DETAILED PROJECT REPORT

TOWARDS CLIMATE RESILIENT LIVESTOCK PRODUCTION SYSTEM IN PUNJAB

August, 2015
Submitted to
Ministry of Environment, Forest & Climate Change
Government of India

Prepared by:
Punjab State Council for Science & Technology

Technical support:
Deutsche Gesellschaftfür Internationale Zusammenarbeit (GIZ) GmbH

On behalf of:
Department of Science, Technology & Environment
Government of Punjab

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PROJECT SUMMARY

Title of Project/Programme:	Towards Climate Resilient Livestock Production System In Punjab
Project/Programme Objective/s:	To ensure sustainability of incomes for small and marginal livestock farmers under ongoing and projected warming scenario in Punjab and harness co-benefits through housing stray cattle in a climate friendly environment. To develop weather linked insurance to compensate for loss in income of small and marginalised farmers due to decrease in milk yield of buffalo/cattle.
Project/ Programme Sector:	Animal Husbandry
Name of Executing Entity/ies/Department:	Punjab State Council for Science and Technology, Government of Punjab
Beneficiaries:	Small to marginal farmers having landholdings of 1-2 ha and having 5-15 dairy animals (30% of the overall beneficiary under the project would be **women**)
Project Duration: Start Date: End Date:	5 years October 1, 2015 (tentative) October 31, 2020 (tentative)
Amount of Financing Requested (Rs.):	18,24,26,172
<u>Project Location</u> State: District:	 Punjab Ludhiana, Bhatinda and Tarn Taran
Contact Details of Nodal Officer of the Executing Entity/ies/: Email: Mobile:	Dr. Satnam Singh Ladhar Additional Director (Environment) Punjab State Council for Science & Technology, Sector 26, Chandigarh Email: ssladhar@yahoo.com Mobile: +919463200886

1. PROJECT BACKGROUND

1.1 Project / Programme Background and Context:

a) Provide brief information on the problem the proposed project/programme is aiming to solve.

The total milk production has gone up in India from around 58 million tons in 1993-94 to 146 million tons in 2014-15[1], making it number one milk producer in the world. The milk production across the years have boosted chiefly due to induction of crossbred cows (cows with 75% or above exotic blood mainly from Holstein and Jersey cows of European origin) from 4.2 million to 14.3 million between 1993 and 2012. The average milk yield of crossbred cows in India is around 7.15 kg/day as against an average milk yield of 5.15 kg/day and 2.54 kg/day of a buffalo and indigenous/non-descript cow[2]. Induction of crossbred cows at a fast rate has resulted in change in structure of the milk economy from being indigenous breed dominant to crossbred and buffalo dominant (see **figure 1**).

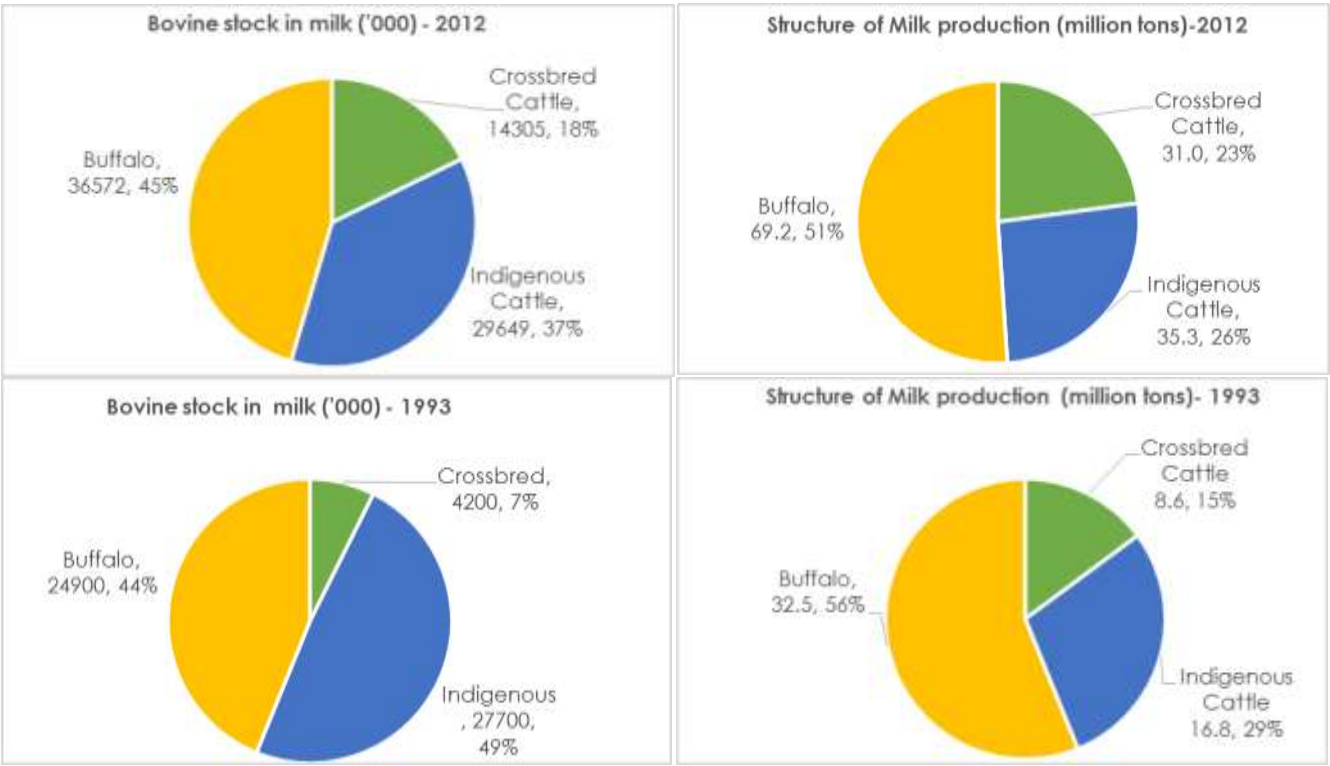

Figure 1: Changing structure of dairy production system in India 1993 and 2012

[1]World Bank 2011. Demand led transformation in milk production in India- Achievement, challenges and opportunities. Available at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2012/05/25/000333037_20120525000858/Rendered/PDF/689010ESW0P0990the0Livestock0setcor.pdf

[2]DAHD, 2014.Basic Animal Husbandry and Fisheries Statistics. AHS series 15.Deptt of Animal Husbadry, Dairying and Fisheries, Minsitry of Agriculture. Available at: http://dahd.nic.in/dahd/WriteReadData/Final%20BAHS%202014%2011.03.2015.pdf

In 2012, the animal husbandry sector in India contributed about 4.1% of the total GDP at current prices (approx. INR 2,17,000 Crores), and was 30% of the total agriculture GDP in 2012[3,4], indicating the sector's significant contribution to the economy. The bulk of the production i.e about 70% comes from the bovine stock holdings of 262 million small and marginal households[5,6].

Punjab has been one of the front runners in white revolution in the country. It ranks 5th in milk production amongst all the Indian states. The total milk production in the State has increased from 4.03 million tons in 1985-86 to 10.35 million tons in 2014-15[7]. Increasing production of milk in the State reflects the positive contribution of technological change in breeding and feeding[8]. In Punjab, agriculture contributes about 19.89% to the states GDP and animal husbandry, including dairy sector, contributing about 8.36%[9]. To increase the milk production in the State, a shift in structure of bovine stock has happened, same as trend at all India level with crossbred cows replacing indigenous breeds. The bulk of the milk in 2014-15 was from buffaloes (7.32 million tons), which is preferred for its higher fat content. In the same year, about 2.77 million tons, came from crossbred and comparatively meagre amount of about 0.21 million tons from indigenous and nondescript cows. Five yearly compounded growth rates indicate that milk production from cross bred cows have grown at the highest rate of 6.8% between the periods from 1985-90 to 2011-14. Milk production from buffaloes grew at a Compounded Annual Growth Rate (CAGR) at 2.13% during the same period. Indigenous and non-descript cows had a negative growth trend till 2005, however, between the period 2006-10, it has shown a revival (See **figure 2**).

[3]AHS, 2014.Basic Animal Husbandry and Fisheries Statistics, AHS Series 15.Deptt of animal Husbandry Dairying and Fisheries, Ministry of Agriculture. Available at: http://dahd.nic.in/dahd/WriteReadData/Final%20BAHS%202014%2011.03.2015.pdf

[4]Planning Commission, 2014.Data book. Available at: http://planningcommission.nic.in/data/datatable/data_2312/DatabookDec2014%202.pdf

[5]Mahendra Dev, 2012. Small farmers in India- Challenges and Opportunities. Working Paper WP 2012-14. Indira Gandhi Institute for Developmental Research. Available at: www.igidr.ac.in/pdf/publication/WP-2012-014.pdf

[6]India Statistical Abstract, 2014.MoSPI, GoI

[7] Animal Husbandry Department of Punjab, Chandigarh & BAHS 2014

[8]Parminder Kaur and A S Bhullar, 2012. Structure of Milk production in — An Analysis of Trends and Sour ends and Sources of Growth Received: June 2012. Indian Journal of Dairy Science.

[9]Statistical Abstract Punjab, 2010 -2011.Septt of Planning.Gov of Punjab.

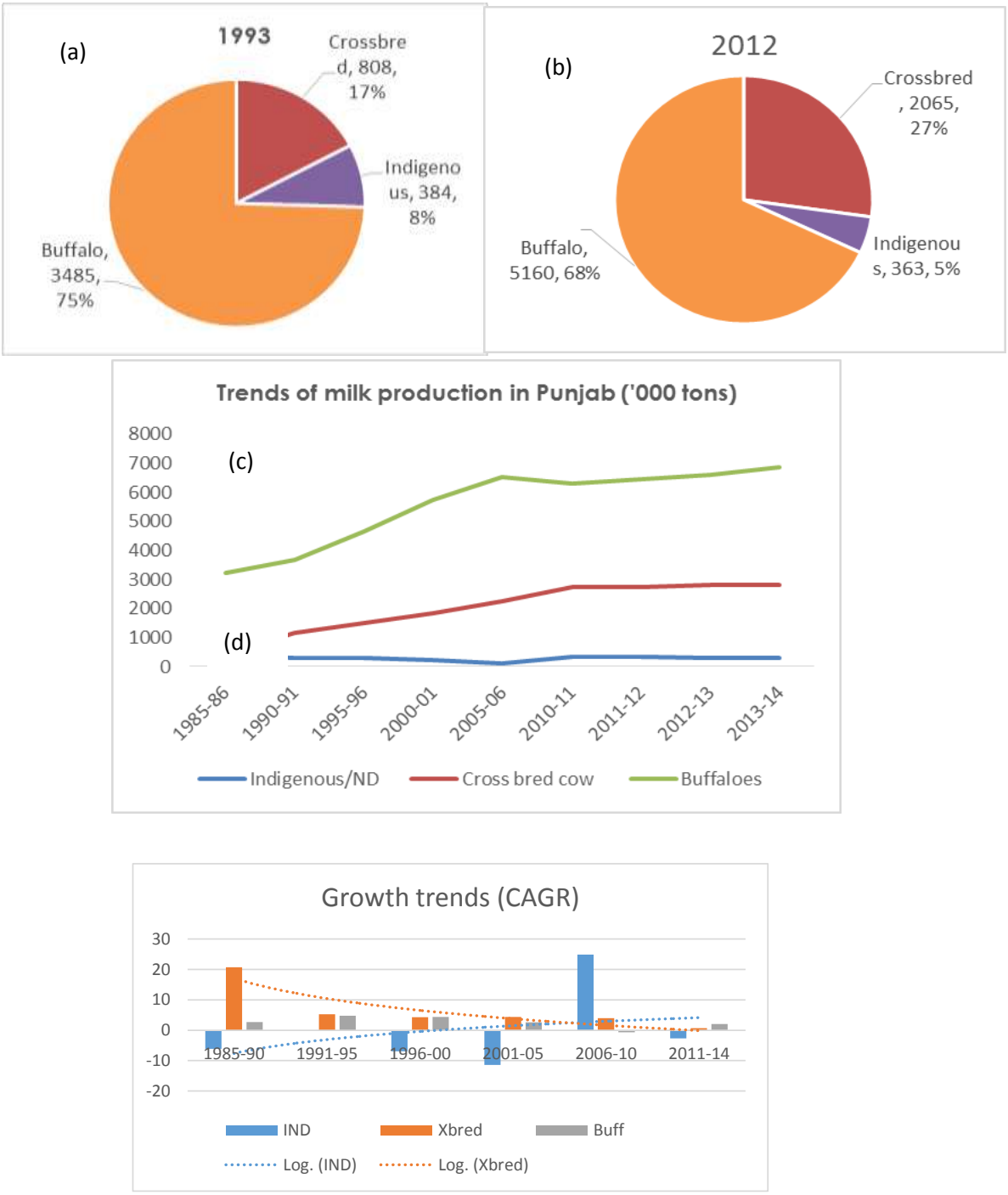

Figure 2: (a) Livestock structure trends in 1993 and (b) in 2007, (c) Milk production trends in Punjab between 1985-86 to 2013-14 by type of bovine stock (d) Five year compounded growth rates of bovine by stock in Punjab. *(Source: Animal Husbandry Department of Punjab, Chandigarh & BAHS 2014)*

Global warming may boost the frequency of occurrence and intensity of severe climate events leading to warmer and more intense summers. The frequency and severity of extreme climatic events such as drought, flooding, and long heat

waves would have substantial impacts on crop and livestock productivity, and therefore in food production and security. As a result of global warming, the prospective for food production from livestock is expected to decline because of high mortality, less productivity and more competition for animal resources[10],[11] (IFAD, 2010).

With rise in temperature and humidity, there is a likelihood of increase in incidence of animal diseases (bacterial, protozoan and viral) that are spread by insects and vectors. Frequency and incidence of mastitis and foot & mouth diseases affecting crossbred cows and other high milk producers. The disease incidence may increase due to increase in the number of stressful days (NAAS Policy paper 65, Dec 13). **As reported in India's National communication to the United Nations Framework Convention on Climate Change (UNFCCC), a rise in temperature by 2-4°C by 2050s will negatively impact milk production by more than 15 million tons by 2050 with respect to current levels of production[9].**

Considering that the bovine stock performance is impacted by heat stress, more in case of cross bred bovine stock and to a much lesser extent in indigenous varieties, it is important to manage heat stress to at least achievable sustainable milk production during such conditions. **This year i.e. in 2015, the temperatures have consistently been above 40°C for more than a week across most of India including Punjab, and which is likely to happen every year as global temperatures are rising due to climate change.** This is important from the point of view of the small and marginal farmers whose main fall back livelihood option, like elsewhere in India, is milk from its bovine stock holding when crops fail. Considering foreseeable challenges of sustainability of milk production as extreme temperature occurrences are likely to prevail in summers in future, it is necessary to have a course correction in the way livestock is managed by small and marginal farmers and the policies that have evolved so far to support them.

Other than the concerns regarding the crossbreds, the State also has a large population of stray cattle, which have been orphaned as they have lost their productivity. The stray cattle tend to destroy standing crops and are prone to accidents as they cross the highways. However when put inside a cooler environment[12,13], they can show better physiological status. Cooling systems essentially alleviate heat load by using the principle of evaporation, leading to

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[10]Sharma A, S. Tyagi, R Prasad, S Kumar, and D.K. Mandal, 2013.Vision 2050.Project Directorate Cattle. Indian Council of Agriculture Research, Meerut.

[11]IFAD, 2009.Livestock and Climate Change. In: Livestock Thematic Papers, International Fund for Agricultural Development. Available from http://www.docstoc.com/docs/22883886/Thematic-paper-on-Livestock-and-Climate-Change-final

[12]Avondano and Reyes, 2006.Avendaño-Reyes, L.; Álvarez-Valenzuela, F.D.; Correa-Calderón, A.; Saucedo-Quintero, J.S.;Robinson, P.H. &Fadel, J.G.(2006). Effect of Cooling Holstein Cows During the Dry Period on Postpartum Performance Under Heat Stress Conditions. Livestock Science. Vol. 105, No. 1-3, (December, 2006), pp 198-206, ISSN 1871-1413

[13]Kadzere, C.T.; Murphy, M.R.; Silanikove, N. &Maltz, E., 2002. Heat Stress in Lactating Dairy Cows: a Review. Livestock Production Science, Vol. 77, No. 1, (October 2002), pp. 59-91, ISSN 1871-1413

improved feed intake and milk production in areas with high environmental temperatures[14,15] .

Therefore, a project titled "Towards Climate Resilient Livestock Production System in Punjab" with an objective, to enhance the livestock production under heat stress conditions and harness co-benefits through housing stray cattle in a climate friendly environment is proposed. This project will ensure sustainability of incomes for small and marginal livestock farmers under the ongoing and projected warming scenario in Punjab. Further, the project also proposes to develop weather linked insurance product, for assessing compensation to the small and marginal farmers due to loss in livestock yield. The design of weather indexed insurance product will be based on the correlation of Temperature Humidity Index (THI) with the loss in milk yield. This project will therefore provide continuity of the income of small and marginalised farmers during heat stress conditions.

b) Outline the economic, social development and climate change in line with the State Action plan on Climate Change and relevant Missions under National Action Plan on Climate Change

The National Mission on Sustainable Agriculture under National Action Plan on Climate Change identified **drought proofing of livestock for overall economic development and improvement of the socio-economic conditions of the resource poor farmers** as one of the prioritized activities. The proposed activity is also highlighted under the Livestock section of Agriculture Chapter of the State Action Plan on Climate Change, which suggests managing heat stress through propagation of indigenous breeds and sheds for livestock.

The project proposes for sustained livestock productivity throughout the year through technologies such as Artificial insemination and Estrus management, targeting small to marginal farmers in the three districts of Punjab i.e. Ludhiana, Bhatinda and Tarn Taran (extreme heat prone districts of Punjab). This product is expected to revolutionise the milk economy by encouraging farmers for adopting indigenous diary animals, as their livelihoods will be ensured under climate stress periods.

This project also provide an opportunity for making the best use of stray cattle by housing them in a large climate resilient shed with in-built facilities of biogas plant, rain water harvesting, energy efficiency and renewable energy etc. This project for the first time in India proposes to develop and demonstrate weather linked insurance product for indigenous and crossbred cattle to compensate farmers for loss in milk yield due to increasing heat stress.

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[14] Armstrong, D.V., 1994. Heat Stress Interaction With Shade and Cooling. Journal of Dairy Science, Vol. 77, No. 7, (July 1994), pp. 2044-205, ISSN 0022-0302.

[15] Ryan, D.P.; Boland, M.P.; Kopel, E.; Armstrong, D.; Munyakazi, L.; Godke, R.A. & Ingraham,R.H., 1992. Evaluating Two Different Evaporative Cooling Management Systems forDairy Cows in a Hot, Dry Climate. Journal of Dairy Science, Vol. 75, No. 4, (April 1992),pp. 1052-1059, ISSN 0022-0302

c) Include climate analysis and vulnerability analysis.

Crossbred cows are homoeothermic animals, so they exhibit optimum performance in their neutral environment which is known as thermo-neutral zone (TNZ). For lactating dairy cows from European breeds, this TNZ ranges between -5 and 25°C, and are called lower critical temperature (LCT) and upper critical temperature (UCT)[7] respectively (see **Figure 3**). Within this temperature range, dairy cows require no additional energy above maintenance to cool or heat their body. LCT is the environmental temperature at which an animal needs to increase metabolic heat production to maintain body temperature. UCT is the environmental temperature at which the animal increases heat production as a consequence of a rise in temperature.

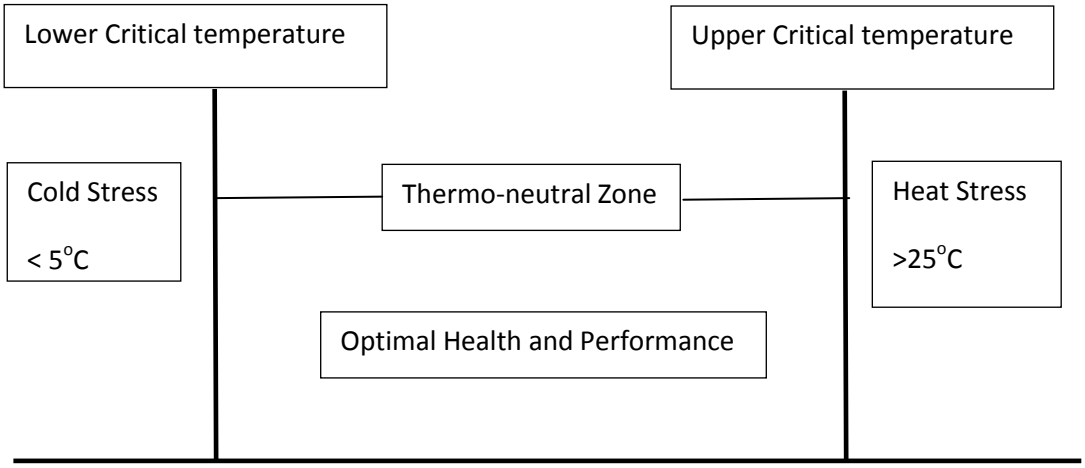

Figure 3: Critical temperature and thermo-neutral zone for crossbred cows
Adopted from Leonel Avendo-Reyes,2012[16]

Heat stress is generally parameterised by the Temperature-Humidity Index (THI), which combines ambient temperature and relative humidity to express an indicator of the degree of heat stress[17]. Heat stress can be derived using the following formula for every 2°C:

$$THI = (0.8 x T_{db}) + [RH/100) x (T_{db} – 14.4)] + 46.4$$

Where THI is Thermal Heat Index; T_{db} is the dry bulb temperature and RH is the Relative Humidity. When THI is less than 72 corresponding to temperatures

[16]Leonel Avendo Reyes, 2012.Heat stress management for milk production, Chapter 9 in the book on "Milk Production - An Up-to-Date Overview of Animal Nutrition, Management and Health", book edited by NarongsakChaiyabutr, ISBN 978-953-51-0765-1, Published: September 26, 2012. Available at: http://cdn.intechopen.com/pdfs-wm/39481.pdf

[17]Hahn L G, 1999.Dynamic Response of Cattle to Thermal Heat Loads. Journal of Animal Science, Vol. 51, E. Suppl. 1, (January 1999), pp. 10-20, ISSN 0021-8112

between -5°C to25^{o}C, the animal is most comfortable. If THI exceed 72, stress sets in. **Figure 4** represents the relationship of Temperature in ^{0}C with the relative humidity in %.

Eighty five percent of Indian region experiences THI>72 in the summer months extending from April to June and continues even in monsoon period till September. In these months, the value of THI ranges from 75-85 at 2.00-4.00p.m when the heat is at its peak. The night temperature remains high as well and morning THI is also high so there is no relief from heat stress[18].

Relative Humidity (%)

Temperature oC	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	65	70	75	80	85	90	95	100
0	62	64	66	67	69	70	72	74	75	77	78	80	82	83	85	86	88	90	91	93	94	98	102	106	138	114	118	122	126
5	63	64	66	68	69	71	73	75	76	78	80	81	83	85	86	88	90	92	93	95	97	101	105	109	138	118	122	126	131
10	63	65	67	68	70	72	74	76	77	79	81	83	85	86	88	90	92	94	95	97	99	103	108	112	138	121	126	130	135
15	63	65	67	69	71	73	75	77	78	80	82	84	86	88	90	92	94	96	97	99	101	106	111	115	138	125	130	134	139
20	64	66	68	69	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	109	114	119	138	129	134	139	144
25	64	66	68	70	72	74	76	79	81	83	85	87	89	91	93	95	97	100	102	104	106	111	116	122	138	132	137	143	148
30	64	66	68	70	73	75	77	79	82	84	86	88	90	93	95	97	99	101	104	106	108	114	119	125	138	136	141	147	152
35	64	67	69	71	74	76	78	80	83	85	87	90	92	94	97	99	101	103	106	108	110	116	122	128	138	139	145	151	156
40	65	67	69	71	74	77	79	81	84	86	89	91	93	96	98	101	103	105	108	110	113	119	125	131	138	143	149	155	161
45	65	67	70	72	75	77	80	82	85	87	90	92	95	97	100	102	105	107	110	112	115	121	127	134	138	146	152	159	165
50	65	68	70	73	76	78	81	83	86	89	91	94	96	99	102	104	107	109	112	115	117	124	130	137	138	150	156	163	169
55	65	68	71	73	76	79	82	84	87	90	92	95	98	101	103	106	109	111	114	117	119	126	133	140	138	153	160	167	173
60	66	69	71	74	77	80	83	85	88	91	94	97	99	102	105	108	111	113	116	119	122	129	136	143	138	157	164	171	178
65	66	69	72	74	78	81	83	86	89	92	95	98	101	104	107	110	112	115	118	121	124	131	139	146	138	160	168	175	182
70	66	69	72	75	78	81	84	87	90	93	96	99	102	105	108	111	114	117	120	123	126	134	141	149	138	164	171	179	186
75	67	70	73	75	79	82	85	88	91	95	98	101	104	107	110	113	116	119	122	126	129	136	144	152	138	167	175	183	191
80	67	70	73	76	80	83	86	89	92	96	99	102	105	108	112	115	118	121	124	128	131	139	147	155	138	171	179	187	195
85	67	70	74	76	80	84	87	90	94	97	100	103	107	110	113	117	120	123	127	130	133	141	150	158	138	174	183	191	199
90	67	71	74	77	81	84	88	91	95	98	101	105	108	112	115	118	122	125	129	132	135	144	152	161	138	178	186	195	203
95	68	71	75	77	82	85	89	92	96	99	103	106	110	113	117	120	124	127	131	134	138	146	155	164	138	181	190	199	208
100	68	72	75	78	82	86	90	93	97	100	104	108	111	115	118	122	126	129	133	136	140	149	158	167	138	185	194	203	212

<72 No Stress
72-78 Mild Stress
79-88 Moderate Heat Stress
89-98 Severe Stress
> 98 Mortality occurs

Figure 4: Bovine Temperature Humidity Index

During summers in North India, maximum temperatures range between 45-50°C and RH is less than 60% , THI values exceed 78, where the animal gets into severe stress zone (see **figure 4**). **A recent on farm study done by Kohli *et al*., 2014[19] indicate that when THI value exceeded 72, milk production in crossbred cows decreased by 35% to 40% with respect to peak performance period of the stock.** Maximum decrease occurred in the month of July-Aug which coincides with

[18]MoEF, 2011. India's Second National Communication to UNFCCC.

[19]Kohli S, U. K. Atheya and A. Thapliyal, 2014.Assessment of optimum thermal humidity index for crossbred dairy cows in Dehradun district, Uttarakhand. Veterinary World, EISSN: 2231-0916 Available at: www.veterinaryworld.org/Vol.7/November-2014/3.pdf

monsoon period, when the highest humidity levels are at its peak in all regions across the country. It was observed that in the high yielding cows once the milk production started declining, there was a loss of 8-9 kg milk per day and this is irreversible process in the given conditions. As a result of loss in milk production from crossbred cows there is a daily loss in income by 45%. However, the indigenous cows yielding less than 10 litres of milk did not get affected by the increasing THI.

About 63% of the Buffalos in rural areas also suspend sexual activity during summers and hence milk production[20]. This condition is popularly known as summer anoestrus. The condition is characterized by inactive, smooth ovaries[21] and abnormal hormonal profiles[22]. Studies carried out by Upadhaya *et al*., (2007)[23] on Indian Murrah indicates a decrease in milk yield by 15-16% in the summer season i.e. from 10.6 Kg/buffalo to 8.8 kg.

Even though, milk production is the major livelihood activity under animal husbandry in the state, the dairy sector in the state is facing problems due to low productivity of animals[24]. **The adverse impacts of climate change particularly the rise in temperature and water stress, has directly or indirectly resulted in reduction in milk production and related morbidity of the animals**. The Annual Climate summary for 2010, published by the Indian Meteorological Department[25], indicates that the maximum and minimum temperatures in the Punjab region have increased by 0.5-1.0^{o}C and by 0.5- 1.5^{o}C respectively in 2010 with respect to the base line 1971-2000. The annual mean maximum temperature is projected to increase by 1.0-1.8^{o}C with respect to the base line in all parts of Punjab by 2021-2050. As per the Punjab State Action Plan on Climate Change[26], by the end of the century however, the mean maximum temperature may increase further by 4.0-4.4^{o}C. The trend in rainfall data also indicates the water stress situation of the state. There is a significant decrease in rainfall as it was around 739.1mm in 1980's while it has decreased to 384.9mm in 2009.

Decrease in yields in *Murrah* – an indigenous buffalo breed, has also been observed in the State. A study carried out by Pawar et al., (2013)[27] at GADVASU

[20]G K das and FA Khan, 2010. Summer Anoestrus in Buffalo- A review. Reprod Dom Anim 45, c494

[21]Roy DT, A R Bhattacharya, and S N Luktuke, 1972. Estrus and ovarian activity of buffaloes in different months.Ind Vet J 49:54060.

[22]Razdan, M.W., 1988, Buffalo performance in relation to climatic environment. Proceedings of the II World Buffalo Congress,173-186.

[23]Upadhyay R. C , S.V. Singh, A. Kumar, S.K. Gupta, Ashutosh, 2007. Impact of climate change on milk production of Murrah Buffalos.Ital.J.Anim.Sci. vol. 6, (Suppl. 2), 1329-1332.

[24] Singh, Jasvinder, D K Grover, and Tejinder K Dhaliwa. 2012. State Agriculture Profile- Punjab. AERC Study no. 30. Agro Economic Research Centre, Department of Economics and Sociology, Punjab Agriculture University.

[25]IMD, 2011. Annual Climate Summary of India

[26]Punjab SAPCC, 2014. Published by Punjab State Council for Science and Technology, Gov of Punjab

[27] Pawar Hitesh N., G.V.P.P.S. Ravi Kumar and Raman Narang, 2013. Effect of Heat Stress on Milk Production and Composition in Murrah Buffaloes, Journal of Buffalo Science, 2013, 2, 98-102

premises, indicate that summer heat stress significantly decreased milk yield by 0.028 kg and milk fat by 0.047%, protein and Solid Not Fat (SNF) in lactating Murrah buffaloes each day for each point increase in the value of THI above 72. Therefore, management strategies are needed to minimize heat stress and attain optimal animal productivity.

d) Project Location details – villages, block/ mandal, district.

Mapping of the trends of crossbred cattle milk production in selected districts of Punjab indicates plateauing of milk production in **Bhatinda, Tarn Taran and Ludhiana** in recent years[30] (see **Figure 5**). These can be linked to prevailing high summer temperatures in these districts.

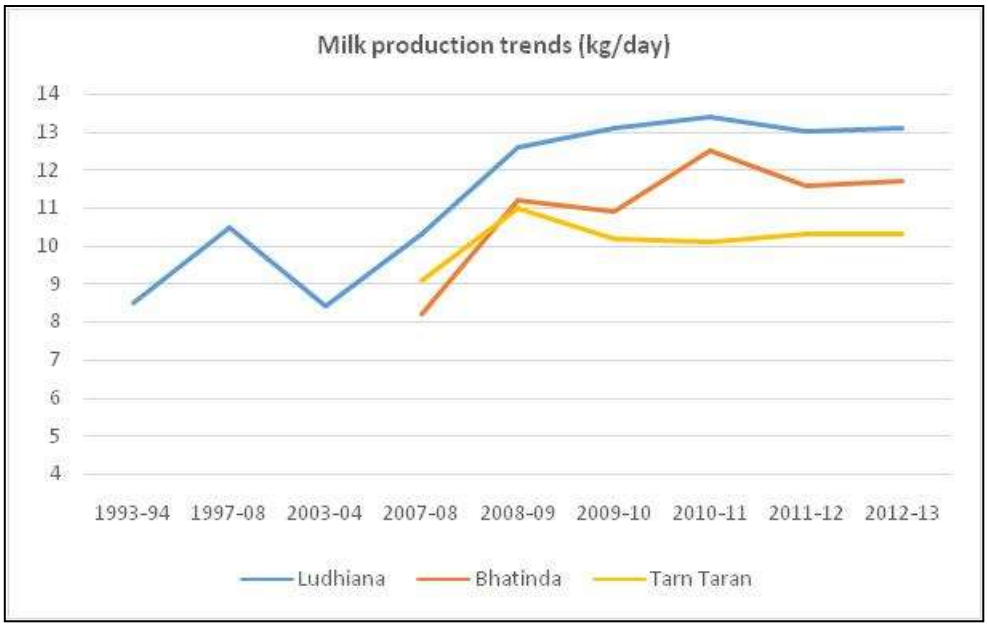

Figure 5: Trends of milk production (in kg/day) from crossbred cows in selected districts in Punjab[28]

As per the statistical abstract, the districts of Tarn Taran, Bhatinda and Ludhiana record temperatures in excess of 40°C, and in 2015 they recorded around 45°C[29]. As an example, **Table 1** shows the extreme temperature, and humidity trends of Bhatinda district observed between the period 1901-2010[30]. The rainfall data is for the period 2000-2012[31]. **The temperature and humidity conditions in Bhatinda indicate that throughout the year the district have a THI**

[28] Dairying in Punjab, 2014.A statistical Profile. Available at: http://www.dairyknowledge.in/sites/default/files/year_and_district-wise_crossbred_cattle_milk_yield.pdf
[29] Statistical Abstract, Punjab, 2014.
[30] IMD, 2010.Extremes of India. Available at: http://www.imdpune.gov.in/Temp_Extremes/histext2010.pdf
[31] http://www.worldweatheronline.com/Bhatinda-weather-averages/Punjab/IN.aspx

greater than 72. Similar trends have also been seen in the other districts i.e. in Tarn Taran and Ludhiana.

Such high temperatures are detrimental to cross bred cattle health and even to the large population of buffalo. Some of the districts in Punjab have recorded extreme heat during summers, in recent years, including in 2015, when extreme high temperatures have persisted for almost one week and more. Further, due to global warming the ambient temperature is expected to rise higher, and frequency of extreme temperatures is likely to increase as well which may jeopardise the entire milk production system in Punjab and the associated economy.

Table 1: Climate trends i.e. extreme temperature (in ^{0}C), humidity trends (in %) between the period 1901-2010 and rainfall (mm) for the period of 2000-2012 of Bhatinda district [32,33]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Record high °C	27.9	31.8	38.9	45.4	47.4	48.2	47.7	40.7	41.5	39.4	38.4	28.9
Average high °C	19.4	21.6	26.5	33.8	38.7	39.4	35.0	34.2	34.5	32.3	27.1	21.3
Daily mean °C	11.6	13.9	18.7	25.1	29.9	32.1	30.2	29.7	28.3	23.8	17.9	12.9
Average low °C	3.7	6.0	10.9	16.3	21.1	24.6	25.3	25.1	22.2	15.1	8.7	4.4
Record low °C	−3.6	−3.9	2.4	8.9	12.4	17.2	18.4	19.3	12.4	7.9	0.3	−1.0
Average rainfall mm	0	27	51	0	0	12	78	51	72	0	6	15
Avg. rainy days (≥ 1.0 mm)	3.0	7.0	4.0	4	0	5	13	6	5	2	2	5
Avg. RH (%)	74	70	64	47	38	48	72	77	69	67	73	76

[32] IMD, 2010.Extremes of India. Available at: http://www.imdpune.gov.in/Temp_Extremes/histext2010.pdf
[33] http://www.worldweatheronline.com/Bhatinda-weather-averages/Punjab/IN.aspx

Considering the persistent high temperatures prevailing in summers consistently in recent years, and foreseeable challenges of sustainability of milk production in the State, it is proposed that project will initially be implemented initially in three districts namely, Tarn Taran, Bhatinda and Ludhiana. Subsequently, it can be replicated to other districts based on the success of the implementation of the project activities.

1.2 Project / Programme Objectives:

The project proposes to have following activities under each objective:

Objective 1: Ensure sustainable levels of livestock production in small and marginal farmer households (HHs) in heat stress conditions

Activity 1: Up gradation of indigenous dairy animals through superior germplasm in Punjab

Resource-poor small and marginal farmers are most affected when their small bovine holdings, the crossbred cattle and buffalo underperforms. Therefore, under this activity, it is proposed to **enhance the pool of pure blood indigenous cattle and buffalo within the bovine mix of small and marginal farmers through Artificial Insemination**. This activity will be implemented on Indigenous breed like the Murrah/Niliravi buffalo and Sahiwal cow, which has a proven performance and survives in lower inputs as compared to crossbreds.

Activity 2: Undertake Estrus (Anoestrus) management for enhanced livestock production

A large percentage of buffalo (approx. 80%) experience cessation of normal ovarian activity during summer months, therefore for continued uninterrupted reproductive activity throughout the year, **breeding of indigenous dairy animals will be carried out within the chosen households at right-time based on a standard estrus synchronization protocol or Fixed-Time Artificial Insemination**. This will further reduce the number of unproductive days in the life-time of a female as well as allow early treatment of shy breeders to minimize their environmental impact.

Activity 3: Design heat tolerant and tick free sheds for housing bovine stock at community as well as institutional levels

Heat tolerant cattle sheds will be designed to enhance the livestock performance during heat stress conditions. The sheds will also be made tick free, which is one of the major concerns affecting the cattle health in Punjab. **Innovative 300 climate resilient sheds (100 each in 3 districts) at the farmer's level and 10-15 demonstrative sheds at institution level will be constructed.** Constructing a livestock shed at institutional level eg: GADVASU will have following benefits:

- Main target population for whom climate resilient model shed are developed are dairy farmers. Developing a demonstration shed for 150 cattle & buffalo will enhance income and livelihood opportunities for dairy farmers in the wake of increasing heat stress and productivity loss of hybrid cattle.
- Setting up of climate resilient cattle sheds at institutional level of great repute like GADVASU can trigger increased demonstration effect. This will act as an inspiration for the farmers to group together at community level and have chance to replicate climate resilient cattle sheds ensuring consistent productivity amidst increasing temperature and humidity.
- Infrastructure for capturing methane emissions and converting into bio-gas can also be established, which can be one of the co-benefits for mitigating the challenges of climate change.

Activity 4: Ensure year round fodder availability

As per the scientific studies, dairy animals should be given optimal amount of fodder (40kg/day/animal) to reach its full milk production potential. **Therefore, this project proposes to conserve green fodder as silage during glut period to be used during scarcity period and plant drought resistant fodder seeds.**

Activity 5: Develop disease forecasting system for better management of livestock in a changing climate scenario

This activity will mainly prevent the animals from the risk due to existing and emerging diseases. **A disease forecasting system providing a correlation between disease occurrence and changes in climate, vegetation cover etc. will be developed in line with the National disease forecasting system 'National Animal Diseases Referral Expert System (NADRES)'.**

Objective 2: Climate Proofing of registered Gaushalas/construction of climate smart model cattle ponds (Cattle shed) housing 2000 stray cattle

This activity proposes to integrate climate smart elements into existing registered Gaushala or develop a model cattle pond with climate resilient features for 2000 stray cattle in one district of Punjab (Tarn Taran). The gaushala/cattle pond will have provisions of drought resistant fodder within the boundaries of the facility, water through rainwater harvesting structures and ground water recharge, solar energy through setting up solar plants, biogas generation through setting up bio-gas bottling plants and energy efficient lighting like CFLs etc.

Objective 3: Develop weather linked insurance to compensate for loss in income of small and marginalised farmers due to decrease in milk yield of buffalo/cattle

Punjab would be the pioneer state for proposing to develop weather linked insurance product, for assessing compensation to the small and marginal farmers due to loss in livestock yield. **The design of weather linked insurance product will be based on the correlation of THI with the loss in milk yield.** It has been proposed that technical support from an Insurance Agency will be taken for designing the product.

Objective 4: Capacity building and dissemination of knowledge products

This project will set an example of how indigenous breeds can ensure livelihood security and stabilise the earnings of small and marginal farmers in a changing climate context and demonstrate the usefulness of stray cattle. Therefore, the lessons learnt needs to be shared for wide-scale assimilation of the benefits. While doing the project, it is also envisaged that the farmers, livestock & insurance specialists and related institutions will have the opportunity to build their capacities to handle livestock in a climate change context. **This activity is proposed to be done through various training programmes/workshops for the key stakeholders. Learnings from the project activities will also be published and disseminated to a wider platforms/ population.**

1.3 Details of Project/ Programme Executing Entity:

a) Name, Registration No. & Date, Registered Address, Project Office Address (for the proposed project)

Name: Punjab State Council for Science & Technology (PSCST), Sector 26, Chandigarh
Registration No. & Date: 1121 of 1983 dated 21.07.1983
Registered Office: Punjab State Council for Science & Technology, Sector 26, Chandigarh, Near Sacred Heart School, Sector 26, Chandigarh.
Project Office Address: As above

b) Available technical manpower for the proposed project implementation: 4 Scientists

c) Three largest Climate Change Adaptation Projects handled (if already implemented)

Project	***Objectives & geo. coverage***	***Amount Sanctioned***	***Funding Agency***	***Geographical Coverage***	***Implementation Period & Outcome***
Preparation of SAPCC for Punjab	To prepare state level Strategy and Action Plan on Climate Change as per National Framework covering 8 Missions	Rs.10.00 lacs	Ministry of Environment, Forests & Climate Change, Govt. of India	Punjab State	2011-12 to 2013-14. Prepared SAPCC involving concerned departments with technical support from GIZ. Stakeholder workshops and public hearing were conducted

					as a part of the process. SAPCC was submitted to MoEF&CC, GoI
Capacity Building of SAPCC	To develop capacities and take up activities for effective implementation of SAPCC involving concerned departments	Rs.10.00 lacs	MoEF&CC, GoI	Punjab State	2014-15 to 2015-16. Three capacity building workshops for stakeholder departments conducted. Meetings for identification and formulation of projects on climate change adaptation and mitigation organized involving experts from GIZ and NABARD.
Gainful Utilization of Paddy Straw as fuel in brick kilns	Initiative for Management and Utilization of Paddy Straw including technology development for briquette making.	Rs.58.00 lacs	PPCB	Punjab State	2014-15 Trials conducted for utilization of paddy straw in the briquette form in brick kilns as an alternative fuel to replace coal.

d) Three largest community based NRM based projects handled

PSCST, in collaboration with, Unati Cooperative Marketing-cum-Processing Society Ltd., Talwara had taken up a DBT-GOI supported project for promoting cultivation & value addition through post-harvest processing of bio-resources (medicinal, aromatic & horticultural crops) in Shivalik belt. DBT, GOI supported the project for the period 2004-07. Subsequently, with vigorous efforts, the processing unit set up under the project was made self-sustainable and a 3 years' agreement was signed with Unati for its operationalization which has been renewed this year for a period of ten years.

Punjab Energy Development Agency (PEDA) had awarded a project for preparation of PDD and PCN for their project on "1 MW solar power plant at village Phulokhari, District Bhatinda". During the year, the Council has prepared and submitted PDD to PEDA. The Council also worked out "Carbon Footprint Estimates" for Punjab Cricket Association (PCA), S.A.S.Nagar for one of the IPL-2009 matches held at PCA Stadium, S.A.S. Nagar declared as Green Match.

e) Three largest Climate Change Adaptation / NRM projects of State / Central Government

Punjab Biodiversity Board was notified on 23rd December, 2004 . The Board is being serviced by PSCST with Executive Director -PSCST as its Member Secretary. The Council is coordinating the scheme "National Wetland Conservation Programme (NWCP)" sponsored by MoEF&CC. Under the scheme, conservation activities were initiated in 1987-88 at Harike wetland, in 1988-89 at

Kanjli and in 1998-99 at Ropar. Conservation measures at Nangal were initiated in 2008-09. The activities are taken up through various executing departments which include afforestation of native tree species for habitat improvement, soil conservation to prevent siltation, conservation of wildlife and fisheries, weed control, water quality monitoring and public awareness, etc. Ranjit Sagar National wetland (which is an interstate wetland of H.P., Punjab and J&K) is being managed by Ranjit Sagar Dam Design Organisation under Deptt. of Irrigation.

Production and Promotion of Neem based Bio-pesticide as environment friendly biodegradable alternative to chemical pesticides. Under the Neem Project supported by Ministry of Chemicals & Fertilizers, Govt. of India for promotion of neem bio-pesticide, bio-efficacy studies have been carried out in collaboration with PAU for evaluating the effect of Neem Kernel Aqueous Extract (NKAE) on pests of key crops of the state viz. wheat, mustard, cauliflower, pea, cotton, paddy, okra, cabbage / cauliflower & chilli.

f) Comment of availability of suitable infrastructure for implementation proposed projects (vehicles, computers, required software/ tools, etc.)

Vehicles – 4, Computers – 62, required software/tools: Not available

g) Whether Executing Entity (EE) was blacklisted, barred from implementation of projects, faced any charges / legal cases related to mismanagement of project and funds. (please list any such incidences and reasons): No

1.4 Project / Programme Components and Financing:

S. No.	Project/Programme Components	Expected Concrete Outputs	Expected Outcomes	Amount (Rs)
1.0	Ensure sustainable levels of livestock production in heat stress conditions	• Blood levels of indigenous graded or non-descript dairy cattle and buffalo upgraded • Provision of drought resistant fodder varieties • Development and Construction of climate resilient sheds at community and institutional levels • Development of disease forecasting system	Enhanced Livestock Production through estrus management and artificial insemination	13,10,34,500

S. No.	Project/Programme Components	Expected Concrete Outputs	Expected Outcomes	Amount (Rs)
2.0	Climate Proofing of registered Gaushalas/construction of climate smart model cattle ponds housing 2000 cattle	• Integrating climate smart elements in existing registered cattle shed (Rain water harvesting, solar plants, energy efficient lighting etc.) • Construction of climate smart model cattle ponds • Establishing Biogas bottling plants • In-house facilities of ponds and fodder	Stray cattle can be effectively put to use eg: dung can be used for bio-gas generation, destruction to agricultural crop can be prevented etc. Greenhouse Gas emissions will also be used	1,64,90,000
3.0	Weather linked Insurance package	Development of weather linked insurance product for assessing compensation to the small and marginal farmers due to loss in livestock yield	Financial security of small and marginal farmers under heat stress conditions	98,76,600
4.0	Capacity building and Knowledge Management	• Development of knowledge products for wider dissemination • Training/workshops for information dissemination and building expertise in breeding management	Project interventions can be replicated to other districts of Punjab and to other states	82,00,000
	Project/Programme Execution cost			**16,56,01,100**
5.0	Miscellaneous cost for petty expenses and cost escalations			33,12,022
	Total Project/Programme			16,89,13,122

S. No.	Project/Programme Components	Expected Concrete Outputs	Expected Outcomes	Amount (Rs)
	Cost			
6.0	**Project/Programme Cycle Management Fee charged by the Implementing Entity**	Timely implementation of the project interventions	Monitoring and Evaluation	1,35,13,050
	Amount of Financing Requested			**18,24,26,172**

1.5 Projected Calendar:

Indicate the dates of the following milestones for the proposed project/programme (projects which have four or more than four years of implementation period would require to have mid-term review after two years of implementation).

Milestones	Expected Dates
Start of Project/Programme Implementation	October 1, 2015
Mid-term Review (if planned)	May 1, 2018
Project/Programme Closing	October 31, 2020
Terminal Evaluation	November 30, 2020

2.0 PROJECT / PROGRAMME JUSTIFICATION

a) Component-wise details and justification of the project components

i. What is the business-as-usual development for the targeted sector?

Small and marginal farmers (having landholdings of 1-2 ha and having 5-15 dairy animals) of the State does not have enough financial resources to provide comfortable environment to livestock. So far, there are very less number of cattle sheds at the household/community level. Therefore, through this project, it is proposed to design cattle sheds at household/community level for 3000 HHs.

Further, State has a large population of stray cattle which are prone to accidents and destroys agriculture crops. State has launched a scheme 'Cattle Ponds for Stray Cattle' through which it is proposed that the stray cattle will be housed in large cattle sheds. However, this project proposes to integrate climate smart elements such as setting up solar plants, biogas generation through setting up bio-gas bottling plants and energy efficient lighting like CFLs, LEDs etc. into existing registered Gaushala or develop a model cattle pond with climate resilient features for 2000 stray cattle in one district of Punjab.

State so far does not have any weather linked insurance product for livestock. This project therefore proposes to develop weather linked insurance product, for assessing compensation to the small and marginal farmers due to loss in livestock yield. The design of weather linked insurance product will be based on the correlation of THI with the loss in milk yield.

ii. What are the specific adaptation activities to be implemented to reduce the climate change vulnerability compared to the business-as-usual situation?

The activities towards meeting the climate change challenges of the State are as follows:

Specific Objective 1: Ensure sustainable levels of livestock production in heat stress conditions

Activity 1.1: Conduct base line survey to identify HH's and institutions where interventions will be conducted

A base line survey will be undertaken, to identify at **least 3000 small and marginal farmer HHs (1000 each in Tarn Taran, Bhatinda and Ludhiana) where the intervention for up-gradation of Non-Descript or graded cattle and buffalo to pure breed , along with management of Estrus in 2 bovine stocks in each household (cow and buffalo) will be carried out**. These HHs should capture diversity of the bovine stock and the socio economic profile of the HHs. **The stakeholders i.e. the Animal Husbandry Department (AHD), Guru Angad Dev Veterinary Animal Sciences (GADVASU) and Punjab Agricultural University (PAU) will be consulted to select the villages.** Already the districts have been identified in consultation with them, keeping in view the facilities they have in each of the districts which can form the backbone for supporting the project activities through the five years.

There are about 49,273 small and marginal landholdings[34] in the chosen 3 districts (see Table 1). We consider that each of the holdings belong to each small and marginal farmer HH. In order to survey 3000 HHs across the 3 districts, about 105 villages have to be surveyed.

Table 1: An analysis of small and marginal holdings and number of villages to be surveyed

	Marginal holdings> 1 ha	Small holdings (1-2 ha)	Total	No. of villages	Holdings/ village	No. of HHs to be surveyed	No. of villages to be Surveyed
Tarn Taran	6103	13039	19142	493	39	1000	26
Ludhiana	8825	5412	14237	724	45	1000	60

[34] Statistical Abstract Punjab, 2012.

Bathinda	**7632**	**8262**	**15894**	**296**	**54**	**1000**	**19**
TOTAL	**22560**	**26713**	**49273**	**1513**	**138**	**3000**	**105**

Source: Statistical Abstract, Punjab, 2012; and http://vlist.in/state/03.html

Activity 1.2: Conduct Artificial Insemination to upgrade indigenous dairy animals through superior germplasm in small and marginal HHs

Most of the **indigenous dairy animals** in the tropics evolved through natural selection, for adaptability and survival to local environments. Often, breeds resemble each other with slight morphological differences, but because of constant inbreeding in one locality, independent breeds have evolved. Most indigenous cattle and buffalo dairy breeds in the tropics are multipurpose (milk, meat, draught) and only a few breeds have good milk potential. In India, about 37 indigenous bovine breeds exist having varied performance level.

In India, the Murrah/ Niliravi and Sahiwal breeds are the most versatile and has exhibited comparable performance throughout the country irrespective of the agro-ecological conditions. The native tract of this breed in Punjab is in Mansa, Moga, Bathinda, Sangrur, Patiala, Faridkot and Amritsar. The average milk production of a *Murrah* buffalo is 6.8 kg to 19.1 kg[35]. The network programme on Buffalo improvement of Central Institute of Buffalo Research (an ICAR institution) has shown that the conception rate through Artificial Insemination is around 40% (**Table 2**).

Table 2: Conception and female calves born and daughters calved under the Field Progeny Testing program on Murrah and Sahiwal breeds in the ICAR network project on Buffalo improvement

Breed	Total AI Conducted	Conception	Conception rate %	Calves Born		Daughters calved
				Total	Female	
Murrah	82117	33477	40.77	20756	9893	1304
Sahiwal	75118	30215	32.65	18965	7562	987

Source: http://www.cirb.res.in/index.php?option=com_content&view=article&id=161&Itemid=66&lang=en. Accessed on 24th July 2015.

Considering on field success rate and comparatively easier availability of superior bull semen, Artificial insemination (AI) for genetic up gradation using *Murrah/ Niliravi and Sahiwal* is therefore being considered. **As per Table 2, the selection of atleast 3000 HHs is justified. If one buffalo per HH is selected for AI then only 40% of them will conceive i.e 1200 and chances are that about 400[36] number of**

[35] Indigenous farm animals of Punjab, Punjab ENVIS Centre NEWSLETTER, Vol. 11, No. 2, 2013-14

[36] Considering about 40% females born out of 1000 conceived after removing 15% embryonic or fetal mortality of conceived animals.

F1-females will be born (by the end of year 2 of project). Subsequently, after 2.5-3 years (near the end of year 5 of project), these animals will be sexually mature and will be inseminated again with pre blood semen for F2 generation. Once the HHs where up-gradation through AI will be taking place are identified, the farmers need to be advised that no cross-breeding of non-descript /graded buffalo, other than the bulls of indigenous pure breeds of *Murrah/ Niliravi and Sahiwal* should be done. This measure will provide an incentive to the farmers in the breeding tracts to rear male stock of indigenous breeds up to the breeding age, as the demand will create a market for the bull semen or natural service. Consequently, the practice of disposing off the male calves for slaughter will be curbed to a large extent. The AI scheme to be adopted in the project is shown in **Figure 6.**

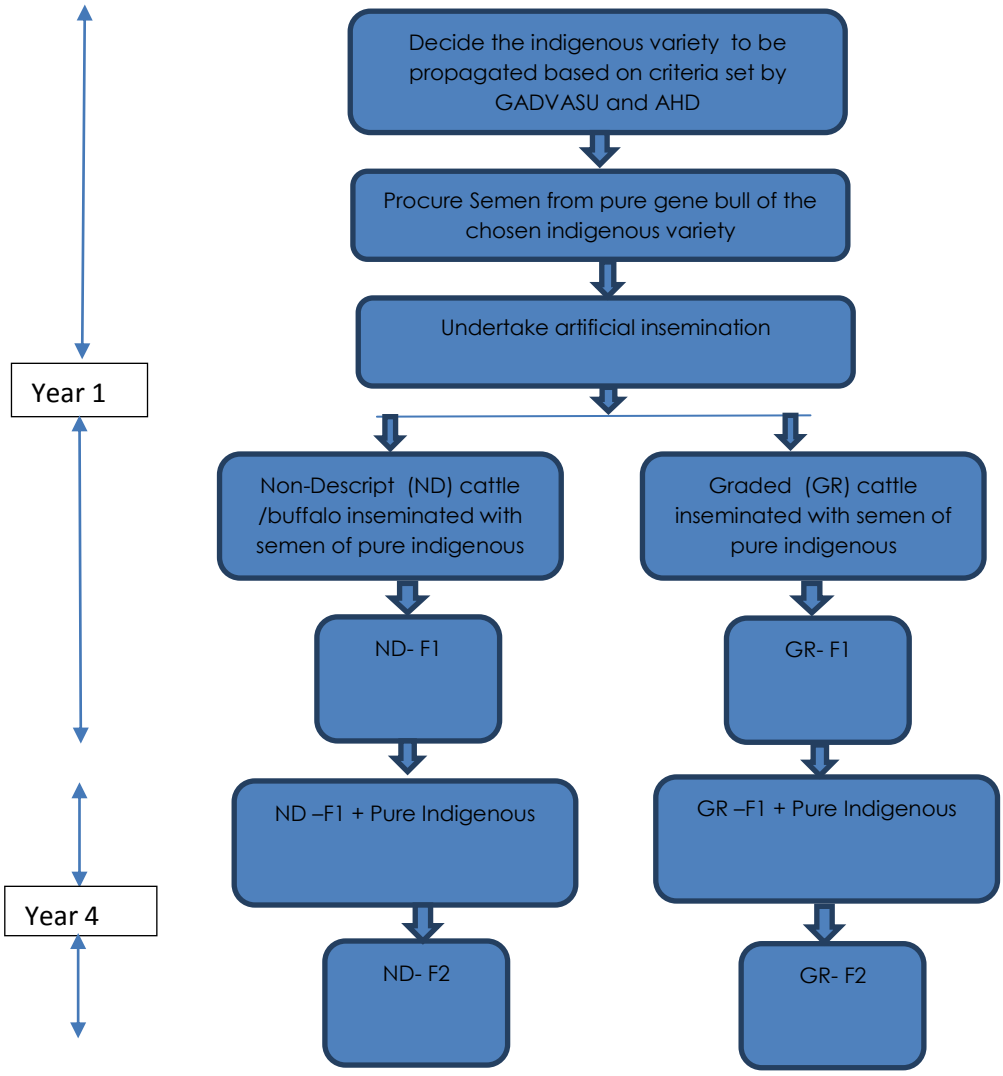

Figure 6: The AI scheme

Activity 1.3: Tool to guarantee an all year round supply of milk through Estrus Synchronization

Breeding of indigenous dairy cattle and buffalo at right-time based on a **standard estrus synchronization or Fixed-Time AI protocol** will be conducive to good summer fertility. This will further reduce the number of unproductive days in the life-time of a female as well as allow early treatment of shy breeders like buffalo to minimize their environmental impact. Our success should be reflected through economic impact as greater proportion of buffalo and cattle exhibiting seasonal decline in reproductive activity can be bred and farmers can have more calves and more milk yield during the lifespan of a dairy buffalo and cattle. **Estrus management in 2 animals per house will be carried out.**

Activity 1.4: Train farmers on post-insemination and estrus management

In this activity, batches of farmers in village camps will be trained by State level veterinary experts on post management practices. **To train farmers from 3000 HHs (Tarn Taran, Bhatinda and Ludhiana), it is proposed that a set of 10 trainings across 100 villages will be carried out twice, (i) before insemination, and a follow up training i.e. 1st few months of the project before the artificial insemination is completed across the chosen villages in the 3 districts. Packages of practices will be printed in local language and distributed amongst farmers.** Help lines linked to the local veterinary hospital will be used for any emergency.

Activity 1.5: Ensure adequate fodder availability using water efficient technologies

It is proposed that drought tolerant varieties of fodder will be grown to provide fodder to the Cattle and Buffaloes during the summer. These can be the combination of **Sorghum, Bajra and Legume.** About 16 types of sorghum are grown in India, yielding 12 to 75 tons/ha green fodder eg: Meethi Sudan variety is drought tolerant and produces 75 tons of green fodder and 22 tons of dry fodder /ha, Punjab Sudex Chari-1 (LY-250)- a multicut variety providing 3-4 cuts, produces 95 t/ha green fodder and 25 t/ha dry matter. The cultivars will be selected by GADVASU in consultation with AHD and PAU and seed of selected cultivar will be purchased and supplied by AHD [37]

In the winters, farmers can grow combination of Oats and Berseem. Mixing Japan rape or Chinese cabbage (2.25 kg seed/ha), increases yield by 20-25 per cent in first cut. The yield may further be increased by introducing early cutting.[38]

In the 3 districts (Ludhiana, Tarn Taran and Bathinda), individual households will grow fodder supported by quality seeds of drought tolerant varieties of the fodder. Efficient irrigation practices will be ensured in growing the fodder. Selected farmers covered under activities 1.2 and 1.3 will be identified for these interventions.

Further, farmers will be assisted or advised to prepare silage[39] and hay under the project to ensure availability of fodder during scarcity. Around 6 Silo bags (tube silo) having capacity of 5 quintals will be provided to selected farmers per year i.e. 30 quintals of fodder. Therefore, fodder ensiled for 3000 farmers will be 90,000 quintals.

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[37] http://agropedia.iitk.ac.in/content/multi-cut-variety-jowarsorghum

[38] http://agropedia.iitk.ac.in/content/package-practices-berseem

[39] Silage or ensilage is a method of preservation of green fodder through fermentation to retard spoiling

It is also proposed that furrow irrigation will be propagated in this project to minimise water use. Land will be levelled with laser leveller. It will save 15-20% irrigation water and also increases yield by 10%. Laser leveller is easily available and can be hired on rent basis.

Activity 1.6: Design and install heat resilient sheds for bovine stock of small and marginal farmers

It is proposed that about 300 climate resilient sheds (100 sheds per district) will be constructed at community and institutional levels for better visibility and replication. At GADVASU, a climate resilient model shed of 150 animal capacities will be developed and constructed for demonstration to farmers. In addition, impact of climate modification will be studied in the animals compared with existing sheds using micro and macro climate parameters. To serve small farmers, 10 animal capacity 10 sheds will be constructed at 3 KVKs, and 7 at other Govt Institutions.

Farmers or institutions will be selected based on the following criteria:

- Availability of the land for developing sheds
- Availability of atleast 5 indigenous dairy animals
- Willingness to adopt management measures (Artificial insemination, Estrus Management etc.)

The design will be modified by the GADVASU to suit the conditions prevailing in small and marginal farmer HHs and at the institutional level to accommodate animals according to the situation. A general design of the sheds is schematically provided in **Figure 7**. It is also envisaged that the sheds will create a tick free environment. The implementation of this activity will be supported by Punjab Dairy Development Board of the concerned districts with technical inputs from GADVASU.

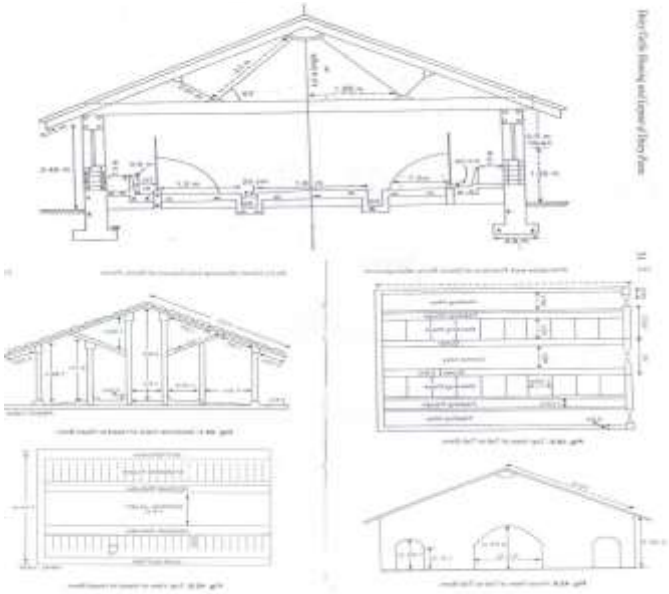

Figure 7: Cattle shed design guidelines from GoI[40]

Activity 1.7: Documentation and analysis of all field data

It is proposed that research fellows will be engaged in the project to document all data related to bovine stock behaviour, feed management, milk production, climate, disease profiling and any other. The basic data collection will include:

- Milk production data
- Lactation periods
- Feeding practices- quantity and type
- **Recordings and analysis of climate data recorded through 3 AWSs installed at Research Stations/KVKs in three districts and transmitted to agrometeorological unit of the PAU and calculation of everyday THI**
- Disease profiling
- Any other

Further, software will be developed to automatically translate all data for decision making. **Body temperature scanners** will also be procured to map the body temperatures of randomly selected inseminated and un-inseminated cows.

It is to be noted that full data from dam population and partial data on F1 population can only be taken during the period of the project. **This is mainly because bovines can be impregnated in a duration of 6 -12 months from the start of the project, then the F1 progeny can be obtained by end of nine months to 1 year. The F1 progeny will mature to be further artificially impregnated only after next 30 months. Therefore, only partial data of F1 can be taken during the project.**

[40]http://animalhusb.up.nic.in/Cattle%20Shaed%20Construction%20Maps%20&%20Guidelines.pdf

Activity 1.8: Disease forecasting for efficient controlling disease in a changing climate scenario

This would cover the study of prevalence of various economically important diseases viz. gastrointestinal parasitic diseases, ticks and tick borne diseases, whose incidence is highly affected by the environmental conditions. Further, the environmental conditions of the Punjab, is conducive to the development and propagation of ticks, thus leading to heavy tick infestations at different times of the year in huge populations of dairy animals causing severe economic losses. The data on the prevalence would be correlated with the meteorological data which would help in efficient forecasting of these diseases. The forecasting will be used for formulation of effective control measures against these diseases i.e. schedule of vaccination, acaricide application, administration of anthelmintic etc. This would decrease the economic losses caused by these diseases in the current scenario of climate change and global warming. **In this regard, services of one research fellow are required for forecasting the diseases and related support.** This disease forecasting system will be developed and implemented by GADVASU.

Specific Objective 2: Harnessing co-benefits from housing stray cattle

Activity 2.1 Climate Proofing of registered Gaushalas/construction of climate smart model cattle ponds (cattle sheds) housing 2000 stray cattle

Under this activity, following detailed selection criteria registered Gaushalas will be identified in one district of Punjab and these Gaushalas will be made climate smart by integrating various climate change mitigation and adaptation elements. As an alternate strategy, this activity will look at developing model cattle ponds for the district following all climate resilient elements of construction. These sheds is proposed to include measures to provide resistance towards parasite (ticks) such as provision of light, concrete floor, sanitary measures etc. **Figure 8** illustrates a modern cattle sheds, with climate resilient features constructed and maintained by NDRI funded through the National Initiatives for Climate Resilient Agriculture (NICRA) project under Indian Council of Agriculture Research.

Figure 8: Photograph of a shed that can house a large number of cattle (source: NDRI cattle shed housing 80 cattle)

The proposed shed will be scientific in all aspects. Factors like concrete flooring, roofing, appropriate scientific flooring slopes, urine channel, dung pits, urine pit etc. will be considered for shed construction (see **figure 9**).

Activity 2.2 Ensuring fodder availability

A part of the Gaushala/cattle pond will have facility to grow drought resistant fodder varieties including fodder tress. Silage pits will be constructed, with GADVASU design and by Animal Husbandry Department .

Activity 2.3: Ensuring water availability (Rainwater harvesting and ponds)

The roof of the Gaushala/model pond can be used for rain water harvesting and the water can be stored in over ground tanks, and excess water can go into dug pits through filter media which will help recharge shafts, trench, dug-well, abandoned tubewell, hand pump, etc. for artificial recharge to ground water. **Rain water storage facilities will be built on ground at each site. The design of the rain water harvesting can be taken from MNREGA guidelines.** Excess water can go into dug pits through filter media which will help recharge shafts, trench, dugwell, abandoned tubewell, hand pump, etc. for artificial recharge to ground water. A typical diagram for rain water harvesting and ground water recharge is shown in the figure below. Additionally Ponds will be created for cattle for assured drinking water.

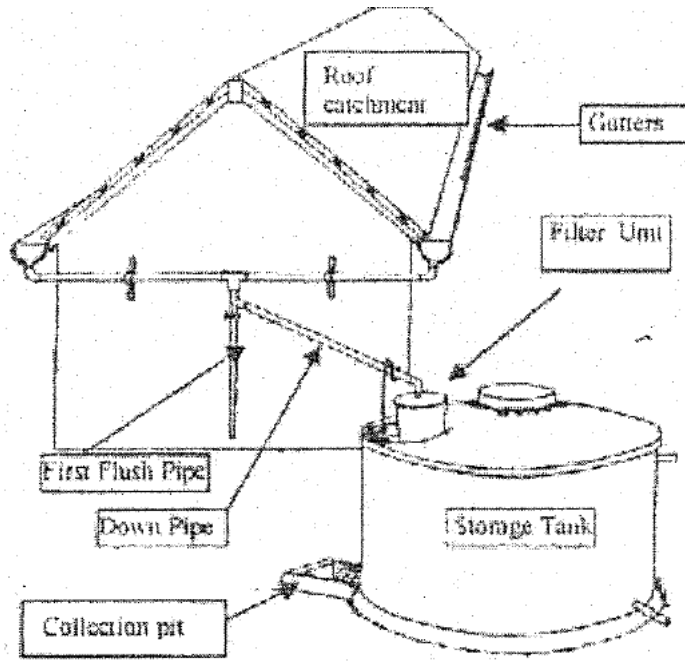

Figure 9: A typical rain water harvesting system[41]

Activity 2.3: Solar Power Generation in sheds

The roofs will be used for generating power from photovoltaics. This can be used for lighting, cooling, and other operations in the sheds. Excess power will be fed into the grid.

Activity 2.4: Energy Efficient lighting of the sheds

The shed area can be lighted by LED for ensuring energy efficiency in lighting. Energy efficient bulbs and CFLs are proposed to be installed.

Activity 2.5: Large scale biogas digester and bottling plants

It is proposed to set up biogas digester and a bottling plant within the compounds of the shelter. About 50,000 kg/day of dung from 2000 cattle will be generated in the sheds, which could potentially generate 2500cum of gas. Therefore, it's a potential source of clean energy. An aim of building two 1000cu m biogas plant at each site. The schematic diagrams of the process, its use and biogas enrichment plant are shown in **Figure 10 and 11** respectively. **A similar plant has been set up in Rajasthan of 1000m^3/day capacity installed with the investment of Rs. 1.95 crore by the promoters. The plant has returned an annual profit of Rs. 34.92 lacs in a period of 3-4 years.** The slurry from the biogas can be sold to local farmers for their use in agriculture to promote organic farming. **An entrepreneurial model will be set up who will bid for the biogas plant and for selling the slurry beyond the project period.**

[41] Select rain water harvesting model designs for MGNREGA projects, Ministry of water resources. Available at http://www.hprural.nic.in/cir302.pdf

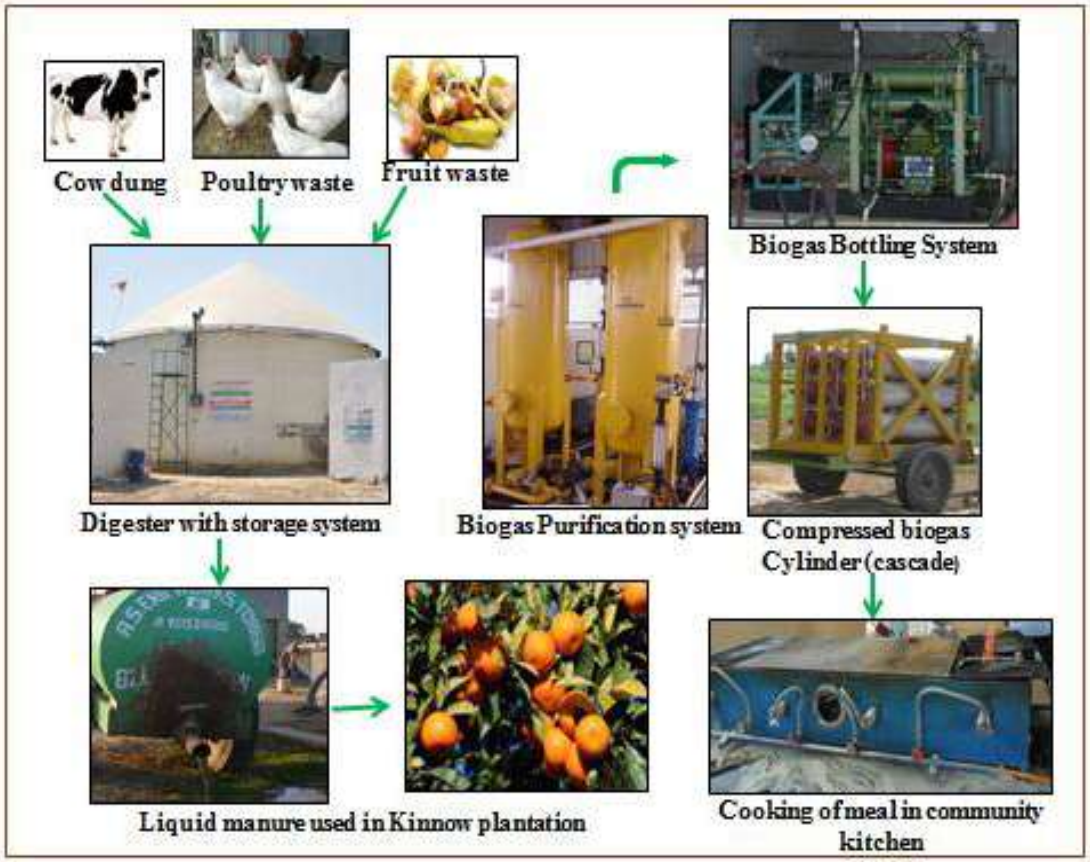

Figure 10: 1000 cu m Biogas digester and a bottling plant

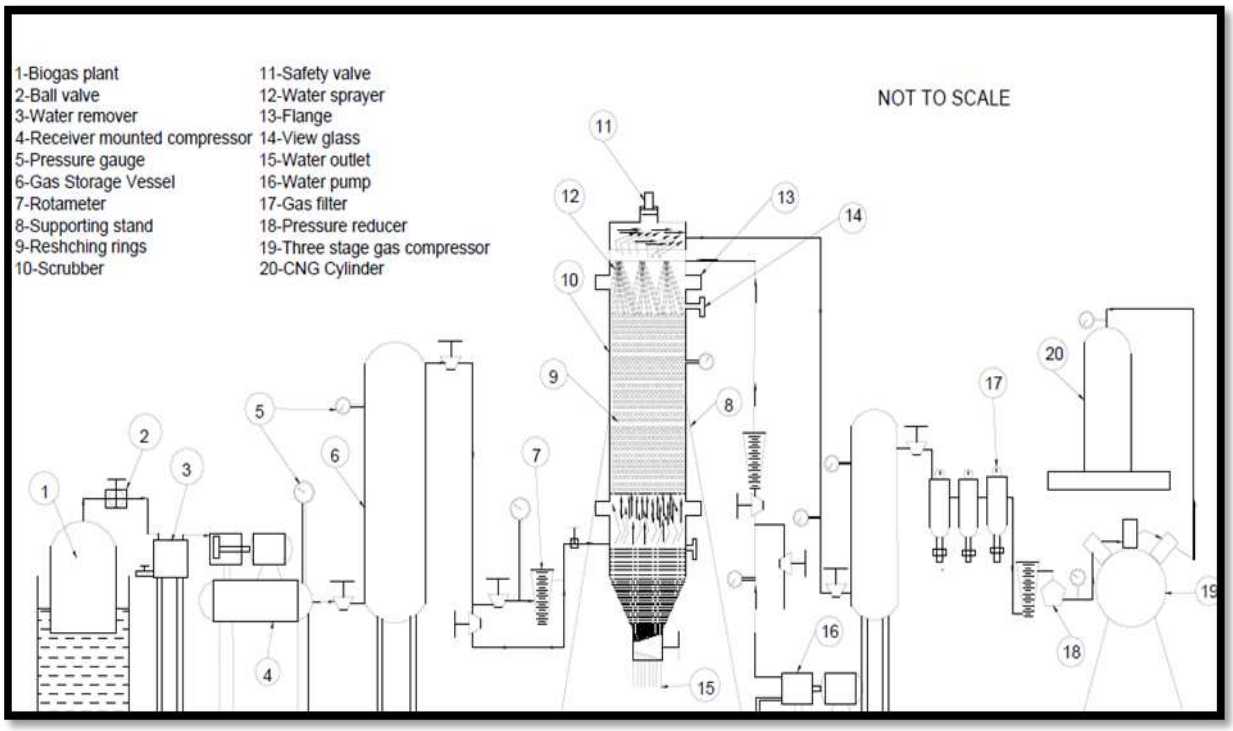

Figure 11: Biogas enrichment Plant designed by IIT Delhi

Specific Objective 3: Devise Weather linked Insurance

Insurance coverage for livestock were traditionally designed to cover mortality risks and distributed through public /private commercial insurers. In India, the livestock insurance products are targeted to dairy production units such as buffaloes and cattle. The first livestock insurance scheme was launched by the Government of India in the 1970s .Various schemes have since been applied in the livestock insurance market. Between 2005-06 and 2006-07 of the 10th Five Year Plan and 2007-08 of the 11th Five Year Plan, the Government of India initiated piloting of livestock insurance scheme in 100 selected districts. The scheme is now being implemented on a regular basis in 300 districts of the country. Under the scheme, the indigenous / crossbred milch cattle and buffaloes are being insured at maximum of their current market price. The premium of the insurance is subsidized to the tune of 50%. The entire cost of the subsidy is being borne by the Central Government. The benefit of subsidy is being provided to a maximum of 2 animals per beneficiary for a policy of maximum of three years. Livestock insurance has been offered as a compulsory product with bank credit for dairy activities. For credit linked products, market based financial institutions like corporate banks and community based financial institutions like MFI-NGOs and co-operative banks have also been used as delivery partners.

An interesting innovation in the field of index-based livestock insurance has been designed in Africa especially Marsabit district of northern Kenya which uses satellite imagery data to predict the loss in forage and vegetation in the drought prone arid and semi-arid regions of Kenya. Pay outs are made as soon as the satellite imagery data falls below a strike level which indicates incidence of drought. **Similarly in Mongolia, an index based insurance scheme was implemented with a credit agreement with the World Bank. The approach was a combination of self-insurance, market based insurance and a social safety net. Herders bear the cost of small losses that do not affect the viability of their business, larger losses are transferred to the private insurance industry and only the final layer of catastrophic loss is borne by the Government of Mongolia.**

Punjab would be the pioneer state for proposing to develop weather linked insurance product, for assessing compensation to the small and marginal farmers due to loss in livestock yield. **The design of weather linked insurance product will be based on the correlation of THI with the loss in milk yield.** The GADVASU will determine the trigger points. It has been proposed that technical support from an Insurance Agency will be taken for designing the product. This activity will be implemented in 3 districts of Punjab (Ludhiana, Tran Taran and Bhatinda) with the technical support from GADVASU and AHD through engaging an Insurance Agency.

The essential features of Weather linked Insurance are:

- Insurance contract responds to an objective parameter (e.g. measurement of temperature) at a defined weather station during an agreed time period.
- The parameters of the contract are set so as to correlate, as accurately as possible, with the loss of milk yield suffered by a specific policy holder.
- All policyholders within a defined area having the same type of species for which policy is designed receive payouts based on the same contract and measurement at the same station, eliminating the need for in-field assessment.

Methodology pertaining to WII product and its application

Product design and marketing

i. Baseline study covering the following:
   - Livestock population and their productivity
   - Dependent direct and indirect beneficiaries
ii. Generating a Vulnerability and Risk Profile
iii. Identification of potential clients (farmers)
iv. Availability of interested parties (insurance agency, financial service provider, banks etc.)
v. Customize a product based on the farmer's need and identify cost effective delivery channels
vi. Design marketing strategies to generate awareness and educate potential clients
vii. Design Monitoring & Evaluation Framework for the insurance product
viii. Selling of the product through developing a contract between farmer and insurance agency

Application of product

i. Set up Automatic Weather Station for collection of weather data and establish a trigger point for temperature and humidity
ii. Alert to farmers on reaching the trigger point through messages
iii. Linking the Temperature Humidity Index (THI) with livestock production
iv. Compensation to the farmers based on the amount of loss of livestock production due to fluctuation in THI
v. Monitoring & Evaluation of the successful implementation of product

Premium contribution: Project will provide 50% premium during its duration (5-6 years). Once the project is complete, farmers will also have to bear the amount of premium supported by the project, unless government subsidy programme is available.

Insurance agency**:** BASIX, Micro Insurance Agency etc. may be appointed for designing the product, as they have rich experience in designing livestock insurance product.

Details of compensation and ultimate benefits in terms of money to the farmers: Farmers will pay regular insurance premium (50% covered by the project during the project duration and beyond that farmers will be responsible for paying the entire premium) and receive pay-outs when THI crosses an agreed trigger point. Compensation will decided based on the breed i.e. age, sex and body condition. Pay-out of the farmers will be based on the level of loss of livestock productivity due to increasing and decreasing THI during the summer and winter season respectively.

Features of WII product

Typical features of a weather linked insurance contract are indicated in **figure 12** below.

A specific meteorological station is named as the reference station.

A trigger weather measurement is set (e.g. maximum temperature), at which the contract starts to pay out.

A lump sum or an incremental payment is made (e.g. an INR amount per 0.1^{o}C rise in temperature above or below of the set limit or trigger)

A limit of the measured parameter is set (e.g. example 50°C), at which a maximum payment is made.

The period of insurance is stated in the contract; it may be divided into phases (typically for extreme heat and extreme cold spells), with each phase having its own trigger, increment and limit.

Figure 12: Typical features of a weather linked insurance

Activity 3.1: Identify potential pilot areas

Identify potential pilot areas and carry out a basic risk assessment. First, identify the targeted area and clientele for the pilot program including the animal(s), weather station(s), and potential clients. Second, carry out a quick initial assessment of the available data and risks to the clients and animals. This will dictate both the technical design of the contract and the operational arrangements for implementation.

Activity 3.2: Identify delivery channels for reaching the end users

Identify an institution or institutions, such as a bank, MFI, farmer organization etc, that can efficiently and cost effectively deliver this product to livestock farmers. This institution must have both sufficient outreach to provide marketing and education to clients and the organizational capacity to handle a new financial product.

Activity 3.3: Design contracts

Design prototype contracts for the given weather station(s) and clients. This design process should ultimately aim to design a contract that acts as the most accurate proxy for the clients' risks while taking into consideration the premium that a client is willing to pay.

Activity 3.4: Discuss the prototype contracts with potential clients and stakeholders

This will be done to determine their interest in insurance, willingness to pay for the contracts, and how closely the initial contracts match their risk. Since the initial contracts are only prototypes, this is a critical step to determine if the product design is appropriate and if there is demand for the product.

Activity 3.5: Finalize contracts and insurance

Revise and finalize the contract structures based on the field research and discussion with clients. After the contracts are finalized, insurance arrangements with the participating risk takers (insurers and reinsurers) and contracts will be drawn up.

Activity 3.6: Market the product

Market the product through the different delivery channels for the pilot. In order for farmers to purchase the contract, they must not only be aware of the product but also understand the product. In most cases, marketing will require a substantial educational component. The project during the piloting of this product may take a decision to provide 50% of the subsidised premium. Once the project is withdrawn, the livestock farmer will have to pay additional amount of the premium supported by the project. However, if there is government subsidy available then it will continue.

Activity 3.7: Monitor the pilot

This includes activities such as monitoring the program in order to detect any unanticipated outcomes, determining if all participating stakeholders are meeting their commitments, and determining the performance of the contract.

Specific Objective 4: Capacity building and dissemination of knowledge products

The activities will be towards ensuring sustainability of the project activities and showcasing the best practices learnt for broadcasting at a larger scale and their use.

Activity 4.1: Training

Training of concerned stakeholders to carry forward the concept of the weather linked insurance and facilitate its wide-scale adoption

Activity 4.2 Workshops for information dissemination

a) Inception workshop at the beginning of the project to firm up the activities and methodologies with all stakeholders
b) Mid-term workshop to disseminate the interim results
c) Final workshop to disseminate the results

Activity 4.3:Develop knowledge products for dissemination

a) Develop films on the best practices
b) Translate the films into brochures
c) Create brochures to advertise the success achieved, if any
d) Publish papers

iii. Please justify with regards to components as on the concrete adaptation activities of the project, and how these activities contribute to climate resilience

The above mentioned project interventions are enhancing the resilience of small and marginalised farmers towards climate change and provides livelihood opportunities under heat stress conditions. The contribution of activities towards climate resilience is as follows:

- Demonstrated sustainable livestock production under heat stress conditions by 1st generation F1 level indigenous dairy animals leading to minimum or no dip in milk collection from bovine stock owned by families participating in the project.

- Sustained livestock productivity throughout the year through estrus management under heat stress conditions of the State.

- Fodder scarcity during summer season will be averted by planting drought tolerant varieties of fodder, silage preparation and ensuring improvement in the nutritional status of the cattle through nutritional additives and minerals deficient in the feed.

- Climate resilient cattle sheds will be built for animals at farmer and institutional (GADVASU/KVKs/AHD institutions) levels, enabling the crossbred and indigenous dairy animals to be comfortable and minimum reduction of milk yield during heat stress.

- Climate smart elements will be integrated into sheds set up for stray cattle or develop a model cattle pond with climate resilient features for 2000 cattle in one district (having an existing registered Gaushala), which will enable the district to demonstrate water self-sufficiency through roof top rainwater harvesting and construction of ponds and dug wells.

- Disaggregated power generation within the stray cattle shed premises through the roof top solar power (10 MW each) and energy efficiency measures will be promoted through installation of LEDs for lighting the sheds instead of conventional lighting. Clean energy will also be generated from dung and bottled methane to be used like CNG and LPG for homes and vehicles respectively. Further, biogas slurry will also be sold to farmers for supporting their organic fertilizer needs.

- All livestock will be monitored at field level and at the sheds for their vital parameters along with weather parameters, providing a substantial database for analysis and the results of the same can be used for measuring the success rate by the State, dairying community and farmers.

- Weather linked insurance package will be developed for indigenous and crossbred cattle to compensate farmers for loss in milk yield and hence loss in income. This product is expected to revolutionise the milk economy of the State, by encouraging more and more farmers to go for rearing indigenous cattle as their livelihoods will be ensured even in climate stress periods.

- Knowledge products will be developed and widely disseminated for raising awareness. Further, trainings will be conducted for the sustainability of the project activities.

b) Details on Economic, social and environmental benefits project / programme

(Reference to the most vulnerable communities, and vulnerable groups within communities, including gender considerations)

Components/Activities	**Key Benefits (Direct)**		
	Social	**Economic**	**Environmental**
Ensure sustainable levels of livestock production in heat stress conditions	• Small and marginal farmers targeted in this project will be protected from heavy loss in livestock production due to increasing weather variabilities, if they continue to have a mix of crossbred cattle • Increasing blood levels of indigenous breeds having resistance to increasing temperature, improves the survival • This activity will also assist the state in reviving the traditional breeds for future multiplication.	• Farmers will continue to enjoy earnings and therefore there will not be any financial tension in the families or within the communities • Increasing blood levels of indigenous breeds having resistance to increasing temperature, stabilises the milk yield even under adverse weather conditions, ensuring continued income for the farmers	• Indigenous dairy animals (Murrah/ Niliravi and Sahiwal) are less emitter of Methane as feed is less compared to the high feed requirement that go into crossbred cattle • Water use efficiency for growing fodder increases due to propagation of water efficient technologies
Harnessing co-benefits from housing stray cattle	• This would emerge as a successful entrepreneurial model for	• Sustainable employment happens. • Huge	• Sheds will use solar power and energy efficient LED lights. Therefore the Greenhouse Gas

	replication around the state as well as amongst other states. • Stray cattle no longer disturb cropping systems and do not die due to accidents, thus avoiding related problems	economic benefit to the entrepreneurs as well as the people employed in the process including bio-gas sale, reduced dependence on external sources of fodder, energy and water, thus saving money	(GHG) that would have been emitted if conventional electricity from thermal power plants is avoided. • GHG emission from cattle will be les due to use of drought tolerant fodder varieties. • Load on water reduces from external sources as ponds and rain water harvesting structures are created. • Drought tolerant fodder varieties will lead to less GHG emission, as input requirement vis a vis water will be less
Weather linked insurance	• Household sustains during period of agricultural crop failure mainly on payments from cattle insurance • Returns from weather linked insurance acts as immediate risk transfer mechanism for small farmers • This reduces the risk of migration and	Clear economic benefit to farmers as compensation available during heat stress periods when milk productivity reduces, maintains steady flow of income	Environmental benefit would include more and more propagation of indigenous cattle, which will lead to less GHG emissions as compared to resource intensive cross bred

	distress for landless farmers • This product for the first time will cover production losses due weather variabilities, increasing confidence amongst livestock farmers for continued investments		

c) Sustainability of intervention

i. How will the project assure that the benefits achieved through its investments are sustained beyond the lifetime of the project?

This project has various innovative and sustainable practices for integrating climate change adaptation in animal husbandry sector, which is a major contributor of country's agriculture GDP. The project proposes for sustained livestock productivity throughout the year through technologies such as Artificial insemination and Estrus management. The project will support this activity till the F1 progeny is produced and further blood level enhancement will be continued by the GADVASU supported by AHD.

This project also provide an opportunity for making the best use of stray cattle by housing them in a large climate resilient shed with in-built facilities of biogas plant, rain water harvesting, energy efficiency and renewable energy etc. Integration of climate smart elements is being done on existing gaushalas on an entrepreneurial mode, so that benefits are sustained based on a business model. Also, integration of climate smart and development model cattle ponds will be done in close coordination with AHD and District Administration, who will further continue and replicate the activities of the project in other districts of the State.

This project for the first time in India proposes to develop and demonstrate weather linked insurance product for indigenous and crossbred cattle to compensate farmers for loss in milk yield. This product is expected to revolutionise the milk

economy by encouraging farmers for adopting indigenous diary animals, as their livelihoods will be ensured under climate stress periods. Upon successful completion of implementation of this product in three districts of Punjab, this product can be advantageous for replication in other districts of Punjab and other agricultural based states (with increasing heat waves and other weather related uncertainties). This product has the potential to generate interest amongst farmers as well as private sector insurance providers.

Besides, the contribution of project to the adaptation aspects of climate change, the project will also has a co-benefit of reducing the methane emission through measures such as propagation of indigenous breed, developing bio-gas plant, adoption of energy efficient lighting and plantation of drought resistance fodder, which will contribute in mitigating the challenges of climate change.

d) Analysis of the cost-effectiveness of the proposed project / programme:

i. Cost effectiveness will compare alternative options available and how the proposed components/ intervention are best for given climatic conditions. It will also how the community has preferred the selected interventions and their views / concerns are addressed while designing the project/ programme The proposal should compare to other possible interventions that could have taken place to help adapt and build resilience in the same sector, geographic region, and/or community.

A comparison of the chosen option vis-a-vis alternative options may be provided as per the table given below:

Activities under Objectives	**Proposed Alternatives**	**Benefits**
Ensure sustainable levels of livestock production in heat stress conditions	• Continued introduction of crossbred which are less tolerance to heat stress with continued loss of yield • Buying Heifers of pure breed, which is very costly i.e. approx. 50,000 INR.	• Enhance the pool of pure blooded indigenous cattle and buffalo within the bovine mix of small and marginal farmers through artificial insemination • Estrus management will ensure additional milk production without spending money on buying additional bovine • Development of heat tolerant and tick free sheds • All the farmers will be helped to receive disease forecasting on their mobile cells which can be relayed out by the AHD
Climate Proofing of registered	• Private sector Gaushala established with religious	• Reaping co-benefits through setting up bio-gas bottling plants

Gaushalas/construction of model cattle ponds housing 2000 cattle	motive • Cattle sheds without climate smart elements emitting GHG and highly dependent on natural resources and non-renewable resources of energy • District Administration develop model cattle ponds with poor facilities for housing stray cattle and with climate smart elements	• Energy efficient lighting like CFLs, solar plants etc. • Water efficient measures such as setting up rainwater harvesting structures and ground water recharge
Weather linked Insurance package	• Mortality linked livestock insurance • One time contingency payment from state budget on animal mortality • People suffer production loss due to heat stress, forcing them for alternate livelihood sources	The cost effectiveness of this product is immense if developed and implemented successfully especially amongst small and marginal farmers whose income is dependent on milk from their bovine stock and any risk to that is a setback to their economy

ii. Weighting of project activities:

How much funding will be allocated to 'investment activities', 'capacity building activities' and 'project management activities' respectively?

Type of Activity	**List of Activities**	**Funding Requirement**
Investment activities	• Ensure sustainable levels of milk production in heat stress conditions through Estrus Management and Artificial Insemination • Climate Proofing of registered Gaushalas/ construction of climate smart model cattle ponds housing 2000 cattle • Weather linked Insurance package	15,74,01,100
Capacity building activities	• Conducting trainings/workshop • Developing knowledge products	82,00,000
Project management activities	• Monitoring and evaluation	1,35,13,050

e) *Alignment with the National and State Action Plans and other Policies / Programmes:*
(Describe how the project / programme is consistent with national or sub-national sustainable development strategies, including, where appropriate, national or sub-national development plans, poverty reduction strategies, national communications, or national adaptation programs of action, or other relevant instruments, where they exist)

Animal Husbandry sector in India contributes about 4.1% of the total agriculture GDP, with Punjab contributing 8.36% and ranks 5th in all India milk production. A rise in temperature by 2-4°C by 2050s will negatively impact milk production by more than 15 million tons by 2050 w.r.t. current levels of production **(NATCOM-2012)**.

In Punjab, the native cattle and buffalo breeds are Sahiwal and Murrah/Nili Ravi. These are comparatively hardy animals as compared to the cross bred varieties to climate variabilities. Milk production decreases in crossbred cows by 35-40% when THI increases by 72 (SAPCC-Punjab).

The National Mission on Sustainable Agriculture (NMSA) under National Action Plan on Climate Change (NAPCC) identified **drought proofing of livestock for overall economic development and improvement of the socio-economic conditions of the resource poor farmers** as one of the prioritized activities. The proposed activity is highlighted under the Livestock section of Agriculture Chapter of the State Action Plan on Climate Change (SAPCC), which suggests managing heat stress through propagation of indigenous breeds and sheds for livestock.

f) Component wise technical standards:
(Describe how the project / programme meets relevant national technical standards, where applicable, such as standards for environmental assessment, building codes, standards related to pollution control, etc. The details need to be provided for each of the interventions proposed)

The overall objective of the project is in line with the NMSA and highlighted under the Punjab SAPCC. Secondly, the project will be governed as per the policy and preference of Government of Punjab in adherence to all the specific local criteria. Apart from that the project would also adhere to the national scientific criteria with regard to adaption such as economic, social and environmental benefits etc. The involvement of the key stakeholders in the Management and Steering Committee will ensure compliance with the law.

Activity	Applicable Standard	Application to project
Activity 1.2: Conduct Artificial Insemination to upgrade indigenous dairy animals through superior germplasm in small and marginal HHs	Standard guidelines provided by AHD, GADVASU on Artificial Insemination and Post insemination management of animals	Enhance the pool of pure blooded indigenous cattle and buffalo within the bovine mix of small and marginal farmers and improve their survival
Activity 1.3: Tool to guarantee an all year round supply of milk through Estrus Synchronization	Standard guidelines on estrus management developed by GADVASU and AHD	Breeding of indigenous dairy animals will be carried out within the chosen households to enhance the milk yield
Activity 1.6: Climate resilient sheds for bovine stock of small and marginal farmers	Standard design of GADVASU, following the state accepted civil construction norms and rates	Designing climate resilient cattle shed at the farmer/community and institutional levels
Activity 2.1 Climate Proofing of registered Gaushalas/construction of climate smart model cattle pounds (cattle sheds) housing 2000 stray cattle	Design specification of Cattle Pond Management Society	Finalise the design of climate resilient stray cattle sheds
Activity 2.3: Ensuring water availability	MGNREGA guidelines and designs will be followed for construction	Designing of Rainwater harvesting structures and ponds
Action 4.0: Weather linked insurance	Product design based on Insurance Regulatory Authority Norms and Statutory Design requirement	Design a weather linked insurance product for assessing compensation to the small and marginal farmers due to loss in livestock yield

g) Duplication Check:

(Describe if there is duplication of project / programme with other funding sources, if any)

Project	Objectives	Complementarity	Geographical Coverage/Agency
Cattle Ponds for Stray cattle	To house stray cattle in Gaushala's proposed to be built in to provide water, fodder, electricity, and vet support	Land for housing stray cattle	22 districts of Punjab, Department of Animal Husbandry
Energy efficient and renewable energy subsidy programmes	To support energy efficient and renewable energy measures	Subsidy for setting up renewable and other energy efficient measures	Punjab Energy Development Agency

h) Details on Stake-holder consultation:
(Describe the consultative process, including the list of stakeholders consulted, undertaken during project preparation, with particular reference to vulnerable groups, including gender considerations).

Consultation	Date/ Place	Participation	Objective	Outcome
Inception meeting	June 1, 2015 in Office of PSCST, Chandigarh	Key departments /institutions of Govt. of Punjab (List of participants is at **Annex-II**)	To identify the priority projects under Punjab SAPCC	Six project ideas were emerged and accordingly, one project idea was prioritized for preparing a detailed proposal for consideration of NAFCC
Conducted brainstorming meetings and field visits	June 17-18, 2015 in Office of PSCST, Chandigarh and GADVASU, Ludhiana	Key departments /institutions of Govt. of Punjab (List of participants is at **Annex-II**)	To discuss the interventions under the selected project	Project interventions were finalised and preparation of DPR was initiated
Stakeholder Meeting	August 5, 2015	Key departments /institutions of Govt. of Punjab (List of participants is at **Annex-II**)	To finalise the draft DPR	Draft DPR was discussed and finalised for forwarding the same to MoEFCC for consideration under NAFCC

i) Learning and knowledge management component to capture and disseminate lessons learned for the proposed project.

This project will set an example of how indigenous breeds can ensure livelihood security and stabilise the earnings of small and marginal farmers in a changing climate context. It will also demonstrate as to how stray cattle can be beneficially used by the State. This will be helpful for avoiding the crop losses and for preventing road accidents. Further, minimal amount of livestock production may also be enhanced. Therefore, the lessons learnt will be shared for wide-scale assimilation of the benefits. While doing the project, it is also envisaged that the farmers, livestock & insurance specialists and related institutions will have the opportunity to build their capacities to handle livestock in a climate change context. This activity is proposed to be done through various training programmes/workshops for the key stakeholders. Learnings from the project activities will also be published and disseminated to a wider platforms/ population.

A stakeholder consultation workshop will be organized at the beginning of the project activities in order to inform the project objectives which would involve state

departments such as Department of Animal Husbandry, Dairy Development Board, Department of Agriculture, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Punjab Agricultural University (PAU), Punjab State Cooperative Milk Producers Federation Limited , other milk societies and representatives from farmers community etc.

After the demonstration of climate resilient cattle shed implementation, local vendors will be identified and trained for further replication of this design. Farmer community will also be trained on maintenance of the roof top water harvesting system associated with climate resilient cattle shed.

The project will also aim to train stakeholders towards adoption of weather linked insurance. The project will train farmers for post insemination management of bovine and progeny. The conclusion of the project will be shared with all relevant stakeholders and strategy for replication will be finalized

j) Sustainability of the project/programme outcomes has been taken into account when designing the project / programme.

Expected outcomes	**Expected concrete outputs**	**Sustainability mechanism**	**Responsible party/ies**
Propagating indigenous pure breed	Enhance the pool of pure blooded indigenous cattle and buffalo within the bovine mix of small and marginal farmers through artificial insemination	The project proposes for sustained livestock productivity throughout the year through technologies such as Artificial Insemination and Estrus management. The project will support this activity till the F1 progeny is produced and further blood level enhancement will be continued by the GADVASU supported by AHD.	GADVASU and AHD
Climate Proofing of registered Gaushalas/construction of climate smart model cattle pounds (cattle sheds) housing	This project also provide an opportunity for making the best use of stray cattle by housing them in a large climate resilient shed with in-built facilities of biogas plant, rain water	Integration of climate smart elements is being done on existing gaushalas on an entrepreneurial mode, so that benefits are sustained based on a business model. Also, integration of climate	AHD and Private Entrepreneurs

2000 stray cattle	harvesting, energy efficiency and renewable energy etc.	smart and development model cattle ponds will be done in close coordination with AHD and District Administration, who will further continue and replicate the activities of the project in other districts of the State.	
Weather linked Insurance package	Development of weather linked insurance product	This product is expected to revolutionise the milk economy by encouraging farmers for adopting indigenous diary animals, as their livelihoods will be ensured under climate stress periods. Upon successful completion of implementation of this product in three districts of Punjab, this product can be advantageous for replication in other districts of Punjab and other agricultural based states, with increasing heat waves and other weather related uncertainties, this product has the potential to generate interest amongst farmers as well as private sector insurance providers.	GADVASU, AHD and Insurance companies
Capacity building and Knowledge Management	Development of knowledge products, trainings etc.	Developed knowledge products can be used for future reference. Trained people can be used to train other people leading to information dissemination to wider public	PSCST, GADVASU, AHD

k) Provide an overview of the environmental and social impacts and risks identified as being relevant to the project / programme.

Checklist of environmental and social principles	**No further assessment required for compliance**	**Potential impacts and risks – further assessment and management required for compliance**
Compliance with the Law	The project activities are in line with the Second National Communications to the UNFCCC, National Action Plan on Climate Change and State Action Plan on Climate Change	No risk
Access and Equity	The project provides fair and equitable access to the project beneficiaries and is based on clear vulnerability aspects linked to livestock productivity. The activities will not impede access to any of the other requirements like health, clean water, sanitation, energy, education, housing, safe and decent working conditions and land rights.	No risk
Marginalized and Vulnerable Groups	The beneficiaries of the project will be small and marginalised farmers, having landholdings of 1-2 hectares and 5-15 dairy animals.	No risk
Human Rights	The project does not foresee any violation of human rights	No risk
Gender Equity and Women's Empowerment	Project would ensure participation by women fully and equitably, receive comparable socio-economic benefits and that they do not suffer adverse effect. It is proposed that amongst the total beneficiary, 30% would be women. Women would be involved in breeding management, training on bio-gas generation etc.	No risk
Core Labour Rights	Payments to labour under the project will be made as per Government approved norms duly following minimum wage rate and hence ensuring core labour rights.	No risk
Indigenous Peoples	Not applicable to this project	No risk
Involuntary Resettlement	Not applicable to this project	No risk
Protection of Natural Habitats	Project does not affect any of the natural habitats	No risk
Conservation of Biological	The project would not cause any impact on	No risk

Diversity	biodiversity values. Rather, will try to bring back the genetic variability.	
Climate Change	The project is basically for enhancing the adaptive capacity of the small and marginal farmers against adverse impact of climate change and is not expected to contribute to GHG emissions. Project additionally has a co-benefit on reducing the GHG produced through propagating indigenous breed, developing bio-gas plant, adoption of energy efficient lighting and plantation of drought resistance fodder, which will contribute in mitigating the challenges of climate change	No risk
Pollution Prevention and Resource Efficiency	Project is not expected to create any environmental pollution and aims for higher resources efficiency for better management of available natural resources like water, energy, fodder etc.	No risk
Public Health	No adverse impact on public health related issues is envisaged.	No risk
Physical and Cultural Heritage	No adverse impact on cultural heritage related issues is identified.	No risk
Lands and Soil Conservation	Creation of pond and recharging of ground water is envisaged to help in land and soil conservation and will not create any damage to land & soil resources.	No risk

3.0 IMPLEMENTATION ARRANGEMENTS

a) Describe the arrangements for project / programme implementation.

i. Who will implement the project and what are their comparative advantages and capacity compared to other potential implementing institutions?

The implementation of the project will be through a multi-department coordination with the overall responsibility led by the Punjab State Council for Science and Technology (PSCST). Responsibilities have been assigned to the departments based on the availability of expertise in the departments for carrying out following tasks:

Agency/committee	Responsibility
Project Steering Committee	A project steering committee headed by the Chief Secretary will advise the project. Members will be drawn from other line departments, PAU and GADVASU
PSCST (Punjab State Council for Science and Technology)	PSCST will be responsible for the following tasks: ○ Oversee the project. ○ Prepare ToR and have contractual documents

Agency/committee	Responsibility
	prepared for each activity for each partner agencies ○ Through PCST all funds will flow to the partners. ○ PSCST will support Department of Animal Husbandry in the development of tender documents and selection process of bids for various activities. ○ Monitoring the project outcomes and outputs. ○ Preparing progress report of the project for the steering committee meetings that will happen annually
Guru Angad Dev Veterinary and Animal Sciences University (GADVASU)	GADVASU will be responsible for: ○ Provide the overall technical lead for the project ○ Conduct the base line survey ○ Monitor the breeding (AI and estrus synchronization) programme and provide technical support, hormonal preparations and semen to AHD Veterinary Doctors ○ Conduct training for farmers on management of cattle post insemination and new progeny for optimal productivity ○ Provide scientific inputs on raising good quality fodder crop under heat stress conditions ○ Provide information on silage and hay making techniques through various demonstration and lectures ○ Provide silage tube bags. ○ Providing design for climate resilient dairy animal sheds. ○ Construction of climate resilient sheds at GADVASU and KVKs. ○ Disease monitoring and forecasting in the adopted HHs/sheds. ○ Deploy research fellows to record all vital parameters of cattle in the stray cattle shed which will be handed over to AHD. ○ Will hire a data analyst who will analyse the field data and produce it for decision making at various levels of governance.
PAU (Punjab Agricultural University)	PAU will be responsible for: ○ Setting up the Automatic Weather Stations (AWS) systems in identified locations in the districts – for AI, Estrus, and for Weather linked Insurance ○ School of Climate Change & Agricultural Meteorology will collect and analyse climate data for supporting decision making on weather linked insurance
AHD (Animal Husbandry	AHD will be responsible for:

Agency/committee	Responsibility
Department)	○ Supporting the establishment of the climate resilient shed development for 2000 bovine population in 1 district ○ Ensure support to GADVASU by deputing local veterinary doctors (at least 10 doctors dealing with selected villages from each district) for carrying out AI of selected dairy animals with pure breed semen and also for carrying out estrus management synchronization (FTAI). ○ Supply of high genetic merit semen in the project area from A graded semen stations. ○ Production of drought resistant seed varieties and supply to AHD ○ Selection of suitable fodder crop and cultivar in project area in consultation with GADVASU ○ Health care & vaccination facilities in the project areas. ○ Distribution of drought resistant fodder seeds to the livestock farmers and facilitating construction of silopits/silotowers/ supply of silobags in the project area. ○ Supply of mineral mixture to the farmers in project area.
Dairy Development Board	○ Support for the establishment of community and institutional level sheds and other dairy related schemes in the project area. ○ Identification of beneficiaries and their training ○ Distribution of financial incentives amongst beneficiaries
PEDA (Punjab Energy Development Agency)	PEDA Will provide the technical support for ○ designing the roof top solar power ○ Installing LED lighting in the stray cattle shelters ○ Installing energy efficient LEDs and Bio gas bottling plants
Micro Insurance Expert	Identify potential pilot area, develop the insurance package in consultation with GADVASU, AHD and farmers, pilot test the package, support design of proto type contracts (to be identified at the Starting of the Project)
Insurance company	Market the insurance package (to be decided at the Starting of the project)

ii. How will the project be coordinated with (and/or mainstreamed into) related development activities of the targeted sector?

The project is proposed to be steered by a **Management Committee headed by Member Secretary-PSCST**, with members from National Bank for Agriculture and Rural Development (NABARD)-Punjab Regional Officer, PSCST, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Punjab Agricultural University (PAU), Animal Husbandry Department (AHD), Punjab Energy Development Agency (PEDA), Dairy Development Department and GIZ (for technical support).

The State Steering Committee on Climate Change, which was constituted while preparing Punjab SAPCC headed by Chief Secretary with members from key departments, research institutions etc., will provide an overarching support in endorsing, implementing, monitoring & evaluating the project. The Project Management Plan can be seen in the **Figure 13**.

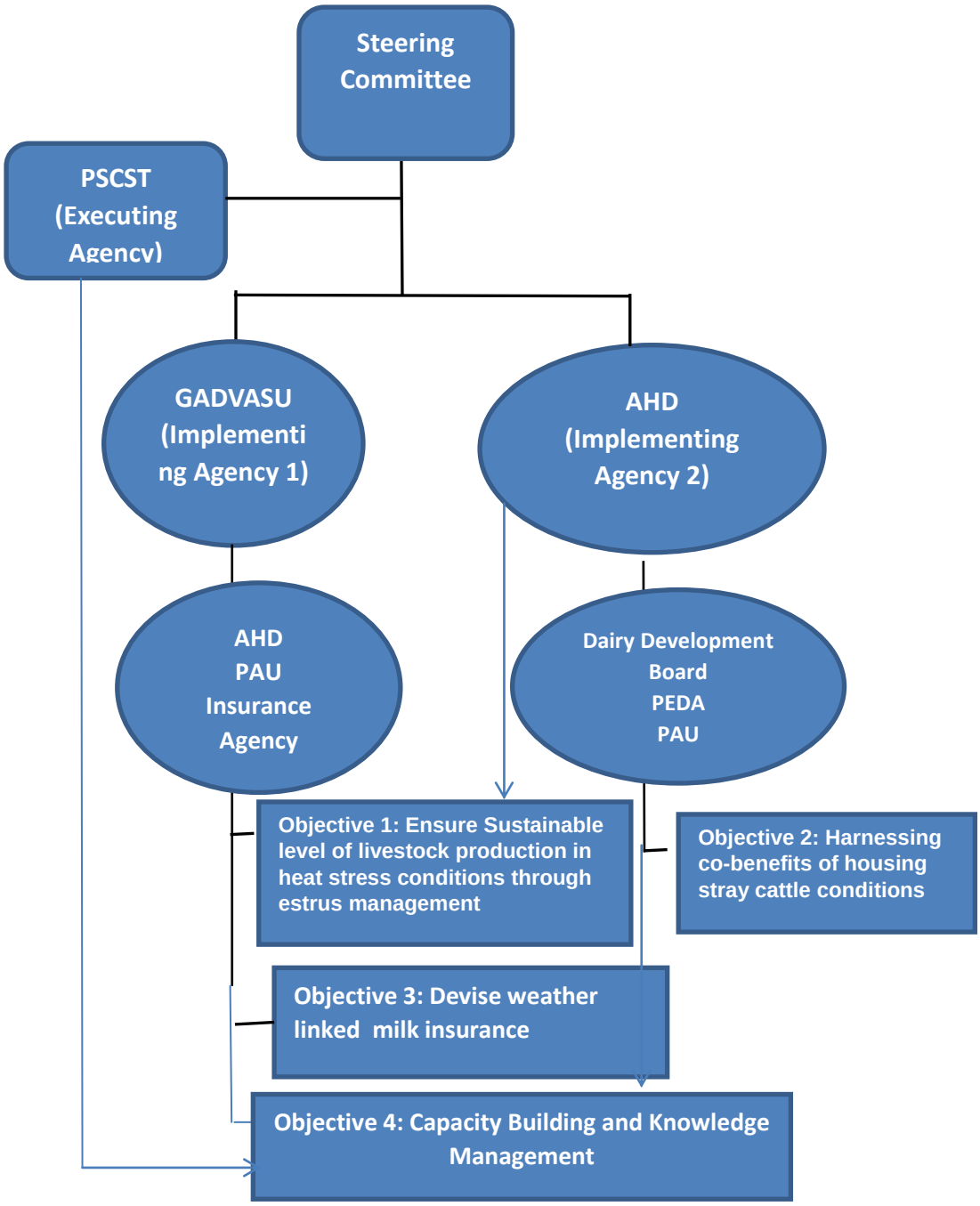

Figure 13: Project Management Plan

b) Describe the measures for financial and project / programme risk management (also include environmental and social risk, if any).

S. No.	Risk	Rating (High / Medium / Low, etc.)	Mitigation Measure
1.	The farmers might not agree to do all the different management approaches.	High	Targeted capacity building along with exposure visits will build the consensus
2.	Bureaucratic hassles may	High	Bureaucrats dealing with the

	delay in initiating the project activities and sanctioning of funds		concerned subject will be invitees for the State Steering Committee on Climate Change, thus, enabling PSCST in facilitating quicker sanctioning of funds Preliminary activities of the project will be initiated on time like preparation of tender docs for buying AWSs etc. and the information of initiation of project activities may be informed to the central ministry for ease in sanctioning of fund.
3.	Extreme drought conditions leading to low productivity of fodder	Medium	Watershed management and linked Micro-irrigation facilities will ensure productivity of fodder. Also based on PAU research, drought tolerant fodder varieties of Sorghum, Legumes etc. would be introduced.
4.	Desired number of pure breeds not born	High	Post insemination management will also be stressed to ensure upkeep of animals Estrus management will ensure continuity of sustainable amounts of livestock production
5.	Mortality of existing cattle	High	Mortality insurance cover will be given to all chosen households
6.	Acquisition of land for building cattle shed by the government	Low	Bureaucrats dealing with the concerned subject will be invitees for the State Steering Committee on Climate Change, thus, enabling PSCST in clarifying land tenure ship As an alternative, project also proposes to look at integrating climate smart elements into existing Gaushalas, where land tenure ship is concurrent to the project period.
7.	Clients may not embrace the weather linked milk insurance package due to not being convinced.	Low	Clients will be appraised by the insurance agency and GADVASU regarding the benefits of the insurance product and related actuarial calculations leading to the premium Premium for the first two years while testing the product for the farmers will be borne by the project. This will be

			incentive for their initial participation
8.	Coordination between insurance company and climate data analyser need to be seamless.	Low	A sub-committee will be formed under the leadership of GADVASU to ensure that coordination between insurance company and climate data analyser is maintained with high level of professionalism, accountability and transparency
9.	All activities suggested may not come to fruition as planned	Low	Since each activity is headed by exclusive entities with high level of competence and experience, outcome of all activities will be ensured. Continuous monitoring will be done to ensure the same.

c) Describe the monitoring and evaluation arrangements and provide a budgeted M&E plan. (Monitoring and evaluation cost need to be included in executing entity management cost).

Proposed budget for M&E amount Rs. 1,35,13,050 (8% of the total project cost). The activity wise budget will be worked out in consultation with NABARD as per MoEF&CC criteria.

Specific Objective 1: Ensure Sustainable level of milk production in heat stress conditions							
Activity 1.1	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Conduct base line survey to identify HH's where interventions will be conducted	Representatives of GADVASU						Completed in 9 months from the start date of the project
Activity 1.2	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Conduct Artificial Insemination to increase mix of pure blood indigenous bovine stock in small and marginal HHs	Representatives of GADVASU and AHD						Conducted throughout the project for 5 years
Activity 1.3	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Estrus Synchronisation	Representatives of GADVASU and AHD						Conducted throughout the project for 5 years
Activity 1.4	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Train farmers on post insemination and	Representatives of GADVASU						Farmers would be trained

Estrus management of bovine stock							during the initial first year and fourth year of the project
Activity 1.5	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Ensure adequate fodder /silage availability using water efficient technologies	Representatives of GADVASU and AHD						Fodder availability will be ensured during the entire timeframe of the project
Activity 1.6	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Design and install heat resilient sheds for bovine stock of small and marginal farmers	Representatives of GADVASU						Climate resilient sheds will be installed by end of the 2nd year
Activity 1.7	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Documentation and analysis of all field data	Representatives of GADVASU			-			Conducted throughout the project for 5 years
Activity 1.8	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Disease forecasting for efficient controlling disease in a changing climate scenario	Representatives of GADVASU and PAU						Conducted during the first four years of the project

Specific Objective 2: Harnessing co-benefits by housing stray cattle							
Activity 2.1	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Climate Proofing of registered Gaushala/construction of climate smart model cattle ponds housing 2000 stray cattle	Representatives of concerned cattle pond management/concerned gaushala management						Climate resilient sheds will be installed by end of the 2nd year
Activity 2.2	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Ensuring year round fodder availability	Representatives of AHD						Fodder availability will be ensured during the entire timeframe of the project
Activity 2.3	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Ensuring water availability in the stray cattle shed	Representatives of concerned cattle pond management/concerned gaushala management						Rain water harvesting, dug-wells etc. will be installed during the initial months of the 2nd year, which will then be made available during the entire

							timeframe of the project
Activity 2.4	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Solar Power Generation in sheds	Representatives of PEDA						Solar panels will be installed during the initial months of the 3rd year, which will then be made available during the entire timeframe of the project
Activity 2.5	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Energy Efficient lighting in the sheds	Representatives of PEDA						Energy efficient lighting will be installed during the later months of the 3rd year, which will then be made available during the entire timeframe of

							the project
Activity 2.6	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Establish large scale biogas digester and biogas bottling plants	Representatives of PEDA						Bio-gas plant will be installed during the initial months of the 3rd year, which will then be made available during the entire timeframe of the project
Specific Objective 3: Devise Weather Linked Insurance							
Activity 3.1	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Identify trigger points for decline in milk production, potential pilot area and clients.	Representatives of GADVASU						Potential pilots will be identified during the later months of 1st year of the project cycle
Activity 3.2	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Identify delivery channels for reaching the end users	Representatives of GADVASU						Potential delivery channels will be identified

							during the earlier months of 2nd year of the project cycle
Activity 3.3	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Design contracts	Representatives of GADVASU and External Agency						Contracts would be designed during the 1st and 2nd years of the project
Activity 3.4	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Discuss the prototype contracts with potential clients and stakeholders	Representatives of GADVASU and External Agency						Discussion on prototypes contracts would be done during the later part of 2nd year or initial part of 3rd year
Activity 3.5	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Finalize contracts and insurance	Representatives of GADVASU and External Agency						Contracts would be finalised by the end of 3rd of the project
Activity 3.6	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Market the product	Representatives of						The product

	External Agency						will then be marketed during the 4th year of the project cycle
Activity 3.7	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Monitor the pilot	Representatives of GADVASU						Success of the selling of the product will be monitored during the 5th year of the project cycle
Specific objective 4: Knowledge management and Dissemination							
Activity 4.1	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Training of weather linked livestock insurance	Representatives of GADVASU and PSCST						The farmers would be apprised regarding the weather linked insurance product details during the 3rd year of the project
Activity 4.2	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Conduct workshops for	Representatives of GADVASU, AHD, PAU						Mid-term workshops

dissemination	and PSCST						would be conducted on an annual basis for the first four years. Further, a final workshop would be done in the later part of the 5th year
Activity 4.3	**Responsible person**	**Yr. I**	**Yr. II**	**Yr. III**	**Yr. IV**	**Yr. 5**	**Timeframe**
Develop dissemination material	Representatives of GADVASU, AHD, PAU and PSCST						Information dissemination materials would be produced during the 4th and 5th of the project

d) Include a results framework for the project proposal, including milestones, targets and indicators with gender disaggregated data (as per the format in annexure1).

Specific Objective 1: Ensure Sustainable level of milk production in heat stress conditions					
Activity 1.1	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Conduct base line survey to identify HH's where interventions will be conducted	About 105 villages surveyed within the project area to identify eligible HHs for interventions Awareness raised amongst farmers on benefits of breeding indigenous pure breed of dairy animals . Parameters such as seasonal variation in milk production and reproductive efficiency of each animal, quantity and type of fodder and feed, disease profile,	Currently, district level Sahiwal cattle atlas has been compiled for Punjab by AHD. This is yet to be published. Bovine mix data and annual average milk production data is available. Loss in milk yield experienced by HHs during extreme heat events, and loss in income by more than 50%.	HHs with 5-15 bovines stock with a mix of crossbred, graded Murrah, Non-Descript cows etc. identified	A report on base line conditions with base line data documented	No risk

	including their housing conditions etc. are recorded.				
Activity 1.2	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Conduct Artificial Insemination to increase mix of pure blood indigenous bovine stock in small and marginal HHs	About 1200 F1 calves born through AI	About 3000 small and Marginal farmers households chosen from Tarn Taran, Ludhiana, and Bathinda districts in Punjab, not having pure blooded Murrah/ Niliravi and Sahiwal.	Pure blooded semen availed from Semen Station nominated by AHD and GADVASU having modern Semen Processing facilities	About 1000 small and marginal households having dam population and F1 progeny within 4th year of the project	Risk: Farmers might not agree to do Artificial Insemination Assumption: Targeted capacity building along with exposure visits will build the consensus
	Vital parameters including milk yield of each bovine stock recorded each day	Average milk yield of different types of bovine exist for the district as a whole	Monitor all 1000 dam and F1 population	Data recorded by GADVASU field staff /research fellow and analysed each year Regular report preparation	
Activity 1.3	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Estrus Synchronisation	Farmers trained in Estrus management	Estrus synchronisation not done	3000 HHs selected for AI will also be targeted for Estrus management of	Estrus management have led to increase in milk production	Risk: Farmers might not agree to do Estrus Synchronisation

			the entire bovine stock		Assumption: Targeted capacity building along with exposure visits will build the consensus
Activity 1.4	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Train farmers on post insemination and Estrus management of bovine stock	3000 farmers trained on post insemination management of female buffalo and cattle	No training on management of artificially inseminated indigenous cattle	3000 HHs practicing post insemination management	Training manual available	No risk
Activity 1.5	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Ensure adequate fodder /silage availability using water efficient technologies	Atleast 40-50kg/day/animal of green fodder is available to each livestock during summers	Availability of fodder/silage not adequate in summers.	Seed of drought tolerant fodder varieties will be supplied through AHD	Around 6000 quintals of sorghum production reported from 75 ha of land	Risk: Extreme drought conditions leading to low productivity of fodder Assumptions: Watershed management and linked Micro-irrigation facilities will ensure productivity of fodder. Also based on PAU research, drought tolerant fodder varieties of Sorghum, Legumes etc. would be introduced.
Activity 1.6	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Design and install heat	Milk yield in bovine	Farmers income loss by	To construct 10	Demo shed at	Risk: Farmers might not

resilient sheds for bovine stock of small and marginal farmers	stock more than base line in such conditions	more than 50% Bovine stock infested with ticks	demo sheds at GADVASU, KVKs and AHD institutes. To provide sheds to all 300 HHs selected for intervention	GADVASU for 150 animals and 10 Demo sheds each of 10 animal capacity at KVKs/institutions 300 scientifically designed sheds constructed for housing 5-15 bovine stock and 10-15 demonstrative sheds at KVKs and GADVASU as per the norms provided by GADVASU Temperature inside the shed is 5-6°C less than ambient. Disease due to ticks will be less reported than in the base lines Milk yields on an average grow up by	agree to provide land for setting up land for setting up of climate resilient sheds <u>Assumption:</u> Targeted capacity building along with exposure visits will build the consensus

				2-3 litres/day/animal	
Activity 1.7	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Documentation and analysis of all field data	Various analysed reports available	No such comprehensive data exist	All HH bovine stock targeted for AI and Estrus management	Reports on the following but not limited to: - Daily milk yield - Disease prevalence - Records of bovine birth rate, and heat incidences - Daily temperature inside the sheds recorded along with humidity during summers - Any other	No risk
	Trends of daily temperature, precipitation and humidity records available	No project site data available	3 AWSs to be installed in 3 districts at project site covering about 30 villages in each district	3 AWSs installed PAU has the data base Database analysed and reported	No risk
Activity 1.8	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**

Disease forecasting for efficient controlling disease in a changing climate scenario	Project level compilation of data on animal performance and disease prevalence	All bovine diseases prevalence data compiled Climate data is not a part of the forecasting	All data to be computerised and available online to GADVASU and AHD	Daily report created and transferred to GADVASU for analysis and action. A compiled annual report available with AHD for their own use and for submission to database management system	No risk
Specific Objective 2: Harnessing co-benefits by housing stray cattle					
Activity 2.1	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Climate Proofing of registered Gaushala/construction of climate smart model cattle ponds housing 2000 stray cattle	The interior of the shed is cooler by 5-6°C wrt ambient	Under nourished stray cattle with no fertility May have diseases and disabilities	To have atleast 50% of the cattle attain better health conditions than base line and about 5% cattle can become reproductive if given good environment and management	Cattle shed built with design provided by project. Lighting and cooling (fans) devices installed along with an AWS, office room, store room etc.	Risk: Delay in getting the land for setting up Gaushala/model cattle pond Assumption: Bureaucrats dealing with the concerned subject will be invitees for the State Steering Committee on Climate Change, thus, enabling PSCST in clarifying land tenure ship. As an alternative,

					project also proposes to look at integrating climate smart elements into existing Gaushalas, where land tenure ship is concurrent to the project period.
Activity 2.2	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Ensuring year round fodder availability	Cattle get all year round feed	Undernourished cattle	Storage facility for making fodder available to 2000 cattle	Silage pits created which can store silage for 2000 cattle	Risk: Extreme drought conditions leading to low productivity of fodder Assumptions: Watershed management and linked Micro-irrigation facilities will ensure productivity of fodder. Also based on PAU research, drought tolerant fodder varieties of Sorghum, Legumes etc. would be introduced.
Activity 2.3	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Ensuring water availability in the stray cattle shed	Roof top rainwater harvesting structure built	No such facility available	10,000 litre roof top tank built	10,000 litre tank built along with pipelines coming from roof top	Assumption: Availability of rain water harvesting plants at a subsided rate

			Dug well underground for ground water recharge	Dug-well created for ground water recharge	
	Cattle and buffaloes immerse themselves in the ponds	No such facility available to stray cattle before	3 ponds	3 ponds created Buffalos- Stray found bathing themselves in the ponds	
	Water available year round	No such facility	A deep tubewell created within the cattle shed premise	One tubewell constructed and water levels verified in each of the stray cattle shed in each district	
Activity 2.4	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Solar Power Generation in sheds	Solar photovoltaic power plant installed on roof top	No such facility available	Solar power units installed in each shed	All devices such AWS, thermometer and humidity sensors, lighting and fans running on solar power	Assumption: Availability of solar power plants at a subsided rate
Activity 2.5	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Energy Efficient lighting in the sheds		No such facility available	LED lighting devices replaces others in each site	Well lit sheds at night	Assumption: Availability of Energy Efficient lighting at a subsided

					rate
Activity 2.6	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Establish large scale biogas digester and biogas bottling plants	Bottled biogas being sold	No benefits from stray cattle so far	A biogas plant of size 2000 cu m set up at each location	Biogas digester and bottling plant set up by end of 2nd year Bottled biogas start getting sold by the end of 3rd year	Assumption: Availability of bio-gas plants at a subsided rate
Specific Objective 3: Devise Weather Linked Insurance					
Activity 3.1	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Identify potential pilot area and clients	Risks identified	No weather linked insurance available for milk production from bovine stock	1000 clientele for the pilot program will be identified who are willing to pay.	A report on assessment of risks to clients, bovine and milk production available	Risk: Farmers may not embrace the weather linked milk insurance package due to not being convinced. Assumption: Clients will be appraised by the insurance agency and GADVASU regarding the benefits of the insurance product and related actuarial calculations leading to the premium .
	Climate records available with GADVASU	Daily Milk yield data available	Synchronise milk yield with THI estimated on the basis of daily temperature and RH	A report analysing daily field level milk production and THI available for year 1	

					Further, premium for the first two years while testing the product for the farmers will be borne by the project. This will be incentive for their initial participation
Activity 3.2	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Identify delivery channels for reaching the end users	Institutions identified - Insurance agency - Institution doing research on weather linked insurance	No such product available	An Insurance agency and an institution working on weather linked insurance research	Institution identified	-do-
Activity 3.3	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Design contracts	A contract available	No such product available	Clients willing to pay the premium and have a mix of bovine- cross bred, Murrah, Sahiwal, Niliravi amongst others	A contract design available that is the most accurate proxy for the clients' risks while taking into consideration the premium that a client will pay	-do-
Activity 3.4	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Discuss the prototype contracts with potential clients and stakeholders	Clients agree with the contents of the proto type and agree to pay the premium	No such product prototype ever discussed	Clients in one of the districts where sheds will not be built at HH level	Meetings with clients with Y/N recorded	-do-

Activity 3.5	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Finalize contracts and insurance	After the contracts are finalized, insurance arrangements will be made	No such contractual prototype available	Insurers in district where HH are not provided with cattle sheds	Revised and finalized contract structures based on field research and discussion with clients	-do-
Activity 3.6	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Market the product	10 meetings carried out across the districts to make clients aware of such a product	No such product available	Atleast 3000 clients	1000 clients have bought the product	-do-
Activity 3.7	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Monitor the pilot	Stakeholders are meeting their commitments	No such assessment available in the area	Clients who have agreed to buy the insurance	A report on the outcomes available	-do-
Specific objective 4: Knowledge management and Dissemination					
Activity 4.1	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Training of weather linked livestock insurance	One training after the designing of the Insurance product	Weather linked livestock insurance	Usage of the product to be spread to 3000 HHs	Report of Insurance Agency	No risk

Activity 4.2	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Conduct workshops for dissemination	One Inception workshop conducted Interim consultative meetings (Atleast 3 for each activity) One Final workshop to disseminate the results Three Awareness workshops for the Weather linked Insurance products	The project is a new concept floated to assess steps towards climate change adaptation of bovine stock and associated economy	Government Farmers AHD under the M/o Agriculture Insurance agencies	8 Workshop proceedings	No risk
Activity 4.3	**Indicator**	**Baseline**	**Target**	**Means of Verification**	**Risks and Assumptions**
Develop dissemination material	At least 4 films developed - AI - Estrus management - Stray Cattle shed management	Some papers available on AI and estrus management. However, field level data will add value to the pool of papers available on this subject.	The Government The Farmers The AHD under the min of Agriculture	Actual films, brochures, papers, articles in paper published	No risk

	- Weather linked Insurance Atleast 5 brochures one on each of the above topic and one summarising the outcomes and outputs At least 10 papers published as a result of this work Success story in local and national news papers	No paper published so far on Weather linked livestock insurance on milk production and cattle morbidity due to heat stress Paper on management of climate resilient Stray cattle shed not available from the Punjab region Some literature from other parts of the country available	The Insurance agencies		

e) Include a detailed budget with budget notes, a budget on the Implementing Entity management fee use and an explanation and a breakdown of the execution costs.

Financial requirement and other details of the project are as follows:

S.No.	ACTIVITY/MONTHS	Units	Unit cost (INR)	Total (INR)	Note	Institution responsible
1.	**Ensure sustainable levels of milk production in heat stress conditions**	**Detailed below**	**Detailed below**	**13,10,34,500**	**Detailed below**	**GADVASU and AHD**
1.1	**Create awareness amongst farming communities**	**10 workshops/ meetings**	**10000/ workshop**	**1,00,000**	**10 meetings per cluster of 10 village on awareness on AI for upgrading indigenous dairy animals to pure blood dairy animals**	**GADVASU**
1.2	**Base line study to identify intervention HHs**	**105 villages**	**Detailed below**	**40,00,000**	**For 3 districts at each of 12 villages selected. 3000 HHs to be covered for survey**	**GADVASU**
1.2.a	Research Fellow – Survey	6 (for 8 months)	30000/month	14,40,000	One RF can do 500 HH / 8 months	GADVASU
1.2.b	Field Co-ordinator – Survey	6 (for 8 months)	10000/month	4,80,000	One field co-ordinator will co-ordinate with RF for doing 500 HH / 8 months	GADVASU
1.2.c	Survey & Travel cost	Around 85-90 visits	--	20,80,000	One RF will do 15 visits / mo X 8 month costing Rs 3000 / visit	GADVASU

S.No.	ACTIVITY/MONTHS	Units	Unit cost (INR)	Total (INR)	Note	Institution responsible
1.3	**Artificial Insemination**	**3000 dam population and 1000 F1 population**	**200/animal**	**64,80,000**	**Detailed below**	**GADVASU and AHD**
1.3.a	Artificial insemination Phase 1	3000 Buffalo-Cattle Graded/ND	200/animal	6,00,000	3000 buffalo/cattle to be targeted in 3000 HH. Inclusive AI, travel and other costs	GADVASU and AHD
1.3.b	Artificial insemination Phase 2	1200 F1	200/animal	2,40,000	Success rate may be as high as 75% as per studies by NDRI, Inclusive AI, travel and other costs	GADVASU and AHD
1.3.c	Research Fellow- AI	3	30000/month	54,00,000	2 Attached with field AI unit, 1 attached with semen station at GADVASU	GADVASU and AHD
1.3.d	Contractual assistant	1	10000/month	2,40,000	To assist at semen station for 2 year AI period	GADVASU
1.4	**Estrus Management**	**6000 animals**	**1800/Animal**	**1,53,40,000**	**Detailed below**	**GADVASU and AHD**
1.4.a	Estrus Synchronisation	6000 animals	1800/Animal	1,08,00,000	About 6000 buffaloes and cattle (2 animals per HH chosen for this project) from the 3000 HHs will be synchronized during the project duration (50 animals assigned to each Vet Officer/year x 4 year x 30 VO)) Cost of synchronization will be about Rs. 1,800 per animal).	GADVASU and AHD

S.No.	ACTIVITY/MONTHS	Units	Unit cost (INR)	Total (INR)	Note	Institution responsible
1.4.b	Research Fellow- Estrus Management	2	30000/month	36,00,000	Attached with Estrus Management Unit	GADVASU
1.4.c	Contractual assistant	1	10000/month	2,40,000	To assist in estrus management unit	GADVASU
1.4.d	Farmers training -1st and 2nd Phase	2x10 clusters trained	10000/training	2,00,000	1 training each at all 12 villages in study	GADVASU
1.4.e	Travel cost – AI, Estrus management and training	100 visits	5000/travel	5,00,000		GADVASU
1.5	**Silage Management**	**Detailed below**	**Detailed below**	**75,37,500**	**Detailed below**	**GADVASU/AHD**
1.5.a	Tube silage preparation and distribution	7500 tons/year	3/quintal/month	3,37,500	6 silo bags of 5 quintals capacity will be provided to 3000 farmers on 50% subsidy.	GADVASU/AHD
1.5.b	Polythene Silage bag cost	9000	800	72,00,000	Silage bag cost to be included for supplying to farmer	GADVASU
1.6	**Climate resilient sheds at community and institutional sheds**	**Detailed below**	**Detailed below**	**8,26,25,000**	**Detailed below**	**GADVASU**

S.No.	ACTIVITY/MONTHS	Units	Unit cost (INR)	Total (INR)	Note	Institution responsible
1.6.a	Climate Resilient Model Shed at GADVASU	1	2,70,00,000	2,70,00,000	Demonstration shed for 150 dairy cattle and buffalo	GADVASU
1.6.b	Climate Resilient Demo sheds for KVKs and Institutions	10	5,00,000	50,00,000	GADVASU KVKs and AHD or other Govt Institutes for 10 animals	GADVASU, AHD and Dairy Development Board
1.6.c	Climate Resilient sheds for individual dairy farmers – 10 animals	150	2,25,000 (75% by project of total 3,00,000)	3,37,50,000	Design to be provided by GADVASU	Dairy Development Board
1.6.d	Climate Resilient sheds for individual dairy farmers – 5 animals	150	1,12,500 (75% by project of total 150000)	1,68,75,000	Design to be provided by GADVASU	Dairy Development Board
1.7	**Monitoring of data**	**3 AWS with data storage facility**	**Detailed below**	**52,52,000**	**Detailed below**	**PAU and GADVASU**
1.7.a	Setting up AWS and connecting to PAU	3 Fixed AWS	500000/AWS	15,00,000	one each at 3 districts	PAU and GADVASU
1.7.b	Hiring Research Fellows	2	30000/Research fellow	36,00,000	Field visit and analysis of data	PAU and GADVASU

S.No.	ACTIVITY/MONTHS	Units	Unit cost (INR)	Total (INR)	Note	Institution responsible
1.7.c	Lap tops, desktop and additional data storage	1 laptop+1 high power desktop	52,000+ 1,00,000	1,52,000	1 Laptop for GADVASU and 1 high power desktop for PAU	PAU and GADVASU
1.8	**Disease forecasting activities**	**Detailed below**	**Detailed below**	**79,00,000**	**Detailed below**	GADVASU and PAU
1.8.a	Recurring cost for disease forecasting and diseases monitoring	-	30,00,000	30,00,000	Cost for chemicals, kits etc	GADVASU
1.8.b	Research Fellow-Disease Forecasting	1	30000	18,00,000	Research Fellow for disease forecasting	PAU and GADVASU
1.8.c	Laboratory assistant	2	10000	12,00,000	Lab Assistant for disease forecasting related to sample collection and processing	GADVASU
1.8.d	Data analyst	1	30000	18,00,000	For computer recording, analysing and compiling data related to base line survey, AI, Estrus, disease forecasting and monitoring.	GADVASU
1.8.e	Data station	1	100000	1,00,000	For computer recording, analysing and compiling data related to base line survey, AI, Estrus, disease forecasting and monitoring.	GADVASU
1.9	Field coordinators	3 Field Coordinators	10,000/coordinator	18,00,000	one for each site for 5 years (3 districts - will coordinate AI, Estrus, Climate data and disease forecasting)	PAU and GADVASU

S.No.	ACTIVITY/MONTHS	Units	Unit cost (INR)	Total (INR)	Note	Institution responsible
2.0	**Climate Proofing of registered Gaushalas/construction of climate smart model cattle ponds housing 2000 cattle**	**Detailed below**	**Detailed below**	**1,64,90,000**	**Detailed below**	**Concerned cattle pond management society/ concerned gaushala management**
2.1	Finalising design of the climate resilient stray cattle shed for 2000 cattle / constructing of model cattle ponds	1	2500000	25,00,000	Only design cost to be borne by the project. Construction cost will come from AHD. 120 mandays @ 15000/day+ travel+ incidental expenses. In case, construction cost cannot be sourced from, a model cattle pond will be constructed through the project cost	Concerned cattle pond management society/ concerned gaushala management
2.2	Designing roof top rainwater harvesting and operationalising underground storage	4 numbers, 10,000 litres each	2,00,000	8,00,000	4 RWH plants of capacity of 10,000 litre each. Design to be taken from the gov. Labour cost borne by Private sector/project	Concerned cattle pond management society/ concerned gaushala management
2.3	Construction of ponds	2 ponds	1,00,000/pond	2,00,000	Two ponds of 1000 cu m each (25m*20m*2m)	Concerned cattle pond management society/ concerned gaushala management
2.4	Fodder plantation	10 ha	12000/ha	6,00,000	For 5 years	PSCST and AHD

S.No.	ACTIVITY/MONTHS	Units	Unit cost (INR)	Total (INR)	Note	Institution responsible
2.5	Silage storage	Rs. 11/quintal	40000 quintals	4,40,000	Private sector/Project cost	Concerned cattle pond management society
2.6	Silage pit	4 pits	100000 per pit	4,00,000	70feet*20 feet*5 feet One each at 2 of the stray cattle sites	Concerned cattle pond management society
2.7	Fodder trees	10 ha	5000	50,000	Cost could not be ascertained. Arbitrary cost in terms of seed/sapling procurement given	Concerned cattle pond management society
2.8	Roof top Solar	40 MW	4,00,000/MW	16,00,000	2 of 20 MW each.	PEDA
2.9	LED bulbs	2000 LED bulbs	1300/bulb	26,00,000	2000 LED and CFL (equivalent to 191 W HPSV)	PEDA
2.10	Setting up of biogas plant and bottling unit	4 digesters + bottling units	500000	20,00,000	4 bio-gas digesters will be set up	PEDA
2.11	Setting up AWS at model cattle pond and linking it to PAU agromet	1	5,00,000	5,00,000	1 AWS in the site	PAU and GADVASU
2.12	Research fellows	2	30000/month	36,00,000	2 for 5 years	PAU and GADVASU
2.13	Field coordinators	2	10,000/month	12,00,000	2 for 5 years	PAU and GADVASU
3.0	**Weather linked Insurance package**	**Detailed below**	**Detailed below**	**98,76,600**	**Detailed below**	**GADVASU**

S.No.	ACTIVITY/MONTHS	Units	Unit cost (INR)	Total (INR)	Note	Institution responsible
3.1	Research fellows	2	30000	36,00,000	Working on data analysis for ascertaining trigger points based on field data for a year and then assisting towards preparation of questionnaires and development of prototype weather linked insurance package	GADVASU
3.2	Field coordinators	2	10,000	12,00,000	Coordination on field	GADVASU
3.3	Contingency	-	20,64,000	20,64,000	For identifying trigger point related work	GADVASU
3.4	Identification of potential clients	3 districts	1000000	10,00,000	Travel and stay cost	GADVASU
3.5	Hiring agency to develop contract prototype with insurance company			20,00,000	Lump sum. Includes all their costs	External agency
3.6	Body temperature scanner	6	2100	12,600	For measuring body temperature of animals	GADVASU
4.0	**Capacity building and Knowledge Management**	**Detailed below**	**Detailed below**	**82,00,000**	**Detailed below**	**GADVASU, AHD, PAU and PSCST**
4.1	Workshops-Inception, mid term and final	3	1,00,000	3,00,000	3 workshops on explaining the project interventions to various stakeholders	-do-
4.2	Workshops-Training	5	2,00,000	10,00,000	5 workshops including people from outside the State explaining the project	-do-

S.No.	ACTIVITY/MONTHS	Units	Unit cost (INR)	Total (INR)	Note	Institution responsible
	towards adoption of weather linked insurance				interventions to various stakeholders	
4.3	Knowledge products developed	--	--	50,00,000	Atleast 2 films, 4-5 manuals for various activities, atleast 10 reports from 4 activities, posters for workshops and 20 research papers	-do-
4.4	Vehicle - Bolero	1	10,00,000	10,00,000	Required in addition to existing official vehicles and private hiring. Required for extensive travelling for baseline survey, AI, Estrus management, training, monitoring and disease forecasting	GADVASU
4.5	Driver on contract basis	1	15,000/month	9,00,000	Required in addition to existing drivers of official vehicles and private hiring. Required for extensive travelling for baseline survey, AI, Estrus management, training, monitoring and disease forecasting	GADVASU
	Execution cost			**16,56,01,100**		
5.0	Miscellaneous cost for petty expenses and cost escalations	-	2% of project cost	33,12,022		PSCST, GADVASU, AHD
	TOTAL			**16,89,13,122**		
6.0	**Cost for management of the project**			**1,35,13,050**	**8% of the total Cost**	

S.No.	ACTIVITY/MONTHS	Units	Unit cost (INR)	Total (INR)	Note	Institution responsible
	including monitoring and evaluation					
6.1	**NIE fee**	**-**		**5067394**	**3 % of the project cost**	NABARD
6.2	**Charges for Coordination, facilitation, visits/meetings etc. during project implementation**	**-**		**8445656**	**5 % of the project cost**	PSCST
	GRAND TOTAL			**18,24,26,172**		

f) Include a disbursement schedule with time-bound milestones at the component level

Project has been proposed for the duration of 5 years involving mainly four components namely, Ensure sustainable levels of milk production in heat stress conditions; Climate Proofing of registered Gaushalas/construction of climate smart model cattle ponds housing 2000 cattle; Weather linked Insurance package and Capacity building and Knowledge Management. Construction of cattle sheds both for indigenous diary animals and stray animals is proposed to be completed by the initial 2 years of the project. Activities relating to enhancing the pool of pure blooded indigenous diary animals through Artificial Insemination and Estrus Management are proposed to be conducted during the entire project duration. Weather linked insurance product will be designed in the first year of the project and will be tested from the 2nd year onwards. Based on the success and demand of the product, it will be replicated to other villages of the districts. The timeline for each activity are as follows:

	Year 1				Year 2				Year 3				Year 4				Year 5			
	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
Activity 1.1: Base line survey																				
Activity 1.2: Artificial Insemination																				
Activity 1.3: Estrus Synchronisation																				
Activity 1.4: Farmer training																				
Activity 1.5: Ensure adequate fodder availability																				
Activity 1.6: Design and install heat resilient sheds at community and institutional levels																				
Activity 1.7: Set up AWS station, connect to PAU and document and analysis all field data																				
Activity 1.8: Disease forecasting																				
Activity 2.1 : Climate Proofing of registered Gaushalas/construction of model cattle ponds housing 2000 cattle																				

	Year 1				Year 2				Year 3				Year 4				Year 5			
	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
Activity 2.2: Build silage storage & plant fodder trees																				
Activity 2.3: Rain water harvesting/ponds/tubewell																				
Activity 2.4: Solar Power Generation in sheds																				
Activity 2.5: Energy Efficient lighting in the sheds																				
Activity 2.6: Establish large scale biogas digester and biogas bottling plants																				
Activity 3.1: Identify potential pilot area and clients for weather linked insurance																				
Activity 3.2: Identify delivery channels for reaching the end users																				
Activity 3.3: Design contracts																				
Activity 3.4: Discuss the																				

	Year 1				Year 2				Year 3				Year 4				Year 5			
	3	**6**	**9**	**12**	**3**	**6**	**9**	**12**	**3**	**6**	**9**	**12**	**3**	**6**	**9**	**12**	**3**	**6**	**9**	**12**
prototype contracts with potential clients and stakeholders																				
Activity 3.5: Finalize contracts and insurance																				
Activity 3.6: Market/Test the product																				
Activity 4.1: Conduct workshops for dissemination																				
Activity 4.2: Develop dissemination material																				

Annex-I

List of stakeholders consulted during the meetings held on June 1, 2015

1. Dr. Satnam Singh Ladhar, Additional Director (Environment), Punjab State Council for Science & Technology, Government of Punjab
2. Mr. Rakesh Mittal (XEN), Department of Irrigation, Government of Punjab
3. Dr. Lakhwinder Singh, Veterinary Officer, Department of Animal Husbandry, Government of Punjab
4. Dr. Vineet Kaur, Dairy Development Officer, Department of Animal Husbandry, Government of Punjab
5. Dr. Harnaam Singh, Additional Director, Department of Animal Husbandry, Government of Punjab
6. Dr. Amarjeet Singh, Joint Director, Department of Animal Husbandry, Government of Punjab
7. Mr. Dharminder Sharma, IFS, Conservator of Forest, Punjab Forest Department, Government of Punjab
8. Dr. L.K. Dhaliwal, Director, Punjab Agriculture University
9. Dr. P.K. Khigra, Associate Professor, Punjab Agriculture University
10. Dr. K. Dua, Incharge Wildlife Centre and Professor (Veterinary Medicine), Guru Angad Dev Veterinary and Animal Sciences University, Government of Punjab
11. Dr. J. P. S. Gill, Coordinator, Guru Angad Dev Veterinary and Animal Sciences University, Government of Punjab
12. Dr. Suchwinder Singh Walia, Assistant Director (Fisheries), Department of Forestry, Wildlife and Fisheries, Government of Punjab
13. Dr. Gurdinder Dhillon, Soil Coordinator, Department of Soil and Water Conservation, Government of Punjab
14. Mr. Ratesh Garg, Executive Engineer, Executive Engineer, Department of Water Supply and Sanitation, Government of Punjab
15. Dr. B. S. Sohal, Joint Director, Department of Agriculture, Government of Punjab
16. Dr. Gurdial Kumar, ADO (PP), Department of Agriculture, Government of Punjab
17. Dr. Maganbir Singh, P.E., Punjab State Council for Science & Technology, Government of Punjab
18. Mr. Pritpal Singh, Senior Engineer, Punjab State Council for Science & Technology, Government of Punjab
19. Mr. Unnikrishnan, Senior Advisor, GIZ
20. Dr. Sumana Bhattacharya, Head (Climate Change and Environment), Intercooperation
21. Ms. Minu K., Subject Specialist (Climate Change and Environment), Intercooperation
22. Ms. Nidhi Madan, Junior Project Officer, GIZ

List of stakeholders consulted during the meetings held on June 17-18, 2015

1. Dr. Satnam Singh Ladhar, Additional Director (Environment), PSCST
2. Dr. Lakhwinder Singh, Veterinary Officer, Department of Animal Husbandry, Government of Punjab
3. Dr. Jasbir Singh, Dairy Development Officer, Department of Animal Husbandry, Government of Punjab
4. Mr. Jaspal Singh, Senior Manager, PEDA
5. Dr. Sarnarinder Singh Randhana, Director, GADVASU
6. Dr. J. P. S. Gill, Coordinator, GADVASU
7. Dr. N. K. Singh, Assistant Professor, GADVASU
8. Dr. Amit Sharma, Assistant Professor, GADVASU
9. Dr. Shukriti Sharma Assistant Professor, GADVASU
10. Dr. Randhir Singh Assistant Professor, GADVASU
11. Dr. Jaspal Singh Hundal, Assistant Professor, GADVASU
12. Dr. Sarvpreet Singh Ghuman, Professor, GADVASU
13. Dr. Balwinder Kumar, Assistant Professor, GADVASU
14. Dr. Lakhvir K. Dhaliwal, Director, PAU
15. Dr. P.M. Ghole, Chief General Manager, NABARD
16. Dr. Sanjay, NABARD
17. Dr. Sunita Sirohi, Professor, NDRI
18. Dr. Upadayay, Professor, NDRI
19. Dr. Kamalpreet Kaur, Principal Scientist, PSCST
20. Mr. Unnikrishnan, Senior Advisor, GIZ
21. Ms. Nidhi Madan, Junior Project Officer, GIZ
22. Dr. Sumana Bhattacharya, Head (Climate Change and Environment), Intercooperation

List of stakeholders consulted during the meetings held on August 5, 2015

1. Dr. Satnam Singh Ladhar, Additional Director (Environment), PSCST
2. Dr. Lakhwinder Singh, Veterinary Officer, Department of Animal Husbandry, Government of Punjab
3. Dr. Jasbir Singh, Dairy Development Officer, Department of Animal Husbandry, Government of Punjab
4. Dr. Sarnarinder Singh Randhana, Director (Research), GADVASU
5. Dr. J. P. S. Gill, Coordinator, GADVASU
6. Dr. N. K. Singh, Assistant Professor, GADVASU
7. Dr. Amit Sharma, Assistant Professor, GADVASU
8. Dr. Shukriti Sharma Assistant Professor, GADVASU
9. Dr. Randhir Singh Assistant Professor, GADVASU
10. Dr. Jaspal Singh Hundal, Assistant Professor, GADVASU
11. Dr. Sarvpreet Singh Ghuman, Professor, GADVASU
12. Dr. Balwinder Kumar, Assistant Professor, GADVASU
13. Dr. Lakhvir K. Dhaliwal, Director, PAU
14. Dr. Kamalpreet Kaur, Principal Scientist, PSCST
15. Mr. Unnikrishnan, Senior Advisor, GIZ
16. Ms. Nidhi Madan, Junior Project Officer, GIZ
