

## **PBSS Colloquium, Cancun 2017**

### **Title: Investment of Pension Funds in Reforestation and Forestry Projects: The Ecuadorian Case Proposal**

List of Keywords: Ecuadorian Social Security Institute (IESS), Actuarial deficit, Pension funds, Climate change, Deforestation, Environmental Degradation, Internal Rate of Return of Tree Species.

#### **Brief presentation of the author**

**Rodrigo Ibarra-Jarrín** is a Professor at the Universidad San Francisco de Quito in Ecuador and the President & CEO of Actuaría Consultores Ltd.

His work is centered on the design, evaluation and implementation of pension plans for health and employee benefits, as well as actuarial modelling for insurance companies, and has 28 years of experience in the Ecuadorian actuarial market.

Rodrigo has a Bachelor's degree with honors in Pure Mathematics from the Escuela Politécnica, Quito, Ecuador, a DEA in Actuarial Statistics from the Institute of Statistics (ISUP), University Pierre and Marie Curie, France, and a MBA from the Universidad San Francisco de Quito. He is a member of the Latin America subcommittee of the IAA.

**Professional Affiliation:** IAF 537 (Certified actuary of the Institut des Actuaire – France)

#### **Contact:**

[rodrigo.ibarra@actuaria.com.ec](mailto:rodrigo.ibarra@actuaria.com.ec)

[ribarra@usfq.edu.ec](mailto:ribarra@usfq.edu.ec)

(+593) 2 250 1001

Av. Orellana E9-195 y Av. 6 de Diciembre, Edif. Alisal de Orellana, Of.804

170517 - Quito, Ecuador

#### **Abstract:**

This paper examines the feasibility of mitigating social and environmental problems through the implementation of reforestation and forestry investment programs for pension funds and social security systems.

It addresses the issue of a rapidly growing unemployment rate, the collapse or deterioration of pension systems, global warming and other environmental consequences of economic activity.

The presentation conducts the analysis by examining how these investment projects would impact the country's responsible economic development, carbon footprint, employment situation, social security financing, among other key variables.

**Title of the paper: Investment of Pension Funds in Reforestation and Forestry Projects:  
The Ecuadorian Case Proposal**

**1. Introduction**

Ecuador is a biodiverse country with an important environmental patrimony that represents an undeniable opportunity for the country's future economic expansion. As a matter of fact, Ecuador is very much in need of taking advantage of this economic potential, due to its poorly performing economy, that includes a growing unemployment rate and an impaired social security system. Some natural resources do stimulate economic development actively, such as petroleum, but others, such as the forestry sector are underexploited, even if they can contribute with much more than with an economic earning. Due to Ecuador's privileged geographic location and fertile land, we have identified the opportunity of implementing investment programs in the forestry field, in order to take advantage of the country's natural wealth and at the same time help the country reach a sustainable economic development model.

This paper analyzes and discusses the feasibility of mitigating certain social and environmental problems through the implementation of reforestation and forestry investment programs by pension funds and in particular, the Ecuadorian Institute of Social Security (IESS).

In the first place, we will analyze three current issues that are alarming and that have led us to identify the need for an investment program that will address them in the long term. These are: the deterioration of the Ecuadorian System of Social Security, the weak labor market, and the environmental threat to our country's ecosystems and global climate change.

Then, we will closely examine our proposal of implementing reforestation and forestry investment programs by the Ecuadorian System of Social Security (IESS). This analysis includes an actuarial valuation of the IESS Pension Fund, the definition of an investment portfolio of different tree species, and the possible return on investment generated by this program.

Finally, we will examine the viability and sustainability of this investment project and its impacts in the different social, economic, and environmental spheres.

**2. Ecuador's Overview**

Ecuador is a small dollarized country of approximately 283,000 square kilometers on the northwest coast of South America. It is considered a megadiverse country with various geographic regions, as well as a culturally rich population with varied ethnic groups. Its population is of approximately 17 million with a decelerating population growth trend. In fact, population growth has decreased from 2.99% in 1990 to 2.05% in 2001, and to 1.95% in 2010.

According to the World Bank, Ecuador's GDP from 2006 to 2014 increased in averaged of 4.3% due to high oil prices and extensive external financing. In 2015, the economy started to slow down; and in the third trimester of 2016, the growth rate stood at a weak 0.5%. The projections are even more alerting for these following years. In fact, the World Bank estimates a contraction of approximately 2.9% in 2017 for the Ecuadorian economy.

Ecuador's economy relies heavily in crude oil exports. Even though oil exports in 2016 decreased 18% compared to 2015, it still represents 30% of the country's total exports. Excluding oil, bananas and shrimp were the most exported goods in 2016. Other exports include tuna, fish products, palm oil, cacao, and processed coffee.

In terms of environmental wealth, one third of all bird species in the entire Amazon inhabit the Ecuadorian Amazon region. In addition, 10% of all tree species on Earth<sup>1</sup> are found in this region. As a matter of fact, Ecuador is the eighth most biodiverse country in the planet, housing more than 20,000 species of plants, 1,500 species of birds, 341 species of mammals and 840 species of amphibians and reptiles<sup>2</sup>.

### **3. Problems**

Despite Ecuador's abundant natural resources, its economic performance is troublesome. In this section we will analyze three current issues that are alarming and that have led us to identify the need of new sustainable and creative investment programs that must consider not only the economic aspect, but also have a conservational scope. First, we will study the underperforming Ecuadorian Social Security System, then we will touch upon the growing number of unemployed and underemployed workers, and finally we will analyze the different threats to the Ecuadorian environment.

#### **3.1 Ecuadorian Institute of Social Security (IESS)**

The IESS is the main pillar of the Ecuadorian Social Security System. It offers a variety of assistance services to its affiliates, and it is divided into four funds: The Pension Fund, The Rural Social Insurance Fund, the Workers Compensation Fund, and the Health Care Insurance Fund.

The Ecuadorian Social Security System covers approximately 53% of the country's population<sup>3</sup>. It is important to highlight that the IESS has grown rapidly in recent years. In fact, coverage has tripled over the last 8 years.

The main source of financing of the IESS is the mandatory contribution of private sector workers and employers. The employee contributes with 9.15% of his monthly income, while the employer contributes with 11.15% of each worker's monthly salary.

In our analysis we will focus on the Pension Fund because it deals with the payment of long term benefits, allowing funds to be invested in long term investment programs such as the one proposed in this paper.

##### **3.1.1 Financial Situation of the IESS Pension Fund**

The financial health of the IESS Pension Fund has received a lot of attention in recent years. In the last actuarial study of the IESS conducted by ACTUARIA Ltd., the actuarial deficit projected reached US\$ 5.14 billion. Additionally, the study reports that if the government's subsidy of 40% of all pensions were to be eliminated, the actuarial deficit reported would increase to approximately US\$ 71 billion dollars<sup>4</sup>.

Nevertheless, the Pension Fund isn't the only Fund suffering from a financing problem. In the same study conducted by ACTUARIA, the Health Care Insurance Fund had a deficit of approximately US\$ 2.6 billion dollars. The alarming financial situation of the Health Care Insurance Fund as well as other important factors has caused the government to implement reforms to the Law of Social Security and the management of the Ecuadorian Institute of Social Security.

---

<sup>1</sup> [http://www.ecuadorexplorer.com/html/vital\\_stats.html](http://www.ecuadorexplorer.com/html/vital_stats.html)

<sup>2</sup> <http://rainforests.mongabay.com/20ecuador.htm>

<sup>3</sup> Board of Directors of the IESS - Labor Report

<sup>4</sup> Actuarial Consultores

### **3.1.2 Reforms and their effects on the stability of the State Pension Fund**

The financial crisis of the IESS has been present for many years, but there have also been recent reforms that have worsened the financing problem. In this section I would like to mention the most relevant ones.

In first place, on November 2015, the Ecuadorian government issued Resolution CD 501 where the established contribution of 9.74% from active affiliates was changed. The distribution of the contributions destined to this Fund was modified, decreasing to 5.86%. The objective of this reduction is to direct more resources to the Health Care Insurance Fund.

Then, the State unexpectedly cut its funding to the Pension Fund. According to the current Social Security Law, the State was responsible for the subsidy of 40% of all paid benefits of the Pension Fund. Nevertheless, in 2015, the State issued the Labor Justice and Recognition of Household Labor Law, which in practice eliminates the State's subsidy of 40%. In reality, this action threatens the financial stability of the Pension Fund as it removes one of its main financing sources.

Lastly, there is evidence of a record debt from the government of around US\$3 billion dollars as reflected in the Financial Statements of the IESS as of December 2014. In 2015, the Government decided to ignore its existence and deny its payment by concluding that the debt is not demandable due to lack of regulation. In this way, the debt was literally removed from the IESS financial statements.

### **3.1.3 Risks of the IESS Pension Fund**

Apart from these reforms that threaten the financial stability of the IESS Pension Fund, there are other risks that have affected previously, and will continue to affect the financial soundness of this institution.

First of all, there is no plan for long-term investment. In 2017, the IESS will divest US\$ 1,752.8 million dollars for the payment of pensions<sup>5</sup>. This difference was not planned, but rather had to be done due to the lack of financing for the payment of benefits.

In addition, liquidity is confused with solvency. The Pension Fund maintained a reserve of approximately US\$ 9 billion dollars in 2016. In turn, the 40% state's subsidy was eliminated with the argument that the IESS had a sufficiently large reserve of funds for the payment of pensions. Nevertheless, they never considered the actuarial alert of the deficit that had been projected by certified actuaries.

There has been an uncontrolled growth in coverage, without having the financial soundness to do so, or the well-needed additional financing sources. As mentioned before, the coverage of the IESS has tripled over the last 8 years, reaching approximately 53% of the country's population.

Finally, I would like to touch upon a problem that affects pension systems worldwide: the global demographic transition. People are living longer and birth rates are decreasing. And this is causing

---

<sup>5</sup> <http://www.eluniverso.com/noticias/2017/03/02/nota/6069367/iess-sacara-1752-millones-su-inversion-pensiones-2017>

less active contributors to have to support an increasing number of pensioners. In fact, population growth in Ecuador has decreased from 2.99% in 1990 to 2.05% in 2001, and to 1.95% in 2010<sup>6</sup>.

Last but not least, the Ecuadorian Government has required the IESS to buy governmental bonds in order to finance their heavy public expenditure, accumulating a debt of approximately US\$ 8 billion dollars as of December 2016.

All these risks are alarming and should be taken into consideration in order to have a more sustainable and supportable Social Security System.

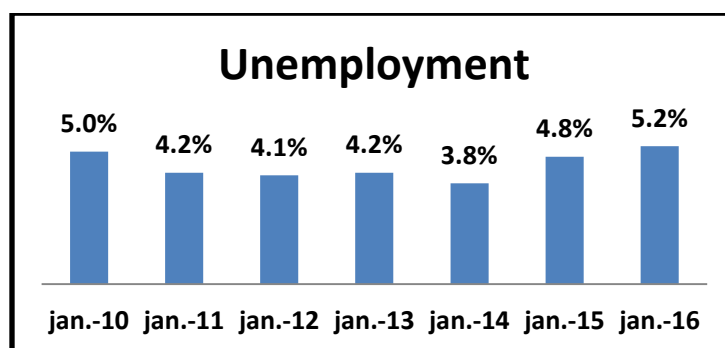
### **3.2 Unemployment**

Another problem that is affecting the economy is the growing number of unemployed and underemployed workers.

As an introduction to the Ecuadorian labor market, it is relevant to note that around 70% of the total population is within working age. From this percentage, 70% are economically active and 98.4% are employed or have some type of formal or informal work<sup>7</sup>.

The following graph presents the evolution of unemployment in the last 6 years.

*Table 1: Unemployment*



Source: Encuesta Nacional de Empleo, Desempleo y Subempleo

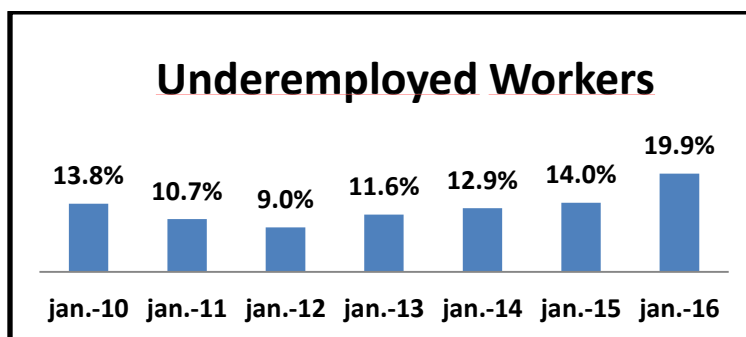
As observed, in the last year the unemployment rate has increased in 0.4 percentage points, reaching 5.2% in January 2016. This is the highest unemployment rate in the period analyzed.

<sup>6</sup> <http://www.tradingeconomics.com/ecuador/population-growth-annual-percent-wb-data.html>

<sup>7</sup> [http://www.ecuadorencifras.gob.ec/documentos/web-inec/EMPLEO/2017/Marzo/032017\\_Presentacion\\_M.Laboral.pdf](http://www.ecuadorencifras.gob.ec/documentos/web-inec/EMPLEO/2017/Marzo/032017_Presentacion_M.Laboral.pdf)

Nevertheless, the real problem lies in the number of underemployed workers that don't have enough work, many of them working on the streets. Their number has increased almost 6% in only one year, as it can be observed in the following graph:

*Table 2: Underemployed Workers*



Source: Encuesta Nacional de Empleo, Desempleo y Subempleo

These indicators demonstrate the poor performance of the Ecuadorian economy, and it doesn't present any signs of making a recovery.

### **3.3 Environmental Threats and Climate Change**

The third and last of the current problems that has led us to search for a sustainable and responsible investment solution for the Ecuadorian economy is the environmental degradation occurring in the country. In a more global perspective, climate change is affecting all parts of the world.

#### **3.3.1 Deforestation and Environmental Degradation in Ecuador**

Ecuador faces serious deforestation problems, as well as soil erosion, water contamination, and droughts and floods caused by global climate change. In fact, Ecuador has one of the highest deforestation rates in South America, with an annual loss of 60,000 to 200,000 hectares of forests per year<sup>8</sup>. On the other hand, there is still hope to stop deforestation and the deterioration of the environment, as there have been major incentives to prevent environmental destruction. As a matter of fact, in the last 20 years, the reforestation rate in Ecuador has been reduced in almost 50%<sup>9</sup>. Now, we have to keep looking for solutions to stop deforestation completely and move to a more sustainable economic development.

#### **3.3.2 Climate Change**

If we open up our perspective, it can easily be perceived that environmental degradation and climate change affects all countries in the world. Climate change has been caused by the concentration of carbon dioxide and other greenhouse gases in the atmosphere due to negligent economic activity. The existence of climate change is undeniable. In the last 100 years, average

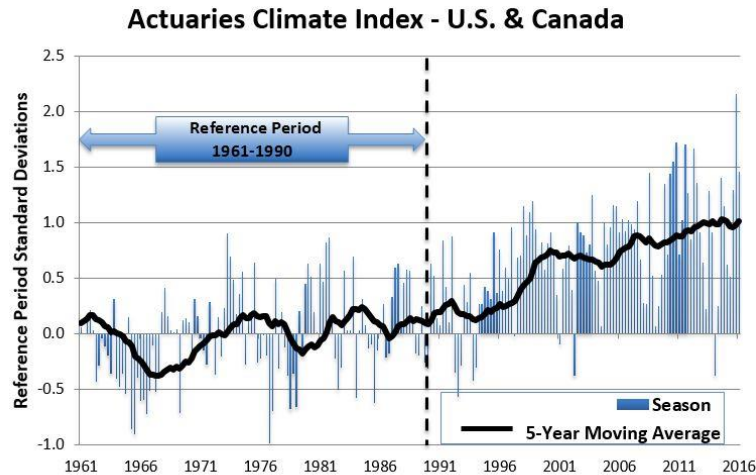
<sup>8</sup> <http://www.eluniverso.com/2011/10/01/1/1430/ecuador-registra-tasas-deforestacion-mas-altas-latinoamerica.html>

<sup>9</sup> <http://www.eltelegrafo.com.ec/noticias/sociedad/4/la-deforestacion-en-ecuador-se-redujo-en-un-49-en-los-ultimos-20-anos>

temperatures have increased in 0.6 degrees Celsius. It doesn't seem like much of a change, but this increase in temperature has led to abrupt variations in different climate factors.

These changes can be observed in the Actuaries Climate Index developed by the Climate Change Committee, that examines changes in the frequency and duration of extreme temperatures over a given time period: high and low temperatures, abundance of rainfall, strong winds, droughts, and variations in ocean currents. The results are shown in the following graph:

*Table 3: Actuaries Climate Index*



Source: Actuaries Climate Index

The fluctuation of this index is represented in blue. The black line represents the 5 year average taken from the reference period of 1961 to 1990. It can easily be observed that the temperature, precipitation, and other climate variables are straying from the average.

#### **4. Proposal**

Due to these alarming problems, we propose a solution that not only holds its own as a viable investment vehicle, but will also prevent governments from using IESS's funds for unrelated purposes. We aim at stimulating the Ecuadorian economy for a more stable labor market. At the same time, our intention is to help with the environmental conservation of the country's forests, and contribute to the battle against climate change.

We propose an investment program to be carried out by the Ecuadorian Institute of Social Security (IESS) in reforestation and forestry projects that matches the future liabilities of the pension payments with an investment portfolio of tree species that mature at different time.

#### **5. Actuarial Analysis**

The actuarial analysis focuses on the expected behavior of the future liabilities of the IESS Pension Fund, based on the current affiliated population, in order to relate them to an investment portfolio in the forestry sector that combines several species that reach maturity in different time horizons.

This section analyzes the sustainability and viability of this project, considering the current financing sources of the IESS Pension Fund, its demographic composition, population projections, and its projected future liabilities corresponding to the payment of pensions.

In the following table, we have projected the expected behavior of active contributors and retirees of the IESS Pension Fund in order to analyze the number of contributors that will finance the future pensions.

*Table 3: Expected Behavior of Active Contributors and Retirees of the IESS Pension Fund (thousands)*

EXPECTED BEHAVIOR OF THE IESS ACTIVE AND RETIRED POPULATION												
Years of Contribution	43	38	33	28	23	18	13	8	3	0	0	Pensioners
Age Group	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+	
2017	26	341	535	525	432	369	325	268	210	127	77	205
2018	26	340	534	524	431	368	324	267	210	127	77	204
2019	26	340	533	524	430	367	324	267	209	126	77	203
2020	26	339	532	523	429	367	323	266	208	126	76	410
2021	26	339	531	522	429	366	322	265	208	125	75	408
2022	26	338	531	521	428	365	321	265	207	124	75	406
2023	26	338	530	520	427	364	321	264	206	124	74	404
2024	26	337	529	519	426	364	320	263	205	123	74	402
2025	26	336	528	518	425	363	319	262	204	122	73	661
2026	25	336	527	517	424	362	318	261	203	121	72	657
2027	25	335	526	516	423	361	317	260	202	120	71	653
2028	25	335	525	515	423	360	316	259	201	119	70	649
2029	25	334	524	514	422	359	315	258	200	118	69	645
2030	25	334	523	513	421	358	314	257	198	117	68	954
2031	25	333	522	512	420	357	313	255	197	116	0	881
2032	25	332	521	511	419	356	312	254	195	114	0	875
2033	25	332	520	510	418	355	311	253	194	113	0	870
2034	25	331	519	509	417	354	309	251	192	111	0	863
2035	25	331	518	508	415	353	308	249	190	109	0	1,209
2036	25	330	517	506	414	351	306	248	188	108	0	1,201
2037	25	329	516	505	413	350	305	246	186	0	0	1,086
2038	25	329	515	504	412	349	303	244	183	0	0	1,078
2039	25	328	514	503	411	347	301	241	181	0	0	1,070
2040	25	327	513	501	409	346	299	239	178	0	0	1,470
2041	25	327	511	500	408	344	297	236	175	0	0	1,459
2042	25	326	510	498	406	342	295	233	171	0	0	1,447
2043	25	325	509	497	404	340	292	230	168	0	0	1,435
2044	25	325	508	495	403	338	289	227	0	0	0	1,257
2045	25	324	506	494	401	336	286	224	0	0	0	1,740
2046	25	323	505	492	399	333	283	220	0	0	0	1,727
2047	25	322	503	490	397	331	280	216	0	0	0	1,713
2048	24	322	502	488	394	328	276	211	0	0	0	1,698
2049	24	321	500	486	392	325	272	206	0	0	0	1,681
2050	24	320	498	484	389	322	268	0	0	0	0	1,961
2051	24	319	497	481	387	318	263	0	0	0	0	1,946
2052	24	318	495	479	384	314	258	0	0	0	0	1,930
2053	24	317	493	476	380	310	253	0	0	0	0	1,912
2054	24	316	491	473	377	306	247	0	0	0	0	1,894
2055	24	315	488	470	373	301	241	0	0	0	0	2,188
2056	24	314	486	466	369	296	235	0	0	0	0	2,166
2057	24	313	483	463	365	290	0	0	0	0	0	1,937
2058	24	311	481	459	360	284	0	0	0	0	0	1,919
2059	24	310	478	455	355	278	0	0	0	0	0	1,898
2060	24	309	474	450	349	271	0	0	0	0	0	1,877

It is important to highlight that in this projection we only include the active population of contributors that will become retirees in future years and not the current population of pensioners themselves. This is because the purpose of this analysis is to tie the future liabilities of current contributors to



different forestry species, so that when current generations retire, part of their pensions will be covered by the return on these long-term investments.

As it can be observed, by 2060, the population of retirees of the IESS from this closed group will be of around 1.88 million.

The current total population of active contributors of the IESS is divided into different age groups or cohorts varying from 15 to 19 years, and go all the way to over 65. In each group, we have determined the average number of years of contributions that the active affiliates still need to make, assuming that the retirement age is 60. Let's take for example the age group between 50 and 54 years. The population in this age group will retire in an average of 8 years to be able to meet the age requirement for retirement. On the other hand, it is projected that the population in this group of age will pass away progressively and only 206,000 will reach the year 2049, considering life expectancy.

In this way, different forest species will be associated with each age group, in order to match the maturity time of each specie with the future liabilities of each generation of contributors, according to their time to retirement.

### **5.1 Portfolio of Tree Species for Investment**

In order to conduct a pilot plan of how this initiative would work in practice, we will perform an analysis with a simplified scenario of the investment of pension funds of the IESS in three tree species that grow in different parts of the country: Teak, Pine Radiata, and Bamboo.

This analysis is based on the hypothesis that the internal rates of return of each species chosen to be part of the forestry investment portfolio are constant every year. In addition, we assume that all pensioners will receive an average pension of US\$ 550 a month, and 25% of the financing for these pensions will come from the yields of our tree investment portfolio.

The internal rates of return of each species vary according to the country and market in which they are sold. On the other hand, for this analysis we have taken the information on the internal rates of return from several national and international sources as a good estimate to the Ecuadorian market for tree plantations and timber. The following table contains the estimated internal rates of return for each one of the species chosen for investment, as well as the terms in which they will be invested, according to the time of maturity of each tree species and the number of years until retirement of the different age groups of the active contributors of the IESS (*Table 3*).

*Table 4: Internal Rate of Return and Terms for Investment in Tree Species*

Species	Teak	Pine Radiata	Bamboo
IRR (%)	23.77%	15.60%	23.01%
Term (years)	43,38 and 33	28, 23 and 18	13, 8 and 3

As observed, Teak has the highest rate of return of these three species (23.77%), followed by Bamboo (23.01%) and Pine (15.60%).

In terms of the prices and uses of wood, they vary widely depending on the maturity of wood and overall quality of the product. Teak's price per cubic meter can vary from US\$ 100 to around US\$ 700. It is the most expensive type of timber from our investment portfolio. This type of wood is

mostly used for furniture, floors, boats, fences, piles for bridges, and packing, among other uses. Moreover, Pine's price per cubic meter can vary from US\$ 22 to approximately US\$ 38, and can be used for furniture, pulp and paper, packaging, boards, and agglomerates. Lastly, Bamboo's price per cubic meter varies from US\$ 31 to around US\$ 43. Amongst its uses are construction material, floors, furniture, irrigation systems, foliage, toys, and agricultural support.

In terms of location, we have chosen an investment portfolio of tree species that grow in the coastal area as well as in the Andean mountains in order to diversify risk. Teak and Bamboo grow at the coast in 6 different provinces, while Pine Radiata grows in the highlands in 5 different provinces. The idea of this investment is to diversify risk by cultivating the trees in different locations. In this way, many communities will participate in the different economic activities related to the cultivation and processing of timber.

## **5.2 Investment**

In order to find out the amount of investment needed to finance 25% of pensions for the future retirees of the current generations of active contributors of the IESS, we conduct an analysis applying the concept of asset liability management in order to match the future liabilities of pension payments with an investment portfolio of species that mature at different times.

In the following cash flow, we compare the projected cost of pensions with the expected income from contributors, assuming a constant pension of US\$ 550 a month. Part of the difference between the cost of pensions and the income received from contributions is expected to be covered by the yields of the tree investment portfolio.

By applying the internal rates of return for each tree species, we obtain the amount of investment the IESS needs to make in each species in order to receive the yields needed to cover the financing needed for the payment of pensions.

As observed in the next Table, Teak will be planted in order to match the future liabilities of the younger generations of the IESS, as its maturity horizon matches the number of years remaining for these contributors to retire. On the other hand, Pine will be cultivated to cover the pension payments of the age groups ranging from 30 to 44, and Bamboo will finance the benefit payments of the older generations that will retire soon.

In this way, if the IESS decides to invest in Teak, Pine and Bamboo to cover 25% of pensions for the current generation of active contributors when they retire, it would need to invest approximately US\$ 4.61 billion dollars. This amount is equivalent to 57% of the current debt that the Government holds with the Pension Fund and represents 5% of the country's GDP.

*Table 5: Investment in 3 species for the financing of the 9 current cohorts  
IESS Pension Fund  
(in thousands)*

Year	Pensioners	Active Contributors	Total Cost of Pensions	Income from Contributions	1 Teak 23.77% 43	2 Teak 23.77% 38	3 Teak 23.77% 33	4 Pine Radiata 15.60% 28	5 Pine Radiata 15.60% 23	6 Pine Radiata 15.60% 18	7 Bamboo 23.01% 13	8 Bamboo 23.01% 8	9 Bamboo 23.01% 3	TOTAL IN US\$
2017	205	3,237	1,498,758	1,700,060	49	1,900	8,675	168,813	288,938	514,250	421,250	990,000	2,216,900	<b>4,610,774</b>
2018	204	3,324	1,536,484	1,988,012	60	2,352	10,737	195,147	334,012	594,473	518,180	1,217,799	2,727,009	
2019	203	3,414	1,574,631	2,431,139	74	2,911	13,289	225,590	386,118	687,211	637,413	1,498,015	3,354,493	
2020	410	3,506	3,279,012	2,860,472	92	3,602	16,448	260,782	446,352	794,416	784,081	1,842,708	4,126,362	
2021	408	3,601	3,361,551	3,208,305	114	4,459	20,358	301,464	515,983	918,345	964,499	2,266,715		
2022	406	3,698	3,445,028	3,392,015	141	5,519	25,197	348,493	596,476	1,061,606	1,186,430	2,788,286		
2023	404	3,798	3,529,275	3,586,233	175	6,830	31,186	402,858	689,526	1,227,217	1,459,427	3,429,870		
2024	402	3,900	3,614,104	3,869,776	216	8,454	38,599	465,703	797,093	1,418,663	1,795,241	4,219,084		
2025	661	4,006	6,127,816	4,092,347	268	10,463	47,774	538,353	921,439	1,639,974	2,208,326	5,189,895		
2026	657	4,114	6,276,949	4,328,157	331	12,951	59,130	622,336	1,065,183	1,895,810	2,716,462			
2027	653	4,225	6,427,047	4,577,551	410	16,029	73,185	719,421	1,231,352	2,191,556	3,341,520			
2028	649	4,339	6,577,698	4,841,311	507	19,839	90,581	831,650	1,423,443	2,533,439	4,110,404			
2029	645	4,456	6,728,454	5,120,265	628	24,555	112,113	961,388	1,645,500	2,928,656	5,056,208			
2030	954	4,576	10,254,627	5,415,286	777	30,392	138,762	1,111,364	1,902,198	3,385,526	6,219,642			
2031	881	4,725	9,751,248	5,757,923	962	37,616	171,745	1,284,737	2,198,941	3,913,668				
2032	875	4,879	9,981,368	6,122,233	1,191	46,557	212,569	1,485,156	2,541,976	4,524,200				
2033	870	5,037	10,211,875	6,509,588	1,474	57,624	263,097	1,716,840	2,938,524	5,229,975				
2034	863	5,201	10,442,014	6,921,445	1,824	71,321	325,635	1,984,668	3,396,934	6,045,852				
2035	1,209	5,370	15,065,936	7,359,354	2,258	88,274	403,038	2,294,276	3,926,856	6,989,004				
2036	1,201	5,544	15,408,127	7,824,962	2,795	109,256	498,841	2,652,183	4,539,445					
2037	1,086	5,724	14,353,855	8,320,020	3,459	135,226	617,415	3,065,923	5,247,598					
2038	1,078	5,910	14,680,000	8,846,393	4,281	167,370	764,175	3,544,207	6,066,224					
2039	1,070	6,102	15,004,812	9,406,059	5,299	207,153	945,819	4,097,104	7,012,555					
2040	1,470	6,301	21,235,926	10,001,124	6,558	256,394	1,170,640	4,736,252	8,106,513					
2041	1,459	6,505	21,709,178	10,633,828	8,117	317,339	1,448,902	5,475,107						
2042	1,447	6,717	22,179,333	11,306,548	10,047	392,770	1,793,305	6,329,224						
2043	1,435	6,935	22,644,286	12,021,819	12,435	486,132	2,219,574	7,316,583						
2044	1,257	7,160	20,435,122	12,782,328	15,390	601,685	2,747,167	8,457,970						
2045	1,740	7,393	29,135,402	13,590,938	19,049	744,705	3,400,168	9,777,413						
2046	1,727	7,633	29,782,461	14,450,690	23,577	921,722	4,208,388							
2047	1,713	7,881	30,424,954	15,364,818	29,181	1,140,815	5,208,722							
2048	1,698	8,137	31,059,968	16,336,761	36,117	1,411,987	6,446,836							
2049	1,681	8,401	31,684,338	17,370,174	44,702	1,747,616	7,979,249							
2050	1,961	8,674	38,066,847	18,468,946	55,328	2,163,025	9,875,916							
2051	1,946	8,956	38,906,403	19,637,208	68,479	2,677,176								
2052	1,930	9,247	39,739,123	20,879,356	84,757	3,313,541								
2053	1,912	9,548	40,561,095	22,200,060	104,904	4,101,169								
2054	1,894	9,858	41,368,077	23,604,290	129,839	5,076,017								
2055	2,188	10,178	49,244,072	25,097,326	160,702	6,282,586								
2056	2,166	10,509	50,192,583	26,690,144	198,901									
2057	1,937	10,850	46,252,117	28,384,053	246,180									
2058	1,919	11,203	47,177,092	30,185,467	304,696									
2059	1,898	11,567	48,079,912	32,101,205	377,123									
2060	1,877	11,943	48,954,619	34,138,532	466,765									

## 6. Projected Solution

After analyzing the demographic composition of the IESS Pension Fund, the projected incomes and future liabilities for the payment of pensions, and the return on investment of the different tree species, we have obtained that in order to achieve the goal of paying a life annuity of an average monthly pension of US\$ 550 to 25% of the current generations of active contributors and future retirees of the IESS, US\$ 4.61 billion should be invested, distributed as follows: US\$ 10.62 million in Teak, US\$ 972 million in Pine Radiata and US\$ 3.63 billion in Bamboo.

Furthermore, the investment of the IESS Pension Fund in this proposed project would bring many benefits in the economic, social, and environmental spheres.

In the first place, this investment will prevent governments from using liquid IESS funds for unrelated purposes, as it has been doing so in recent years. That is, there will be funds invested in the long-term that can't be used immediately for loans to the government, transfers of capital from one fund to another, among other purposes other than for the payment of pensions. In addition,

divestment would not be possible because the funds will be invested in tangible goods, meaning that the IESS wouldn't be allowed to deplete their invested reserves for the payment of pensions that should be financed alone by the contributions from active affiliates and investment yields. In this way, this investment program would help mitigate the first problem that was mentioned in the first section of this paper: the depletion of the IESS Pension Fund.

In addition, it would target the second issue mentioned above regarding the increasing number of unemployed and underemployed workers in the Ecuadorian economy. By investing in tree plantations, jobs would be generated, not only in the plantation and felling of trees, but in the different industries related to the timber industry. This is due to the fact that this investment would fortify the wood industry in the country, creating new economic opportunities such as the production of furniture, handicrafts, paper, agglomerates, and related activities. In this way, Ecuador will be able to consolidate as a strong timber exporter, decreasing its dependency on oil production.

Additional to these benefits in the economic and social spheres, this project without a doubt would help the country fight against deforestation and other environmental destruction that occurs at alarming rates. Planting more trees will help capture more carbon dioxide and greenhouse gases that cause global warming, will help with the regulation of the rain cycles, and maintain the flow of rivers. In addition, forests can clean up air pollution to improve the quality of the air we breathe in. In terms of biodiversity, forests could help us maintain and conserve species that are not found anywhere else in the world.

In addition, to the State Pension Fund investing in this type of forestry project, this method of investment can be expanded to other participants of the economy. This could open up new opportunities for individual citizens to invest in responsible projects or for companies to participate by offering retirement plans for employers as additional benefits with programs tied to the forestry field. In this way, Ecuadorians could be offered the opportunity to capitalize their money in good performing investments, and at the same time promote a more responsible economic development.

As seen, Ecuador's biodiversity and privileged geographical location can be used in our advantage in order to stimulate a sustainable economic model. Our proposal for the IESS to invest its funds in reforestation and forestry projects can be expanded further to include other members of our economy, to help mitigate certain social and economic issues that are alarming, and at the same time fight for the correct conservation of the country and our planet's future.

Finally, it is our responsibility as actuaries to be more involved in our society by protecting our pensioners and searching for solutions that can help our communities' economic, social and environmentally responsible development.

**Rodrigo Ibarra-Jarrín**

## References and Bibliography

- Actuarial Consultores.(2013) “Consultoría Actuarial para la revisión y aprobación de los balances actuariales del Instituto Ecuatoriano de Seguridad Social”. (Acceso: 10/02/2017).
- Actuaries Climate Index. “Component Graphs: USA and Canada”. Extraído desde: <http://actuariesclimateindex.org/explore/component-graphs/>. (Acceso: 14/02/2017).
- “Bamboo Business. Rentability of the Project”. Extraído desde: <http://www.bambuguaduapremier.com/WebEng/viabilitybamboo.php>. (Acceso: 25/01/2017).
- Index Mundi. “Expectativa de Vida al Nacer: Ecuador”. Extraído desde: <http://www.indexmundi.com/g/g.aspx?c=ec&v=30&l=es>. (Acceso: 14/02/2017).
- Instituto Ecuatoriano de Seguridad Social.(27/04/2016). “Cobertura Institucional”. Extraído desde: [https://www.iess.gob.ec/es/medios-de-verificacion/-/document\\_library\\_display/3Enk/view/6794106/42901?\\_110\\_INSTANCE\\_3Enk\\_redirect=https%3A%2F%2Fwww.iess.gob.ec%2Fes%2Fmedios-de-verificacion%3Fp\\_p\\_id%3D110\\_INSTANCE\\_3Enk%26p\\_p\\_lifecycle%3D0%26p\\_p\\_state%3Dnormal%26p\\_p\\_mode%3Dview%26p\\_p\\_col\\_id%3Dcolumn-1%26p\\_p\\_col\\_count%3D1](https://www.iess.gob.ec/es/medios-de-verificacion/-/document_library_display/3Enk/view/6794106/42901?_110_INSTANCE_3Enk_redirect=https%3A%2F%2Fwww.iess.gob.ec%2Fes%2Fmedios-de-verificacion%3Fp_p_id%3D110_INSTANCE_3Enk%26p_p_lifecycle%3D0%26p_p_state%3Dnormal%26p_p_mode%3Dview%26p_p_col_id%3Dcolumn-1%26p_p_col_count%3D1). (Acceso: 01/02/2017).
- Instituto Ecuatoriano de Seguridad Social. (30/06/2016). “Ejecución presupuestaria de ingresos al 30 de junio de 2016”. Extraído desde: <https://www.iess.gob.ec/documents/10162/8122aa89-3faa-481c-89c9-9e2a18a0ab04>. (Acceso: 20/01/2017).
- Instituto Ecuatoriano de Seguridad Social.(27/04/2016). “Informe Narrativo Redención de Cuentas”. Extraído desde: [https://www.iess.gob.ec/es/fase-1/-/document\\_library\\_display/3Enk/view/6794102/42905?\\_110\\_INSTANCE\\_3Enk\\_redirect=https%3A%2F%2Fwww.iess.gob.ec%2Fes%2Ffase-1%3Fp\\_p\\_id%3D110\\_INSTANCE\\_3Enk%26p\\_p\\_lifecycle%3D0%26p\\_p\\_state%3Dnormal%26p\\_p\\_mode%3Dview%26p\\_p\\_col\\_id%3Dcolumn-1%26p\\_p\\_col\\_count%3D1](https://www.iess.gob.ec/es/fase-1/-/document_library_display/3Enk/view/6794102/42905?_110_INSTANCE_3Enk_redirect=https%3A%2F%2Fwww.iess.gob.ec%2Fes%2Ffase-1%3Fp_p_id%3D110_INSTANCE_3Enk%26p_p_lifecycle%3D0%26p_p_state%3Dnormal%26p_p_mode%3Dview%26p_p_col_id%3Dcolumn-1%26p_p_col_count%3D1). (Acceso: 06/02/2017).
- Instituto Ecuatoriano de Seguridad Social. (02/12/15). Resolución No. C.D. 501. Extraído desde: <https://www.iess.gob.ec/documents/10162/33703/C.D.+501?version=1.0>. (Acceso: 14/02/2017).
- Instituto Nacional De Estadística Y Censos (INEC). “Encuesta Nacional de Empleo, Desempleo y Subempleo: Indicadores Laborales diciembre 2016”. Extraído desde: [http://www.ecuadorencifras.gob.ec/documentos/web-inec/EMPLEO/2016/Diciembre-2016/122016\\_Presentacion\\_Laboral.pdf](http://www.ecuadorencifras.gob.ec/documentos/web-inec/EMPLEO/2016/Diciembre-2016/122016_Presentacion_Laboral.pdf). (Acceso: 16/01/2017).
- Instituto Nacional De Estadística Y Censos (INEC). (1/01/2015). “Población Y Demografía”. Extraído desde: <http://www.ecuadorencifras.gob.ec/poblacion-y-demografia/>>. (Acceso: 05/02/2017).
- Keyla Pilar Dalmau Ribadeneira, Sonia Johanna Gallardo Bastidas, Iván Rivadeneira. “Proyecto de Cultivo de Teca como Alternativa de Forestación e Inversión a Largo Plazo”. Extraído desde: <https://www.dspace.espol.edu.ec/bitstream/123456789/648/1/1195.pdf>. (Acceso: 10/02/2017).
- “Social, economic and environmental considerations”. Extraído desde: <http://www.fao.org/docrep/018/i3274e/i3274e03.pdf>. (Acceso: 11/02/2017).