



# A RISK ANALYSIS OF SMALLHOLDERS RUBBER HOUSEHOLDS IN QUANG BINH PROVINCE

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**Abstract:** Smallholder rubber farms have been adopted and rapidly developed in Quang Binh province, playing a very important role in the economic development of the locality, such as creating jobs, increasing income for rural labourers, contributing to hunger eradication and poverty reduction. However, this model has been facing risks due to the impact of factors such as the volatile prices in the domestic and foreign markets, the vagaries of weather and climate, the increase in natural disasters, increasing costs due to epidemics, reduced production efficiency and the competitiveness of products in the domestic and foreign markets. Under this context, this study assessed the development of the smallholder rubber model in Quang Binh in terms of scale, economic efficiency, and productivity, and based on these findings the study analyzed the risks caused by natural disasters, pest damage, varieties, farming techniques, market and financial risks; it also analyzes the relationship between risks and economic performance to evaluate status of the smallholder rubber model in Quang Binh and how it would be in risky condition, through which specific analysis of economic efficiency in terms of price risk, interest rate risk. On the other hand, the study also analyzed the current use of measures to minimize the risks to consider, evaluate the risk management of the smallholder rubber farms in Quang Binh.

**Keywords:** Smallholder rubber, Rubber in Quang Binh, risk in rubber business, risk analysis

## 1 Introduction

Smallholder rubber farms have started in Quang Binh province since 1993, after the efficiency from rubber trees was realized, and with the funding support (free interest loan) of the Program 327 – "Reforestation of barren land and hills". However, due to limited capital resources, the fund guaranteed 40 – 50 % investment process, the majority of poor people did not have sufficient capital to complement smallholder rubber model, and this led to a decline in planting area, and the smallholder rubber model was disrupted. By 2000, thanks to the agricultural diversification project from 2000 to 2006, smallholder rubber farms began to develop from 2008 to 2012, and in 2012 reached 10 365.7 ha, a 1.59 times increase compared to 2008, mining production increased 90.56 % reaching 3028 tons against 2008 leading to an increase from 850kg/ ha to 950 kg/ha. Despite the rapid development, rubber business is still facing many kinds of risk, such as volatile price in domestic and foreign market, vagaries of weather and climate change the increase in natural disasters, increasing costs due to epidemics, reduced production efficiency and reduced competitiveness of products on domestic and foreign markets, etc. For example, in 2013 the 10th storm heavily damaged rubber trees in Quang Binh province, which caused the planting area to drop by 22.31 %, and yields fell 3.25 % compared to 2012 and consequently, rubber production in 2014 was 3 598.8 tons, fell down by 42.1 % in comparison to 2013 and 43.97

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% in comparison to 2012; rubber prices also fluctuated: in 2011 over 20 000 VND/kg fresh pus, 2013 is 10 000 VND/ kg and currently over 8 000 VND/kg [1], [2].

This indicates that developing smallholder rubber model is one of the most important solutions contributing significantly in the development strategy of local economy, improving incomes and creating jobs for local people. However, risks in smallholder rubber farms have a huge effect on productivity and economic efficiency. Therefore, it's essential to analyze risks to find out solutions for sustainable development model in Quang Binh.

## **2 Research Methodology**

### **2.1 Spatial scope**

Key growing areas such as Viet Trung farm, Trach Hoa District, Tay Trach District, Phu Dinh District and Le Ninh Farm were chosen for analyzing the risks of rubber smallholders in Quang Binh province.

### **2.2 Collecting data**

Secondary data were collected from publications about producing and trading rubber in Quang Binh province.

Primary information was collected from a survey of representative smallholder-rubber households using a questionnaire. The sample size was 200 households, which were chosen by stratified statistical methods from year 1 to year 20 over the life of rubber trees and for each year and selected 10 representative households. These households were selected randomly. Data from year 21 to year 30 were based on the research of the Rubber Research Institute, experts and practical researches. Moreover, the study also assessed disease on rubber trees.

Necessary information for the study was also collected by interviewing scientists, local managers of rubber farms, leading companies, and farms which have a deep understanding of rubber manufacturing business.

### **2.3 Analysis Method**

Statistical method of analysis: The study used statistical methods to split the overall group into sub-statistics that have different properties; statistical graphs method to present and analyze statistical information in the form of charts, graphs and maps and statistics; and analyze time sequence to reflect the development of rubber trees in each stage.

Method for expenditure accounting, yield and production efficiency: Conducting a survey and determining the production costs for each period, determining actual latex yield harvested; calculating the average production value, value added, thereby determining mixed income, profitability and efficiency targets of rubber growers.

Identifying risks: Using statistical data from the records at the rubber plantation commune, agricultural division of districts and DARD for losses from risky events that occurred in

the rubber manufacturing and business, thereby assessing the trend of the loss of business that rubber producers faced.

Sensitivity analysis: Identifying variables that most influence the net profit of the model, quantifying their influence, and evaluating the impact of rubber prices and loan rates on the net profit of rubber smallholders in Quang Binh in the period from 2008 to 2013.

### 3 Research results

#### 3.1 Scientific basis of risk analysis in rubber manufacturing and business

Risks in rubber manufacturing and business: Events that occur beyond the control of producers, such as natural disasters, epidemics, price fluctuations, changes in laws, cultivation techniques, etc. have measurable impact and damages on the results and efficiency of rubber business.

Risk analysis in rubber manufacturing business: In order to monitor the risks in the rubber manufacturing business, the following steps must be followed: (1) Define the context and scope of risk management; (2) identify the risks; (3) risk analysis; (4) risk assessment and (5) risk management. In particular, risk analysis is an important step and divided into 2 parts. The first part called informal analysis shows a common way to describe the likelihood of events with low or high probability, and the second part is the formal analysis to make important decisions to adjust the efforts in order to achieve the best choice.

#### 3.2 Status of smallholder rubber development in Quang Binh

Planting area, yield and production: The development of smallholder rubber households in Quang Binh from 2008 - 2013 is shown in Table 1.

**Table 1.** Planting area, yield and production of smallholder rubber households in Quang Binh from 2008-2013

Criteria	2008	2009	2010	2011	2012	2013
Planting area (ha)	6 515.0	7 115.0	8 583.0	9 408.0	10 365.7	8 662.1
Business area (ha)	1 866.0	2 366.0	2 466.0	2 742.0	3 187.2	3 088.8
Establishment area (ha)	4 649.0	4 749.0	6 117.0	6 666.0	7 178.5	5 573.4
Yield (dry ton)	1 589.0	2 319.0	2 219.0	2 524.0	3 028.0	2 625.4
Productivity (ton/ha)	0.85	0.98	0.90	0.92	0.95	0.85

*Source: Statistics Office of Quang Binh 2013, Department of Agriculture and Rural Development*

As can be seen from Table 1, smallholder rubber manufacture in Quang Binh from 2008 to 2013 had a high growth rate in all categories, namely production area, establishment area yield and productivity. However, in 2013, due to the storms, the business area, establishment area, yield and productivity decreased in comparison to 2012. In the period of 2008-2013, productivity was more volatile, unstable and much lower than the norm. The analysis results

show that there was a huge growth in area and yield, but the yield (0.9 to 1 ton of dry latex/ha) was lower compared with that of the estate manufacture, and far lower than the yield of other localities like Quang Tri (1.4 tons/ha) and Nghe An (1.2 tons/ha) [2].

Soil: Soil and land classes are shown in Table 2. Only 5 districts in Quang Binh have suitable soil for growing rubber trees. However, diverse soil quality in each locality makes it difficult for manufacturing organization because different types of soil require different farming techniques.

**Table 2.** Soil for rubber in Quang Binh

No	Places	Soil type	Relief	Relative height (m)
1	Minh Hoa	I b, IIb, III	2, 3	< 400
2	Tuyen Hoa	IIb, III	2, 3, 4	< 400
3	Bo Trach	Ib, IIa, III	1, 2	< 300
4	Quang Ninh	II III	2, 3	< 200
5	Le Thuy	IIb,III	2, 3, 4	< 200

*Source: Quang Binh Agricultural diversification project*

Scale: Table 3 shows that the households with less than 2 ha of planting area account for 49% and those with more than 4 ha only 7.5 %. This fact does not make it advantageous for investing and applying scientific and technical advances in production.

**Table 3.** Smallholder rubber scale in Quang Binh in 2013

No.	Area per household (ha)	Household		Area	
		Number	%	ha	%
1	< 2	2 546	55.5	4 244.48	49
2	2 - 4	1 720	37.5	3 768.06	43.5
3	> 4	321	7	649.67	7.5
<b>Total</b>		<b>4 587</b>	<b>100</b>	<b>8 662.2</b>	<b>100</b>

*Source: Department of Agriculture and Rural Development and survey data 2013*

Seedling: Table 4 shows the fact of using seedling in Quang Binh and reveals that before 2005 rubber cultivars of unknown origin accounted for almost 50%, and from 2013 the unknown origin of seedling decreased, accounting for 10.15% of the total.

**Table 4.** Planting area according to seedling in Quang Binh

	Area per household (ha)	Household		Area	
		Number	%	ha	%
1	GT1	645.95	24.64	285.3	3.29
2	RRIM 600	421.18	13.56	1 758.3	20.30
3	PB235	253.70	5.75	63.4	0.73
4	VM515	278.85	6.32	0	0.00
5	RRIV 6	2.38	0.54	536.6	6.19
6	RRIV 4	59.12	1.34	2 551.6	29.46
7	PB 260	-	-	2 296.1	26.51
8	PB 86	-	-	576.6	6.66
9	Unknown origin	2 728.95	47.85	879.6	10.15
<b>Total</b>		<b>4 412.20</b>	<b>100</b>	<b>8 662.2</b>	<b>100</b>

Source: Quang Binh Agricultural diversification project, Department of Agriculture and Rural Development

### 3.3 Risk analysis in small holder-rubber production in Quang Binh

*Disaster and Weather risk:* These are the main types of risks to smallholder rubber households, and storms cause the most damage. The storm information in Quang Binh in period of 1983 – 2013 is shown in Table 5.

**Table 5.** Storm frequency and extend of damage of smallholder rubber households in Quang Binh from 1983 to 2013

Intensity of wind	Frequency	Damaged area (%)	Probability
12 and upward	2	40 - 60	0.051
10 - 11	2	20 - 40	0.051
8 - 9	3	10 - 20	0.077
6 - 7	6	2 - 10	0.154
5 and downward	26	< 2	0.667
<b>Total</b>	<b>39</b>		<b>1.000</b>

Source: National Center for Hydro – Meteorological Forecasting, Department of Agriculture and Rural Development and author

Table 5 shows smallholder rubber households in Quang Binh may face risks from wind, storms that cause serious damage, but the probability of occurring is only 5.1%, so developing

smallholder rubber households is reasonable. However, manufacturer should comply with recommendations and planning about seeds, planting and cultivation techniques.

*Pests:* There are 10 harmful diseases that affect rubber trees in Quang Binh. The most popular diseases are powdery mildew, black leaf wilt, blight and ulcers stripes shaved face. Table 6 shows that the powdery mildew disease and ulcerative stripes shaved face account for the highest rate of disease, while the other illnesses occur less frequently. However, the rate and extent of disease are over 50%; therefore the farmers should pay more attention to disease control in order to ensure an efficient production.

**Table 6.**Rate and level of common diseases on rubber trees in Quang Binh

Types of disease	Total trees	Damaged trees	Proportion (%)	Level of disease (%)
Powdery Mildew	50	35	70	76.40
Leaf wilting black head	50	32	64	67.20
Face shaved stripes ulcer	100	75	75	71.71
Corynespora	50	30	60	60.04
Leaf falling in rainy season	50	25	50	48.40
Cracked bark, leaking latex	250	130	52	52.80

*Source: Survey results and calculations in 2013*

Pest analysis shows that compared to diseases, pests do not have high impact on rubber plantations. But consideration must be taken on some dangerous species such as red spider and grasshopper [2].

*Seedling Risks:* Table 7 shows the proportion of households using varieties with resistance to windstorms accounting for only 23.59%. Meanwhile, the rate of using high yielding varieties, but less resistant to wind, hurricanes and pests is 62.63%. Unknown sources of seedling is 13.78%.

**Table 7.**Seedling used by smallholder rubber households in Quang Binh

Seedling	Areas (ha)	Proportion %
- GT1	17.3	4.41
- RRIM 600	75.2	19.18
- RRIV 6	12.7	3.24
- RRIV 4	112.3	28.65
- PB 260	120.5	30.74
- Unknown origin	54.0	13.78
<b>Total</b>	<b>392.00</b>	<b>100.00</b>

*Source: Survey results and calculations in 2013*

*Risk of cultivation techniques:* Analysis shows that smallholder rubber farmers in Quang Binh do not apply the correct techniques in planting such as design of plots, rows, density and distance, resulting in many risks such as break due to wind, storms, pests and diseases, and low yields. The reason is that in Quang Binh, because rubber plantation has recently developed, the reclamation work, design of plots, row planting, direction, density and distance of planting do not follow cultivation procedures; there is no protective belt or it is too thin to show any effects [2], [4].

*Market and finance risks for smallholder rubber production:* Latex prices and loan interest in period 2008 - 2013 reflected in Fig. 1 show that the smallholder rubber production has faced many risks, among which, the loan interest rate and rubber price are the greatest.

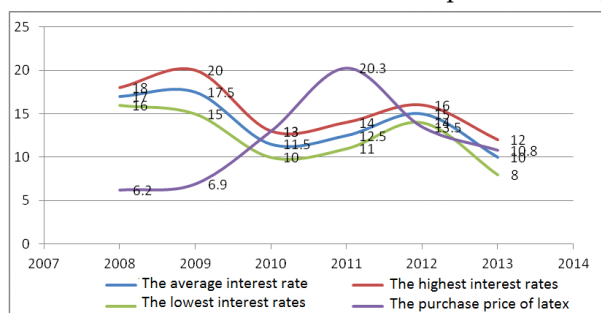


Fig. 1. Movement of interest rate and latex purchase price in Quang Binh from 2008 - 2013

### 3.4 Analysis of the relationship between risk and economic efficiency of smallholder rubber households in Quang Binh

#### *Economic efficiency of production of smallholder rubber households in risky conditions*

Based on the impact of risk on the profit of rubber growers, it can be seen that natural disasters and weather calamities cause the most damage, followed by risks in cultivation, pest control diseases, product variety and price (Table 8).

#### *Economic efficiency of production of smallholder rubber households in rubber price*

As can be seen in Fig. 2, at an interest rate of 9%, the possibility for NPV of 1 ha rubber farm under smallholder model (CSTD) to be greater than 0 is quite high and reaches 98%. Considering the direct relationship between price and NPV, it is possible to see that price has a strong impact on NPV change. With an estimated price change from 6 000 VND/kg to 20 000 VND/kg, NPV values change from VND 28 495 000 to 383 706 000, and the average value is VND 181 416 000. These figures show that rubber latex prices are related directly to the NPV value obtained, and the dependence of NPV on the price level is high.

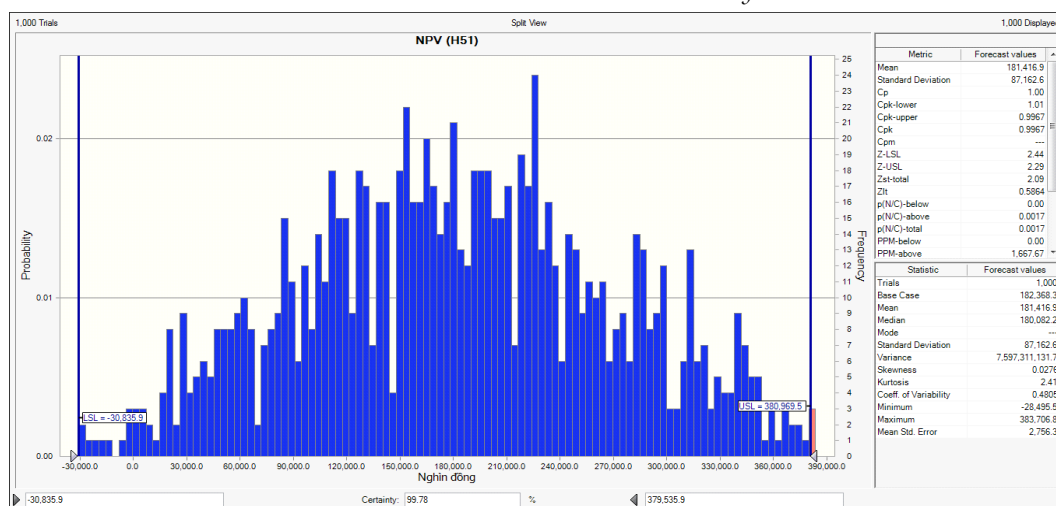
#### *Economic efficiency of rubber smallholder model in loan rate risk*

The NPV analytical results of the smallholder rubber model in Quang Binh under variation loan rates during 2008 - 2013 and of the rubber latex price in 2013 at 10 000 VND/kg show that the interest rate has a direct influence on the value NPV obtained (Fig.3). However, NPV value fluctuations due to interest rates range from VND 1 168 to VND 79 781, this range is lower than the impact of price, which is at VND 10 000. NPV is greater than 0 in all case of interest rate in stage from 2008 to 2013.

**Table 8.** Economics efficiency in smallholder rubber households in risky condition

Type of risks	Frequency	Proportion (%)	Impact on profit (%)		
			Maximum	Minimum	Mean
Natural disaster, weather	200	100	100	4	26.83
Pest	200	100	30	1	8.28
Seedling	177	88.5	20	1	5.11
Technical cultivation	197	98.5	35	2	12.26
Seedling price	177	88.5	5	0.03	0.84
Pesticide price	200	100	7	0.09	1.5
Fertilizer price	200	100	7	0.1	1.6
Labor cost	200	100	10	0.2	2.2
Selling price	198	99	20	1	7.54
Changing in demand	0	0	-	-	-
Lacking of capital	200	100	15	0.5	6.54
Interest rate increase	200	100	17	0.5	6.34

Source: Survey results and calculations in 2013



**Fig. 2.** NPV distribution of smallholder rubber households according to variation of rubber latex price from 2008 to 2013



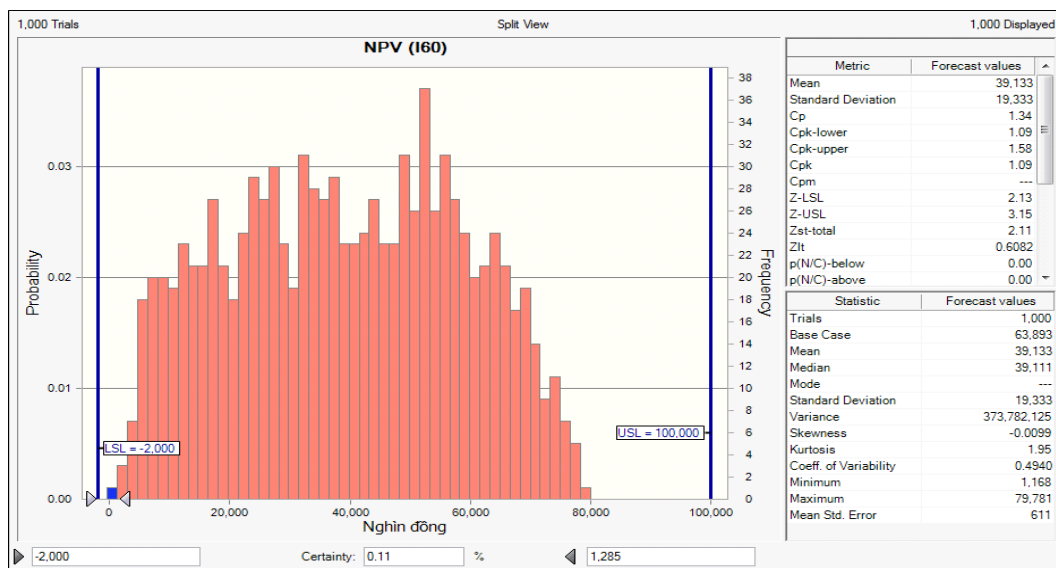


Fig. 3. Variation of NPV value according to interest rate in stages 2008-2013

NPV analysis according to interest rate fluctuations and price in the period 2008 - 2013 provides positive results. Most of the NPV obtained from smallholder rubber model are greater than 0 in all cases. When looking at some specific NPV that farmers want to achieve, the point reliability of NPV in each case is greater than 50%. It could be conclude that despite the risk, rubber manufacture will still be profitable if the level of prices and interest rates are fluctuating around those of 2013.

*Economic efficiency in terms of risk of product price and loan rate*

NPV analysis results from the variability of latex prices and loan rates during the period of 2008-2013 with latex prices from 7 000 VND/kg or more show that the NPV values in this case are positive, even in the case of the highest loan rate at 17.5 % in 2009, the NPV is still higher than 0 in all cases of more 10 000 VND/kg for rubber latex. However, current prices are maintained at 10 000 VND/kg, so the NPV is positive.

Table 9. Sensitivity of NPV as prices and interest rates varied in period of 2008 to 2013

Price (VND) Rate (%)	6.2	6.9	13.0	20.3	13.5	10.8
17.0	-35.483	-28.543	35.833	112.528	41.086	12.720
17.5	-35.609	-28.255	31.940	104.321	36.897	10.127
11.5	-34.498	-19.958	106.747	258.377	117.132	61.050
12.5	-35.208	-22.447	88.754	221.831	97.869	48.648
15.0	-35.845	-26.515	54.794	152.098	61.459	25.470
10.0	-32.697	-14.904	140.148	325.702	152.857	84.227

Source: Survey results and calculations in 2013

Therefore, there are many factors affecting the business of rubber production such as price, interest rate, etc. causing the risk and expense of production for smallholding rubber households. However, with prices at 7 000 VND/kg or higher and interest rates at 17.5 % or less, the NPV in all cases would be positive. These show that the investment for smallholding rubber production in Quang Binh province has high economic efficiency.

### 3.5 Analysis of the actual use of risks mitigation measures in smallholder rubber production and in Quang Binh

The measures to reduce weather and disaster risk are presented in Table 10.

**Table 10.** Measures to reduce weather and disaster risk

<i>Measures</i>	<b>Level of use</b>					
	Many		medium		none	
	Frequency (People)	Rate%	Frequency (People)	Rate%	Frequency (People)	Rate%
1. Growing forest belts and plants against wind	0	0	20	10	180	90
2. Obviously derived varieties	60	30	80	40	60	30
3. Varieties recommended for Quang Binh	50	25	70	35	80	40
4. Planting in right time in Quang Binh	50	25	126	63	24	12
5. Select varieties resistance to wind	0	0	30	15	170	85
6. Applying technical measures	10	5	120	60	70	35
7. Applying remedies rubber garden	50	25	140	70	10	5

*Source: Survey results and calculations in 2013*

Table 10 reveals that the use of mitigation measures is not high. In particular, the rate of households that do not plant forest belts against wind is as high as 90 %; followed by the rate of households that do not plant varieties resistant to wind at 85 %.

Rating the measures to reduce disease risks is represented in Table 11. The results show that the rate of smallholder rubber households in Quang Binh province having used mitigation measures is not high. The rate of households that do not plant disease resistant varieties is at 50 %, and the households that do not use plantproactive detection and prevention account for 30 %, and the average is at 60 %.

**Table 11.** The use of measures to reduce risks of diseases in smallholder rubber households in Quang Binh

Measures	Level of use					
	Many		medium		none	
	Frequency (People)	Rate	Frequency (People)	Rate	Frequency (People)	Rate
		%		%		%
1. Disease resistant varieties	0	0	90	45	110	55
2. Proactive detection and prevention	20	10	120	60	60	30
3. Specific chemical drug prevention	50	25	150	75	0	0
4. Enhancing the care	60	30	120	60	20	10
5. Insect prevention technical training	70	35	82	41	48	24

*Source: Survey results and calculations in 2013*

Rating the measures to reduce of varieties risk is shown in Table 12. It can be seen that the rate of smallholder rubber households that do not use the recommended methods and suitable seed varieties in Quang Binh is still high.

**Table 12.** Rating the use of measures to reduce of varieties risk

Measures	Level of use					
	Many		medium		none	
	Frequency (People)	Rate (%)	Frequency (People)	Rate (%)	Frequency (People)	Rate (%)
1. Obviously derived varieties	60	30	100	50	40	20
2. Advised varieties	20	10	90	45	90	45
3. High yielding varieties	30	15	150	75	20	10
4. Varieties matching the weather in Quang Binh	50	25	80	40	70	35
5. Varieties fit the land and soil	10	5	130	65	60	30

*Source: Survey results and calculations in 2013*

In addition to the risks posed by natural disasters, pests, etc., the farming techniques are a major risk factor for smallholder rubber production in Quang Binh, reducing productivity and economic efficiency. However, the results in Table 13 show that the households in Quang Binh using care techniques is low.

**Table 13.** The use of farming techniques to reduce risk

Measures	Level of use					
	Many		medium		none	
	Frequency (People)	Rate %	Frequency (People)	Rate %	Frequency (People)	Rate %
1. Farming technique training	70	35	82	41	48	24
2. Cultivation techniques for planting	20	10	130	65	50	25
3. Applying techniques measures	10	5	80	40	110	55
4. Applying proper harvesting techniques	10	5	120	60	70	35

*Source: Survey results and calculations in 2013*

Rating of financial measures reducing risk in Table 14 shows that the use of these measures is very low: 100 % of the households do not buy insurance, and 90 % do not have a contract for producing rubber.

**Table 14.** Rating of financial measures to reduce risk

Measures	Level of use					
	Many		medium		none	
	Frequency (People)	Rate %	Frequency (People)	Rate %	Frequency (People)	Rate %
1. Full information	30	15	80	40	90	45
2. Production under contract	0	0	20	10	180	90
3. Buying insurance	0	0	0	0	200	100
4. The intervention of local authorities	30	15	80	40	90	45
5. Reducing the proportion of loans	10	5	70	35	120	60

*Source: Survey results and calculations in 2013*

The analysis results show that the smallholder rubber households in Quang Binh province tend to be neutral or do not pay much attention to natural risks, epidemics, ect., and they lack a serious attitude towards risk; they know that manufacturing rubber with a long production cycle faces risks with weather, climate, diseases and prices, but they do not take inadequate measures to reduce risks.

## 4 Conclusion

The assessment of the smallholder rubber development in Quang Binh shows that the model plays an important role in the rubber development strategy in Quang Binh. Nowadays, the area, yield, and production of smallholder rubber households have increased rapidly and account for over 50% of total rubber area of the province. However, the development process was divided into many stages, and in the period from 2007 to 2013, the average growth rate of the area and the yields were the highest, but the yields were still lower than those of other provinces such as Quang Tri and Nghe An. Results of the risk analysis show that the smallholder rubber households in Quang Binh are facing many risks, in which, the risks of natural disasters is the main cause of the greatest damage, followed by the risk of farming techniques, pests, seedling and selling prices. Analyzing the relationship between risk and economic efficiency shows that the smallholder rubber households with the absence of risk will be highly effective. In terms of reduced risks and reduced profitability, the level of effectiveness depends on the particular risk; in cases of strong winds, the greatest impact may reduce 100% profits and on average the reduction level is 26.8% of the profit. Other risks such as volatile price, interest rates rise or unguaranteed farming techniques account for the lower level but remain with a strong damage. To consider if under the current risk condition the investment in smallholder rubber is still effective, the article analyzes the variation of NPV by latex prices and interest rate in period of 2008 – 2013, which shows that with prices at 7 000 VND/kg of fresh latex or higher and interest rates at 17.5% or less, NPV is positive in all cases. This result reflects that the production and investment in the province of Quang Binh are still profitable despite having been many risks in economic efficiency. Analysis of the actual use of risk measures shows that the production of rubber in Quang Binh is still risky, but the proportion of smallholders households using measures to prevent and minimize risks is quite low, in which the highest rate is not use the measures such as planting trees and other forest belt against the wind; varieties match the weather in Quang Binh; buying insurance; production under contract.

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