

REVIEW ON SCIENTIFIC RESEARCH ON ECOLOGY AND ENVIRONMENT AT VIETNAM NATIONAL UNIVERSITY OF AGRICULTURE

Tran Duc Vien¹, Ngo The An², Nguyen Thanh Lam^{3*}

¹*Chairman of University Council, Vietnam National University of Agriculture (VNUA)*

²*Department of Agroecology, Faculty of Environment, VNUA*

³*Department of Environmental Management, Faculty of Environment, VNUA*

Email*: ntlam_cares@vnua.edu.vn

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ABSTRACT

Vietnam National University of Agriculture (VNUA), a leading university in agro-forestry and aquaculture, has made significant contributions to the field of ecology and environmental protection towards sustainable agricultural development in Vietnam. This paper reviews existing publications and scientific works conducted by VNUA's researchers, focusing in three specific regions: upland, peri-urban, and coastal zones. Research results reveal that forestland degradation is the main problem of the upland. Accordingly, the proposed solutions include decentralizing forest management and improving payment practices for environmental services. In peri-urban areas, fertilizers and pesticides abuse in agriculture, environmental pollution, and food safety violations are the main concerns and the corresponding priority measure are the high-tech farming in the context of land shortage and market development for safety vegetables. In coastal areas, climate change and saltwater intrusion are viewed as the critical problems and there is a need for further research on smart agriculture to adapt to climate change in these areas.

Keywords: Ecology and environment, environmental pollution, resource degradation, VNUA.

Tổng quan hoạt động khoa học công nghệ trong lĩnh vực sinh thái - môi trường tại Học viện Nông nghiệp Việt Nam

TÓM TẮT

Là một trường đại học trọng điểm trong khối nông lâm ngư, Học viện Nông nghiệp Việt Nam (HVNNVN) đã sớm có nhiều đóng góp có ý nghĩa trong lĩnh vực sinh thái môi trường, góp phần phát triển bền vững nông nghiệp nông thôn. Bài báo này tổng kết các công trình nghiên cứu của Học viện theo 3 vùng địa lý mang tính đặc thù của Việt Nam là vùng cao, vùng ven đô thị và vùng ven biển. Kết quả nghiên cứu chỉ ra vấn đề chính đối với vùng cao là suy thoái đất rừng. Định hướng nghiên cứu được đề xuất cho vùng này là xã hội hóa trong quản lý tài nguyên rừng; và hoàn thiện cơ chế chi trả dịch vụ môi trường rừng. Vùng ven đô có các vấn đề sử dụng hóa chất trong sản xuất nông nghiệp, ô nhiễm môi trường và mất an toàn thực phẩm. Định hướng ưu tiên của vùng ven đô là nông nghiệp công nghệ cao trong điều kiện khan hiếm đất sản xuất; phát triển thị trường sản xuất rau an toàn. Vùng ven biển có các vấn đề về biến đổi khí hậu, xâm nhập mặn. Trọng điểm nghiên cứu cần phát triển cho vùng này là sản nông nghiệp bền vững thích ứng với biến đổi khí hậu.

Từ khóa: Học viện Nông nghiệp Việt Nam, sinh thái môi trường, suy thoái tài nguyên, ô nhiễm môi trường.

1. INTRODUCTION

In recent years, the problems associated with natural resource degradation have received abundant attention from scholars in both the environmental and security aspects.

Environmental pollution, degradation of natural resources, and climate change have occurred in many parts of the world and have caused many negative impacts on the well-being of humans and the natural environment. As a result, governments and international organizations

have put a lot of effort in addressing these problems. In this context, the Vietnamese government has made a strong commitment to the reduction of green house gas emissions and increased green development during the Paris Climate Conference (COP21 2015); thereby, a number of environmental policies have been launched in the country (Vietnam's INDC, 2015).

VNUA (the former name was Hanoi University of Agriculture No.1), plays a very important role as a leader of science and technology in ecology and environmental sciences in the rural areas of Vietnam. Over the past decade, a number of research studies on ecology and the environment have been carried out by VNUA's researchers and have been published as articles in international and national journals, books and scientific reports. These publications mainly focus on three regions: upland, peri-urban, and coastal zones of Vietnam. For the upland regions, the key issues are forest protection, biodiversity conservation, and sustainable upland farming within an integrated market, while urbanization, pollution and food safety, and overuse of fertilizers and pesticides are critical concerns in the peri-urban areas. In the coastal areas, climate change and salt intrusion, and their impact on agriculture are the main issues.

This paper reviews representative publications and papers in ecology and environment sciences carried out by VNUA researchers in order to demonstrate the contributions of VNUA to sustainable agricultural development in Vietnam. This paper focuses on major studies conducted in the three aforementioned geographic regions.

2. UPLAND NATURAL RESOURCES MANAGEMENT

In Vietnam, 3/4 of the natural area belongs to the uplands where forest degradation, soil erosion, leaching, and land degradation in swidden farming are alarming problems. In order to develop better options for soil fertility management in this region, the researchers of the upland working group carried out long-term studies in the northern uplands and the north central part of Vietnam. The most representative publications examine nutrient dynamic under swidden farming based on research over a 20-year period (Tran Duc Vien *et al.*, 2008; Tran Duc Vien *et al.*, 2009). The results describe the nutrient trends under different management options at different states of swidden-fallow stages in North West of Vietnam (Figure 1).

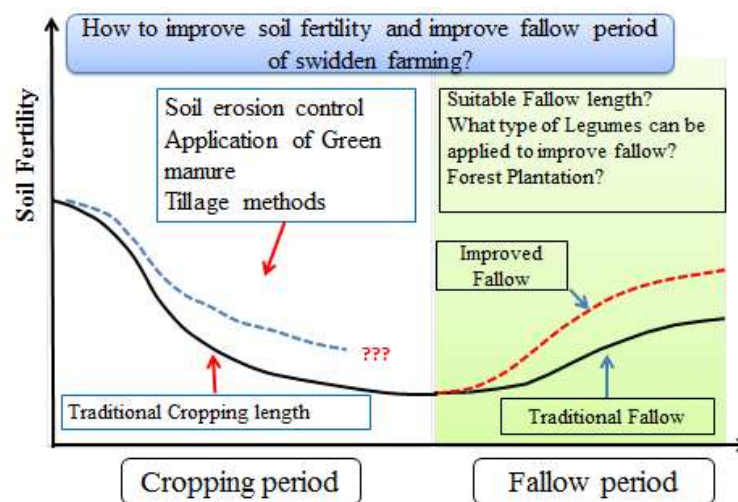


Figure 1. Conceptual framework for swidden studies and solutions to maintain soil fertility

Source: Tran Duc Vien *et al.*, 2009.

The dynamics of soil fertility in the swidden farming as shown in Figure 1 play a very important role because they provide the scientific fundamentals for selecting appropriate measures in order to shorten fallow periods and plant legumes. Similar research projects have been done in Yen Chau and for trans-boundary watershed management in Nghe An and Xieng Khoang.

Soil erosion is considered the main cause of the decline of soil fertility in the uplands. The fallow period plays a very important role in nutrient build-up and reduction of soil erosion (Nguyen Thanh Lam *et al.*, 2005; Nguyen Van Dung *et al.*, 2008). Thus, all different upland management methods try to optimize the fallow period to adapt to local socio-economic contexts. Tran Duc Vien and Nguyen Thanh Lam (2006) found that it was not easy to implement this measure due to the pressures of population growth and market fluctuation. In recent decades, a shortened fallow period is often found in the uplands of Vietnam due to expanding cassava and canna plantations. This directly impacts the sustainability of composite swidden farming. (Tran Duc Vien *et al.*, 2009).

Other aspects of upland agriculture have been identified through the study of the "Upland group" on the negative impacts from upland intensive farming (Ziegler *et al.*, 2009). These authors suggest that intensive farming can change water flows, promote soil erosion and landslides, and water quality might be impacted by fertilizers and pesticides. (Tran Duc Vien *et al.*, 2009).

Today, integration of forest plantations and biodiversity conservation into food security in the upland region of Vietnam is considered an alternative strategic solution in upland resource management. The forest plays an important role in maintaining the soil fertility of the whole watershed. Since the early 1990s, a number of studies provided strong evidence that forest protection and development strategies were imperative for sustainable agricultural development in many parts of country, such as Yen Bai and the Central highlands (Tran Duc Vien and Le Thanh Ha, 1993; Cu Xuan Dan *et al.*, 1994; Tran Duc Vien, 2001). Institutional management, planning and decentralization are

responsible for the success of organizations in natural resources management. Tran Duc Vien and Nguyen Vinh Quang (2005) investigated forest management in Son La and Nghe An provinces and found that overlapping functions in forest management carried out by the various organizations in the same province lead to the limitation of forest management and planning activities. These authors suggested that local authorities should be more empowered in forest management so that they can more easily deal with their own problems in the local area. Based on these findings, the Vietnamese government laid down forestry socialization as a policy and accepted the participation of multi-sectors in forest protection and development in 2010. From that time onwards, the role of the local communities has received more attention from policy makers. They have become important stakeholders and have participated in all the forestry management activities, namely forest monitoring, and benefit sharing (Danielsen *et al.*, 2013; Brofeldt *et al.*, 2014; Tran Nguyen Bang & Ngo The An, 2015).

In response to the above mentioned issues, many research topic initiatives have been created by VNUA. These include (i) Improving the local livelihood of forest owners; (ii) Socializing forest resources management; (iii) Enhancing mechanisms for Payment for Forest Ecosystem Services (PFES); and (iv) Reducing greenhouse gas Emissions from Deforestation and forest Degradation and enhancing carbon stocks (REDD+) (Tran Duc Vien *et al.*, 2016).

3. MANAGEMENT OF AGRICULTURAL ENVIRONMENT IN PERI-URBAN AREAS

Over the past few years, the peri-urban areas have become priority areas for studying ecology and the environment at VNUA. Tran Duc Vien (2002b) and Pham Van Hoi *et al.* (2009a & b) in collaborations with experts from Wageningen did research on agriculture in the peri-urban areas of Hanoi. The results showed urgent issues of agriculture in the peri-urban areas including: environmental pollution, food safety, urbanization, diseases, and overuse of pesticides and fertilizers.

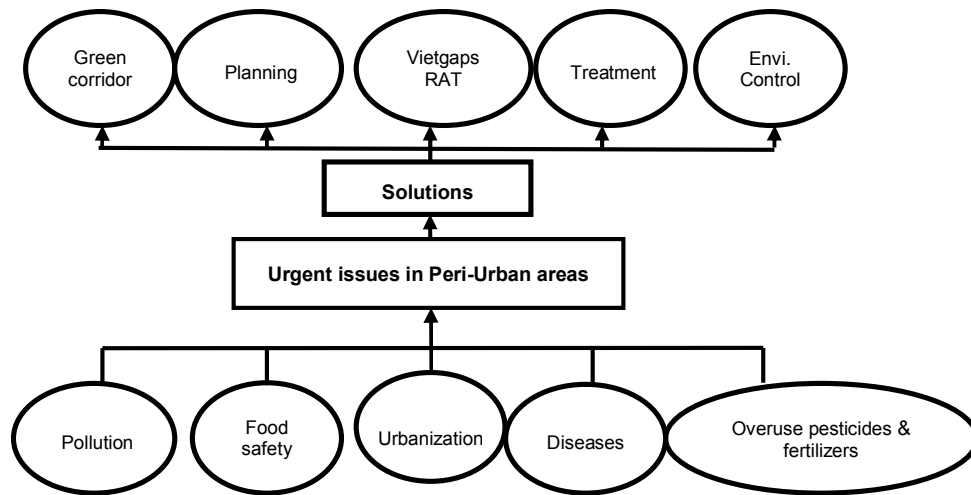


Figure 2. Environmental issues in Agriculture and Solutions for Peri-Urban areas in Vietnam

As mentioned above, environmental pollution in animal husbandry is considered a major challenge for the suburbs in particular and agricultural focus areas in general. The research findings of lecturers of the Faculty of Environment show that animal manure has not yet been treated carefully and it might cause eutrophication and lead to serious environmental pollution in peri-urban areas (Nguyen Thuy Dung *et al.*, 2015). Peri-urban areas are also the most sensitive places for the poultry trade and are characterised by the potential risk of bird flu infection. For a solid scientific basis, VNUA cooperated with international scientists to develop systematic research on the vectors of avian flu in the suburban areas of Vietnam. (Saksena *et al.*, 2014).

Fertilizer and pesticide abuse is of increasing concern because of the harmful impacts on human health. An intensive research by Pham Van Hoi *et al.* (2009b) showed that the number of dealers selling plant protecting chemicals (e.g., pesticides, herbicides, fungicides) increased rapidly at the rate of up to 40% per year in the Red River Delta and the suburbs of Hanoi.

In the animal husbandry sector, VNUA's study, carried out on 20 farms in Bac Giang Province, shows that the use of antibiotics in

animals on farms have not been managed strictly and suitably. Furthermore, the selection of antibiotics is based mainly on experience and recommendations of the drug manufacturing companies. (Duong Thi Toan and Nguyen Van Luu, 2015).

Nutrient management issues in the farming systems in intensive farming areas in the Red River Delta have been mentioned in the research of Tran Duc Vien (1992) from the early 1990s. The author carried out a three year research study and proposed solutions for nutritional management in the paddy fields with frequent floods in Hoa Lu district, Ninh Binh province, by developing a fish-rice model (Tran Duc Vien, 1994a,b). These models were promoted and expanded to the whole country by the Ministry of Agriculture and Rural Development (Tran Duc Vien and Pham Chi Thanh, 1994).

VNUA also proposed technical solutions in environmental ecology based on research done in the peri-urban areas of the Red River Delta. Doan Van Diem *et al.* (2011) found different varieties of different species (rice varieties DH60, CH133, and DT10; hybrid peanuts 75/23 and B5000; mung bean DX02; soybeans AK03 and V74) that can be adapted to infertile soil in the Soc Son district of Hanoi under non-drought conditions. In addition, in order to improve the sustainability of farming systems, VNUA

focused on the development of solutions to enhance material recycling in agricultural systems. Nguyen Xuan Thanh *et al.* (2007a, b) carried out several studies on recycling of agricultural residuals in the field using biological products to make compost in a simple and easy way for application purposes. Results showed that one hectare of summer rice will generate ten tons of straw that can be used to produce five tons of compost with the same quality as animal manure from the Red River Delta. This is a considerable amount of fertilizer, which plays an important role in setting the ecological balance of intensive farming in peri-urban areas.

These research results of VNUA have oriented research to solve the major issues of peri-urban areas and the Red River Delta: (i) High-tech agriculture in conditions of land scarcity for agricultural production, and (ii) Developing the market for safe vegetable production combined with the mobilization of all resources in agricultural production and agricultural waste recycling.

4. COASTAL ENVIRONMENT NATURAL RESOURCE MANAGEMENT

Vietnam is one of the countries most likely to be seriously affected by climate change, especially in the coastal areas. The impact of extreme weather events such as erratic rainfall patterns, increased intensity of hot and cold spells, and saltwater intrusion have brought major challenges for local agricultural producers (Nguyen Thi Bich Yen *et al.*, 2014; Ngo The An and Tran Nguyen Bang, 2014). Figure 3 summarizes the causes of agricultural loss, including climate change impacts and natural disasters such as drought, floods, and mangrove forest degradation.

Recently, there have been an array of studies carried out by VNUA researchers in the Red River Delta coastal area, especially in the areas near the Red River mouth, the most vulnerable zone in the North of Vietnam. Meteorological time series data in the coastal area of Nam Dinh province showed that the

mean temperature has increased by 0.3°C per decade; saltwater has moved upstream from the mouth of the Red River by 10 km; and the measured salinity content was over 15% (Nguyen Thi Bich Yen *et al.*, 2014). Using the B2 climate change scenario, Ngo The An and Tran Nguyen Bang (2014) applied the Multi Criteria Analysis in GIS to assess the potential risks in Giao Thuy district. The results show that the aquaculture production areas with high economic value are the most vulnerable areas in the district. According to the assessment, the typhoon scenario can cause the loss of 300 billion VND per year, accounting for an aquaculture production area of nearly 2,400 ha.

The proposed adaptive solutions for climate change in the coastal areas include changing crop cultivars, planning sustainable aquaculture production, and protecting mangrove forests (Dang Thi Hoa & Quyen Dinh Ha, 2014). In addition, resettlement, constructing infrastructure projects to mitigate and prevent the impacts of natural disasters, and improving the drainage system and transportation infrastructure were proposed to non-agricultural areas; developing eco-tourism coupled with the agro-aqua-forestry model development were suggested for agricultural areas (Tran Thi Giang Huong *et al.*, 2015).

Regarding the capacity of technical transfer and solutions, Nguyen Tat Canh *et al.* (2006) have successfully produced deep placement fertilizer and applied the process in sedge cultivation in Kim Son district of Ninh Binh province and Nga Son district of Thanh Hoa province. The research results were widely tested and the deep placement fertilizer has effectively been applied to various crops in the saline coastal areas of Vietnam. In aquaculture, the polyculture of shrimp with red tilapia where white shrimp were acclimatized to brackish water has been successfully tested by Kim Van Van and Ngo The An (2016) in Giao Thuy district, Nam Dinh province. As high variability of water conditions is expected due to climate change, this model can be considered as a strategy to increase the adaptive capacity of aquatic production along Nam Dinh coastal areas.

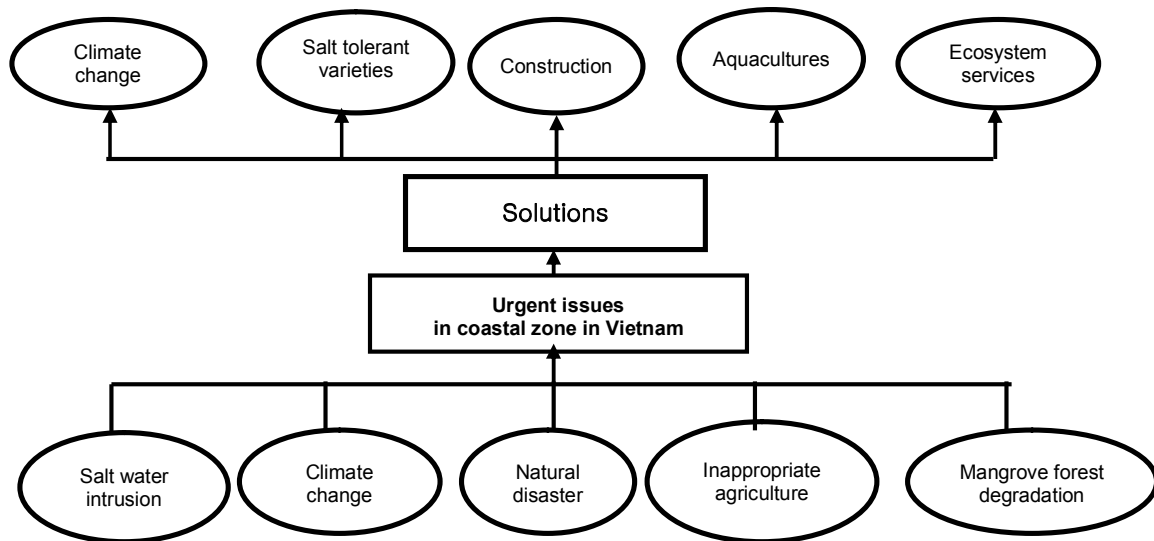


Figure 3. Environmental issues in Agriculture and Solutions for the coastal zone in Vietnam

In order to maintain the sustainability of climate change adaptation solutions, the integration of cultivation techniques and market development is essential. Ngo The An *et al.* (2016) have successfully implemented a new melon variety cultivation model that combines the transferring techniques for composting agricultural residues and improving the grower's marketing development skills. The results suggest that the market plays an important role in the adaptive strategy of local farmers. The newly introduced crop varieties are only adopted when farmers could anticipate the possibility of selling their new products.

In terms of land use management, the proposed solutions for coastal areas such as land exchange and aggregation, and restructuring the transportation and drainage systems were claimed as essential practices in order to cope with climate change along the coastal areas of Vietnam (Xuan Thi Thu Thao *et al.*, 2015).

The research findings of VNUA confirmed that science and technology development, land management renovation, and sustainable agricultural development adapting to climate change are essential to the economic development of the coastal areas. These are

important focuses in the strategic research development of VNUA in the future.

5. CONCLUSIONS

To sum up, the historical development of VNUA shows its great contribution to the development of agriculture and environmental protection. The research results of the upland areas, peri-urban areas, and coastal areas by VNUA's researchers provide several appropriate solutions to the issues in specified geographical locations. While the identified major issues existing in the mountainous areas include forestland degradation, the problems of coastal areas are climate change, saltwater intrusion, drought, flood, and mangrove forest degradation, and the overuse of pesticides and fertilizers, food safety, water pollution, and vulnerability of the agricultural ecosystem are the concerns in peri-urban areas. The authors have synthesized the nutrient rules of slope land to mitigate soil degradation, have proposed management systems for peri-urban agriculture based on an ecosystem approach, and developed a model of a climate-smart agriculture system. In the future, the core-oriented studies of VNUA will be focused on sustainable

mountainous soil management, assisting and consulting coastal areas to effectively adapt to climate change, producing safe and environmental friendly products, and applying technological innovations in cultivation practices. On the basis of VNUA's great performance from a long history of research and education, these objectives could be effectively realised in the near future.

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