

EFFICIENCY OF ADAPTIVE MANAGEMENT PRACTICES ON ONION-BASED CROPPING SYSTEM IN VINH CHAU, SOC TRANG PROVINCE

**Tran Thi Ngoc Huan¹, Trinh Quang Khuong¹, Tran Thi Kieu Trang¹,
Trinh Thanh Thao¹, Thach Ngoc Quang², Thach Suong², Huynh Van Thien²,
Nguyen Minh Chi³ and Pham Thi Huong⁴**

¹Cuu Long Rice Research Institute, Can Tho, Vietnam;

²People Union of No.2 Ward, Vinh Chau, Soc Trang, Vietnam;

³Economic Department of Vinh Chau, Soc Trang, Vietnam;

⁴Women Union of Vinh Chau, Soc Trang, Vietnam

ABSTRACT

Demonstration plots were conducted at 3 villages of Ca Sang, Ca Lang A and Vinh Binh, No. 2 Ward, Vinh Chau town, Soc Trang Province, Vietnam on an onion-based cropping system in 2010-2011 on 33.1 ha of 93 farmer fields by implementation of model farming. Management practices applied the integrated crop management (ICM) with (i) water conservation by increasing the thickness of rice straw mulching; (ii) fertilization that followed the safe onion cultivation by reducing the chemical fertilizer and supplementing with bio-organic fertilizer (200-500 kg/ha); (iii) pest management following IPM combined with bio-insecticides. Model farming that applied ICM showed high efficiency and became one of the effective adaptation measures. The adaptive management practices remarkably contributed in solving the watering control on onion-based cropping system under drought and salt intrusion in coastal region of Vinh Chau, Soc Trang where underground water is a sole water input in the dry season. The water input saved ranged from 9.5% to 13.3%. These methods also helped to improve the cultivation environment and effectively prevented soil degradation. Economic efficiency increased from 8.9% to 58.6% compared with traditional farming practices.

Keywords: Adaptive management practices, Integrated Crop Management (ICM), onion-based cropping system

INTRODUCTION

Vinh Chau district (currently known as Vinh Chau town) has a sea shore of 43 km, mostly reinforced against the sea, with a yearly encroachment of 50 - 80 m (Department of Resource and Environment of Soc Trang, 2009). This is advantageous for exploiting and developing potential for aquaculture and fishing but creates difficulties in crop production due to salinization and lack of freshwater for farming. Consequently, Vinh Chau farmers emphasize the development of growing products such as onions, radishes, peanuts, mung beans, red pepper, etc. on the soils which are mixed with 40% of sand. Annually, farmers in Vinh Chau

produce about 5,000 ha of purple onions, with a yield of over 80,000 tonnes (Department of Agriculture and Rural Development of Vinh Chau district (2010); Department of Economic of Vinh Chau Town (2011). However, local people's farming habits are inadequate. They use excessive land and inappropriate care and restoration of the land quality. In such extreme conditions, underground and rain water are the main sources for water input of production and living. Farmers mostly use agricultural chemicals and inorganic fertilizers. They seldom supplement with organic fertilizers. Soil nutrients have been exhausted and soil degradation has become serious due to impacts

of drought and salinization thus affecting the yield of major farm produce and local people's income. So research is needed that applies Integrated Crop Management (ICM) as an adaptive management practice for improving soil fertility, preventing and controlling soil degradation on onion-based cropping system and increasing the farmers' profit.

MATERIALS AND METHODS

The demonstration plots were conducted on 33.1 ha of 93 farmer fields at Ca Lang A, Ca Sang and Vinh Binh villages, No.2 Ward, Vinh Chau town, Soc Trang province in a year's rotation covering the main 2010-2011 onion crop, the 2011 Spring-Summer upland crop and the 2011 Summer-Autumn rice crop.

The treatments were two management practices: (1) model farming that applied the Integrated Crop Management (ICM) and included: (i) saved water management by increasing the thickness of rice straw mulching for wetting and restricting the evaporation in dry condition (rice straw from 1,000 m² paddy was applied over 2,000 - 2,500 m² of onion area in the model farming instead of 3,000-4,000 m² in the local farming); (ii) fertilization that followed the procedure of safe onion cultivation (MARD, 2009) which reduced the use of chemical fertilizer and supplemented with bio-organic fertilizer (200-500 kg/ha); (iii) pest management following IPM and combined with bio-insecticides; and (2) local farming methods of traditional cultivation based on chemical agriculture.

Data on fertilizer rate, the prices of seeds, pesticides, etc... were recorded for each crop and for whole cropping systems. The incidence of insect pests and diseases in three crops was recorded. The change of soil property as organic matter, N, P, K were evaluated before and after

applying the model. Data on crop yields were collected and processed by the procedures of IRRI, 1995. Data were statistically calculated using SPSS 10.05 and T test. The economic efficiency of two management practices was also calculated.

RESULTS AND DISCUSSIONS

The environmental effect

Among the adaptive management practices, the application of bio-organic fertilizer (200-500 kg/ha) became the method that effectively prevented soil degradation resulting from drought and salt intrusion. In addition, bio-organic fertilization helped to reduce the amount of inorganic fertilizers used and improved the cultivation environment. In the 2010-2011 main onion crop, it reduced nitrogen use by 25.2 kg N/ha (14.9% of total N applied), and potassium use by 13.8 kg P₂O₅/ha (10% of total P₂O₅ applied) (Table 1). In the 2011 mung bean crop, the model farming practices reduced nitrogen use by 15.5 kg N/ha from local farming methods (22% total N applied) (Table 1). In the 2011 rice wet season, the N rate was reduced in the model farming by 14.8 kg N/ha (12.4% of total N applied) on medium rice (IR42) and by 18.5 kg N/ha (17.6% of total N applied) on aromatic rice ST5 and salt tolerant - high yielding rice varieties (OM6377; OM5451). But this method used 6.1 kg/ha more P₂O₅ than the local farming practice (equivalent to 13.7% of total P₂O₅ applied) and 3.9 kg/ha more K₂O (increased of 8.5% of total K₂O applied) on medium rice and slightly increased application of P and K on aromatic rice ST5 and salt tolerant- high yielding rice varieties that supported for hard stem and heighten their lodging tolerance (Table 1).

Table 1. Comparison the fertilizer rate between the model farming and local farming in the onion-based cropping system of 2010-2011 in Vinh Chau, Soc Trang

Fertilizer (kg/ha)	2010-2011 Main onion crop			2011 Mung bean crop			2011 Rice crop*		
	Model Farming (1)	Local Farming (2)	Difference (1-2)	Model Farming (1)	Local Farming (2)	Difference (1-2)	Model Farming (1)	Local Farming (2)	Difference (1-2)
N	143.9	169.1	-25.2	54.8	70.3	-15.5	105.0	123.5	-18.5
P ₂ O ₅	124.0	137.8	-13.8	50.3	34.5	15.8	50.7	44.6	6.1
K ₂ O	124.7	111.5	13.2	36.7	6.5	30.2	50.0	46.1	3.9
Bio-organic	466.7	0.0	466.7	250.0	0.0	250.0	200.0	0.0	200.0

* 2011 Rice crop that included medium rice of IR42; aromatic rice of ST5 and salt tolerant - high yielding rice varieties of OM6377; OM5451

Instead of growing radish as the Spring-Summer crop as in previous years, farmers grew mung bean as the 2011 Spring-Summer crop. Mung bean is known as a plant which needs less water than other plants especially compared with radish. So accompanied with application of the adaptive management practice of increasing the thickness of straw mulching, selection of mung bean was the best choice for the long time of drought and salt intrusion condition of 2011 dry season. It helped to save a remarkable amount of water. Adaptive farming methods

saved from 546 to 656 m³ water/ha (a 9.5% reduction) in main onion crop of 2010-2011 and saved 385-393 m³ water/ha (13.3% reduction) in mung bean of Spring- Summer crop 2011.

Effect of the adaptive management practices on crop production and economic efficiency

Efficiency of the model farming that applied ICM to adapt to drought and salt intrusion in 2010-2011 onion crop

Table 2. Onion yield and economic efficiency of the model that applied the adaptive management practices to improve soil fertility, prevent and control soil degradation in the main onion 2010-2011 crop in Vinh Chau, Soc Trang

Items	Model farming (1)	Local farming (2)	Difference (1 - 2)
Yield (tonne/ha)	20.83	19.53	1.30
Total income (1,000 VND /ha)¹	374,873	351,552	23,321
Seeds (1,000 VND/ha)	12,303	12,303	0
Soil preparation (1,000 VND/ha)	4,881	4,881	0
Making beds (1,000 VND/ha)	6,550	6,550	0
Sowing (1,000 VND/ha)	5,393	5,393	0
Mulching by rice straw (1,000 VND/ha)	2,677	1,041	1,636
Watering (1,000 VND/ha)	22,610	24,971	-2,361
Weeding (1,000 VND/ha)	4,101	4,465	-364
Fertilizer (1,000 VND/ha)	13,290	13,920	-630
Pesticides (1,000 VND/ha)	4,518	5,181	-663
Harvesting (1,000 VND/ha)	8,882	8,882	0
Drying and transport (1,000 VND/ha)	4,991	4,991	0
Total costs (1,000 VND/ha)	90,195	92,579	-2,3840
Profit (1,000 VND/ha)	284,677	258,973	25,704

¹Onion was sold from 17,000 VND/kg to 20,000 VND/kg depending on selling time

In the main onion crop of 2010-2011, the onion yield was very high because of favourable weather conditions. Application of adaptive management practices increased the onion yield by 1.3 ton/ha (6.7%) compared with the local farming. That productivity resulted in an increase of total income by 23,332 million VND/ha (Table 2).

As for economic efficiency, model farming that applied the adaptive management practices helped to reduced total costs by 2,384 million VND/ha compared with the local farming in the



Figure 1. Watering for onion and other upland crop in Vinh Chau

Efficiency of model farming that applied ICM to adapt to drought and salt intrusion in the 2011 mung bean crop

In the 2011 mung bean crop, the model farming practices resulted in a yield increase of 300 kg/ha (equivalent to 16.8%) compared with the local farming. The difference in total income was 8,029 million VND/ha (Table 3).

Model farming that applied the adaptive management practices helped to reduced total costs by 1,259 million VND/ha compared with local farming practices in the Spring-Summer mung bean crop of 2011. Increasing the

onion crop 2010-2011. Application of increased rice straw mulching to save water raised the mulching cost by 1,636 million VND/ha but reduced the watering cost by 9.5%. Other input costs also decreased: weeding costs by 8.2%, pesticide cost by 12.8% and fertilizer cost by 4.5% compared with the local farming. Overall total costs were reduced and total income and consequently profit were increased by 25,704 million VND/ha (9.9%) compared with the local farming practices (Table 2).



Figure 2. Harvesting the main Onion crop 2010-2011 in the model farming

thickness of rice straw mulching increased mulching cost by 366 thousand VND/ha but reduced watering cost by 922 thousand VND/ha (17.1%). Other input costs also decreased: weeding cost by 33.4% and pesticide cost by 26.8%. The fertilizer cost increased by 19.8% because of supplemental application of bio-organic fertilizer (250 kg/ha) and higher application of P and K compared with the local farming (Table 1). As a result, the profit of the model farming was 9,288 million VND/ha (58.6%) greater compared with local farming practices (Table 3).

Table 3. Mung bean yield and economic efficiency of the model that applied the adaptive management practices to improve soil fertility, prevent and control soil degradation in 2011 Spring-Summer crop in Vinh Chau, Soc Trang

Items	Model farming (1)	Local farming (2)	Difference (1 - 2)
Yield (tonne/ha)	2.09	1.79	0.30
Total income (1,000 VND /ha) ¹	55,871	47,842	8,029
Seeds (1,000 VND/ha)	1,563	1,563	0
Soil preparation (1,000 VND/ha)	2,496	2,496	0
Making beds (1,000 VND/ha)	4,124	4,124	0
Sowing (1,000 VND/ha)	1,518	1,518	0
Mulching by rice straw (1,000 VND/ha)	1,908	1,542	0,366
Watering (1,000 VND/ha)	4,465	5,386	-0,922
Weeding (1,000 VND/ha)	1,582	2,374	-0,792
Fertilizer (1,000 VND/ha)	4,012	3,351	0,662
Pesticides (1,000 VND/ha)	1,564	2,136	-0,572
Harvesting (1,000 VND/ha)	4,434	4,434	0
Drying and transport (1,000 VND/ha)	3,053	3,053	0
Total costs (1,000 VND/ha)	30,720	31,979	-1,259
Profit (1,000 VND/ha)	25,150	15,862	9,288

¹Mung bean was sold from 21,000 VND/kg to 37,000 VND/kg depending on selling time.



Figure 3. The model farming that applied the adaptive management practices in mung bean and onion for seed crop in Spring-Summer of 2011 in Vinh Chau, Soc Trang

Efficiency of the model that applied ICM to adapt to drought and salt intrusion in 2011 Summer Autumn rice crop

In an intensive crop rotation with rainfed rice conditions, besides growing medium rice varieties of IR42 and special-aromatic rice variety of ST5, farmers in Vinh Chau, Soc Trang have used salt-tolerant and high-yielding

rice varieties of OM6377 and OM5451 in Summer-Autumn to improve on the poor quality and long duration of IR42. This technique helped to regulate the seasonal schedule earlier to reduce the damage caused by heavy rains in late Summer-Autumn (from September to October) and became one of the effective adaptation measures.

Due to the specific local characteristics of using little mechanization and a large proportion of unskilled labor, rice production in Vinh Chau gained a profitable income but was not high compared with other rice growing areas. However use of the adaptive management practices in 2011 Summer-Autumn crop increased the profit by 1,545 million VND/ha compared with the traditional management

practices of farmers (Table 4). The total area of 33.1 ha of rice under model farming brought benefit for the community of 51.14 million VND.

In brief, model farming that applied the adaptive management practices to drought and salt water intrusion in the year 2010-2011 on onion based cropping system in Vinh Chau.



Figure 4. Special characteristics of rice production in Summer Autumn crop in Vinh Chau, Soc Trang (*Harvesting, threshing by hand and store rice straw for mulching of onion and other upland crop*)

Table 4. Rice yield and economic efficiency of the model that applied the adaptive management practices to improve soil fertility, prevent and control soil degradation in the Summer Autumn of 2011 in Vinh Chau, Soc Trang

Items	Model farming (1)	Local farming (2)	Difference (1 - 2)
Yield (tonne/ha)	5.75	5.53	0.22
Total income (1,000 VND/ha) ¹	39,587	38,046	1,541
Seeds (1,000 VND/ha)	1,604	1,538	66
Soil preparation (1,000 VND/ha)	1,500	1,500	0
Sowing/transplanting (1,000 VND/ha)	2,465	2,465	0
Re-transplanting (1,000 VND/ha)	858	790	68
Watering (1,000 VND/ha)	501	628	-128
Weeding (1,000 VND/ha)	476	492	-16
Fertilizer (1,000 VND/ha)	4,993	4,816	177
Pesticides (1,000 VND/ha)	1,136	1,309	-173
Harvesting (Cutting & Threshing) (1,000 VND/ha)	5,565	5,565	0
Drying and transport (1,000 VND/ha)	1,608	1,608	0
Total costs (1,000 VND/ha)	20,706	20,710	-4
Profit (1,000 VND/ha)	18,881	17,336	1,545

¹Rice was sold from 6,500 VND/kg to 7,500 VND/kg depending on varieties and selling time.

The model farming method that applied ICM in Vinh Chau, Soc Trang brought a high effect for the Khmer ethnic community. The average profit was 36.537 million VND/ ha (Table 5) and the total increased profit in the demonstration area of 33.1 hectares was 1.21

billion VND. Besides increased economic efficiency, the adaptive management practices contributed to changing conventional cultivation habits to meet the standards of Global GAP onion production (Xuan Truong, 2012; Nam Tho, 2012)

Table 5. Comparison of productivity and economic efficiency of the cropping system (onion- mung bean- rice) in the model farming that applied the adaptive management practices to improve soil fertility, prevent and control soil degradation in Vinh Chau in 2010-2011*

Items	Model farming (1)	Local farming (2)	Difference (1 - 2)
Yield (tonne/ha)	28.66	26.84	1.82
Total income (1,000 VND /ha)¹	470,331	437,440	32,891
Seeds (1,000 VND/ha)	15,470	15,404	66
Soil preparation (1,000 VND/ha)	8,877	8,877	0
Making beds (1,000 VND/ha)	10,674	10,674	0
Sowing (1,000 VND/ha)	9,376	9,376	0
Mulching by rice straw (Onion & upland crop/Re-transplanting (Rice)	5,443	3,373	2,070
Watering (1,000 VND/ha)	27,576	30,985	-3,410
Weeding (1,000 VND/ha)	6,159	7,331	-1,172
Fertilizer (1,000 VND/ha)	22,295	22,087	208
Pesticides (1,000 VND/ha)	7,218	8,626	-1,408
Harvesting (1,000 VND/ha)	18,881	18,881	0
Drying and transport (1,000 VND/ha)	9,652	9,652	0
Total costs (1,000 VND/ha)	141,621	145,268	-3,648
Profit (1,000 VND/ha)	328,708	292,171	36,537

¹Total of three crops of Onion – Mung bean – Rice on an hectare of farming land.

CONCLUSION

The model farming method that applied ICM demonstrated high efficiency and became one of the effective adaptation measures. It contributed to solving the water management problems on an onion- based cropping system under drought and salt intrusion in coastal region of Vinh Chau, Soc Trang. The water input was reduced by from 9.5% to 13.3%. It also helped to improve the cultivation environment and effectively prevented soil degradation. The economic efficiency increased by from 8.9% to 58.6% compared with the traditional farming practices of farmers in the year of 2010-2011.

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TÓM TẮT

Hiệu quả của biện pháp canh tác thích ứng trên cơ cấu luân canh cây trồng có cây hành tím ở Vĩnh Châu, Sóc Trăng

Mô hình trình diễn được thực hiện tại ruộng của 93 nông dân thuộc 3 khóm Cà Săng, Cà Lãng A và Vĩnh Bình, thị xã Vĩnh Châu, tỉnh Sóc Trăng trên 33,1 ha cơ cấu luân canh cây trồng có cây hành tím năm 2010-2011. Mô hình áp dụng biện pháp canh tác tổng hợp bao gồm (i) quản lý nước tiết kiệm bằng cách gia tăng độ dày lớp rơm rạ phủ luống hành; (ii) bón phân theo qui trình trồng hành tím an toàn, giảm lượng phân hóa học và bổ sung phân hữu cơ sinh học (200-500 kg/ha) (iii) Quản lý dịch hại theo IPM kết hợp với sử dụng thuốc trừ sâu sinh học. Kết quả cho thấy mô hình áp dụng biện pháp canh tác tổng hợp đem lại hiệu quả cao và trở thành một trong những biện pháp canh tác thích ứng. Mô hình đã đóng góp đáng kể giải quyết vấn đề nước tưới (với nước ngầm là nguồn nước tưới duy nhất tại địa phương) trên cơ cấu luân canh cây trồng có cây hành tím trong điều kiện hạn hán và xâm nhập mặn ở vùng ven biển Vĩnh Châu. Lượng nước tưới tiết kiệm được từ 9,5-13,3%. Mô hình cũng góp phần cải thiện môi trường canh tác, ngăn chặn hữu hiệu suy thoái đất. Hiệu quả kinh tế của mô hình gia tăng từ 8,9% đến 58,6% so với biện pháp canh tác truyền thống của nông dân.