural land management practices in the croplands as well as the marginal uplands, hillylands, and highlands. On the other hand, the proposed ACIAR project supports its core function of conducting R&D on soil and water resources.

The BSWM has a project in place (2016-2017)- Land Resources Evaluation and Suitability Assessment of Strategic Production Areas for Cacao and Coffee (2016-2017). The rubber crop is the next project to be done on land suitability.

The Regional Executive Director of the Department of Agriculture, Caraga Region, Renato P. Manantan expressed strong support to this ACIAR project. There are on-going efforts related to the crafting of more industry roadmaps including rubber. The ACIAR project on rubber-based cropping systems and nutrient management will be urgently needed for the improvement of farming systems and future development in the Caraga Region particularly in the Province of Agusan del Sur.

The Department of Agriculture has on ongoing partnership with the Department of Trade and Industry (DTI), in collaboration with the Philippine Rubber Industries Association (PRIA) to push further the development of the Philippine Rubber Industry by building a nationwide strategic alliance among industry stakeholders in Mindanao.

There are ongoing efforts to boost the economy of the CARAGA region through initiatives of the Board of Investments (BOI) and the Department of Trade & Industry (DTI) to craft their local version of national industry roadmaps (including rubber) in pursuit of further growth and competitiveness in the region.

d) *Provincial Government of Agusan del Sur.* Provincial Government of Agusan del Sur expressed that human power and field site for research are the main support for this proposed project. It is willing to assign fulltime personnel (2) to be focal person for the project; although there is a need to specify the work so that the right personnel can be identified. There are 2 research stations operating in the Agusan del Sur (Talacogon and Trento) where the rubber research can be conducted. The partnership with previous AusAid Scholars can be very important for successful implementation of the ACIAR

project. The majority of the key partners in the local provincial government of Agusan del Sur is composed of previous AusAid scholars. Engr. Linda Buquir (Project Director) and Engr. Oscar Jurado (Project Coordinator), of the USAD Program are both former AusAid scholars.

Complementary program to PGAS in rubber development is the National Greening Program of the DENR and the rubber plantation establishment under High Value Crops Development Program of DA.

e) *Agusan del Sur State College of Agriculture and Technology*. It was founded in 1906 and has strong expertise in agricultural research, development and education. Its experimental farms can potentially be used as one of the field sites for this project. In addition, the Agusan del Sur State College of Agriculture and Technology, together with the Provincial Economic and Development Office, Agusan del Sur can be potential collaborators in economic analysis and social sciences (women's equity).

f) *The University of Science and Technology of Southern Philippines (USTsP).* We visited the Analytical Chemistry Laboratory of the University of Science and Technology of the Southern Philippines (USTsP) in Cagayan de Oro main campus (http://www.must.edu.ph/) and met and discussed with Dr. Oliva P. Canencia, Research Director of USTsP and Dr Gerlie Leopoldo, Head of the Chemistry Department, USTsP. They expressed their enthusiasm and strong support for this project, and particularly, their chemistry laboratory can facilitate basic soil chemical characterization which can provide strong support (e.g. soil and plant nutrient analysis) for the proposed project and is very close to the proposed project sites in Claveria (1.5 hours by car) and Bayugan, Agusan del Sur (3-4 hours by car). It is noted that the Misamis Oriental State College of Agriculture and Technology (MOSCAT), which has been a partner in previous ACIAR projects in Southern Philippines, is now under USTsP. The International Council for Research in Agroforestry (ICRAF) also has a satellite office in USTsP.

g) World Agroforestry Centre (ICRAF) Philippines. We visited and discussed with Dr. Jun Mercado, ICRAF site manager in Southern Philippines. Dr Mercado has some experience in the research of multiple-cropping systems in Southern Philippines and he can provide the field site for our project. .

5.4.2 Partnership with the private sector

The seminar-workshop we run in Butuan city was participated in by 56 individuals representing various stakeholders such as Farmer Leaders / Rubber Farmer Cooperatives, Municipal Agricultural Technicians, Academe, and the Provincial Government of Agusan del Sur. There is plenty of enthusiasm and support from various private sector organisations, such as farmers, rubber buyers and planting stock suppliers and fertiliser companies and other rubber plantation companies. Through leveraging private sector partnerships and investment, the ACIAR funded project will bring about a greater and quicker change on the farmers' income and poverty.

The ACIAR project will involve the creation of a Technical Working Group (TWG) on Rubber Production. There will be regular TWG members from the private sector such as local-regional rubber buyers, suppliers (e.g. planting stocks), NGOs, people organisations (e.g. rubber cooperatives) who will be involved in TWG meetings. This is important as it will provide a venue for all players to engage in participatory planning and implementation of the project. In addition, the Department of Trade and Industry will also be involved as a regular TWG member as they will be able to provide linkage for smallholder famers to small-medium enterprises/companies [e.g. Farma Rubber Industries, Inc., Standard Rubber Development Corporation (SRDC), and Philippine Pioneer Rubber Products Corporation etc.] within the rubber industry. The potential private companies as partners are strategically located within Agusan del Sur. There are two existing private sector partners – Bayugan Rubber Producer Cooperative (BARUPCO) and VPO farms, who are

actively working with the Provincial Government partner in marketing and Business Support for the Rubber industry in the Agusan del Sur. BARUPCO is the rubber cup lump consolidator while the VPO farms will be engaging in the processing of cup lumps- and is expected to engage in full operation next year in Agusan del Sur.

5.5 Relevant research and development investments in Agusan der sur, Southern Philippines

5.5.1 ACIAR investment (projects) in soil management and crop nutrition in the Philippines

Research activities conducted in the past 10 years under the land and water resource management priority in the Philippine uplands were mostly done in Northern and Central Philippines (Elgin et al. 2012; and see below), where climatic conditions and soil types vary significantly from the southern Philippines.

SMCN/2003/006 - Enhancing agricultural production in the Philippines by sustainable use of shallow groundwater. This project was to establish measures to exploit shallow groundwater sustainably, aiming to increase crop production in lowland, rain-fed agricultural areas of the Philippines. This project focused on two pilot sites within the neighbouring municipalities of Pasuquin and Burgos, Ilocos Norte in the north-western tip of Luzon in the Northern Philippines. Results from the assessment of the current potentials of shallow groundwater resource in both pilot study sites showed that resource use is still less than its maximum sustainable yield although there are threats of deteriorating water quality (e.g. elevated salinity at lower depths) and potential decline in water quantity particularly during dry seasons. The technical evaluation suggests that crop intensification and diversification can still be pursued in the Burgos site using the shallow groundwater resource using measures to avoid compromising its quality.

SMCN/2003/011 - Herbicide use strategies and weed management options in Filipino and Australian cropping. The major goal for this study was to pre-emptively develop understanding and a local capacity around herbicide resistance and its management. Through the course of the project, it also became evident that other weed population shifts associated with direct seeding were of importance, including increasing prevalence of weedy rice. There is likely to be reduced incentive for investment in resistance prevention when gaining resistance from a neighbour is likely.

SMCN/2004/078 - Evaluation and adoption of improved farming practices on soil and water resources, Bohol Island, the Philippines. The overall aim of the project was to promote the adoption of improved farming on highly erodible? soils on steeply sloping uplands in two upper watersheds in Bohol, Central Philippines. This was achieved through the implementation and demonstration of erosion amelioration practices, and measurement of the environmental, economic and agronomic consequences.

While some ACIAR funded projects were conducted in Southern Philippines (see below, SMCN/2009/031 and SMCN/2012/029), one of them was also generally focused on land conservation aspects, rather than examining the soil-plant interaction and nutrient use efficiency for a specific cropping system and the other was concentrated on vegetable crop production and soil and nutrient management. However, our proposed project was specifically to examine rubber-based farming in the uplands with cropping components that would address poor soil nutrient management and inappropriate cropping systems in the uplands. This complements the above two current or ongoing research activities in Mindanao that examine the “soil and nutrient management strategies for sustainable vegetable production (Dr Stephen Harper) and “watershed evaluation for sustainable use of sloping agricultural land” (Dr Anthony Ringrose-Voase).

SMCN/2009/031 - Watershed evaluation for sustainable use of sloping agricultural land in the southern Philippines. This project aimed to enable improved planning of agricultural

development in upland watersheds in the southern Philippines such that agricultural production can be increased and watersheds can be protected - precursors to reducing rural poverty and improving livelihoods. This project focused on mapping land and soil properties and analysing the suitability of sloping land for agricultural intensification within a watershed context.

SMCN/2012/029 - Soil and nutrient management strategies for sustainable vegetable production in southern Philippines. This project was built on previous work in southern Philippines and focuses on commonly grown vegetables such as eggplant, ampalaya, bell pepper, tomatoes and leafy vegetables. Its overall aim was to develop soil and nutrient management practices for smallholder farmers in this region to increase cost-effective production of vegetables.

5.5.2 National initiatives and investment in research, development and extension in rubber production in Agusan del sur, Philippines

Fig. 5 latex is collected from a rubber tree (rubber tapping).

As discussed above, the rubber crop has been on the priority list of high economic value commodity crops for research and development, particularly in the areas of soil health, nutrient and water management, development of bio-fertilizers and soil fertility enhancers (Harmonized National R & D Agenda Agriculture, Aquatic and Natural Resources Sector 2017-2022, DOST-PCAARRD) and farming systems and nutrient diagnostics (RDE Agenda and Program 2017, Department of Agriculture, Philippines). In the Agusan del sur Provincial Commodity Investment Plan (2014-2016), rubber is listed as the first priority commodity crop. Both national and provincial governments are committed to increase the growth of rubber and other high value commodity crops to lift poverty in the province. Around 22,000 poor households or smallholder farmers within Agusan del Sur (Community-based Monitoring System 2012) are expected to benefit from the program.

More recently (March 2017), Philippine Rural Development Project under the Department of Agriculture approved a PhP20-million crumb rubber enterprise expansion project in Bayugan City, Agusan del Sur. This will stimulate the growth of rubber plantation and the farmers' income in the neighbouring towns (http://primer.com.ph/blog/2017/03/09/first-rubber-mfg-plant-to-rise-in-mindanao/).

While the other research issues associated with low rubber productivity [including high rubber yield varieties, planting materials, bark and root diseases, high occurrence of TPD (tapping panel dryness)], and planning tool for efficient mono-cropping plantation development have been addressed in Philippines, development of effective climatic-resilient rubber-based cropping systems, land suitability for rubber and nutrient management (e.g. nutrient diagnostic tools, fertilization etc.) are largely unknown.

This project is necessary to support both the national and local government in their efforts to uplift the economic conditions of marginalized communities (i.e. improved productivity through an effective and climatic-resilient rubber-based cropping system) and to rehabilitate the degraded upland areas in Mindanao (i.e. improved soil nutrient management practices). Funding for agricultural research activities from the ACIAR would provide critical knowledge-based or scientific decision-making support to government (e.g. PGAS, PCAARRD, DA-BAR, DA-BSWM) initiatives to boost sustainable rubber production and economic income among the smallholder farmers and ensure sustainable

management of land resources and empower women to tackle poverty and maximise development outcomes.

This project complements other existing projects:

- This project builds on BSWM's completed and ongoing projects such as Land Resource Evaluation and Suitability Assessment of Strategic Production Areas for Cacao and Coffee (2016-2017); National Soil Sampling and Testing for Fertility and Crop Suitability Assessment (2016-2017), and Inventory of soil fertility assessments (2010-2015);
- According to PCAARRD, this project in Agusan del Sur is under the Rubber Industry Strategic Science and Technology Plan and under the Cultural Management Technology Chain (nutrient management and site performance trials). Under the Cultural Management Technology Chain, the project does not duplicate any of the existing projects but complements various S & T interventions. Specifically, the proposed project will fit very well with the identified research need: a) Understand the Role of Mucuna in Early Development of Rubber Plantation - Soil Nutrient/Fertility Management [Compare smallholder farmers' practice in rubber farm development and management with Corporate method of management in the aspect of early plantation establishment (first 1-3 years); and b) Determine/compare fertility levels; Quantify fertility/biomass, etc.] - for S&T intervention on formulation of low-cost fertilizer and effective technology promotion of efficient fertilizer system for rubber.

This project aligns well with current investments

- NEDA (The National Economic and Development Authority) has recently approved the Inclusive Partnership for Agricultural Competitiveness (IPAC) that focuses on developing agribusiness synergies in financially-viable production of crops including rubber. The project's total estimated cost is PhP10.2 billion and is expected to be completed within five years.
- According to PRRI, the DA has a Farm-to-Market Road (FMR) program and is implementing it aggressively (this means the project also aligns with infrastructure priorities)
- According to the Provincial Government of Agusan del Sur, the project supports provincial investments in the Upland Sustainable Agri-Forestry Development (USAD) Program where rubber projects have been successfully implemented like the 5-hectare rubber technology demonstration farm that showcased the mono-cropping system with cover crop (*Mucuna bracteata*) as intercrop, rubber seedling nursery to support seedling dispersal, and the 2-hectare budwood garden project to ensure the purity of clones of the planting materials being distributed to farmers.

6 Conclusions and Recommendation

6.1 Conclusions

1. From this SRA, it has been confirmed that the research (on soil nutrient management and developing cost-effective rubber-based cropping systems) not only contributes to reduction of poverty and aligns with but is highly ranked as a priority/interest of Australia and the Philippines. The project is consistent with priorities in the Philippine Development Plan 2016-2022, the DOST-PCAARRD National Harmonised Agenda and the Research, Development and Extension (RDE) Agenda and Programs of the Department of Agriculture – Bureau of Agricultural Research, Philippines.

2. It also highlights that there is a clear research question and gap that could be addressed through science-based work, particularly in soil nutrient management and effective rubber-based cropping systems, and there are clear impact pathways in terms of reducing poverty and increasing incomes of smallholder rubber farmers benefiting more than 22,000 households in the CARAGA region, particularly in Agusan del Sur.

3. The key soil and nutrient constraints to rubber productivity have been identified, including: little information about land suitability for rubber crops; lack of knowledge and skills in the areas of soil nutrient diagnosis and management; low use of fertilizer among smallholders due to high cost of chemical fertiliser and lack of access to soil analysis services and technical support due to poor analytical capacity available in the local region.

4. The SRA also strongly demonstrates that there is strong support and clear interest from relevant government partners/institutions to pursue the partnership and research, as evidenced by the Statement of Support and openness of stakeholders to further coordination. Market channels were also identified in Agusan del Sur to ensure economic impacts and sustainability of the proposed ACIAR research undertaking for smallholder farmers.

5. It also shows significant advantages of the Australian commission organisation (Griffith University) and local partners in terms of having complementary capacity/expertise to undertake the research and add value to it, considering the reputation of the Soils Group at Griffith University, and that many of those involved in the Philippine local level (especially from the partner local government) are previous AusAid scholars who are eager to give back to their communities.

6.2 Recommendation

1. From this SRA, there is a need for the implementation of a project on developing soil and nutrient management and effective, climate resilient rubber-based cropping systems to improve productivity and income for smallholder farmers in southern Philippines. This will address the issues raised at the national and local levels on the need to address the poverty in this region.

2. The project is timely as it will complement existing research and development priorities at the national level and will also be highly supported at the local level, particularly in the government of Agusan del Sur which already has an existing and successful program providing technical assistance to rubber farmers.

7 Reference

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8 Appendix

8.1 Appendix One Terms of Reference

TERMS OF REFERENCE FOR DEVELOPMENT OF SMALL RESEARCH AND DEVELOPMENT ACTIVITY

Project Leader: Professor Chengrong Chen
Position: Professor/ARC Future Fellow
Organisation: Griffith University
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Background

Agusan del Sur is one of the poorest provinces in the country with 37% of households with income below the poverty threshold (NSCB, 2013). The majority of these households belong to indigenous or smallholder farmers who have poor access to technology and are dependent on subsistence farming on their small piece of land (ca. 3-5 hectares). In line with the National Government's rubber program which aims to address poverty, the Provincial Government of Agusan del Sur (PGAS) is committed to increase rubber areas and production in the next few years by providing quality planting materials to interested smallholders. Around 22,000 poor households or smallholder farmers within Agusan del Sur (Community-based Monitoring System 2012) are expected to benefit from the program. However, research is required to ensure most appropriate use and management of these vulnerable upland areas.

Research activities conducted in the past 10 years under the land and water resource management priority in the Philippine uplands were mostly done in Central Philippines (e.g. Leyte), where climatic conditions and soil types vary significantly from the southern Philippines. These previous studies also were generally focused on land conservation aspects, rather than examining the soil-plant interaction and nutrient use efficiency for a specific cropping system. Specifically, the there is a need to examine rubber-based farming in the uplands with cropping components that would address the poor soil nutrient management and inappropriate cropping systems in the uplands. There is also a need to operationalise the functionality of SMCN/2009/031 "Watershed evaluation for sustainable use of sloping agricultural land", with the application of methods of land suitability and participatory landuse planning developed in that project being led by the Philippines team. Whilst rubber is the focus of attention, rational land suitability assessment will empower farmers and authorities to adapt to changing climate, market and political circumstances.

Scope

The overall purpose of the Small Research and Development Activity (SRA) is to establish the current situation relating to the inclusion of a perennial tree crop into the cropping system of Southern Philippines, and investigate the justification for and viability of an ACIAR supported project. The SRA should identify the highest research priorities for Philippines down to an implementable scale, and evaluate potential benefits of major potential research-led interventions, with rubber as the case study. Some points for the SRA to consider are:

- The current situation in relation to cultivation of rubber in Agusan del Sur, and the prioritisation for these systems by Philippines authorities;
- The current understanding of the extent of suitability for, and soil constraints to, rubber considering current and predicted environmental conditions;
- The factors that determine the capacity of farmers to adapt to changing conditions? What needs to be done to improve the adaptive capacity of farmers and policymakers?
- The extent and accessibility of existing soil and land management information;
- The in-country soil related analytical capacity;
- The in-country relevant soil related research capacity and enthusiasm for a project, and an evaluation of complementarity of Australian and Philippine research communities;
- Relevant research and development investments (past, present and future, inclusive of but not exclusively, ACIAR investments);
- Potential research and development partners.

The above should be provided to ACIAR in the form of a report that indicates the current situation in Philippines with respect to upland management, capacity and research and capacity needs.

Outputs and timing

Output	**Timing**
Small research and development activity proposal submitted to ACIAR	4 July 2016
Report on scoping mission to Philippines	30 September 2016
Situational analysis report	15 February, 2017
Report to ACIAR that reviews research needs, and an analysis of the benefits associated with the main options.	1 May, 2017
Final Report covering situational analysis, research priorities (types and locations), potential partnership arrangements for future work.	10 June, 2017

Budget
The financial limit of ACIAR funds for the SRA is $70 000 (AUD).
1st payment on signing: $60,000 (AUD)
2nd payment on receipt of satisfactory Final Report, no later than 20 June, 2017: $10,000 (AUD)

Dr Robert Edis
Research Program Manager Soil Management and Crop Nutrition
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8.2 Appendix 2 Photo documentation

Date: 20 September 2016
Time: 9:00 – 10:00 am
Location: ACIAR – Australian Embassy
Attendees: Mat Kimberley, Deputy Head of Mission; Andrew Hodges, DFAT First Secretary – Economic; Mara Faylon, ACIAR-Philippines Assistant Manager

Date: 20 September 2016
Time: 11:00 am – 12:00 pm
Location: PRRI
Attendees: Executive Director Rodolfo Galang;
Anio and Gemma, PRRI Staff

Date: 20 September 2016
Time: 1:00 pm – 4:00 pm
Location: BSWM
Attendees: Sonia Salguero, OIC Director; Edna Samar, Division Chief, Research Division; Elmer Borre, Division Chief, Agricultural Land Management and Evaluation Division; Samuel Contreras, Division Chief, Soil Conservation and Management; and Maribel Jalalon, Senior Agriculturist, Laboratory Services Division

Date: 21 September 2016
Time: 9:00 am – 10:00 am
Location: PCAARRD
Attendees: Dr. Reynaldo Ebora, Acting Executive Director; Dr. Edwin Villar, Deputy Executive Director for Research and Development; Dr. Rodolfo Ilao, Director, Agricultural Resources Management Research Division; Dr. Marcelino Siladan, Senior Science Research Specialist, Forestry and Environment Research Division; Ms. Tess de Guzman

Seminar-Workshop in Butuan City, Caraga Region with smallholder farmers, municipal agricultural technicians and other stakeholders on the 22nd of September 2016. Speakers included Ms. Sonia Salguero, OIC Director of DA-BSWM; Mr. Rodolfo Galang, Executive Director of DA-PRRI; Mr. Glen Garcia, local soil expert from CARAGA State University (recommended by an ACIAR partner from Visayas State University); Mr. Armando G. Valiente, Officer In-Charge of the Provincial Agriculture and Veterinary Office (PAVO); and Dr. Esmael Elevazo, Chairman of Bayugan Rubber Producers Cooperative (BARUPCO).

Appendix 3 Workshop attendees

Seminar-Workshop on Improving Soil Nutrient Management to Enhance Smallholder Farmers' Income and Productivity in Rubber-based Cropping System in Southern Philippines
September 22, 2016
Almont Inland Resort, Butuan City

	Name	Gender	Position/Designation	Address	Contact Number	Signature
1	[illegible]	M	[illegible]	[illegible]	0940 [illegible]	
2	[illegible]	F	AT	[illegible]	[illegible]	
3	[illegible]	F	AT	[illegible]	[illegible]	
4	[illegible]	M	Farmer	[illegible]	[illegible]	
5	[illegible]	M	Farmer	[illegible]	[illegible]	
6	[illegible]	M	Farmer-Barangay	[illegible]	[illegible]	
7	[illegible]	M	Manager, Barangay	[illegible]	[illegible]	
8	[illegible]	F	Agri-II / Visayan	[illegible]	[illegible]	
9	[illegible]	M	Publication	[illegible]	[illegible]	
10	WILLIAM [illegible]	M	Technician	[illegible]	[illegible]	
11	[illegible]	F	AT	[illegible]	[illegible]	
12	[illegible]	M	BOD	[illegible]	[illegible]	
13	[illegible]	M	BOD Chair, Barangay	[illegible]	[illegible]	
14	[illegible]	M	BOD	[illegible]	[illegible]	
15	[illegible]	F	AT-LCU	[illegible]	[illegible]	
16	[illegible]	F	Agri II / Rubber Link	[illegible]	[illegible]	
17	[illegible]	M	PC-Mngo Leader	[illegible]		
18	[illegible]	M	Farmer	[illegible]		

Name	Gender	Position/Designation	Address	Contact Number	Signature
19 Rey Nelson T. Bataluna	M	A.T	Pagpandad, ADS		
20 Renato T. Puctot	M	FARMER	"		
21 RIMAR J. SAGARAL	M	FARMER	LAPAZ, ADS		
22 Julius C. Quijada	M	Agriculturist II	Prov'l. ~~Vet~~ Agri Office - ADS	09985578369	
23 Pregfe O. Polgapipe	"	ABC Pres.	[illegible]	09999087929	
24 [illegible] Cestalta, [illegible]	"	[illegible]	Ipil, Zamb. Sib.	09154204905	
25 Glenn Arthur A. Garcia	M	Faculty - CSU	Ampayon, Butuan City	09178495057	
26 Emme Castañares		PEO 2	PMDU - ADS		
27 SONIA SAGUILLO	F	Director BSU	Quezon City		
28 [illegible]	M	Prof.	Griffith Uni	61-0422377367	
29 ALLAN B. PEARSON		PPDO - DRIVER	PGAS		
30 Pedro V. Retual	M	AT	LGU - [illegible]		
31 LINDA M. BUQUIR	F	USAD. coord / PGAS	PLGU - ADS	0917328866	
32 MARVIN A. MONDOVO	M	Chairperson [illegible]	[illegible]	0919 4699650	
33 ANWAR A CANA	M	DA - PRRI	Sambulawan, ZSP	0926307981	
34 Evenezer Al A. Ismael	M	DA - PRRI	IPIL, ZSP		
35 Allan Gleudale V. Cabaña	M	DA - PRRI	Ipil, Zamboanga Sibugay		
36 GERALD, JOSE III.	M	DA - PRRI	Ipil, ZSP		
37 Juanito Tayuyong	M	DA PRRI	IPIL ZSP		
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41 Wagas, Abel F	M	ACC IV	DA Caraga	09399664307	
42 MORIDO, MARCO ANTONIO C.	M	Sr. Agric	DA - CARAGA	09219892333	
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44 Alexander C. Bulgon	M	MA	LGU - [illegible], ADS	09209764707	
45 [illegible] C. Vicera	M	PNP	ADS PPO		
46 ERWIN B. ECCARTIN	M	PNP	ADS PPO		
47. Rolando Maestrado	M	BLGU-Amolingan	Amolingan Esp. ADS	09202184347	
48. Carmelo S. Llanto	M	RDE Director	ASSCAT - Bunawan, ADS	09369943260	
49 JESSIE C ESTIMOS	M	AA III	PAO - ADS	09160499571	
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51. RODOLFO GARANG	M	Director	PRRI-[illegible], Z. Sibugay	09778549998	
52. JIMZEN SALVADOR P. MORENO	M	BRGY. KAGAWAD	BLGU-MAHAYAHAY-SIBAGAT	09463323809	
53 Amancia A. Lugatiman	"	Mahayahay	"	09294991097	
54 Virginia Q. Tongga		Mahayahay	SPAR		
55. ARMANDO G. VALIENTE	M	OIC - PAO	PAO - AGUSAN DEL SUR	09255217743	
56. OSCAR G. JURADO	M	Engr. II	PAO - Agusan del Sur	09464814925	

Appendix 4 Statement of Support

STATEMENT OF SUPPORT

We recognize that there is an urgent need to contribute to the reduction of poverty in marginalized upland communities of the southern Philippines.

We acknowledge that soil erosion, land degradation, low soil fertility and poor nutrient management in uplands of southern Philippines are key issues associated with low productivity of current cropping systems (subsistence farming, monoculture etc.).

We acknowledge that research development intervention is needed to address the above-mentioned issues through developing effective rubber-based cropping systems and improving nutrient management leading to productivity and sustainability and increases smallholder farmers' income.

Through this seminar-workshop, we have participated and contributed to scoping efforts to establish the current situation relating to the inclusion of high-valued perennial crops into rubber-based cropping systems of the Southern Philippines, and the justification for and viability of an ACIAR supported project.

We believe that this proposed project is necessary, timely, viable, and aligns well with national and local government priorities and addresses our interests for sustainable economic, social and environmental development.

Therefore, we fully support the efforts of Griffith University and ACIAR in developing a full proposal for **'Improving soil nutrient management to enhance smallholder farmers' income and productivity in rubber-based cropping systems in Southern Philippines'** and give our cooperation to the project.

Signed:

Name	Designation	Signature
ISMAEL A. ELEVAZO	Manager, Rayugan Rubber Producers Coop.	
SONIA M. SALGUERO	Director - Bureau of Soils and Water Mgt.	
Carmelo S. Llanto	RDE Director - ASSCAT	
Abel F. Wagas	Agricultural Center Chief III DA - Caraga	
ARMANDO G. VALIENTE	PROVINCIAL AGRICULTURIST OFFICER - AGUSAN DEL SUR	
Glenn Arthur A. Garcia	Caraga State Univ - Faculty	
RODOLFO L. GALANG	Director, Philippine Rubber Research Institute	

22 September 2016

Butuan City, Philippines

Name	Designation	Signature
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22 September 2016

Butuan City, Philippines

Page 2 of 3

Name	Designation	Signature
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Merly T. Magbanua	Rubber Coordinator	
MARICAR O. LOPEZ	FRUIT TREES COORDINATOR	
JERRY R. BITOY	TECH. STAFF	
ERWIN B. ESCARTIN	PNP	
RAYMUNDO VILLAR	PNP	
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22 September 2016

Butuan City, Philippines