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PAU Tensiometer Innovative Technology Insurance Scheme (PAUTITIS)



Summary Report



Agriculture Insurance Company of India Limited

CIPT
Centers for International Projects Trust

Centers for International Projects Trust (CIPT)

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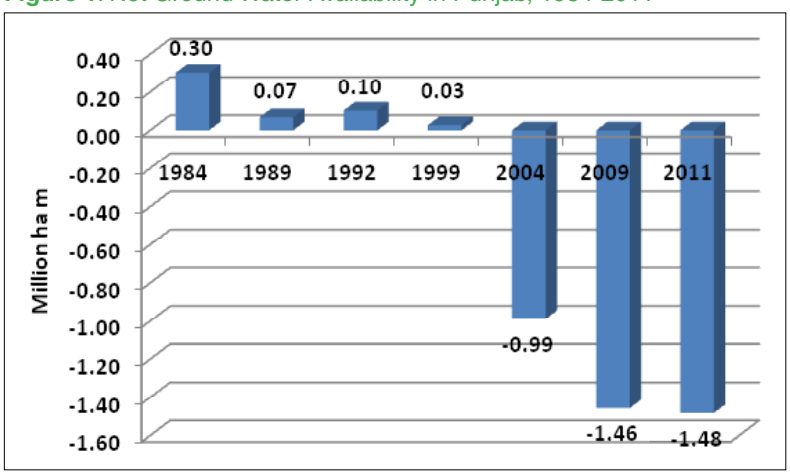
1. Introduction

Punjab agriculture is a fitting example of intensive cultivation with the dominance of rice-wheat monoculture. Cropping intensity and input use of Punjab is highest among all the states in India. The NPK use in Punjab is 243kg/ha, cropping intensity is 189% and area under assured irrigation is 98%, which are much above the national averages (135kg/ha, 138% and 45%, respectively). Almost three-fourth of the cultivated area is irrigated by groundwater. Assured procurement, high productivity and remunerative pricing of paddy and wheat crops favored the dominance of paddy-wheat monoculture. The combined area under these crops was less than 40% during 1966-67 which has touched almost 80% in the recent times.

Water intensive nature of paddy cultivation, increasing dependence on groundwater resources and increasing cropping intensity coupled with fast pace of urbanization and industrialization led to the widening gap between the demand for groundwater and sustainable levels of its supply over time. The ever increasing demand-supply gap is visible from the net availability of groundwater in Punjab declining from 0.30 million ha m in 1984 to 0.03 million ha m in 1999, turning negative from 0.99 million ha m in 2004 to 1.48 million ha m in 2011 (Figure 1).

Figure 1: Net Ground Water Availability in Punjab, 1984-2011



Source: Central Ground Water Board

The potential solutions to achieve long-term sustainability of groundwater resources in Punjab include a significant shift in the cropping pattern by pursuing crop diversification and the promotion of a number of water saving technologies and practices in the major food crops. The efforts of crop diversification have not been very successful in the past due to multiple reasons such as comparatively poor economics, and less effective procurement, and relatively much higher production risk of alternative crops as compared to paddy and wheat. However, the water saving technologies such as laser levelling of land has shown remarkable success in the past and has proved to be very effective in water conservation. There are other technologies and practices such as tensiometer and direct seeding of rice which have a significant potential to save water use in agriculture. These technologies can significantly bring down the consumption of water in paddy, the most water intensive crop of the region.

2. Tensiometer: A Low-Cost Water Saving Device for Paddy

The Centers for International Projects Trust (CIPT), in collaboration with Punjab Agricultural University (PAU),has been promoting the use of tensiometers in paddy amongst the farmers of Punjab since 2009.

The tensiometer is a simple device designed to measure soil moisture or water potential, i.e. the energy plants need to exert to pull water from the soil at current moisture condition. It consists of a porous ceramic cup, connected through a rigid body tube to a vacuum chamber and all the components are filled with water. The body tube is transparent so that the water within the tensiometer can be seen easily.

The tensiometer is inserted in the soil in such a way that the ceramic cup is placed in the plant root zone. The ceramic cup is porous so that water can move though it to equilibrate with the soil water. A partial vacuum is created as water moves from the sealed tensiometer tube. The pressure associated with this vacuum is a measure of the energy that would need to be exerted by the plant to extract water from the soil. It can be recorded by a gauge or the critical values for a particular plant can be marked on the tube.

Figure 2: PAU Tensiometer

The idea behind the use of tensiometer is that if the indicated soil moisture is below what the plant optimally needs to grow, there is need to irrigate. Such irrigation scheduling can reduce water use in crop because farmer generally over irrigates the crop irrespective of its requirement especially when water and power to pump out water is free of cost or highly subsidized. A simplified version of tensiometer was developed by the Punjab Agricultural University, Ludhiana, India with a nominal cost of about Rs. 450 per tensiometer and is shown in Figure 2.

In this tensiometer, the usual gauge has been replaced by three colored bands of green, yellow and red. While the water level in tensiometer at green level signifies no need for irrigation, there is need to irrigate when the level enters the yellow stripe level. The entry into red level indicates a level that may adversely affect crop yield.

3. About the PAUTITIS scheme

The Centers for International Projects Trust, Punjab Agricultural University and Agriculture Insurance Corporation of India (AIC) Limited developed an insurance product to promote the use of water saving technology “Tensiometer” amongst the paddy grower of Punjab in 2014. The objective of the scheme was to promote low cost technology and provide insurance coverage for the loss of yield due to use of technology among farmers. The CIPT, PAU and AIC piloted the scheme with 500 farmers of 8 different districts in Punjab during the Kharif season of 2014.

Unlike yield or weather insurance, which are more prevalent forms of crop insurance, insurance for promoting adoption of technologies must be looked upon differently. While scientific evidence points to no significant risk in adoption of such technologies, farmers may perceive some risk based on their own understanding. The insurance product must cover only that marginal risk of loss in productivity rather than covering the entire output in the crop.

Under the pilot named PAUTITIS, insurance was provided to farmers against the yield loss ranging between 75 to 250 kg per acre owing to the use of tensiometers in their paddy fields. CIPT paid a premium of Rs 135 per farmer for a total of 500 farmers, to help them to adopt the tensiometer technology. The purpose was not only to help them overcome any risk associated with yield loss through adoption of new technologies such as the tensiometer but also to make the farmers more aware about the sensitive water situation in the state and irrigate crops like paddy responsibly.

4. Execution of the scheme

CIPT and PAU developed an implementation and monitoring plan addressing the need of the scheme. A comprehensive approach was followed for promoting the use of tensiometers among new farmers and estimating the extent of water and energy savings. The approach comprised various steps which are outlined below:

4.1 Identification of the operational area

The tensiometers were installed in 8 districts of Punjab, namely, Amritsar, Kapurthala, Tarn Taran, Moga, Ludhiana, Sangrur, Barnala and Patiala. There were a total of 29 villages covered under the pilot. Some of the farmers in each village were covered by the insurance scheme and some were not insured in order to make a comparative evaluation of the effectiveness of the insurance product. In total, 500 farmers were offered the insurance product and 437 were selected as the control group, making a total of 937 farmers in the pilot.

4.2 Recruitment of field staff

A team of 10 field workers was recruited by CIPT under the USAID project for the installation, monitoring and promotion of tensiometers.

4.3 Installation and capacity building for use of tensiometers

The tensiometers were installed at the farmers' fields by well-trained field workers. The farmers were made aware of the issues of water depletion in Punjab and were trained effectively on the use of tensiometers. More than 50 training camps were held in different villages across the selected districts in Punjab.

4.4 Regular monitoring and follow up

The use of tensiometers by the farmers during the entire cultivation period of paddy was monitored regularly by the team of field workers. During monitoring, the field workers were ascertaining the users and non-users of technology and were also addressing the problems and queries of the farmers related to the use of tensiometers.

4.5 Data collection and analysis

CIPT and PAU team collected a comprehensive set of data related to the socio-economic profile of the farmers, land details, water table depth, irrigation water use and tensiometer reading from all the farmers

enrolled in the insurance scheme as well as from the control farmers for evaluation of the pilot project. The purpose of data collection was to evaluate the rate of adoption, extent of water and electricity saving and comparison of productivity across the farmers using tensiometers with and without insurance facility.

5. Socio-economic profile of the farmers participating in PAUTITIS pilot program

As discussed earlier, a total of 937 farmers participated in the pilot program on technology insurance (PAUTITIS). These farmers were classified into four categories, namely marginal (≤2.5 acres), small (2.5≤5 acres, medium (5≤10 acres) and large (>10 acres)farmers. While insurance against yield loss due to tensiometer adoption was provided to 500 farmers, around 437 farmers were selected as control group. These farmers were distributed almost similarly across the four farm size categories as was the case with insured farmers. The distribution of insured and non-insured farmers across various districts is given in Table 1.

Table 1: Distribution of insured and non-insured farmers across various districts

Name of the district	No. of villages	No. of insured farmers	No. of non-insured farmers	Total No. of farmers
Amritsar	7	150	92	242
Barnala	1	20	49	69
Kapurthala	4	60	77	137
Ludhiana	2	20	19	39
Moga	2	20	6	26
Sangrur	9	170	111	281
Patiala	3	40	53	93
Tarn Taran	1	20	30	50
Overall	**29**	**500**	**437**	**937**

A comparative analysis of the socio-economic characteristics of the farmers involved in the PAUTITIS project reveal that relatively younger farmers were inclined to opt for the insurance scheme as the average age for insured farmers was 39 years as compared to 47 years for non-insured farmers. The average number of years of schooling was also higher for the insured farmers (11 years) as compared to the non-insured farmers (8.7 years). In addition, the average size of operational holding for the insured and non-insured farmers was 10 and 9.1 acres, respectively. The farmers who opted for insurance product were having relatively larger proportions of area under paddy and that land was laser levelled. The detailed comparison of the socio-economic characteristics is given in Table 2.

Table 2: Socio-economic characteristics of the insured and non-insured farmers

Particulars	Insured farmers	Non-insured farmers
Average age (years)	39	47
Education (no. of years)	11	8.7
Av. Operational land (acres)	10	9.1
Av. area under paddy (acres)	9.1 (91)	7.4 (81)
Av. area laser levelled (acres)	6.2 (62)	4.9 (54)
Note: Figures in parentheses are percentages of total operated area		

6. Major findings of the PAUTITIS project

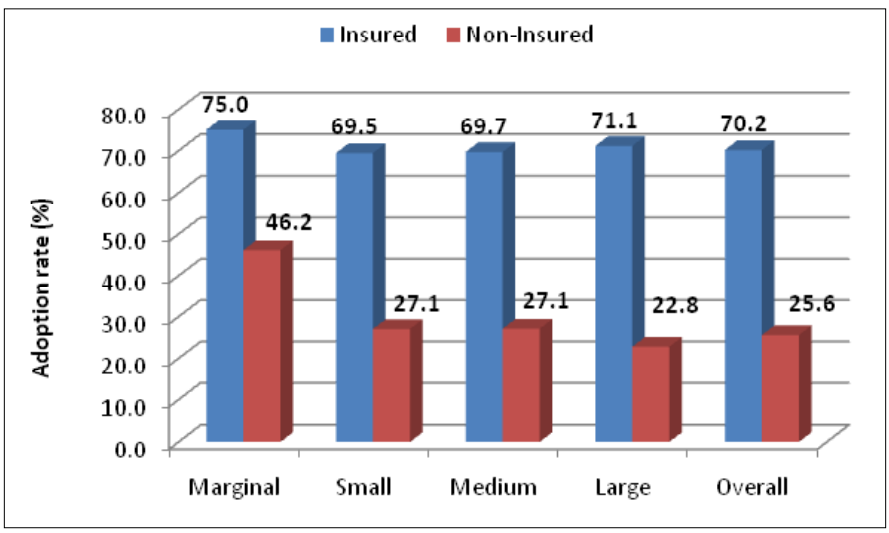
6.1 Technology insurance and adoption rate

The objective of the project was not only to help farmers save water but also strengthen the adoption rate of tensiometer through insurance. The figures below depict a comparison of adoption rates between the insured adopters i.e. the farmers who were insured and used tensiometers on their fields and the non-insured adopters meaning those who were not insured but had used the tensiometer on their fields.

The overall rate of adoption for insured farmers was 70.2%, while the adoption rate for non-insured farmers was 26.5%. The rate of adoption was substantially higher for all the farm size categories of insured farmers as compared to non-insured farmers. The adoption rates for different categories are depicted in Figure 3.

The rates of adoption for the insured and non-insured farmers were further explored across major categories

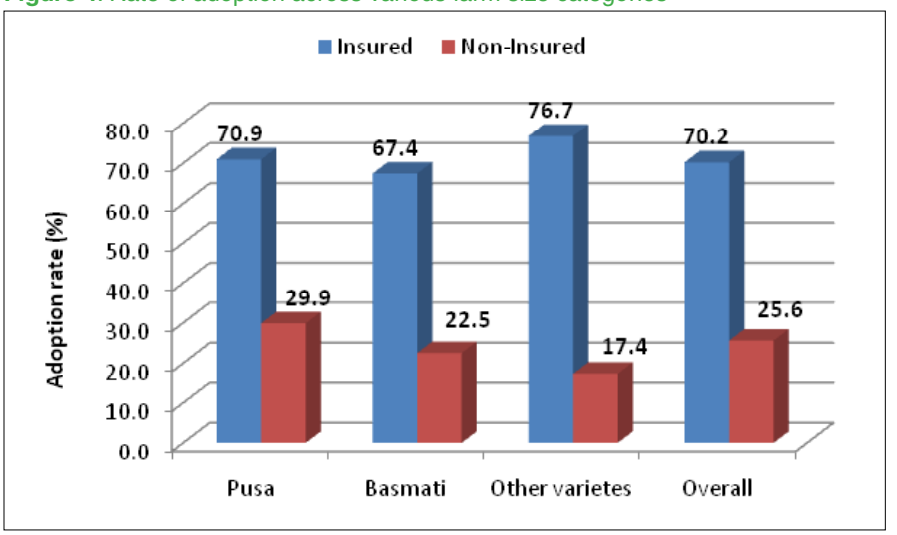
Figure 3: Rate of adoption across various farm size categories



of paddy sown. Such a categorization was made keeping in mind the varying water needs of such categories of paddy. The paddy was divided into i) Pusa, ii) Basmati and iii) other local varieties. It was evident from Figure 4 that the adoption rate was significantly higher amongst the insured category of farmers as compared to the non-insured farmers.

Finally, results showed that the adoption rates were much higher for the farmers who were insured for yield

Figure 4: Rate of adoption across various farm size categories



loss due to tensiometer use. It indicates the significant role that technology insurance can play in boosting the adoption of modern technologies, especially resource saving technologies.

6.2 Technology insurance, water and electricity savings

There was no clear trend on the impact of technology insurance on the extent of water saving. On an average, the extent of water saving was 806,174 litre/acre for insured farmers and 809,875 litre/acre for the non-insured ones (Table 3). The difference in the extent of water saving between the and insured and non-insured farmers was non-significant. Likewise, the extent of electricity saving was 142 Kwh/acre and 144 Kwh/acre for the insured and non-insured farmers, respectively. There was mixed evidence on the superiority of insurance in terms of extent of water saving across different districts of Punjab where the project was implemented. While the extent of water and electricity saving was higher for the insured farmers in Amritsar, Barnala, Sangrur, Patiala and Tarn Taran districts, the savings were relatively higher for the non-insured farmers in Kapurthala, Ludhiana and Moga.

A further examination of the water and electricity savings across different categories of paddy varieties revealed that insured farmers saved more water and electricity in Pusa varieties of paddy, while the non-insured farmers saved relatively more water in basmati and other varieties of paddy (Table 4). There are many other factors such as the depth of water table, horse power of motor, etc., which affect the extent of water and electricity use in a crop. A further refinement of the pilot program in the future may reveal whether there is any significant impact of the insurance on the extent of water saving or not.

Table 3: Extent of water and electricity saving across insured and non-insured farmers in various districts

Districts	Insured farmers		Non-insured farmers	
	Water saving (litre/acre)	Electricity saving (Kwh/acre)	Water saving (litre/acre)	Electricity saving (Kwh/acre)
Amritsar	654,431	103	646,457	102
Barnala	1,041,300	194	941,823	176
Kapurthala	703,455	118	718,400	121
Ludhiana	716,400	119	759,085	124
Moga	932,785	161	1,081,800	198
Sangrur	878,842	164	835,740	146
Patiala	1,023,579	183	925,400	162
Tarn Taran	814,400	141	746,400	128
Overall	**806,174**	**142**	**809,875**	**144**

Table 4: Extent of water and electricity saving across various categories of paddy

Districts	Insured farmers		Non-insured farmers	
	Water saving (litre/acre)	Electricity saving (Kwh/acre)	Water saving (litre/acre)	Electricity saving (Kwh/acre)
Pusa	882,513	161	843,288	153
Basmati	672,361	109	688,800	115
Other varieties	822,000	139	880,200	149
Overall	**806,174**	**142**	**809,875**	**144**

6.3 Technology insurance and impact on yield

The yield difference was measured as the difference in control plot and the tensiometer plot in quintals per acre. The control plot was taken as contiguous to the plot where tensiometers were installed. It was ascertained that practices of crop cultivation were same in both the plots. The yield difference between the control and the tensiometer plots for both insured and non-insured categories of farmers was found to be non-significant. However, the yield of rice in the tensiometer plots was higher than that of the control plot. The analysis of the yield differences revealed that differences were higher for insured farmers in Pusa varieties and the differences were higher for the non-insured farmers for basmati and other paddy varieties. For insured farmers, rice yields were higher by 4 to 19 kgs per acre and in case of non-insured adopters the rice yields of the tensiometer plot were as high as 70 kgs per acre (Table 5). If we relate the extent of water saving with the yield differences, it appears that larger reductions in water use in paddy were resulting into relatively higher yields. It points towards wasteful use of water in paddy and the need for enhancing water use efficiency in agriculture.

Table 5: Yield differences across insured and non-insured farmers

Varieties	Yield difference (qtls/acre)	
	Insured adopters	Non-insured adopters
Pusa	+0.04	+0.00
Basmati	+0.13	+0.70
Other	+0.19	+0.50

Note: + sign indicates that the yields in tensiometer plot were higher than that of the control plot

7. Conclusions

The insurance for the adoption of tensiometers in paddy resulted into a significant increase in the rate of adoption of the technology by the farmers. The adoption rate was more than 2.5 times the normal rate. However, there was no clear evidence related to the impact of technology insurance on the extent of water and electricity saving and also on the yield advantage. High rates of adoption ultimately translate into much higher savings of water and electricity which not only help in conserving the precious groundwater resource, but also in reducing the expenditure on electricity (in the form of subsidies) by the government. It is estimated that in the usual scenario without the provision of insurance for tensiometers, the 500 farmers in the PAUTITIS project could have saved only 107 million litres of water and 19,014 Kwh of electricity. However, the rise in adoption rate let to much higher water and electricity saving of 283 million litres and 49,982 Kwh, respectively.

In nutshell, the innovative insurance products can yield rich dividends in the form of resource savings and cost reduction by boosting the adoption of conservation technologies. These insurance products can be specially designed for the newly developed technologies and practices. The use of the insurance products can increase the rate of adoption and the process of adoption of the technologies can be achieved relatively faster than the normal process of dissemination.

* * *

PAUTITIS program in 2015

In continuation to PAUTITIS 2014, the same experiment is being carried out during the Kharif season of 2015 in Punjab. A total of 1,000 farmers (500 adopters and 500 non-adopters) have been sampled, from the same districts like the previous year, to carry out the proposed experiment. The number of farmers in each district is given in Table 6.

Table 6 : Spread and coverage of PAUTITIS 2015

S.No.	District	Number of Villages	Number of farmers
1)	Ludhiana	4	72
2)	Sangrur	3	72
3)	Moga	3	64
4)	Patiala	5	80
5)	Barnala	3	79
6)	Kapurthala	2	41
7)	Tarn Taran	5	51
8)	Amritsar	3	41

The idea behind this years experiment is to scientifically document and corraborate the water and energy savings due to the use of tensiometer. in addition, we also hope to risk-proof the farmers from yield losses, and demonstrate that insurance is expected to play an important role in boosting the adoption rates of any new technology.

Centers for International Projects Trust

The Centers for International Projects Trust (CIPT) is the India Office of the Columbia Water Center. Established in 2008 as not-for-profit trust, the purpose of CIPTs work is to understand and perform applied research in the fields of water, energy, agriculture, climate, environment and economic upliftment.

CIPT is developing and pilot testing new models for effective water and energy management across different regions of India. We work towards providing rigorous, research-based knowledge as the foundation for various field based initiatives involving the local communities, government, non-government and private partners.

Agriculture Insurance Company of India Limited

Agriculture Insurance Company of India Limited (AIC) has been formed at the behest of Government of India, consequent to the announcement by the then Hon'ble Union Finance Minister in his General Budget Speech FY 2002-03 that, "to subserve the needs of farmers better and to move towards a sustainable actuarial regime, it was proposed to set up a new Corporation for Agriculture Insurance".

AIC has taken over the implementation of National Agricultural Insurance Scheme (NAIS) which, until FY 2002-03 was implemented by General Insurance Corporation of India. In addition, AIC also transacts other insurance businesses directly or indirectly concerning agriculture and its allied activities.

Punjab Agricultural University

The Punjab Agricultural University (PAU) is located in Ludhiana, Punjab. The University covers an area of 1,510 acres on its main campus and 4,615 acres at the regional research stations. PAU performs the integrated functions of teaching, research and extension in agriculture, agricultural engineering, home science and allied disciplines.

PAU has played a key role in increasing food grain production in the Punjab State several folds share its reputation and ushering in an era of Green Revolution in India. It has also made notable contributions in increasing livestock and poultry production. In recognition of its outstanding achievements in agricultural research, education and extension, it was adjudged the Best Agricultural University in India in 1995.

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