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Research Article

Plant Diversity And Food Security At Households In Mekong Delta – Viet Nam

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Abstract

The research aims at collecting basic data with the participation of farmers in the Mekong Delta – Viet Nam; then proposes solutions to enhance farmers' capability in bio-diversity management, which help ensure household food security for the furture. Also in the research, the group of researchers has focused on agricultural manufacturing efficiency, food security and plant diversity at household level. The PRA - Participatory Rural Appraisal and Questionnaires menthod were used in this research. The result of research showed that the main resource of farmers' income within is from grain rice production, accounted for 95.2% in An Giang province, 74.4% in Hau Giang province and 87.9% in Soc Trang province. The division of labor in terms of gender is relatively reasonable. It has also found out that farmers have considerable knowledge of household food security; that plant diversity is decreasing as agricultural products are subjected to change towards market needs (24.3% in An Giang province, 27.1% in Hau Giang province and 33.3% in Soc Trang province). Besides, the research results also showed the fact of food insecurity and how households to react in case of food insecurity.

Keywords

Rice manufacturing, efficiency, Mekong Delta, plant diversity

INTRODUCTION

Vietnam's economy has mainly relied on agricultural manufacture with 80% of the population living in rural areas and 74% of labor force working in agricultural sector. Agricultural products play a leading role in export as well as make an important contribution to the country's economic development. The Mekong Delta is the rice bowl of the country as the region has the potential and advantage of growing rice towards modernization. In recent years, there are a growing number of farmers who have applied new technologies in manufacturing and to create new types of rice that is adaptive to climate changes. Several research results worldwide have shown that biodiversity is the key to securing global food supplies (Zhu et al., 2000). This method was extended to 1.57 million hectares between 2000 and 2004 in China. It increases yield by 675 kg/ha and 259 million USD in income and cost savings. Blast disease in the mix was 67% less severe than in monoculture (Zhu, et al., 2005). Many scientists have also shown that biodiversity will bring food security to people. Food security exists when all people have economic and physical access to adequate, safe, nutritious food. Unfortunately, food security does not exist for a significant proportion of the world's population (FAO, 2012). Many others have nutritional deficiencies that are often related to an inadequate supply of micronutrients. The United Nations Millennium Development Goals Program has also identified hunger eradication as a central part of the Development Goals (United Nations, 2012). Some see the development and use of GM crops as the key to reduce hunger (Juma, 2011; Borlaug, 2007), while others see the technology as a greater risk to food security (Shiva et al., 2011; Friends of the Earth, 2011). Beside in, apart from recent increases in productivity, as traditional methods are still widely used, there have been negative impacts caused by over-using fertilizer and pesticide in growing rice. Besides, salt invasion and effects of climate change have now posed many challenges to the agricultural sector and to bio-diversity preservation in households. Furthermore, water shortage during dry season is also a big problem as there has been a few hydro power plants built in the upper of the Mekong River (outside Vietnam's territory). The purpose of the research is to assess plant diversity and food safety at households in the Mekong Delta, then proposes solutions to enhance farmers' knowledge of cultivar preservation to maintain plant diversity at households. Also, results of the research will be a source of reference for other scientists to build up models to enhance community's capability and to help farmers cope with food insecurity, less plant diversity in the context of climate changes.

MATERIAL and METHODS

Data collection method

The data collection method used in the research is the combination of the PRA - Participatory Rural Appraisal and Questionnaires method. The two methods mentioned above are good ways to collect data with high accuracy then researchers will synthetize and analyze the collected data to produce results. The data was collected on households who have been living in the area for about 50 years. Through PRAs and Questionnaires, it is possible to collect all needed information, such as: all factors relevant to their lives and agricultural activities (agricultural manufacturing models, methods used, income...), their knowledge of food security and of nutritious meals, their capability towards plant diversity, food shortage due to climate changes (the status and how to react, including traditional ways). The secondary data of the research was collected from relevant reports in 2000, 2006 and 2014 and 2018 produced by local authorities. For primary data, group of researchers had conducted interviews with 180 households in the three selected areas of the Mekong Delta, which are An Giang province (representing alluvial and flooded

area), Hau Giang province (representing area with alum land and flooded land during rain season) and Soc Trang province (representing area affected by salt invasion) in 2019. Besides, in-depth interviews were also conducted with local authorities in agriculture sector to collect relevant data. Through collected data analysis, researchers brought out an in-depth look on food security and plant diversity at households nowadays.

Data analysis method

The data was processed by Excel and SPSS 16.0 as well as synthetized by data statistics method.

RESUTL and DISCUSSIONS

Description of examined sample

Age range of interviewees

There were three groups divided by age range of interviewed farmers in three researched provinces, including group 1 is of interviewees whose age were below 45 (< 45), group 2 from 46 to 60 (46 - 60) and group 3 above 60 (> 60). According to Image 1, Hau Giang province has the biggest group 3 (> 60), accounted for 36.7%, higher than that of An Giang and Soc Trang, with the same ratio of 16.7%. Besides, for group 2 (46 - 60), Hau Giang has the highest ratio of 61.7% than 51.7% of An Giang and 55% of Soc Trang. For group 1 (< 45), An Giang anh Soc Trang respectively had the ratio of 31.6% and 28.3% while Hau Giang had the lowest of 1.6% only.

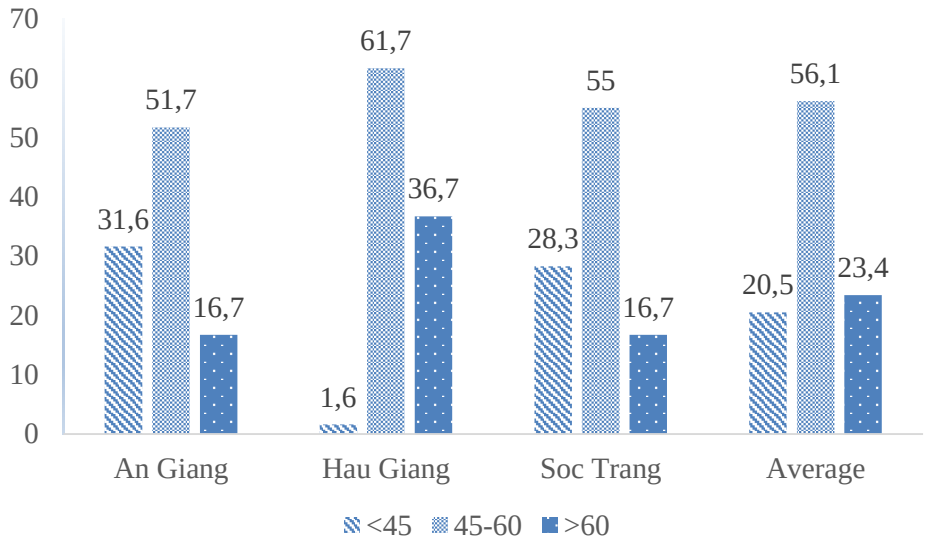

Figure 1. Groups by age of farmers in the researched areas (Unit: %)
Source: Survey results of 180 households

Number of members in households

The average numbers of household member in An Giang and Soc Trang were the same of 4.5 members/household. Hau Giang had the highest number of 5.1 members/household while the average number was 4.7 members/household.

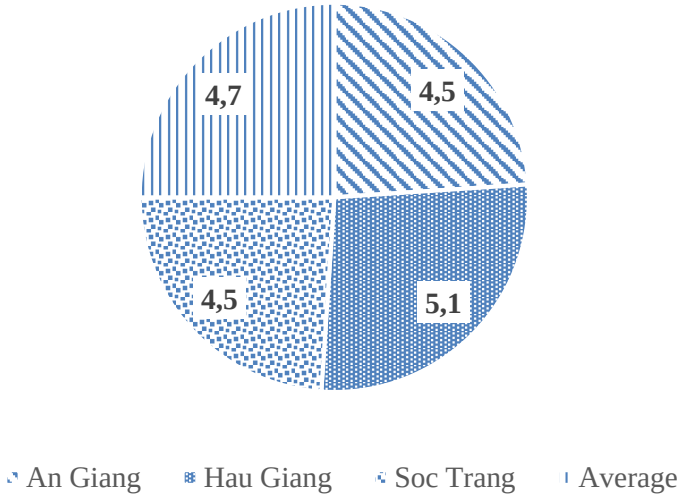

Figure 2. Average number of members in each household in researched areas (Unit: %)
Source: Survey results of 180 households

Education background of participants

According to Table 1, An Giang had the highest ratio of farmers with primary education (49.4%) followed by Soc Trang (31.4%) and then Hau Giang with only 5.3%. About ratio of farmers attended secondary school, Soc Trang had the highest ratio of 40.4% then An Giang of 30.9%. Ratio of farmers having high school education was the lowest with just 25.5% in Soc Trang, 11.9% in An Giang and 5.2% in Hau Giang. Also, Hau Giang had the highest level of farmers with no education (72.4%) while the levels in An Giang and Soc Trang were low, just 5% and 2.7% respectively. The statistic showed that education background of farmers and/or people involving farm work was relatively low, the level was even extremely low in the areas with many Khmer people. Poor education had long been the barriers that prevent farmers from acquiring and applying technology innovation in agricultural manufacturing.

Table 1. Education background of farmers/ people involving agricultural manufacturing

Seq.	No education	Pre-school	Primary school	Secondary school	High school	College/ University
An Giang	5	0	49.4	30.9	11.9	2.9
Hau Giang	72.4	8	5.3	6.2	5.2	2.9
Soc Trang	2.7	0	31.4	40.4	25.5	0
Average	26.7	2.7	28.7	25.8	14.2	1.9

Source: Survey results of 180 households

Profitable work at households

For households in the Mekong Delta, their earnings mainly came from agricultural manufacturing, such as: growing rice and other crops, raising livestock, growing fruit trees, working as hired labor... According to the research, the activities mentioned above earn the most income for households in researched areas. Table 2 showed the gender ratio involving in profitable agricultural activities. According to the Table, the ratios of male working in agricultural activities were the highest in all three researched areas, which of 65% in An Giang, 41.4% in Hau Giang and 54.5% in Soc Trang while the average

ratio of male working in government bodies and enterprises was 12.5%. On the other side, the ratios of female involving in agricultural activities in An Giang, Hau Giang and Soc Trang were 34.5%, 42.1% and 33.9% respectively. In the researched area of An Giang, ratios of male working in small business and non-agricultural activities were the lowest of 1.6% and 1.7% respectively. In Hau Giang, ratios of male working in small business, non-agricultural activities and self-employed were also low, 1.4%, 3.5% and 4.1% respectively. In Soc Trang, ratio of male involving in small business was the lowest of 0.8%.

Apart from agricultural manufacturing, running small business, with the majority of female involved, had also made an important contribution to households' income. In An Giang, female accounted for 18.8% in doing small business while in Soc Trang the ratio was 5% and Hau Giang 2.4%. The ratio of male involving in small business remained low, 1.3% on average.

Table 2. Major income sources of households

Seq.	An Giang		Hau Giang		Soc Trang		On average	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
Agricultural manufacturing	65	34.5	41.4	42.1	54.5	33.9	53.5	36.8
Work as hired labor in agricultural manufacturing	8.1	2.2	7.5	3.8	15.1	6.4	10.2	4.1
Do small business	1.6	18.8	1.4	2.4	0,8	5	1.3	8.7
Work in local authorities/enterprises	12.2	19.4	15.2	13	10	10.3	12.5	14.2
Non-agricultural	1.7	2.2	3.5	0	2.9	2.3	2.7	1.5
Self-employed	3.2	2.2	4.1	1.4	2.3	1.6	3.2	1.7
Raise cattle	8.2	3.1	18	26.9	14.5	33.1	13.6	21
Do house chores	0	17.6	0	4.4	0	7.4	0	9.8
Aquaculture	0	0	5.5	4.5	0	0	1.8	1.5
Others	0	0	3.5	1.5	0	0	1.2	0.5

Source: Survey results of 180 households

Research showed that, farmers think that agricultural manufacturing plays a decisive role in household food security, raising livestock comes second. The research had also found out that, growing fruit trees in each area had not had much impact on food security. The selection of which fruit trees to grow, mainly are banana, mango, orange, star apple... was based on the land and water at each area. Fruit trees are often grown on free land for consumption purpose only (not for sale) in An Giang, or just considered as added income in Hau Giang and Soc Trang. As stated in Table 3, in An Giang, Hau Giang and Soc Trang, agricultural manufacturing earned the most income with the ratio of 95.2%, 74.4% and 87.9% respectively. In An Giang and Hau Giang, growing rice/sticky rice ranks no. 1 among activities having most impact on household food security, growing other crops comes second with 2.7% in An Giang and 8.6% in Hau Giang. In Soc Trang, which was different from An Giang and Hau Giang, the second activity affects household food security was raising livestock with 7.7% and the least affected activity was growing fruit tree (0.4%).

Table 3. Agricultural activities with impact on food security at households

Seq.	An Giang	Ratio %	Hau Giang	Ratio %	Soc Trang	Ratio %	On average
Rice/sticky rice	123.960	95.2	81.093.3	74.4	96.199	87.9	100.417
Raising livestock	2.740	2.1	6.816.7	6.3	8.405	7.7	5.987
Other crops	3.499	2.7	9.433.3	8.6	0	0	4.311
Fruit trees	0	0	6.816.7	6.3	450	0.4	2.422
Others	0	0	4.816.7	4.4	0	0	1.606
Aquaculture	0	0	0	0	1.700	1.6	567
Official/staff	0	0	0	0	2.650	2.4	883

Source: Survey results of 180 households

Data analysis showed that growing rice/sticky rice earned almost income of households in An Giang, Hau Giang and Soc Trang with ratio of 83.6%, 63.4% and 74.2% respectively. The second income source varies between the three provinces, which was small business in An Giang (9.4%), non-agricultural work in Hau Giang (11.5%) and raising livestock in Soc Trang (10.9%). In An Giang, the least income source was non-agricultural work, accounted for just 0.2% while in Hau Giang was work as hired labor in agricultural manufacturing (1%) and in Soc Trang was growing other crops (0.1%). Natural resources and manufacturing conditions show the impacts on households' main income sources. People in An Giang province enjoy the advantages of the land, favorable manufacturing conditions and ample water resources so they have long been focusing on agricultural manufacturing with the involvement of almost all members in the family. While in Hau Giang and Soc Trang where these conditions are less favorable so apart from agricultural manufacturing, they must do other jobs to earn the extra income, such as working as hired labor. Although agricultural manufacturing generates the main income, but it was relatively low. For example, in An Giang province, income per capital from growing rice/sticky rice was as low as VND 27.5 million/capital/year. It's even lower in Hau Giang and Soc Trang, VND 15.9 million/capital/year and VND 22.8 million/capita/year respectively. Data analysis showed that, despite of having good conditions for agricultural manufacturing but the income from agriculture remains inadequate and unstable. Poor education background of farmers in the research areas, is to blame for low income as they often do manufacturing in traditional ways and have little access to new technologies that can help increase their income.

Table 4. Resources of income in research areas

Seq.	An Giang	%	Hau Giang	%	Soc Trang	%	On average	%
Rice/sticky rice	123.960	83.6	81.093.3	63.4	102.689	74.2	102.581	73.7
Raising livestock	2.740	1.8	10.533.3	8.2	15.075	10.9	9.449	7
Other crops	3.499	2.4	8.933.3	7	167	0.1	4.200	3.2
Fruit tree	0	0	8.543.3	6.7	463	0.3	3.002	2.3
Work as hired labor in agriculture	3.816	2.6	1.250	1	690	0.5	1.919	1.4
Work as hired labor in non-agriculture	351	0.2	14.700	11.5	10.217	7.4	8.423	6.4
Official/staff	0	0	0	0	5.191	3.8	1.730	1.3
Aquaculture	0	0	0	0	1.817	1.3	606	0.4
Small business	13.983	9.4	2.800	2.2	2.000	1.4	6.261	4.3

Source: Survey results of 180 households

Farmers' knowledge of food security

Awareness of farmers on food security

Farmers' knowledge of food security showed in Fig. 3 and 4 and categorized in 5 different groups. Group 1 includes households having enough food for daily life, group 2 of households having money for spending on food and other necessities, group 3 of households having adequate nutritious meals, group 4 of households which own land for agriculture, group 5 of households suggest that the manufacturing costs were stable and other groups of households with more than 1 main labor, households with profitable crops/trees...

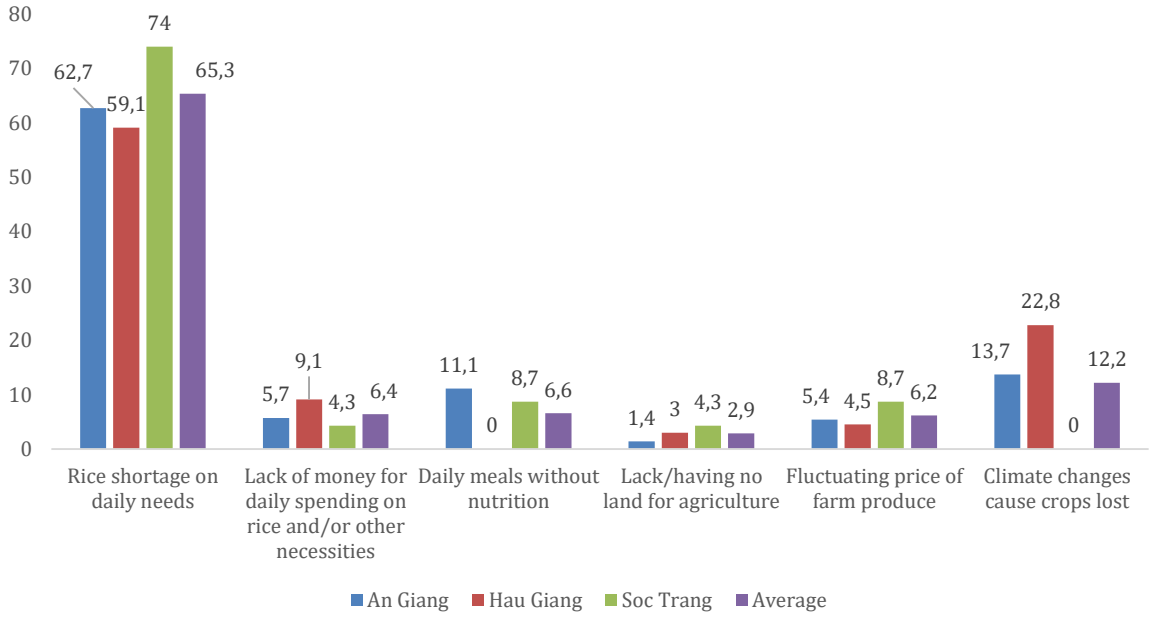

Figure 3. Farmers' knowledge of food security

Source: Survey results of 180 households

The research also collected data regarding knowledge of food insecurity. The data was categorized in 6 groups like the data on knowledge of food security except for group 6. Group 6 was about the farmers' opinion on impacts of climate changes on food insecurity at households. Almost farmers thought that having sufficient food in daily meals means food security, accounted for 59.8% in An Giang, 70.3% in Hau Giang and 74.3% in Soc Trang. In contrary, food insecurity means shortage of food on daily basis, accounted for 62.7%, 59.1% and 74% respectively in An Giang, Hau Giang and Soc Trang. The data showed that farmers have basic knowledge of food security but for them food security means having enough rice to eat while other types of food, such as meat, fish... to provide daily nutrition have not received much attention.

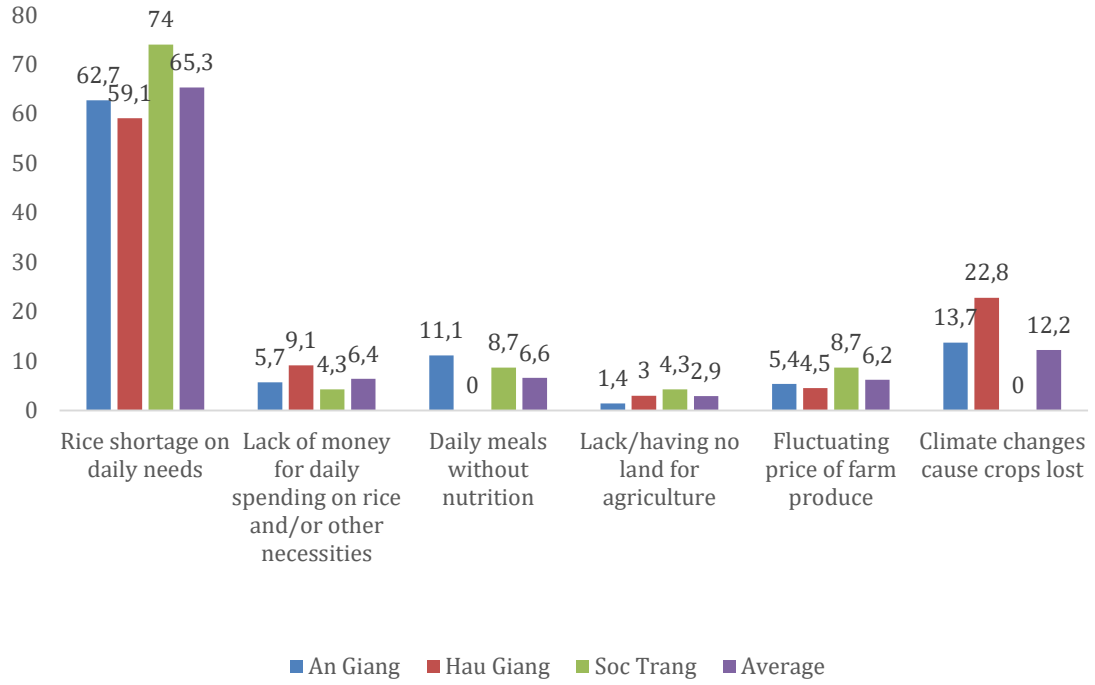

Figure 4. Farmers' knowledge of food insecurity
Source: Survey results of 180 households

Food insecurity at households

According to Table 5, food security hardly happens. The ratio of food shortage occurring once a year was the highest, 8.9% on average, that of food shortage occurs three times a year was 1.1% while there has been no more than three times of food shortage in all researched areas. While food insecurity hardly occurs, the quality of meal & nutrition had not received much attention of farmers.

Table 5. Food security status at households

Seq.	An Giang	Hau Giang	Soc Trang	On average
Zero food shortage	86.7	80	91.7	86.1
Food shortage once a year	10	11.6	5	8.9
Food shortage twice a year	1.6	6.7	3.3	3.9
Food shortage three times a year	1.7	1,7	0	1.1
Food shortage four times a year	0	0	0	0
Food shortage five times a year	0	0	0	0
More than 5	0	0	0	0

Source: Survey results of 180 households

How households cope with food insecurity (if it does occur)?

Table 6 showed how farmers to cope with food insecurity. Their reactions to food insecurity if it does occur, were identified, and categorized into 7 groups. In An Giang, the ratio of farmers who tend to borrow money in case of food shortage is the highest (33%), borrowing food comes second, 26.6% then skipping meals/buying cheaper food with 13.8%. In Soc Trang, in case of food shortage, people often borrow food from neighbors (31.2%) while borrowing money accounted for 26.6% and doing work to earn extra income, 23.3%. In Hau Giang, facing food shortage, people often look for extra work for more earnings (30.7%), 23.3% of them borrow food and only 1.1% among them would ask for help from local authorities. The results showed the tight relationship between households in rural community, when facing difficulty, people often ask for help from neighbors first. Looking for other source of income and/or food comes last. Farmers tend to be inactive, don't try to take the advantages of resources to cope with food shortage or with difficulty.

Table 6. Households to cope with food shortage

STT	An Giang	Hau Giang	Soc Trang	On average
Borrow money	33	6.5	26,6	22
Borrow food	26.6	23.3	31,2	27
Go for hunting	12.8	12.9	7.4	11
Work for extra income	8.5	30.7	23.3	20.8
Skip meal/buy cheaper food	13.8	16	9.7	13.2
Ask for help from the local authorities	2.1	1.1	0.9	1.4
Plant new type of tree	3.2	0	0.9	1.4
Others	0	9.5	0	3.2

Source: Survey results of 180 households

Plant diversity in the community

Types of plant at households

Survey results showed that the purpose of growing rice was mainly for sale, accounted for 90% of output in Soc Trang, 89.9% in An Giang and 83.8% in Hau Giang. For consumption, the ratio was extremely low. Besides, total working hours on growing rice was much higher than that of other crops and fruit trees (Table 7). In natural ecological systems, it has been shown that biomass production can be enhanced with an increase in biodiversity (Flombaum P and Sala OE, 2008; Fridley JD, 2002). Tilman *et al.* (2001) showed that the biomass yield from the experimental fields in which 16 grass species were mixed was increased by 2.7 times compared with the fields where only a single species was grown. They also demonstrated that the more plant species the field contains, the more stable the ecological system is from year to year (Tilman *et al.*, 2006; Li L *et al*., 2007; Morgado and Willey, 2008; Dybzinski *et al.*, 2008). There was great potential for using intercropping to improve yields in crop systems, but this must be tested at a scale suitable for agricultural production (Altieri MA, 1999; Willey RW, 1979).

Table 7. Popular plants in households

	Rice/Sticky rice			
	An Giang	Hau Giang	Soc Trang	On average
For sale	89.9	83.8	90	87.9
For consumption	10.1	16.2	10	12.1
Working hours	76.5	61.3	71.4	69.8
Income	91.1	73.8	78.4	81.1
	Other crops			
For sale	95.6	73.4	50	73
For consumption	4.4	26.6	50	27
Working hours	46	23.8	50	39.9
Income	23.1	15.9	0	13
	Fruit trees			
For sale	0	56.5	100	52.2
For consumption	0	43.5	0	14.5
Working hours	0	15.9	100	38.6
Income	0	16.8	5.5	7.4

Source: Survey results of 180 households

Cultivar trends in households year on year

According to research on rice seed resources in the three areas, for rice seed dated back before 1975, it was for use or exchange only, almost no sale on the market. In An Giang, before 1975, 63.3% of farmers used home-made seeds, the ratio reduced to 52.8% from 1980 - 2000 and 42.6% after 2000. For other crops, the ratio was also high, which was 66.3% before 1975, 52.3% from 1980 - 2000. In the period after 200, thing has been changed as farmers often buy cultivar (corn and others) in the market or from unspecific sources, made of 75%. In Hau Giang, the trend was somewhat like An Giang, farmers kept seeds for next crop of about 86.5% (before 1975), 70% from 1908 to 2000 and 41% after 2000. In Soc Trang, before 1975, 87.7% farmers kept seed for next crops, 55.1% from 1980 to 2000 but after 2000, 40.6% among them has been looking to buy seeds in the markets. The data showed that, for rice, as the main crop, farmers tend to keep seeds for next crops although the ratios are relatively low. For other crops, in the past they also stored seeds for next crops but recently they often buy from markets.

Seed and cultivar sources have been less importance as farmers face difficulties in finding market for their output, prices keep fluctuating, low quality rice no longer having markets (24.3% in An Giang, 27.1% in Hau Giang 33.3% in Soc Trang). Another reason was that the ecosystem had changed so the conditions were less favorable on growing crops leading to the fact that cultivar had been less important (18.9% in An Giang). In Hau Giang and Soc Trang, the second reason makes cultivar less important was changes in manner of agricultural manufacturing, made of 23.6% and 23.7% respectively. Changes in ecosystem come third, 15.7% and 16.8% respectively. Besides, the irrigation systems had become more and more outdated and less effective, less supportive in Hau Giang and Soc Trang also lead to less importance of cultivar, 17.2% in Hau Giang, 10.3% in Soc Trang. In Hau Giang and Soc Trang, there was another reason of low productivity cultivar leads to the disappearance of the cultivar, made of 9.9% and 7.9% respectively. In An Giang only, the ratio was as high as 15.1%.

CONCLUSION

The results of the research showed that the farmers have considerable knowledge of household food security. That means they had sufficient supply of food; however safe and nutritious meals still had been neglected. At each household, the labor division in farming was equal in terms of gender. In 3 researched areas, growing rice/sticky rice earned the highest income among all profitable work at households. Plant diversity tended to decrease year by year. Besides, farmers still store seeds in barn for the next crop. The results of the research were helpful that can be used to set up training programmes aiming at improving farmers' knowledge and skills on agricultural manufacturing in the context of climate changes; as well as encouraging new technologies apply in agricultural manufacturing.

REFERENCE

Altieri, M.A. 1999. The ecological role of biodiversity in agro-ecosystems. Agr Ecosyst Environ 74: 19–31.

Borlaug, N. 2007. Feeding a hungry world. Science 318: 359.

Dybzinski, R., Fargione, J.E., Zak, D.R., Fornara, D., Tilman, D. 2008. Soil fertility increases with plant species diversity in a long-term biodiversity experiment. Oecologia 158: 85–93.

FAO. 2012. The State of Food Insecurity in the World. Food and Agriculture Organization of the United Nations, Rome.

Fridley, J.D. 2002. Resource availability dominates and alters the relationship between species diversity and ecosystem productivity in experimental plant communities.

Flombaum, P., Sala, O.E. 2008. Higher effect of plant species diversity on productivity in natural than artificial ecosystems. Proc Natl Acad Sci U S A 105: 6087–6090.

Friends of the Earth. 2011. Who Benefits from GM Crops: An Industry Built on Myths. Friends of the Earth International, Amsterdam.

Hoang-Trong, Chu Nguyen Mong Ngoc. 2005. SPSS data analyzing. Hong Duc Publisher, Ho Chi Minh city, 179 pages.

Huynh-Quang, Tin. 2009. Impacts of famer - Based training in seed production in Vietnam. PhD Thesis. The University of Wageningen, Wageningen, the Netherlands.

Juma C. 2011. *Preventing hunger: biotechnology is key*. Nature 479: 471–472.

Li, L., Li, S.M., Sun, J.H., Zhou, L.L., Bao, X.G. 2007. Diversity enhances agricultural productivity via rhizosphere phosphorus facilitation on phosphorus-deficient soils. Proc Natl Acad Sci U S A 104: 1192–1196.

Morgado, L.B., Willey, R.W. 2008. Optimum plant population for maize-bean intercropping system in the Brazilian semi-arid region. Sci Agric 65: 474–480.

Nguyen Duy Can. 2009. PRA - Participatory Rural Appraisal. Agriculture Publisher, Ha Noi.

Shiva, V., Barker, D., Lockhart, C. 2011. The GMO Emperor has No Clothes. Navdanya International, New Delhi.

Tilman, D., Reich, P.B., Knops, J., Wedin, D., Mielke, T. 2001. Diversity and productivity in a long-term grassland experiment. Science 294: 843–845.

Tilman, D., Reich, P.B., Knops, J.M.H. 2006. Biodiversity and ecosystem stability in a decade-long grassland experiment. Nature 441: 629–632.

United Nations. 2012. *The* Millennium Development Goals Report 2012. United Nations, New York.

Willey, R.W. 1979. Intercropping- its importance and research needs. Part 1. Competition and yield advantages. Field Crop Abstracts 32: 1–10.

Zhu, Y., Chen, H., Fan, J., Wang, Y., Li, Y. 2000. Genetic diversity and disease control in rice. Nature 406: 707–716.

Zhu, Y.Y., Fang, H., Wang, Y.Y., Fan, J.X., Yang, S.S., 2005. Panicle blast and canopy moisture in rice cultivar mixtures. Phytopathology 95: 433–438.