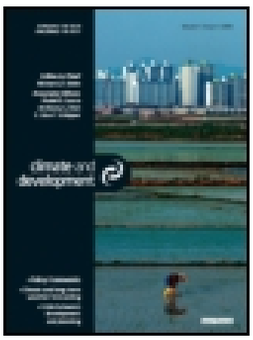

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A comparative analysis of gender and youth issues in rice production in North, Central, and South Vietnam

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ABSTRACT

This paper examines how rice farmers at all gender and ages perceive climate change and adopt Climate Smart Agriculture (CSA) technologies to enhance resilience and adaptation in three sub-regions of Vietnam. Impacts on livelihoods resilience, workloads of left behind family members, gender roles and responsibilities are also assessed. Using data from 579 randomly-sampled households, results show that women play a more important role in rice production in North and Central compared to the South due to higher rate of male out-migration. Differences in awareness and adoption of CSA technologies are observed although men and women across provinces have similar perception of climate change. The key challenges of youth engagement include drudgery in farm operations, labour-intensive technologies, low profit, inadequate access to land and credit, and lack of agricultural insurance scheme. Results imply that farmers should be provided with equal opportunities in trainings and field demonstrations on CSA technologies. Recommendations to attract the youth include: (i) promote on-farm training at school; (ii) organize exchange visits, trade fairs, competition on farming techniques; (iii) develop good production and business model; (iv) emphasize the important role of farmers and agriculture; (v) update agricultural policies and programmes; (vi) upgrade the skills and knowledge of extension workers.

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1. Introduction

Vietnam's agricultural production and socio-economic structures have been significantly affected by climate change (CC) e.g. flood, drought and sea-level rise (SLR) (ADB, 2013; Vien, 2011). It is projected that this will alter the development process and security issues related to food, water, energy and social safety as well as political, cultural, economic, diplomatic and commercial security (MONRE, 2008, 2010, 2012a, 2012b, 2013). Rice production which is the backbone of Vietnam's economy in terms of poverty reduction, food security, employment and export, however, is heavily affected by SLR, floods or drought (Trung, 2013). Rice production is also one of the major sources of greenhouse gas (GHG) emissions. Thus in recent years, various CSA technologies for rice production have been introduced in Southeast Asian countries to enable them to sustainably increase agricultural productivity and incomes, as well as to build both the resilience and capacity of agricultural and food systems to adapt to CC, and seek opportunities to reduce and remove GHG to meet their national food security and development goals (Solomon & Giuseppe, 2016).

Climate variability has been increasingly recognized as a global crisis that affects every country, people in different locations, social classes, men and women, elderly and children (Trung, 2013). Women and men are often affected differently by CC and have differences in access to resources, time constraints, labour participation in farm, off-farm and non-farm activities, and roles in decision-making based on sociocultural norms. Therefore, they have different needs, interests and priorities in adopting new technologies. Thus, agricultural interventions to help farmers adapt to CC must consider gender differences in access to resources, needs, responsibilities and roles (Huyer, Campbell, Hill, & Vermeulen, 2016).

Indeed, no CSA technology is gender neutral because vulnerability is often determined by socio-economic factors, livelihoods, people's capacity and access to knowledge, information, services, and support (Nelson & Huyer, 2016). The effectiveness of CSA technologies in which male and female farmers contribute differently in agricultural production also varies across ecological regions of country. Therefore, the study on the CSA adoption of men and women is necessary to understand how the different social expectations, roles, status, and economic power of men and women affect, and are affected differently by CC. It will improve actions taken to reduce vulnerability and combat CC in the country (Aida-Canada International Development Agency, 2002) and to ensure that men and women can equally benefit from any intervention in the agricultural sector to reduce risks linked to CC (FAO, 2015).

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The roles and benefits for men, women and youth should be considered to promote equitable access to resources, information and power in the agri-food system (CGIAR, 2015; Cole, Kantor, Sarapura, & Rajaratnam, 2014; Derbyshire, Dolata, & Ahluwalia, 2015). Moreover, long-term mitigation strategies must engage youth because they are more likely than the older farmers to adopt CSA technologies because youths are characterized by innovative behaviour, low risk aversion, less conservativeness, greater physical strength and greater knowledge acquisition propensity (Leavy & Smith, 2010). Thus, youth analysis is important to achieving desired development outcomes of increased production, improved outcomes for poverty alleviation, increased well-being for all and more equitable distribution of burdens and benefits in agriculture among women and men. The most common definition of youth is the period of transition from childhood to adulthood, encompassing processes of sexual maturation and growing social and economic autonomy from parents and carers (Bennell, 2007). For the purpose, youth is defined in accordance with Vietnam's Youth Law (Law no. 53/2005/QH11) that applies an age range of 16–30 years old.

Moreover, many rice-farming households are under pressure to look for other sources of employment and income due to high input costs and low prices for paddy and extreme weather. About 50% of household principal men in North Vietnam (i.e. heads of households who actually make the major decisions in the household) and 9.0% in South of Vietnam migrate out of their respective provinces, leaving behind their spouses to meet the labour requirements of rice-farming (Paris et al., 2010). The labour out-migration could have an impact on livelihood resilience, workloads of family members left behind as well as on gender roles and responsibilities. Thus, apart from the gender issues, this study also analyzed the effects of labour out-migration on the livelihoods of rice-farming households and the welfare of family members who stay behind.

This study examines whether there is a gender difference in adoption of CSA technologies among regions of Vietnam under the impact of high labour out-migration. Moreover, the youth inclusion in CSA technologies was also studied to determine if all relevant stakeholders are equally benefiting from any intervention and positively contributing to the communities and nation.

2. Research methodology

2.1. Selection of study sites

The study was conducted in Bac Lieu, Ha Tinh and Thai Binh provinces that are representative of three agro-ecological

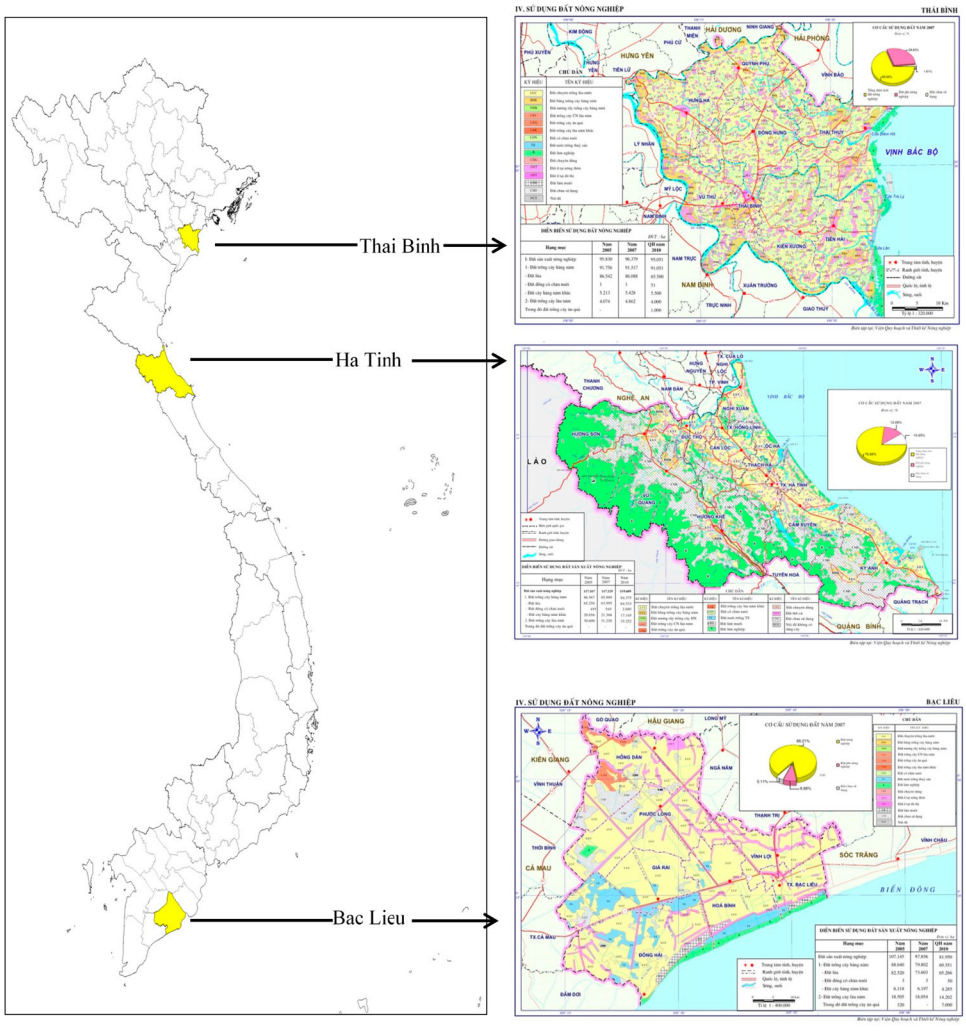

Figure 1. Location of the study sites in Thai Binh, Ha Tinh, and Bac Lieu Provinces (Source: Invest in Vietnam, 2017).

regions of Mekong River Delta (MRD), North Central Coast and Red River Delta (RRD) of Vietnam, respectively (Figure 1).

The RRD in the North is the second most important agricultural production zones in Vietnam that are critically vulnerable to the impacts of CC such as flood, drought and salinity intrusion (Chaudhry & Ruysschaert, 2007). Thai Binh province, a Coastal Eastern province in RRD have fairly flat topographic feature with a slope of less than 1.0 percent (Thai Bin Donre, 2011). Farmers can grow two-rice crops in the irrigated areas (Paris et al., 2010). Land in Thai Binh is not only suitable for rice production but also for food crops, short term industrial crops, tropical food crops, bonsais, and flowers (Thai Bin Donre, 2011).

Ha Tinh province, situated in the central coastal region, is one of the most vulnerable to SLR, typhoons, storm surges, flash floods, drought, and saline water intrusion (Chaudhry & Ruysschaert, 2007). About 80% of the province is covered by mountains and a small delta which is separated by mountains and rivers. Farmers in the province can grow two crops of rice a year in irrigated areas. Aquaculture and fishing are also very important source of livelihood in the province due to its long coastal line (Thao, 2012).

MRD is one of the major rice-growing regions of the worlds that is most vulnerable to flooding, sea water intrusion with high tide, contaminated soil, SLR, and seasonal tropical storms (Ninh, 2007). Bac Lieu province that is in located in the southeast of MRD has a relatively flat topography with three ecological zones, namely brackish water; fresh water and salt water (GSO, 2017c). Three rice crops are grown in the province with both rainfed and irrigated rice production systems (Paris et al., 2010). However, the SLR and CC have a significant impact on agriculture and aquaculture production (Phong et al., 2015). About one-third of paddy rice area in the province is affected by drought and salt-water intrusion (Vien, 2011).

Women in the South Vietnam tend to have more participation in agriculture than those in North Vietnam (GSO, 2008; Pistor, Le, & Le, 2012). In terms of provincial poverty incidence, Thai Binh and Bac Lieu are the provinces that have low poverty rates in Vietnam, at 8.4% and 6.4% for Thai Binh and Bac Lieu, respectively (GSO, 2017b). Although Ha Tinh's poverty incidence has significantly declined to 18.2% during the 10-year period of 2006–2015, it is still one of the poorest provinces in Vietnam.

2.2. Sampling and data collection

Primary data was collected in 2016/2017 crop seasons from 579 rice-farming households in the three provinces through face-to-face interview using a designed household questionnaire. A stratified random sampling procedure was used to select 12 villages of three districts in each province. Villages that do not cultivate rice were not included. Lists of prospective interviewees who are cultivating rice were prepared with the help of the local government official for each village. In each province, 200 farmers who were selected and evenly distributed by gender (Table 1).

In each village, the questionnaire was pilot tested with two farmers who were randomly selected from sampled area. Pretests were conducted in-person. After pre-testing, some questions in the questionnaire were revised to ensure an effective survey. The information included the farmers' choice of adoption of CSA technologies as well as household-specific characteristics, economic factors; climate-related shocks; farm characteristics; market and institutional factors and attitudes that influence farmers' decision on uptaking CSA technologies.

Table 1. Number of farmers in Bac Lieu, Ha Tinh, and Thai Binh provinces, 2017.

Province	Number of farmers Men (n_1)	Total Women (n_2)	
Bac Lieu	99	91	190
Ha Tinh	99	97	196
Thai Binh	86	107	193
Total	**284**	**295**	**579**

Source: Survey data, 2017.

2.3. Method of data analysis

Descriptive analysis was applied to compare differences among the three provinces in terms of socio-economic characteristics, distributions of male and female labour in rice production, the contribution of men and women in decision-making on rice production and household activities, the knowledge on CC and adoption strategies, as well as constraints and enabling factors to adoption of CSA technologies by gender and youth.

This study also applied the Chi-square test of independence to define the difference in responses, i.e. the extent men and women in each province report comparable perceptions on CC. Respondents were asked to report their perceptions on multiple CC variables (e.g. temperature and rainfall variability, incidence of drought, flood, salinity, and lacking irrigation water) that they have noticed in the last five years. The perception of CC involving the three-point Likert scale (1 = increase, 2 = decrease and 3 = irregular change) was recoded as 1 for a perceived "increase" or "decrease" and 0 "otherwise". The Chi-square test is also useful for examining whether the fraction of men's choices of CSA technologies differ significantly from that of women. The data were analyzed by using Stata statistical software: Release 14 (StataCorp, 2015).

Women's Empowerment Index (WEI) (Bose, Ahmad, & Hossain, 2009) was calculated to assess the decision-making authority of the female household heads in relation to male household heads on specific questions (i.e. What does specific activity in crop and livestock? Who has access to or control of the products? Who benefits? Who makes decisions for specific concerns?) on rice production and household activities across the two groups (migrant and non-migrant). The hypothesis is that women are relatively more empowered when the male household head is absent. The agriculture-related domains included: crop selection, farm management, post-harvest management, husbandry, and cash investments (e.g. farm inputs, food, large assets, livestock, land, children's education, house construction). The rating values of the decision makers have been assigned according to the weight in favour of the wife for all selected indicators.[1] Therefore, the higher the index, the more empowered is the female household head.

Women's Empowerment Index (WEI):

$$\mathrm{WEI} = \frac{\sum_{j=1}^{5} x_j}{d} \quad (1)$$

where: x, value of decision-making; d, total number of decisions given by the respondent; j, code for the decision-making topic.

3. Results and discussion

3.1. Migration, gender, and youth issues in rice production

Despite the rapid growth rate, Vietnam is facing many employment-related challenges, especially with regards to youth employment (VUSTA, 2011). The creation of job opportunities for youth in agriculture is important to reduce poverty and unemployment. However, the rural youth are no longer tied to the land due to the impact of "Doi Moi" (innovation) reforms in 1986. The big cities, such as Hanoi (North) and Ho Chi Minh City (South), are more attractive than the countryside where rural communities offer fewer employment opportunities for young people, outside of basic subsistence farming, pushing them to seek further opportunities elsewhere (Kirsten, Apland, Dunaiski, & Yarrow, 2017). This trend also resulted in expanding flows of female labour migration to these two cities (Paris et al., 2010). The 2015 Internal Migration Study found 52.4% of migrants were female (GSO & UNFPA, 2016) and female internal migrants in Vietnam were a year younger than men on the average (Guilmoto & De Loenzien, 2014; Jones, Presler-Marsahll, & Dang, 2014).

3.1.1. Pattern of out-migration by destination

Internal[2] and international migrations are considered as key patterns of migration. The internal migrations were categorized into rural to rural and rural to urban while international migrations were labour working outside the country. Table 2 shows that a higher proportion of the migration in three provinces is from rural to urban areas (63.8% in Bac Lieu, 57.0% in Ha Tinh, and 63.4% in Thai Binh).

Table 2. Pattern of out-migration by destination (percentage).

Pattern of out-migration	Bac Lieu	Ha Tinh	Thai Binh
Internal			
Rural to rural	35.4	29.0	33.5
Rural to urban	63.8	57.0	63.4
International	0.8	14.0	3.1
Total number of migrants	127	214	164

Source: Survey data, 2017.

A higher proportion of international migration was observed in Ha Tinh province (14.0%) while this rate was low in Bac Lieu (0.8%) and Thai Binh (3.1%) provinces. Ha Tinh is one of the top provinces that sent a large number of migrant workers abroad (IOM, 2017) and has the highest unemployment rates among economic region categorized by the GSO (GSO, 2015). During the interviews, a high proportion of respondents in Ha Tinh province (79.1%) reported their interest to borrow money from Vietnam Bank for Agriculture and Rural Development or Vietnam Bank for Social Policies to pay for international migration. Remittances from international migrants can help repay loan, ease credit constraints in farming, reduce poverty and provide more children's education that are consistent with the findings of Paris et al. (2010). International migration becomes an important livelihood strategy and may help them to escape out of poverty.

3.1.2. Distribution of family members among households with migrants and non-migrants

The percentage distributions of family labours among households with migrants and non-migrants are shown in Table 3. A higher proportion of migrants who are fathers in Ha Tinh (16.8%) and Thai Binh (22.6%) provinces migrated compared with Bac Lieu province (5.5%) while the mothers stayed behind to take over fieldwork responsibilities and management of the household and farm.

The proportion of migrants who are young people is very high (78.7% in Bac Lieu, 75.2% in Ha Tinh, 48.2% in Thai Binh). In Bac Lieu province, a higher proportion of migrants was young people (42.5% young women, 36.2% young men).

This is in contrast in Ha Tinh and Thai Binh provinces, where more young men (48.1% in Ha Tinh, 25.0% in Thai Binh) migrate than young women (27.1% in Ha Tinh, 23.2% in Thai Binh). The high level of young women migration in Bac Lieu province is explained by the availability of non-farm jobs (e.g. factory worker in shrimp processing factories, factory worker in textile/garment industries, self-employed business, handicraft, etc.) in the commune/district/province, availability of working members and the low level of female engagement in rice production that allow them to participate in non-agricultural sectors. Women in Ha Tinh and Thai Binh provinces have less incentives and opportunities to be involved in non-agricultural sector due to their dual responsibilities in

Table 3. Distribution of family labours among households with migrants (percentage)

	Bac Lieu		Ha Tinh		Thai Binh	
Family member	Migrant	Non-migrant	Migrant	Non-migrant	Migrant	Non-migrant
Father (principal men)[a]	5.5	29.3	16.8	33.3	22.6	34.0
Mother (principal women)[a]	1.6	34.3	2.8	44.4	6.7	50.9
Son (16–30 years old)	30.7	9.1	48.1	13.0	25.0	9.2
Daughter (16–30 years old)	23.6	3.9	20.1	5.0	11.0	4.3
Other young men (16–30 years old)	5.5	0.9	0	0	0	0
Other young women (16–30 years old)	18.9	5.0	7.0	0.8	12.2	0
Other men[b]	6.3	10.1	4.7	2.3	14.6	0.6
Other women[b]	7.9	7.4	0.5	1.2	7.9	1.0
Total percentage	100	100	100	100	100	100
Total no. of family labours	127	464	214	399	164	326

Source: Household surveys, 2017.
[a]Principal women and men are heads of households who actually make the major decisions in the household.
[b]Other men and women include grandfathers and grandmothers and brothers, sisters of household head.

household and farm activities resulting from the high level of male migration to cities.

3.1.3. The labour distribution in rice production

The gender division of labour in rice production was not rigidly enforced in Vietnam due to the absence of cultural restrictions on their mobility to the public space but varied across geographical location and household circumstances (Kabber & Anh, 2002). Therefore, the adoption of CSA technologies may have different impacts on men and women. The gender division of labour supply depends on many factors such as the type of production systems (irrigated or rainfed), economic status of households, availability of male working members, and degree of mechanization of specific operation. In Bac Lieu province where the average farm size is 1.4 hectares, the farmers can grow three-rice crops in both rainfed and irrigated areas. In the case of the irrigated rice areas of Thai Binh and Ha Tinh provinces, the average farm sizes are 0.33 and 0.18 ha, respectively and the farmers can grow rice twice a year.

Based on the labour inputs (person days/hectare) in rice production, the relative share of men is generally higher than women in Bac Lieu province which is in contrast to Ha Tinh and Thai Binh province where women have higher level of engagement in rice production than men. In particular, men contributed 70% of total labour inputs per hectare while women contributed only 30% in Bac Lieu province. In contrast, women have higher labour contribution in rice cropping activities than men in Ha Tinh (46% of men and 54% of women) and Thai Binh (45.4% of men and 54.6% of women) (Figure 2).

A close scrutiny of the labour participation in each operation shown in Appendix Table 1 clearly reveals that women provide their labour in almost all of the operations except in harvesting/threshing, which is highly mechanized in Bac Lieu province. Although men take the lead in all rice production activities, women are concentrated on three activities of the rice cropping cycle, namely crop establishment (48.8%), seed preparation (40.5%) and post-harvest (37.7%). In contrast, rice production had stronger involvement of women in Ha Tinh and Thai Binh provinces. However, men are more involved than women in land preparation and harvesting while women provide more labour in seed preparation, crop establishment, crop management, and post-harvesting tasks. The difference in the labour distribution among the provinces can be explained as follows.

In Bac Lieu province, rice production is the main income source that contributed 78% to their total household income in 2017, thus adult male labours have less incentive to be engaged in raising livestock and other off-farm and non-farm jobs. Moreover, rice income is sufficient to support the family. Also, the province has many advantages in rice production such as large farm size, high tenure security, favourable conditions for rice production, and high level of mechanization (e.g. 100% farmers could access combine harvesters). Thus, men dominated women in rice production such as decision-making on inputs used and investment while women were more likely to engage in raising livestock and other off-farm and non-farm jobs rather than rice farming.

In Thai Binh and Ha Tinh provinces, women provided more labour in rice production than men, which can be attributed to a higher rate of male out-migration due to the small contribution of rice to total household income and the extreme weather conditions for farming activities. In fact, a higher proportion of migrants who are male household heads in northern and Central Vietnam (as compared to southern Vietnam) migrated out of the provinces and left their spouses behind to take over the labour requirements of rice-farming activities. Based on the finding of distributions of family labours among households with migrant and non-migrant, about 16.8% and 22.6% of migrants who are male household head in Ha Tinh and Thai Binh provinces, respectively, migrated out of the province, leaving behind their spouses to meet the labour requirements of rice farming while only 5.5% of migrants are male household heads in Bac Lieu province (Table 3).

Generally, men and women can work either separately or jointly in the same field. However, when an operation is not mechanized, more women participate in performing the farm tasks. The rise in mechanization has resulted in reduction of field activities of women. For example, women used to be heavily involved in transplanting and harvesting. However, the women were displaced when the plastic drum seeder for sowing and combine harvesters were introduced. Nevertheless, the decline in women's labour participation in rice farming does not mean that women are no longer involved in farm management or they are not knowledgeable about farming (Duyen, Sander, & Wassmann, 2018). During the interviews, women

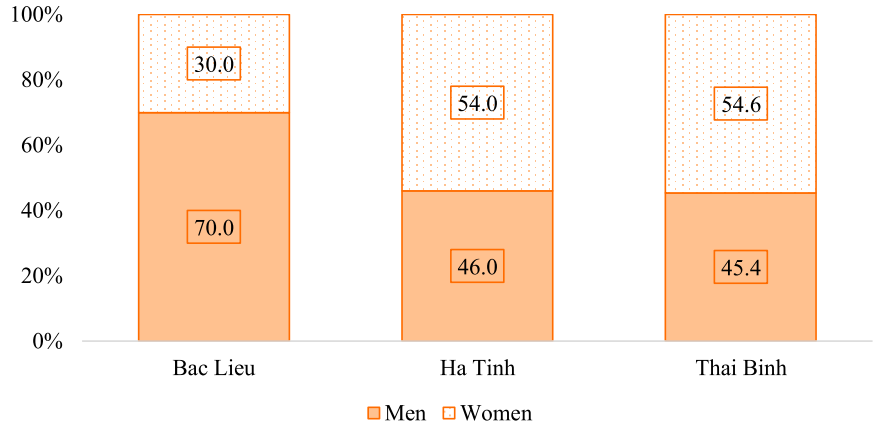

Figure 2. Distribution of labour in rice production by gender in Bac Lieu, Ha Tinh and Thai Binh provinces. (Source: Survey data, 2017).

are as knowledgeable as men in many aspects of rice farming activities, particularly on the amount of and costs of inputs. Especially, women in Ha Tinh and Thai Binh provinces who are left behind due to male out-migration have to perform dangerous tasks, e.g. spraying pesticides, which are usually men's responsibilities. However, mainstreaming of gender into CSA should take into account the women's burden in household and farm activities that reflects women's dual responsibilities in economic production and domestic chores.

3.1.4. Gender differences in decision-making

Aside from the gender-based division labour, men and women also have distinct roles in decision-making in different regions of Vietnam. Traditional men's and women's roles are changing under conditions of rapid economic transformation going on Vietnam and the impact of high level labour out-migration. Thus, it is important to understand not only who is doing the work but also who is making decisions about crop selection, crop management, post harvest, animal husbandry, and investment. Knowing who makes decisions in specific areas of concerns has implications on project design and implementation. The men's and women's participation in decision-making on farm-related matters and household matters would differ depending on a number of factors and circumstances such as husband's short-term or long-term absence, women's experience, skills and knowledge received from training programmes, or direct access to agricultural extension services, inputs, etc.

Results of WEI were shown in Table 4. In Bac Lieu province, the women's participation in decision-making on rice production is generally low, but fairly high on animal husbandry and cash investment. Also, men and women made joint decisions on specific concerns in Bac Lieu province where the study did not find a difference between migrant and non-migrant households because of the low rate of migration of principal men (5.5%) and principal women (1.6%). Women are mainly responsible for deciding how much rice to allocate for home consumption and bargaining the rice price with the private traders. Women alone make decision on day-by-day household management decisions (i.e. purchase of food, non-food needs, clothes, children's education, purchase of small animals and poultry). Moreover, men and women make decisions on high-cost investments such as build/repair house renovation/construction, purchase of large animals, farm machinery/equipment. In contrast, the income of the husband and wife from rice farming and other crops is pooled as family income and in most cases, is managed by the wife. The low level of women's participation in making decision on rice production is due to their low level of engagement in rice production as well as access to technical knowledge and information. One of the reasons is the exclusion of women from farmer's training and agricultural extension activities.

In contrast, principal women are highly empowered in making decisions on crop selection, farm management, and post-harvest operations in Ha Tinh and Thai Binh provinces. These differences between migrant and non-migrant households are statistically significant. Moreover, the study found that principal women regardless of whether or not they are from migrant or non-migrant were also highly empowered in making decisions on livestock/poultry raising and cash investments in North and Central Vietnam. These findings indicated that when principal women are left behind, they have greater participation in making decisions. Thus, women left behind should be the target of agricultural extension and trainings in farm activities where they have already a fairly high level of engagement and that are deemed suitable for them given the nature of farm work.

3.2. Gender and youth issues and CSA technologies

In accordance with Goal 2 of the Sustainable Development Goals (SGDs), Vietnam has issued several policies and programmes to promote sustainable agriculture development through CSA technologies. For example, the government approved Decision 899/QD-TTg on the project "Agricultural restructuring towards improving added value and sustainable development" which mentions the need of water saving techniques in agriculture; Decision 923/QĐ-BNN-KH of MARD on "Green growth action plan for agriculture and rural development by 2020" which promotes implementation of water saving techniques, and short-duration, pest-diseases resistant varieties in rice production and other crops (MARD, 2017); and the project: "Integrated Coastal Management Program (ICMP)" starting in 2011 with the cooperation of MARD and the German Federal Ministry for Economic Cooperation and Development (BMZ) to introduce climate-smart models (GIZ, 2011).

Regarding Goal 5 on mainstreaming gender equality, Vietnam has emphasized gender equality in many constitutions and important laws, such as the Gender Equality Law, the Law on the Election of Deputies to the National Assembly and People's Council, the Law on Marriage and the Family

Table 4. Women's Empowerment Index by province, 2017.

	Bac Lieu			Ha Tinh			Thai Binh		
Decision-making Indicators	WM	NM	Diff.	WM	NM	Diff.	WM	NM	Diff.
Crop selection	1.49	1.53	−0.04	3.26	2.93	0.33*	3.70	3.20	0.50**
Farm management	1.38	1.36	0.02	3.21	2.84	0.37**	3.65	3.14	0.51**
Post-harvest	2.06	2.06	0.00	3.64	2.83	0.81***	3.78	3.42	0.36*
Husbandry	3.26	3.12	0.14	3.66	3.44	0.22	3.64	3.38	0.26
Cash investment	2.69	2.59	0.10	2.77	2.67	0.10	3.10	2.87	0.23
Number of households	59	131		116	80		88	105	

Source: Survey data, 2017.

Notes: WM refers households with migrants; NM refers households without migrants.

*, **, ***refers to significant at 10%, 5%, and 1%, respectively

WEI indices are: 1 = the husband alone makes decisions; 2 = the husband dominates in decisions; 3 = the husband and wife make joint decisions; 4 = the wife dominates in decisions; 5 = the wife alone makes decisions, even in the presence of the husband.

2014, to close gender gap and enhance the status of the women. In agriculture sector, although 60% of its labour force is women, female farm owners only constitute 9% which explains partially their limited access to agricultural resources, e.g. land, credit and technology, than men. This potentially discourage women from effectively engaging in and receiving benefits from adoption of new agriculture technologies (GSO, 2014; Women Leadership Development, 2017).

In addition, although agriculture is the backbone of Vietnam's economy, which contributed 15.3% of national GDP (GSO, 2017a), the sector is dominated by older farmers. There have been many national and provincial programmes to attract young people to participate in agriculture sector through providing jobs such as extension worker, agricultural technician. However, young people still have a negative perception of agriculture which is often seen as a last resort when jobs cannot be found in other sectors.

3.2.1. Gender differentiated perceptions of climate change

Analyzing the gender-differentiated perceptions of CC is a first step to understanding the potential differential impacts of long-term CC on men and women. Many studies have found the gender differences in perceptions of CC due to the differential exposure to CC based on livelihood activities, roles within the households and community (Kristjanson et al., 2017). In this study, respondents were asked about their perceptions of extreme climate events (temperature and rainfall variability, incidence of drought, flood, salinity intrusion, and lack of irrigation water) in the last five years shown in Appendix Table 2.

In general, while many men and women report similar impacts of CC, some differences exist among the three provinces. Particularly, men and women in Bac Lieu and Ha Tinh provinces reported similar perceptions on the climate variability while there are a gender differences about perceived changes in drought and flood in Thai Binh province. Women are significantly more likely to report a high incidence of drought (18.4% men, 31.1% women) and flood (52.9% men, 71.7% women) in the last five years. This is explained by a fairly high level of female engagement in rice production in Thai Binh province.

There were fewer respondents in Ha Tinh and Thai Binh provinces than those in Bac Lieu province (67.7% men, 75.8% women) who perceived the effects of salinity on their farms. A high proportion of men and women in all three provinces perceived high temperatures and rainfall variability. Their observations were conformed with hydro and meteorology statistical data reported in 2017 by the Vietnam GSO that showed the large gap of rainfall between the highest (about 4000 mm/year) and lowest rainfall level (about 2000mm/year) in the three regions in 15 years period 2002–2017. Regarding temperature trend, the number of hot days and nights increased significantly since 1960 in every season while the number of cold days and nights decreased significantly. In addition, the mean annual temperature increased most rapid in southern Vietnam and central highlands (WB & ADB, 2018). This implies an unanticipated and irregular change in climate conditions in Vietnam that could have significant impacts on rice productivity and livelihood.

3.2.2. Gender differentiated perceptions of adoption of CSA technologies

In the previous section, the data shows that there are no significant gender differences in the perceptions and experiences of CC risks in the three provinces. During the survey, a number of proposed CSA technologies, namely water-saving techniques (i.e. Alternate wetting and drying[3] (AWD), water-saving techniques integrated in SRI[4]), improved stress-tolerant rice varieties (e.g. certified seeds, tolerant of drought, flood and salinity), crop diversification (e.g. crop rotation, intercropping), integrated pest management[5] (IPM), system of rice intensification (SRI), mechanization (e.g. laser land levelling,[6] sowing machine,[7] straw baler machine[8]), and application of right amount of fertilizers (e.g. Phosphorus reduction,[9] Nitrogen reduction[10]), were introduced to farmers to adopt to or reduce effects of CC. Appendix Table 3 presents perceptions of men and women in adoption of these CSA technologies. The respondents were asked whether the proposed CSA technologies are suitable for women given the nature of farm work? The findings provide important information for developing concrete strategies that engage men and women in CSA.

In Vietnam, water-saving techniques are not applied solely, but are integrated with 1Must-5Reduction[11] (1M-5R), large field model (LFM) or SRI model. AWD technique integrated with 1M-5R and LFM have been implemented in Bac Lieu province, while the water-saving technique that is integrated with the SRI model have been implemented in Ha Tinh and Thai Binh provinces. This study found that there was a statistically significant difference in response of men and women to water-saving techniques in three provinces. Less men than women in three provinces reported that the water-saving techniques were suitable for women. This is probably because men dominated women in irrigation operation. Although men are dominant in irrigation activities, women could be trained on water-saving techniques because a high percentage of men and women in these provinces agreed that water-saving techniques were appropriate for women.

With regards to improved stress-tolerant varieties and crop diversification, the study found the difference in response of men and women in Bac Lieu and Thai Binh provinces. In particular, there were many women than men who reported that these CSA technologies were suitable for women. In general, high proportions of male and female respondents of three provinces reported that these CSA technologies were appropriate for women. The finding implied that women should be provided opportunities to attend training activities and field demonstrations on new rice varieties and crop diversification.

This study found difference in the response of men and women in application of agricultural machines such as laser land levelling, sowing machine, straw baler machine, etc. in Thai Binh province. Less men than women reported that these agricultural machines were suitable for women in Thai Binh province because of the high level of women's engagement in rice crop management.

There was a significant gender difference in response of IPM, SRI and adoption of the right amount of fertilizers in Ha Tinh and Thai Binh provinces. More women than men

reported that these CSA technologies were suitable for women. Results show that women in Ha Tinh and Thai Binh provinces were relatively more empowered when their husband was absent. The responses of male and female farmers provided ample information for identifying appropriate strategies on targeting the dissemination of these CSA technologies, e.g. whether to promote it to men or women across different regions of Vietnam.

In sum, there are relatively few differences between men and women in choosing CSA technologies for rice production among provinces. These differences can be explained by the difference in men and women's roles (i.e. labour contributions in rice production, in other crops and livestock, participation in decision-making and marketing) among and across regions of Vietnam.

3.2.3. Key barriers to CSA adoption perceived by men and women

Aside from analyzing the gender-differentiated perceptions of adoption of CSA technologies, the barriers perceived by men and women are also needed to ensure the successful out-scaling of CSA technologies. In Vietnam, the low level of CSA adoption often relates to low availability of required inputs, high costs of installation with limited access to credit and markets, high labour costs and a limited level of technical knowledge and skills (Nguyen, Roehrig, Grosjean, Tran, & Vu, 2017). Appendix Table 4 provides some insights into key barriers that men and women face in accessing, using, and managing CSA technologies. The barriers were classified into: (A) technical factors, i.e. CSA technologies are too complex to apply and require costly inputs; (B) government policy, i.e. lack of government policies to support CSA technologies, lack of accessible services (new varieties, agricultural machines); (C) human factors, i.e. shortage of labour, CSA technologies are knowledge-intensive and require skills training; (D) financial factors, i.e. lack of capital to purchase inputs, lack of access to agricultural credit; (E) economic factors: low market demand, low market price of rice; (F) bio-physical factors, i.e. topography (fragmented lands, slope of plots), soil and water condition (infertile soil, water shortage, poor water quality).

In Bac Lieu province, there was some difference between men and women in reporting the barriers in adopting CSA technologies in rice production. It can be explained by the gender differences in their contribution, control of decision-making, and experience in rice production. More women than men reported that CSA technologies are too complex to apply (35% men, 51% women) and the technologies to knowledge-intensive (64% men, 76% women) were constraints to adoption. This is because men dominated women in rice production activities since men contributed 70% of total labour inputs per hectare while women contributed only 30% (Figure 2). Thus, women tend to avoid complex and knowledge-intensive CSA technologies because they have limited experiences in rice cultivation. In contrast, less women than men reported that lack of access to agricultural credit as well as economic factors such as low market demand and low market price of rice are barriers to CSA adoption.

The study found no gender difference in responses on barriers to adoption of CSA technologies in Ha Tinh province while a higher proportion of women than men cited that shortage of labour, lack of capital to purchase inputs and low market price of rice were the constraint to adopting CSA technologies in Thai Binh province. This is plausible since women in Thai Binh province dominated men in rice farming activities. This can be attributed to a higher rate of male out-migration due to the small contribution of rice in total household income and the extreme weather for farming activities.

The key barriers to CSA adoption cited by farmers of the three provinces are relatively similar. These include:

(1) *Lack of knowledge skills and training on CSA technologies.* Water saving technique and improved stress-tolerant varieties are knowledge-intensive technologies. Given the low levels of education of farmers, farmers' knowledge can be enhanced through "hands-on" training for example through participation in Farmer Field Schools (FFS) and demonstration farms. The proportion of male and female participants in training programmes in different regions of Vietnam should be based on their distributions and roles in rice production activities among households.
(2) *Unfavourable bio-physical factors.* The adoption of any technology depends on its suitability to natural conditions. Therefore, there is a need to adequately describe the experimental areas that represent the CC risk such as areas prone to flooding, waterlogging, drought, and salinity. For example, the farmers should test themselves the rice varieties that should be introduced in these areas given their experience through Participatory Varietal Selection (PVS).
(3) *Lower market price of rice.* The market rice price is one of the main considerations of farmers in selecting new rice varieties. The higher the price, the higher profits and income they will obtain. Farmers are not interested to use a new rice variety if they are not sure of the market price. However, a rice variety can have lower yields but can still command a high price. An example is a traditional variety that has good eating and cooking quality and at the same time has a high market price. Thus, adequate market information is also an important factor that influences CSA adoption.
(4) *Lack of government policy supporting CSA technologies.* Farmers cannot actively implement CSA technologies without an enabling policy environment. For example, lack of timely agricultural extension services discourages farmers to implement these technologies in an effective manner. Complex and limited access to credit services makes farmers stick to conventional techniques rather than invest in new technologies for rice production.
(5) *Lack of access to services (new varieties, agricultural machines).* Even when farmers are knowledgeable about the benefit of new improved and stress-tolerant varieties, they are not likely to use these varieties when there is not timely access to seeds or lack of good quality seeds suppliers. Moreover, the reluctance of adoption of straw baler machine may be due to a lack of available machinery (Ngo, Tran, Le, Wassmann, & Sander, 201 9).

(6) *Lack of capital to pay for farm inputs.* CSA technologies require capital for land preparation, hiring of labour, and purchase of inputs for crop production. Due to poverty and lack of capital, smallholder farmers are often constrained to fully adopt CSA technologies. Often, they borrow money to purchase inputs before planting season and then pay the moneylenders during harvesting season.

3.2.4. Challenges to rural youth engagement in agricultural production

Young people play an important role in contributing towards a sustainable world, shaping social and economic development, and building a solid foundation of the world's future (The Climate Smart Agriculture Youth Network, 2017). Young people who are energetic, technologically competent and exposed to new innovations are in the best position to carry on commercial and technological agriculture from the older generation (Adebayo, 1999). Thus, building youth knowledge and skills in CSA technologies will enable them to make a positive contribution to their communities and nations because it provides them the necessary information needed to mitigate these threats and contribute to the adoption of CSA technologies and enhancement of agricultural livelihoods. Although the Vietnamese government have many programmes for the youth as provided in the Strategy on developing youth in 2013-2020, the positive contributions of young people in Vietnam to the development of the agricultural sector, especially in rice production, have largely not been recognized (Asian Farmers Association for Sustainable Rural Development, 2014).

The present study found that there are a number of reasons why young people do find agricultural work unattractive, as follows: (1) drudgery in farm operations (heavy and dirty work), (2) Low farming profit margins (high input cost, low product price), (3) inadequate labour saving technologies for ease of operations, (4) inadequate finance/credit facilities, input price subsidy, lack of agricultural insurance scheme, (5) inadequate land and poor road network, (6) public perception about farming (i.e. low status of farmer and agriculture), and (7) extreme climatic conditions (e.g. flood, drought, salinity, etc.). Faced with these challenges, the young people in the rural area try to seek better paying employment in other sectors (e.g. industrial and service sectors). As a result, most of those who migrate to the urban areas seeking greener pastures are young people. They leave the bulk of agricultural production in the hands of older people who often do not have much incentive and ability to implement CSA technologies and are simply engaged in subsistence farming.

The respondents were also asked whether they have encouraged the young members in the family to engage in agricultural sector? Only 20% respondents in Ha Tinh and Thai Binh provinces answered that they encouraged their children to engage in agricultural sector while this figure was 40% in Bac Lieu province. This percentage is high for Bac Lieu province because they have large farm size, favourable conditions for rice production, high level of mechanization, high yield and income.

Although the young people do not wish to go into farming, they are willing to work as extension workers at village, commune or district level. As reported by a young person in Bac Lieu province:

> I just got a bachelor's degree in agronomy and applied for a position of an extension worker in Commune People's Committee. Being an extension worker, I could not only help my family in farming activities, but I could share my knowledge with local farmers. I am very interested to attend training classes on modern practices and technologies because the academic background in the university is not enough. (Male, 22 years old, Bac Lieu province)

Thus, agricultural development policies should be designed to encourage young students to be involved in agricultural development programmes in rural areas after graduating. For the young people without the formal education, they could be targeted and encouraged to take up agriculture as a self-employed farmer (e.g. agri-business). Recognizing the important role of agricultural production and rural youth, Vietnam implemented policies supporting young farmers in Vietnam. For instance, the programme called "600" that encourages 600 excellent graduated students to become vice chairman of commune people's committee at 64 poor districts of Vietnam. Another programme is "The movement on youth in good production and business" that encourages rural youth to apply technology, biotechnology, innovative thinking, sharing knowledge and participate in new rural construction. However, the effectiveness of these programmes is not significant due to inconsistent policies and weak institutional framework for policy coordination (Asian Farmers Association for Sustainable Rural Development, 2014).

3.2.5. Key enabling factors enhancing adoption of CSA technologies

Based on the barriers discussed above, farmers were asked what strategies and practical actions they thought would help remove the constraints while simultaneously promoting adoption of CSA technologies. The findings are shown in Appendix Table 5. Although there was no significant difference in the reported key enabling factors enhancing adoption of CSA technologies between men and women in each province, the study found the differences in the factors promoting adoption of CSA among the three provinces. This difference could be important in designing appropriate CSA technologies for scaling-out.

The most common reported factors that motivate farmers in Bac Lieu province to adopt CSA technologies were training programmes and participatory engagement to overcome knowledge constraints (75% men, 79% women). It was followed by good yield and lower production cost (i.e. higher profitability) by reducing inputs since farmers' goal is to maximize profits and minimize production costs. Therefore, the strategies for disseminating CSA technologies should provide adequate evidence on the costs and benefits of these mitigation options that takes into account complex and dynamic conditions of rice cultivation across the country that can convince farmers to switch their crop management to CSA technologies.

In Ha Tinh province, the key enabling factors for adoption of CSA technologies cited by men and women were training on CSA technologies (92% men, 82% women), demonstrations of CSA technologies (62% men, 63% women), and support of extension workers (61% men, 58% women). In Thai Binh province, the

training programmes on CSA technologies (84% men, 80% women), getting a good harvest if applying CSA technologies (52% men, 65% women), and government policies to support CSA technologies (56% men, 50% women) were cited as the main factors for enhancing the adoption of CSA technologies.

Although farmers in three provinces gave different responses on key enabling factors enhancing their adoption of CSA technologies, all respondents in these provinces are interested in gaining new knowledge and skills required by CSA technologies through training programmes.

More to this, the respondents were asked what will encourage the youth to participate in agriculture to understand the incentives for youth involvement in agricultural development programme. Majority of respondents reported that the most enabling factors include: (1) Technology and modernized farming, (2) Adequate land (i.e. more land per farmer), (3) Market orientation in agriculture, (4) Organic farming, (5) Adequate rural financial/credit facilities. These results could be useful for policy makers in designing proper and effective enabling policy environment and platforms for youth and farmers' engagement in CSA.

4. Conclusions and recommendations

Women have a higher level of engagement in rice production in Thai Binh and Ha Tinh provinces as compared to women in Bac Lieu province. The difference between these regions can be attributed to the differences in social-cultural and political conditions that also impact gender roles. Additionally, a high rate of male migration in Ha Tinh and Thai Binh provinces results in an increase in women's workloads and their participation in decision making related to farming activities. The result should suggest that women in the northern and Central Vietnam should be provided more opportunities in training programmes and field experiments regarding CSA technologies that are deemed suitable for them.

In contrast, income from rice production which was the main income source for the farmers in the Bac Lieu province was sufficient enough to support their families so that they did not have pressure to seek employments outside their farms. Also, Bac Lieu province has many advantages in rice production such as large-scale field, high tenure security, favourable conditions for rice production, high level of mechanization. Generally, women are the custodians of household cash while men are in charge of rice production activities. Thus, the strategies for disseminating CSA technologies in Bac Lieu province should consider the distinct gender roles and gender-based division of labour.

In general, farmers should be provided equal opportunities for all, men, women, youth, elderly farmers, and ethnic groups to attend training activities and field demonstrations on new technologies to ensure that they can equally learn and benefit from any intervention that can reduce risks linked to CC. Given the low levels of education of both men and women, their knowledge can be enhanced through "hands-on" training for example through participation in FFS and demonstration farms. For this purpose, women farmers should be provided more training opportunities in farm activities where they have already a fairly high level of engagement and that are deemed suitable for them given the nature of farm work.

There was difference between men and women in each province and across provinces in reporting CSA technologies in favour of women while the key barriers to CSA adoption cited by farmers of the three provinces are relatively similar including: (1) Lack of knowledge skills and training on CSA technologies; (2) Unfavourable bio-physical factors; (3) Lower market price of rice; (4) Lack of government policy supporting CSA technologies; (5) Lack of access to services (new varieties, agricultural machines); (6) Lack of capital to pay for farm inputs. The gender differences in the response of CSA adoption provide useful information on how to target dissemination to men and women across regions of Vietnam. In addition, the farmers' responses on key barriers to CSA adoption also provide information for identifying the appropriate strategies to dissemination of these technologies. For instance, the AWD technique does not require more labour and capital than the traditional rice cultivation technique. However, AWD requires farmers with specific skills and farming experience so that farmers can apply the technique effectively. Thus, extension services are important in promoting the CSA technologies and upgrading the skills of extension workers to speed up the CSA adoption.

The study also provide recommendations for promoting the youth engagement in agriculture as follows: (1) provide more opportunities for on-farm training for youth at primary and secondary school level; (2) organize exchange visits for rural youth, participate in trade fairs, exhibition, competition on farming techniques; (3) develop and expand the models on production and business for rural youth; (4) build respect for farmers by emphasizing the important role of farmers and agriculture; (5) provide motivation and improve the image of agriculture by updating policies and programmes; (6) upgrade the skills and knowledge of local agricultural extension workers about CSA technologies to enhance the confidence of farmers on their technical capability.

Notes

1. WEI indices are: 1 = the husband alone makes decisions; 2 = the husband dominates in decisions; 3 = the husband and wife make joint decisions; 4 = the wife dominates in decisions; and 5 = the wife alone makes decisions, even in the presence of the husband.
2. Internal migration refers to the movement of people from 'one place to another temporarily, seasonally, or permanently … for voluntary and/or involuntary reasons', within the borders of a sovereign state (Anh, Vu, Bonfoh, & Schelling, 2012).
3. AWD is a field water management technique developed by IRRI to improve water use efficiency in rice production. Most of the AWD field experiments that have been tested successfully in non-saline soils have significantly decreased water use and increased farm profitability. Total water inputs (irrigation and rainfall) decreased by 15–30% without a significant impact on yield. In these studies, it was concluded that rice yield remained satisfactory if irrigation was re-supplied when the soil water tension was around −10 kPa or when the perched water table reached a threshold value of −15 cm below the soil surface (Richards & Sander, 2014).
4. Five technical principles of SRI: (1) Use healthy young seedlings, (2) Transplant single seedlings, (3) Weed early, (4) Manage water and aerate soil and (5) Apply manure and compost (FAO, 2015).

5. Integrated pest management (IPM), also known as integrated pest control (IPC) is a broad-based approach that integrates practices for economic control of pests. IPM aims to suppress pest populations below the economic injury level (EIL). The UN's Food and Agriculture Organization defines IPM as "the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms. Entomologists and ecologists have urged the adoption of IPM pest control since the 1970s. IPM allows for safer pest control (MARD, 2014).
6. Laser land leveling improves irrigation efficiency and conserving water; planting is more uniform, which helps achieves higher yields. Therefore, this practice reduces rice production costs by reducing consumption of water, seeds, fertilizers, chemicals and fuel as well as decreasing rice lodging.
7. Sowing machine: Rice seeding by machine would save human labors, seeds, increase rice yields and it ensures uniform spacing and plant density.
8. Baler machine: A large amount of straw leaving in the fields after the harvest and straw burning refers to a common agricultural practice. However, this practice has adverse impacts on environment and contributes to climate change. By using the straw baler machine, most of straw in the fields would be gathered and balled and the open burning could not happen regularly. Straw could also be utilized for straw mushroom growing or rice straw compost. The benefits of these practices have been proved by production of farmers.
9. Phosphorous reduction: the amount of P fertilizer is applied commonly by farmers excessive the need of rice; hence the P fertilizer surplus has been accumulated in soil for many years in MRD. For this reason, applying the right reduced amount of P fertilizer for rice production is required due to reducing input costs without decreasing rice yields. According to the results of CLUES project, the rice farmer could apply 20–40 kg P2O5/ha without the influence on the rice yield. Table 3.20 represented the partial budget for determining the profitability of rice at different rate of P_2O_5 fertilizer (Nhan et al., 2015).
10. Nitrogen reduction: Currently, there are more than 30 percent of N fertilizer applied for rice production losses transferring into GHG. The surplus of N fertilizer applied on rice production causes polluted environment since it flows into ground water or contains on grains leading to low quality standard for rice exporting. The rice farmers could apply 4–6 kg ure per cong (1 cong = 1000 m^2) in SA season and 6–8 kg ure per cong in WS season.
11. One must" recommends that farmers must use certified seeds; "Five Reductions" include reducing seed rate (use from 80–100 kg seeds/ha, use drum seeder), reducing fertilizer (reduce nitrogen fertilizer, apply fertilizer by using leaf colour chart), reducing pesticide (only use pesticide when necessary by following the guidance of technical staffs), reducing water (reduce water amount in irrigation and number of water pumping), and reducing post harvest loss (reduce grain loss in and post harvest, use combine harvester to harvest rice and rice dryer to dry rice) (Chi et al., 2013).

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